



D1.1 – Evaluating Technologies and Market Dynamics for Accessibility, Mobility and Energy Efficiency



Project Acronym: AccesS

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The Universal Accessibility Suite Initiative

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DELIVERABLE D1.1

Evaluating Technologies and Market Dynamics for Accessibility, Mobility and Energy Efficiency

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Executive Summary

'D1.1 - Evaluating Technologies and Market Dynamics for Accessibility, Mobility and Energy Efficiency' aims to provide a state-of-the-art overview identifying those key technologies and relevant market trends that are aligned with the objectives of the AccesS project and geared towards improving accessibility and sustainability in smart cities and smart built spaces, with a focus on the design and development of inclusive and accessible environments that accommodate the diverse needs of people with various disabilities and elderly people with reduced mobility.

The report is organized around three key areas:

- **Accessibility, inclusion, and comfort:** the review highlighted innovative solutions such as accessible showers, voice-activated payment methods, captioning technology, and web accessibility enhancements. Additionally, patents on web and travel accessibility were identified, alongside scholarly articles exploring digital inclusion and gesture control. Market reports and trend news have offered valuable insights into thermal and lighting comfort, accessible homes, and evolving architectural trends in accessibility. European regulations were also explored, ensuring alignment with the latest standards.
- **Healthy and sustainable mobility:** the study reviewed critical solutions, patents, and good practices regarding motorized vehicles for accessible mobility, mobile applications, and technological innovations supporting health and mobility. Market information and reports on sustainable mobility underscored the growing focus on inclusive and eco-friendly transportation solutions, while trend analysis and European regulations provided a clear framework for future developments in this space.
- **Energy consumption and greenhouse gas emissions:** the analysis identified implemented solutions such as building automation, photovoltaic glass, and energy monitoring tools. Patents and best practices related to energy efficiency and emission reduction were examined, complemented by economic information about the built environment's significant impact on energy use and emissions. Market reports and trend news focused on making buildings greener and finally, the European regulations related to the subject have been analyzed.

This deliverable provides a comprehensive overview of current solutions, emerging trends, and estimated economic impacts, with the aim of offering stakeholders interested in urban design, mobility, and building management and construction best practices for promoting the development of inclusive and sustainable cities and spaces.

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1 Introduction

1.1 Scope and objectives of the deliverable

The scope and objectives of this deliverable focus on the comprehensive evaluation of technologies and market dynamics related to accessibility, mobility, and energy efficiency. This analysis encompasses a detailed review of implemented solutions, relevant patents, scientific articles, and examples of best practices. Additionally, it examines the current economic and market situation, identifying key trends and developments in standardization efforts.

1.2 Structure of the deliverable

The deliverable is divided into three key factors: firstly, Accessibility, Inclusivity and Comfort; secondly, Healthy and Sustainable Mobility; and lastly, Energy Consumption and Greenhouse Gas Emissions. Each of these research areas has been further subdivided into specific categories, including Implemented Solutions, Patents, Scientific Articles, Good Practices, as well as Economic and Business Information, Market Reports, Trend News, and Regulation. This structure ensures a comprehensive evaluation of each topic, covering both technological developments and the broader economic and regulatory context.

1.3 Relation to Other Tasks and Deliverables

WP1 aims to establish the technical and non-technical context for developing and implementing AccesS solutions. This context-setting includes ensuring that the system aligns with methodologies for social inclusion, user-centered design, and active mobility. These efforts will directly support the goals outlined in WP2, making WP1 a critical precursor for WP2's activities. WP2 will further refine these insights to create solutions that are inclusive and responsive to the needs of individuals with reduced mobility and other vulnerable groups in active mobility contexts.

The AccesS Suite, developed in conjunction with WP1 and WP2, will be paired with an Accessibility Assessment Tool designed to evaluate the accessibility of buildings and infrastructure. This tool will be developed according to an Accessibility Assessment Scheme, which WP1 helps to contextualize by identifying key criteria, user expectations, and accessibility challenges.

The accessibility assessment scheme's focus on measurable performance indicators will ensure that solutions are not only theoretical but actionable, promoting user-centered and socially inclusive urban environments.

2 Accessibility, inclusivity and comfort

Accessibility, inclusivity, and comfort are central to the Access project's mission to make smart cities and buildings universally usable. Accessibility ensures that spaces are usable for everyone, including individuals with disabilities. Inclusivity emphasizes designing environments that respect and integrate diverse needs and perspectives, promoting equality. Comfort enhances the user experience by making spaces easy and enjoyable to navigate and use. Together, these principles create adaptive, supportive environments, which the Access project aims to implement widely across European urban spaces.

In the upcoming sections, the Access project will cover diverse aspects of accessibility, including patents, scientific articles, good practices, and implemented solutions, to showcase technical and practical insights. Economic, business, and market data will provide a business context, while trend news and regulatory information address ongoing developments and legal frameworks. This structured approach ensures stakeholders have a comprehensive view of advancements and challenges, helping to foster inclusive, accessible, and commercially viable urban environments.

2.1 Patents

Method of achieving barrier-free access to web page information through mediator

The patent provides a method of achieving barrier-free access to web page information through a mediator. The method comprises the steps that 1, the web page information on a network is acquired; 2, the content of the web page information is analyzed, and an accessibility problem is found out; 3, focusing on the accessibility problem, the information of an original web page is modified, and new web page content is formed; 4, the new web page content is transmitted by the network. According to the method, the accessibility problem on the web page is modified on the network, and then the modified information is transmitted out through the network, so that the capability of information accessibility is improved in the whole Internet environment.

Applicant: SHENZHEN LIANDI INFORMATION ACCESSIBILITY CO LTD

Patent Number: CN107330015A

[Read more here.](#)

System and apparatus for rating accessibility for users with accessibility needs

The patent describes a system and apparatus for rating accessibility of a number of locations for user and/or members with specific accessibility needs. The user and/or member interacts with a database through his or her communication device or through a website to access locations in a geographic zone that provide accommodations for people with specific accessibility needs in a variety of accessibility categories.

The system provides detailed accessibility features within each accessibility category and rates the locations according to the accessibility categories. The member can also input new locations, rate locations already contained in the database or provide other feedback regarding compliance with legal accessibility guidelines and/or other accessibility standards within the United States and abroad. The system updates the ratings of the accessibility categories and the accessibility features based on input from members.

Applicant: SIGNORELLI SHAROL A [US]; SIGNORELLI JR STEVEN JOSEPH [US]; THE FUNABILITIES COMPANY [US]

Patent Number: US11657073B2

[Read more here.](#)

Ride-share accessibility

A method, executed via a mobile device or another type of computer, which allows a user to request a ride-share vehicle that will accommodate the wheelchair, referred to below as an accessibility device. A method includes transmitting a ride-share request to a ride-share server, the ride-share request including information about an accessibility device, determining a present orientation of the accessibility device, and transmitting the present orientation of the accessibility device to the ride-share vehicle.

Applicant: FORD GLOBAL TECH LLC [US]

Patent Number: US11544636B2

[Read more here.](#)

Accessory Protocol For Touch Screen Device Accessibility

A patent defining techniques and systems supporting the control of a touch input device, e.g., a touch screen device, from an accessory communicatively coupled to the device are disclosed. These techniques can be used to provide a protocol that a non-touch input accessory can use to interact with a device with a touch-based user interface. Users with any type of disability can interact with a touch screen or other touch input device, provided that the users have an accessory that they can control. Interactions between the touch input device and non-touch screen accessories can be standardized so that many different accessories can interact with all of the applications executing on a device.

Applicant: APPLE INC

Patent Number: US2011214056A1

[Read more here.](#)

Accessibility menu from remote control

An accessibility button is provided on the remote control, which may replace any existing buttons that may be present for closed captioning. When the accessibility button is pressed, the TV screen text to speech function is immediately enabled, including accessing closed captioning functions.

Applicant: SONY CORP [JP]

Patent Number: US10579732B2

[Read more here.](#)

2.2 Scientific articles

Smart city as a social transition towards inclusive development through technology: a tale of four smart cities

This research paper explores how smart city initiatives have the potential to address many contemporary urban challenges, utilizing information and technology. Increasingly, smart cities are considered as social innovation processes to achieve sustainable and inclusive urban development.

This paper explores 'smart city transitions' across varied urban contexts, in particular, how smart city transitions are enacted and how they contribute to inclusive urban transformation and public value. Using a multiple case studies approach, the research investigated infrastructure planning practices in Amsterdam in the Netherlands, Seoul in Korea, Portland in the U.S. and Ho Chi Minh City (HCMC) in Vietnam, cities that were known for strong efforts to establish integrated platforms to enhance societal benefits.

The paper showcases that building an inclusive, integrated and multi-level planning approach is a prerequisite for effective and sustainable transformation into smart cities, and that the strategy for smart city initiatives should be flexible, contingent and practical to solve the wicked problem of a particular city, rather than sticking to a formulaic one-size fits all approach. Smart city transitions tend to be multi-level endeavors mediated through open governance systems and integrated platforms in order to address citizen's varied needs for better and equitable access to public services.

[Read more here.](#)

Sustainability means inclusivity: engaging citizens in early stage smart city development

The challenge of how cities can be designed and developed in an inclusive and sustainable direction is monumental. Smart city technologies currently offer the most promising solution for long-term sustainability. However, smart city projects have been criticized for ignoring diverse needs of the local population and increasing social divides.

A sustainable urban environment depends as much on creating an inclusive space that is safe, accessible and comfortable for a diverse group of citizens as it does on deploying “smart” technologies for energy efficiency or environmental protection. This is because citizens will be more likely to adopt technologies promoting sustainability if they are well-aligned with their lived needs and experiences.

This paper, presents the rationale behind an ongoing interdisciplinary research project that aims to address exactly the problem outlined above by using a participatory design approach. Focusing on a smart city test site in Sweden where sensors are currently being deployed to collect data on noise, particles, vehicle numbers and types (amongst other), the goal is to bring local residents and government representatives into dialogue with technical developers by adopting a “meet-in-the-middle” approach.

[Read more here.](#)

Enhancing Accessibility and Inclusivity For People With Disabilities Using Hand Gesture Recognition

This study introduces a new method of home automation tailored to the needs of those who have trouble moving about. Using only your hands, the user can turn on and off lights, fans, and other electrical devices. Providing individuals with mobility impairments with the means to autonomously manage their living area is the declared goal of the initiative, which aims to encourage greater independence and better their quality of life.

The suggested system uses computer vision and machine learning techniques to decipher recorded hand motions seen through a camera interface. The system may be able to interpret specific hand movements as commands to operate different home appliances if it has learned to recognize them. We create and deploy a reliable system for the detection and categorization of gestures in real-time.

The study aims to enable people with impairments to live more independently and comfortably in their homes by giving this home automation system that is controlled by gestures. Accessibility and inclusion in smart home settings are significantly advanced by the study’s effort, which leverages state-of-the-art technology and prioritizes user-centric design concepts.

[Read more here.](#)

Accessibility Standards and Their Implementation in Custom Data-Driven Maps

This paper provides an overview of several standards and gives an example of their implementation in custom visualizations such as dynamic data-driven maps. A specially developed tool MapSpice for data visualization will be presented in this paper. This tool is developed and designed to fulfill accessibility standards and requirements of the web publishing industry. There are descriptions and examples of important features and functionalities in map visualizations that are developed using accessibility best practices.

Following these guidelines and recommendations map content is accessible to a larger range of people with different disabilities, including blindness and low vision, photosensitivity, speech disabilities, deafness and hearing loss, limited movement, learning disabilities, cognitive limitations, and others. The result of this paper will be an overview of accessibility standards and guidelines and their implementation in custom data-driven maps developed by MapSpice.

[Read more here.](#)

A Smart Supermarket must be for All: a Case Study Including the Visually Impaired

Shopping in the supermarket is a necessity in modern life. This task, however, can be a challenge for people with disabilities, making them dependent on relatives or supermarket employees to aid them. In this paper, researchers investigate the subject by proposing and experimenting with a system that takes advantage of current ubiquitous computing to support all customers in finding and selecting products in a supermarket.

Based on the Internet of Things (IoT), this system is embedded in a mobile platform. A case study conducted with users –(including visually impaired ones) is reported and discussed. The results are compared with previous experiments conducted with users without disabilities, revealing the impact the system has in terms of efficiency, and feelings of satisfaction, control and motivation.

[Read more here.](#)

From the Point Cloud to Virtual and Augmented Reality: Digital Accessibility for Disabled People in San Martin's Church (Segovia) and Its Surroundings

This article explains the working methodology followed to carry out a project in which the 3D laser scanner survey of San Martin's Church (placed in Plaza Juan Bravo, in the historic city center of Segovia Spain), has been undertaken. There is also a virtual tour through the nearby streets, which lead us to the Jewry Museum, going through the Paseo del Salón. The final aim is to obtain derivative CAD products such as technical plans, solid models and different videos, as well as a simplified 3D model.

[Read more here.](#)

2.3 Good practices

AccessibleEU

AccessibleEU is one of the flagship initiatives proposed by the European Commission Strategy for the Rights of Persons with Disabilities 2021-2030. 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.

AccessibleEU offers:

- Online library on accessibility: direct links, databases, information about standards, guides, studies, good practices and support materials on accessibility.
- Networking: a community of practice comprising accessibility and disability experts.
- Accessibility training: workshops, online trainings and mutual learning events, among others on different accessibility topics.
- Accessibility monitoring and surveillance: provides support to monitor compliance with EU legislation across sectors in each EU country.

[Read more here.](#)

ACCESSIBLITECH

Information and Communication Technologies (ICTs) are essential for many aspects of daily life. Mobility restrictions as a result of the coronavirus pandemic prompted the massive use of these tools, especially those for work, education and remote assistance. Many people with disabilities found that many of these tools did not meet certain accessibility requirements or were completely inaccessible. This was compounded by the difficulty of finding solutions, already available on the market, capable of solving many of the problems experienced.

ACCESSIBLITECH is a European project, which has developed a map of accessible and inclusive technological solutions, at European level, and a methodology to evaluate technologies that have the potential to improve the quality of life and experience of people with disabilities in the areas of teleworking, eLearning and telecare.

[Read more here.](#)

Accessibilitas

Accessibilitas is a digital platform on accessibility, promoted by the ONCE Foundation and the Royal Board on Disability with the aim of promoting the generation and dissemination of knowledge on universal accessibility.

The platform concentrates information of interest in terms of physical, technological, and communication accessibility, including technical and legal regulations, guides and manuals, news, calls for conferences and courses, multimedia material, and much more.

The contents of Accessibilitas are especially aimed at all individuals whose professional practices may influence the accessibility of spaces. In essence, it provides a space for any person and institution interested in contributing to universal design.

[Read more here.](#)

InclusiveSpaces

Inclusion is a prerequisite for any successful transition to a more sustainable city and society. A thriving city is one that is not only green and resilient in the face of climate change, but also inclusive to all members of society. InclusiveSpaces proposes a design-for-all intersectional approach to standardizing and digitizing frameworks for transitioning towards an inclusive and climate-friendly built environment.

The InclusiveSpaces wants to introduce co-design accessibility concepts, engaging people with disabilities and older people to improve inclusiveness, social cohesion and climate change mitigation and adaptation and to develop socially innovative solutions that foster universal design principles, empower diverse target groups, and promote climate-friendly practices

[Read more here.](#)

Built4People

BUILT4PEOPLE is a co-programmed partnership in Horizon Europe's Cluster 5 (Climate, Energy and Mobility). It brings together the European Commission (EC) and two leading associations (ECTP and WorldGBC Europe) with a membership base of actors in the built environment.

The partners co-programme EU research and innovation funding for the built environment, ensuring it is invested in projects which will accelerate innovations towards a sustainable, people-centric transformation of Europe's built environment sector.

The Built4People partners bring together the whole value chain to accelerate people-centric innovation for a sustainable built environment. Within the context of this partnership, a Strategic Research and Innovation Agenda for the next few years has been developed that determines the topics in which the EU funds will be invested.

[Read more here.](#)

Cultural Access Collaborative

Cultural Access Collaborative facilitates a dynamic community of cultural administrators and people with disabilities to remove barriers in Illinois' cultural organizations. Their goal is to share resources, information and support to ensure more accessible and inclusive experiences for guests, collaborators, and employees with disabilities. They have compiled resources to begin or continue the access journey of cultural institutions, as accessibility and inclusion efforts are ongoing and achieved over time through incremental change.

[Read more here.](#)

iNCLUSION Project

iNCLUSION is an Erasmus+ project launched in July 2024 with the goal of s making heritage sites more accessible and inclusive for everyone, particularly people with disabilities. The project aims to establish a skills blueprint for the accessibility management of audiences with disabilities in cultural heritage by applying inclusive pedagogies to motivate higher education students approach audiences with disabilities.

[Read more here.](#)

2.4 Implemented solutions

The solutions shown below have been selected for their relevance and pertinence to the AccesS project, as they address key aspects for enhancing accessibility, inclusion and usability for people with disabilities and elderly people with reduced mobility.

Each of these solutions aligns with the project's objectives by promoting independent living, digital and financial inclusion, and communications accessibility in the context of smart cities and smart buildings. Collectively, these solutions contribute to the project's goal of creating an inclusive, accessible and user-centered built environment.

iAccess Life

iAccess Life is a mobile app that lets users with disabilities rate, review & research places based on their accessibility. Download our app and find accessible places near you! iAccess Life will provide users with a wealth of knowledge around the accessibility of establishments such as restaurants, hotels, concert venues, and sporting arenas so they can easily find wheelchair accessible places and establishments that accommodate their needs.

[Read more here.](#)



Showee, a smart shower

Smart shower designed for people with disabilities who face challenges both physical and intellectual. It has a height-adjustable structure and includes a smart touchscreen that guides users through each step, from wetting and lathering to drying. By adapting to a user's level of autonomy, it gives them back a lot of privacy without endangering their safety.

[Read more here.](#)



Augmental, head tracking and 'silent speech'

Augmental is helping people with disabilities to use computers by developing technologies that detects head-movements and tongue gestures. With this movements and gestures users can now control the cursors.

[Read more here.](#)



Papara, voice card

Papara is a mobile-enabled debit card that allows visually impaired customers to hear the billing amount in retail stores using its voice point-of-sale terminals. The technology will allow the visually impaired to spend money on their debit card independently. It is powered by voice-activation technology catalyzing efforts to use natural speech controls for the benefit of those living with visual disabilities.

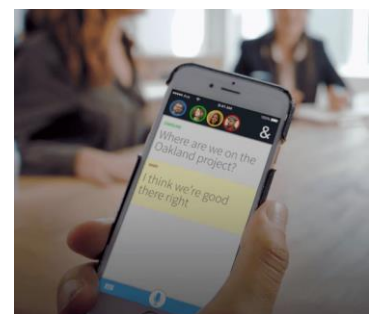
[Read more here.](#)



Ava, live captions for deaf and hard-of-hearing people

Ava products provide closed captions for all online meetings and videos on Mac, Windows, and Web. It gives users instant access to 99 percent accurate captions using a mix of real-time AI-based captions and live transcription.

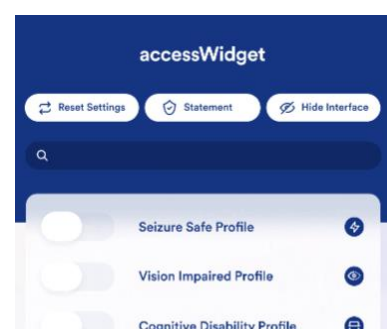
[Read more here.](#)



AccessiBe, web accessibility solution

The AI startup has developed a plug-and-play solution that makes website content accessible to users with visual, hearing and motor impairments, as well as other functional disabilities. The software scans website data, automatically makes modifications, and then transmits the content to end-users in the right format.

[Read more here.](#)



SpeechCode

Adding audio format, the SpeechCode software increases reach, accessibility and safety of any information. Affordable-easy-sustainable. The SpeechCode Generator software transforms any information into a data code, which holds the entire content. Once scanned with the free SpeechCode App, it presents it - without Internet access - as text and/or in audio format.

[Read more here.](#)



V-CHAIR®

This smart bed convertible into a chair helps prevent ulcerations and pulmonary or urinary infections derived from lack of movement, facilitates rest and empowers the patient. It also improves the quality of life of caregivers thanks to the fact that it facilitates the tasks of assistance and patient care, avoiding injuries and overexertion.

[Read more here.](#)



SONA

SONA is a portable handlebar that can be attached to any shopping cart. The shopping assistant allows those who are blind or have low vision to lead more independent lives, like running errands without requiring assistance. The buttons include a voice-operated shopping list, locator for specific items in the store, a navigation system, a scanner for items with and without barcodes and an alert to notify staff that the customer needs assistance.

[Read more here.](#)



WeWALK Smart Cane 2

Smart cane packed with safety, navigation, and AI features. Driven by lived experiences and the voices of the visually impaired community, its goal is creating the ultimate mobility tool for visually impaired people. It is a smart mobility companion designed to provide sensory, and multi-modal feedback to people with visual impairment for a seamless orientation and mobility experience.

[Read more here.](#)



2.5 Economic and business information

The integration of accessibility, inclusivity, and comfort in building design is not only a social imperative but also a significant economic and business opportunity. In today's market, the demand for buildings that cater to diverse populations is growing, due to continually improving awareness on the topic of inclusiveness. Moreover, the factor energy efficiency is crucial, as the environmental footprint of accessible and comfortable buildings is considered.

To this end, commercial and free software are available, for evaluating the impact of building design on comfort (e.g., thermal, acoustic, visual, air quality) and energy efficiency. Building comfortness, or the similar expression of the Indoor Environmental Quality (IEQ), and energy efficiency are altered by building designs that accommodate accessibility, such as addition of ramps and larger rooms or door frames.

Additionally, these designs may severely increase the cost of construction. Accessibility-friendly design for new constructions may increase cost, but these costs are outweighed by future savings from reduced healthcare expenses and the avoidance of expensive retrofits¹. Disability retrofits can cost up to tens of thousands of €². Similarly, retrofits to improve comfortness and IEQ can also take several thousands of € to accomplish³. Considering comfortness from the design stage may increase cost 5-10%^{4 5}.

Concerning software tools to design buildings and evaluate their impact on energy and comfortness, it is difficult to establish exact market share numbers for the various options. However, there are two solutions that are widely used in industry.

The commercial software [Autodesk Revit](#) and its associated add-ons (e.g. [Dynamo](#), [Insights](#)), can be used to exploit BIMs for monitoring and simulating energy and comfort levels. On the comfort simulation perspective, Autodesk also offers [CFD](#) to perform fluid-physics simulations for air and affected quantities (e.g., indoor temperature). [EnergyPlus](#) and [OpenStudio](#) are solutions that are a free alternative to Autodesk products, widely used by designers and architects, which focus on energy modelling.

EnergyPlus often acts as a component to other software, to model energy and (implicitly) comfort, as in the case of [DesignBuilder](#). Other tools, such as the ones offered by [IES VEB](#) have a smaller share. These two software families (Autodesk and EnergyPlus) seem to dominate the market of energy / comfort -sensitive building design.

¹ Centre for Ageing Better. (2022). [Building properties to new minimum standards could cost more inaccessible homes.](#)

² Graded Tradesmen. [How much does a disability retrofit cost?](#)

³ [ReCO2ST](#): Affordable and sustainable renovation for better energy efficiency.

⁴ Charlene W. Bayer (2020) [Evidence-Based Design for Indoor Environmental Quality and Health.](#)

⁵ [5]. Carpio, M., & Tzuc, O. (2022). [Comfort and energy analysis in a tropical climate using adaptive comfort models in social housing.](#) Buildings, 12(11), 1983.

2.6 Market reports

There seems to be a lack of available market reports that tackle the very specific topic of inclusivity and accessibility in the context of comfort (thermal, acoustic, visual, air quality) and energy efficiency. Following, reports are presented that deal with individual components of the subject, as well as concerning tools used to design accessible and comfortable buildings.

How much is the indoor comfort of a residential building worth? A discrete choice experiment

This is not an ordinary financial report, but it addresses the specified topic and provides economic data. The study was to estimate the willingness to pay (WTP) for innovative technical solutions that improve thermal, visual, acoustic, and indoor air quality in residential buildings. The study found that the sample population, mostly under 40, prioritizes thermal comfort (WTP = 377.94 €/m²), followed by visual comfort (WTP = 166.83 €/m²), acoustic comfort (WTP = 119.60 €/m²), and indoor air quality (WTP = 79.21 €/m²). These findings could potentially influence future investment decisions and design practices in the building sector, promoting sustainable and comfortable living environments.

[Read more here.](#)

Europe Indoor Air Quality (IAQ) Monitoring Solution Market Size, Share & COVID-19 Impact Analysis

This paper looks at market trends, growth drivers, and challenges. It states that the market was valued at \$1.23 billion in 2020 and is expected to increase at a compound annual growth rate (CAGR) of 6.3% between 2021 and 2028. Increased awareness of the health effects of indoor air quality, demanding regulatory standards, and technological improvements in Indoor Air Quality (IAQ) monitoring technologies are all key drivers of growth. The report also highlights the key market players and their strategies.

[Read more here.](#)

Forecast for accessible homes 2020: Accessible housing in local plans

This briefing shows the results of our analysis of local plans in England conducted between July and October 2020. The findings provide an update on Habinteg's 2019 Insight report: Forecast for accessible homes. By analyzing policies set out in local plans our team have constructed a forecast for the number of new homes that are planned to meet accessible housing standards.

[Read more here.](#)

2.7 Trends news

Embracing inclusivity and redefining accessibility in architecture

This blog post highlights the significance of inclusive and accessible design in modern architecture. It addresses how being inclusive benefits not only people with disabilities, but also the general user experience and community well-being. The article discusses many design tactics for making spaces more accessible, such as addressing sensory experiences, advocating universal design principles, and using sophisticated technologies. The article promotes a holistic approach to design that addresses the different requirements of all users, resulting in more equitable and functional surroundings.

[Read more here.](#)

Design for Inclusivity at the UIA World Congress of Architects 2023

This article summarizes the event's talks and ideas, with a focus on the necessity of diversity in architectural design. The congress highlighted a comprehensive approach to inclusivity, taking into account not only physical accessibility but also age, gender, socioeconomic status, and neurodiversity. The conversations emphasized the importance of intersectionality in design, which ensures that buildings accommodate a diverse range of human identities and experiences. While no exact cost figures were provided, the event emphasized the broader economic and social benefits of inclusive design, arguing for spaces that provide dignity, comfort, and usability to all individuals.

[Read more here.](#)

The importance of thermal comfort in architecture: types, examples, and strategies

This blog underlines the importance of maintaining ideal indoor temperatures for improved occupant well-being and productivity. It highlights numerous tactics that architects can employ to promote thermal comfort, such as good insulation, natural ventilation, and sun orientation. The article discusses the advantages of thermal comfort, such as better health, enhanced efficiency, and lower energy expenditures. It also investigates the effects of regional temperature, cultural differences, and individual metabolic rates on perceived comfort levels, calling for a more personalized approach to architectural design. It highlights current trends such as natural ventilation integration, strategic solar orientation, and the use of appropriate insulation materials to improve thermal comfort in buildings.

[Read more here.](#)

Building for everyone: Inclusive design and accessibility

This article highlights the vital need of establishing inclusive spaces through thorough architectural design. It promotes a transition from retrofitting to proactive, inclusive design based on ADA

standards. Physical accessibility features such as accessible parking and building walkways are important, as they ensure easy and safe access for all users. Sensory accessibility is also addressed, with the use of sensory-responsive devices to assist those with sensory impairments. Thunderbird's Global Headquarters exhibits these values with amenities such as universal changing tables, making the building friendly and accessible to all, and setting a high standard for future architectural undertakings.

[Read more here.](#)

How Can Buildings Work for Everyone? The Future of Inclusivity and Accessibility in Architecture

The article that follows highlights the significant demand for architectural designs that respond to various demands while stressing accessibility and inclusivity. It highlights the challenges involved in developing spaces that accommodate persons with impairments and aging populations, pointing out the World Bank's estimate that 1 billion people live with disabilities. The article promotes creative design ideas and technology, such as high-contrast materials and smart lighting, to improve sensory navigation and ensure universal accessibility. These techniques strive to make built environments more inclusive, promoting independence and well-being for all users.

[Read more here.](#)

How a Small Church Can Benefit From New Technology

Just as there is no one size fits all church model, there is no one size fits all tech package that will solve every obstacle you face as a church. While one church may benefit from an online database, another may find it completely unnecessary. This will all depend on the size of your congregation, the different ministries and initiatives you are offering, your pastoral staff and leadership, and much more.

If you are a church on the fence about implementing technology into your operations, services, or communications this article showcases how a few small tech enhancements could support your church's overall mission, and provides a few of the simplest and most impactful technologies you can start with, such as management software to track church metrics you wish, send bulk communications, and organize data, online giving systems for church-goers, online and social media presence to connect with their congregations and surrounding communities digitally and digital projection equipment to provide worship lyrics on a screen, sermon visuals, projected bible verses, event information, video clips, or biblical readings in relation to the worship experience.

[Read more here.](#)

2.8 Regulations

- [ISO 7730:2005](#): Ergonomics of the thermal environment.

- [ISO 16814:2008](#): Building environment design — Indoor air quality.
- [ISO/FDIS 16813](#): Building environment design — Indoor environment (final draft stage, under development).
- [ISO 21542:2021](#): Building construction — Accessibility and usability of the built environment.
- [EN 16798-1:2019](#): Energy performance of buildings - Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.
- [EN 17210:2021](#): Accessibility and usability of the built environment - Functional requirements.
- [UNE 41531:2018 IN](#) Accessibility of the Immovable Cultural Heritage. General criteria and methodology.

2.9 Summary and Key Insights

This section on "Accessibility, Inclusivity, and Comfort" highlights innovative solutions designed to enhance accessibility in both physical and digital environments for individuals with various disabilities. These solutions address not only physical barriers but also cognitive and sensory challenges.

Implemented solutions include technologies like Showee, a smart, height-adjustable shower designed for people with physical and intellectual disabilities, offering privacy and autonomy without compromising safety. Augmental introduces head-tracking and tongue gesture technologies to allow people with limited mobility to control devices more efficiently, improving their digital interactions.

Important advancements in the form of patents, such as a system for barrier-free web access (CN107330015A), which dynamically modifies web content in real-time to resolve accessibility issues, thereby enhancing the overall web experience for users with disabilities. Another significant patent focuses on rating the accessibility of physical locations (US11657073B2), providing users with personalized information about accessible spaces in their geographic area. This innovation empowers people with disabilities to find environments that are tailored to their specific needs, further advancing accessibility in everyday settings.

In addition to technological innovations, scientific articles in this report explore the broader impact of digital accessibility on social inclusivity. For example, studies on gesture-based home automation systems demonstrate how these technologies allow users with mobility impairments to control their home environments through simple hand movements, thereby promoting independence and improving their quality of life. The focus on user-centric design ensures that accessibility is integrated into smart home technologies, which greatly enhances the autonomy of individuals with disabilities.

Market trends indicate a growing emphasis on creating environments that are not only accessible but also prioritize comfort—encompassing thermal, visual, and acoustic factors—while also ensuring sustainability. European regulations play a key role in guiding these developments, ensuring that new solutions align with the latest accessibility standards. This combination of accessibility and comfort is crucial as the built environment evolves to meet the diverse needs of its users. These trends reflect an

increasing recognition of the importance of inclusive design, which benefits not only individuals with disabilities but also society as a whole, promoting more equitable and user-friendly spaces.

The following table provides an overview of gaps and challenges identified in promoting accessibility and inclusion in the built environment based on the findings of this report, linked with the project's operational objectives.

Table 1. Gaps in accessibility and inclusion in built environments and smart cities.

AccessS Operational Areas	Identified Gaps
User-centered design for accessibility	• Current discussions around inclusivity in the built environment do not fully integrate the perspectives of people belonging to vulnerable populations, including the elderly and people with different disabilities to ensure that technologies are not only accessible, but also intuitive and adapted to the specific needs of diverse users. • Lack of comprehensive user testing and feedback loops with diverse disability groups including the elderly. • Insufficient training for cultural staff to design and implement activities to be inclusive to people with disabilities. • No clear focus on user centered co-design for accessibility solutions in smart cities and buildings, especially in regards of customizable and personalized user interfaces that can adapt dynamically to individuals varying levels of accessibility, including cognitive and mobility aspects.
Digital innovations for accessible and inclusive built environments	• Lack of widespread awareness about available digital tools and technologies that can enhance user independence in smart buildings and cities. • Difficulties in accessing these technologies due to geographic availability or limited commercialization, which in many cases also means that many of these solutions are only developed in English, which adds an additional language barrier. • No clear guidelines on affordability and economic barriers that prevent many from accessing these innovative solutions: while technologies exist, high costs often restrict access, particularly for marginalized populations. • Limited focus on developing digital innovations for accessibility in the cultural sector, specially heritage sites and museums. • There is insufficient emphasis on the integration of assistive technologies in public spaces (e.g. tactile surfaces or auditory signals) to improve the comfort and confidence of users with disabilities, reduced mobility or cognitive challenges. This also entails a gap in training programs for staff in public customer services (transport, hospitality, cultural spaces...) regarding the specific needs of users with diverse needs and how to assist them.

Inclusive and sustainable design	• Lack of integration between inclusion standards and sustainability practices in building engineering; it is one or the other, but not both. • There is a gap in how accessibility criteria can be incorporated in a sustainable fashion without significantly increasing the cost of manufacturing and/or construction. • Lack of analysis of potential problems or conflicts that may arise between environmental sustainability and accessible design, e.g., sustainable materials that may not be inclusive to/for all users.
Standardized Framework for Inclusive Environments	• Existing frameworks do not address the full spectrum of accessibility challenges and needs or are not flexible enough, especially to address marginalized groups. • Lack of standardized frameworks for assessing or certifying accessibility in technological solutions in buildings and cities, resulting in fragmented approaches to inclusive design. • Absence of unified and specific training, frameworks and guidelines that address accessibility in cultural heritage sites and cultural organizations
Innovation, Public Awareness, and Industry Collaboration	• Insufficient collaboration among stakeholders (industries, architects, builders, policymakers, and advocacy groups), which may hinder the development of comprehensive solutions.
Universal Accessibility	• Some solutions may not reach all demographic groups due to socioeconomic barriers or a lack of knowledge about digital technologies, especially among older populations (digital divide). • Lack of awareness about platforms like Accessibilitas or ACCESSIBILITECH, which provide specific guidelines and recommendations on accessibility. • Gaps in universal design principles that lead to the continued exclusion of certain groups.

3 Healthy and sustainable mobility

Healthy and sustainable mobility within the Access project promotes transportation solutions that reduce environmental impact while enhancing public health and accessibility. By focusing on eco-friendly transportation options, like cycling, walking, and electric vehicles, this approach helps reduce urban pollution and supports equitable access to transit. This is vital for creating inclusive cities where mobility options are safe, affordable, and accessible to all, including people with disabilities. Such mobility frameworks enhance quality of life and align with sustainability goals.

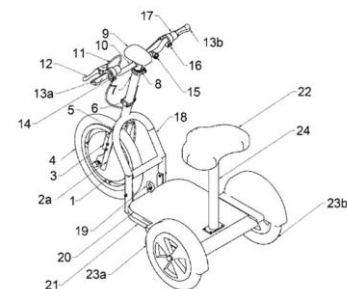
The following pages offer a compilation of patents, scientific articles, good practices, implemented solutions, economic and business insights, market reports, trend analysis, and regulatory information. Each area provides insights into technical innovations, real-world applications, market dynamics, and policy frameworks. This comprehensive approach supports the project's mission to advance mobility solutions that are accessible, eco-friendly, and beneficial for all users.

3.1 Patents

Folding portable electric scooter

A three wheeled stand-up or sit down foldable and portable electric personal mobility vehicle for fulfilling the needs of a broad spectrum of users including the users with disabilities and recreational users.

The personal mobility vehicle has two major parts, including a front wheel frame assembly and a rear frame chassis assembly. These major parts are configured to easily fold into a smaller size so that the vehicle can be easily transportable and more conveniently stored. Furthermore, a versatile seat and seat post are implemented to enable a user to sit or stand, and the seat can be easily removed, without tools, to create more space should a user wish.



Applicant: SCHNEIDER JEFFREY [US]

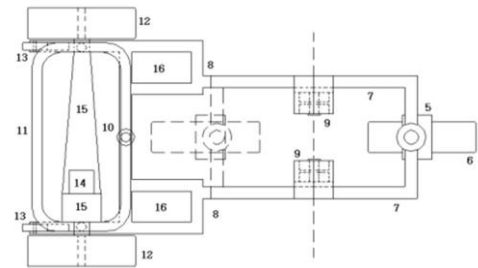
Patent Number: US11260926B2

[Read more here.](#)

Three wheels electricity scooter that fold by trunk shape

The present invention relates to an electric scooter which is composed of three wheels, which is capable of short-distance movement in a stable form and is conveniently folded and carried in a trunk (wheeled suitcase). The two rear wheels are connected by a differential gear with a built-in reduction gear.

Directly connecting DC motor on the top, the body part is a curved frame that folds up, and it is a structure that makes it look like a trunk (wheeled suitcase) when it is folded by connecting a folding handle shaft with a motor speed control knob and a built-in differential gear with a reduction gear. The electric wheel is a three-wheeled electric vehicle that can be steered through the handle part while sitting on an adjustable saddle in an unfolded shape, to drive at a safe speed on general roads and bicycle roads, and to pull and move stairs in buildings and vehicles like a cart in a folded shape.



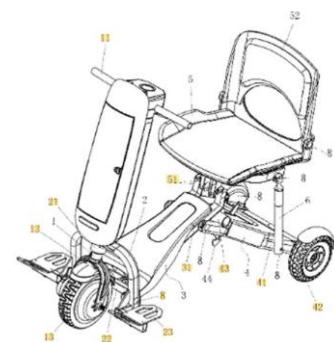
Applicant: 오동관 [KR]

Patent Number: KR200436310Y1

[Read more here.](#)

Folding electrically powered vehicle

A folding electrically powered vehicle includes a handlebar unit mounted at an upper end of a stem; a front wheel; an inverted U-shaped front suspension assembly including an intermediate joint pivotably mounted on a lower portion of the stem, a rearward curved frame member, and two foot rests; a front frame having two ends of a front portion pivotably secured to the two ends of the suspension assembly, the front frame including two rearward extending bars; a rear frame including two side bars pivotably secured to the rearward extending bars, two rear wheels, and a stop tube across front portions of the side bars; a seat assembly including two bottom tubes pivotably secured to two ends of the rearward extending bars respectively, and a pivotal seat back; and two shock absorbers.



Applicant: PUC PERFECT UNION CO LTD [TW]

Patent Number: US10562583B1

[Read more here.](#)

Auto foldable electric scooter

The present invention relates to an electric scooter for driving an elderly person, and more particularly, to an electric scooter for an elderly person who can open and collapse automatically.

Applicant: LEE DOO WON [KR]

Patent Number: KR101995507B1

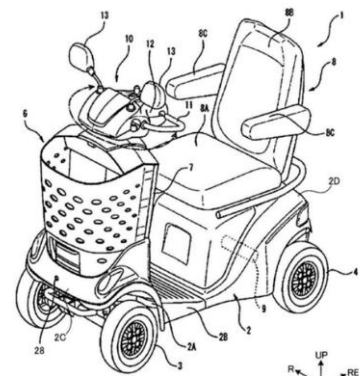
[Read more here.](#)



Control device and electric vehicle

A control device and an electric vehicle, which perform collision suppression control in an electric vehicle such as an electric scooter without giving a driver a sense of discomfort.

The control device is provided with a camera, detects an obstacle in a predetermined range in the traveling direction of the electric vehicle, and performs collision suppression control between the obstacle and the electric vehicle according to the output of the camera, and is provided with: a risk level determination unit that determines a collision risk level of the obstacle with the electric vehicle based on a distance between the obstacle and the electric vehicle; and a control level adjustment unit that adjusts the control level of the collision suppression control according to the collision risk level to perform the collision suppression control. When a cancel switch for temporarily canceling the collision suppression control is operated by the driver during the collision suppression control, the control level adjustment unit lowers the control level and displays the presence of an obstacle on the electric vehicle.



Applicant: 鈴木株式会社

Patent Number: CN111661212B

[Read more here.](#)

Mapping and data collection of in-building layout via mobility devices

A method includes receiving sensor data relating to an environment from a plurality of mobility devices, determining locations of one or more points of accessibility within the environment based on the sensor data, creating an environment map based on the sensor data, and transmitting the environment map to a mobility device. The environment map includes the one or more points of accessibility.



Applicant: TOYOTA MOTOR NORTH AMERICA INC [US]

Patent Number: US11642257B2

[Read more here.](#)

Automatic map generation system for the vulnerable using deep learning-based object recognition technology

The present invention relates to a system designed to create maps for individuals with transportation vulnerabilities and to provide customized route guidance. Specifically, it focuses on a system that offers multiple features to assist users of electric mobility aids, such as electric wheelchairs.

These features include promptly alerting others in the event of a fall caused by the overturning of the mobility aid, continuously monitoring road surface conditions to help improve the road environment through maintenance and repairs, analyzing the user's driving patterns and posture to prevent health issues like bedsores during prolonged use, and providing personalized route guidance tailored to the needs of transportation-vulnerable individuals, including people with disabilities.

This is achieved by gathering route data and spatial information through voluntary participation of the users or individuals using the electric mobility aid.

Applicant: KYUNGSUNG TECH CO LTD [KR]

Patent Number: KR102537450B1

[Read more here.](#)

Indoor road guidance system for the transportation handicapped

The present invention relates to an indoor road guidance system designed for vulnerable road users, providing optimal route guidance based on the user's specific type and selected mobility aid.

The system includes a road guidance database (DB) containing map information that links beacon locations in each building and position coordinates within zones assigned to each beacon with geomagnetic sensor values. Indoor guidance routes are mapped based on combinations of user type and mobility aid.

Additionally, the system features a position acquisition unit that determines the user's indoor location by receiving position data, including geomagnetic sensor values, from a terminal application used by the vulnerable road user.

Finally, a guidance provision unit delivers an indoor route from the user's current location to a destination. This guidance is sent to the user's terminal application by retrieving the appropriate route based on the user's selected mobility aid and type from the road guidance DB.

Applicant: HUMANCARE CO LTD [KR]

Patent Number: KR102487037B1

[Read more here.](#)

3.2 Scientific articles

Enabling mobility and inclusion: Designing accessible autonomous vehicles for people with disabilities

Accessible transport would increase opportunities and services for People with Disabilities (PwDs) including but not limited to work, healthcare, and social inclusion, which will translate into positive economic and community outcomes. Accessible transport will reduce restrictions on PwDs' freedom

of movement, which violates their rights and undermines their dignity and inclusion. The lack of accessible transport represents one of the biggest challenges for PwDs.

This paper provides an overview of accessible road vehicles and captures key information needed to design an accessible AV. A comprehensive analysis of 57 studies reveals relevant design requirements for a diverse group including PwDs. Recommendations for the design of accessible AVs are provided. The paper emphasizes the importance of user acceptance, accessibility, and trust.

The design process should consider various PwD types and trip stages, employ multimodal outputs, conduct trials, explore subsidizing fares for PwDs, and create specialized vehicles for different purposes or contexts.

[Read more here.](#)

Development of a DGPS-Based Localization and Semi-Autonomous Path Following System for Electric Scooters

More and more elderly and disabled people are using electric scooters instead of electric wheelchairs because of higher mobility. However, people with high levels of impairment or the elderly still have difficulties in driving the electric scooters safely. Semi-autonomous electric scooter system is one of the solutions for the safety: Either manual driving or autonomous driving can be used selectively.

In this paper, researchers implement a semi-autonomous electric scooter system with functions of localization and path following. In order to recognize the pose of electric scooter in outdoor environments, they design an outdoor localization system based on the extended Kalman filter using DGPS (Differential Global Positioning System) and wheel encoders. They added an accelerometer to make the localization system adaptable to road condition.

Researchers also propose a path following algorithm using two arcs with current pose of the electric scooter and a given path in the map. Simulation results are described to show that the proposed algorithms provide the ability to drive an electric scooter semi-autonomously. Finally, they conduct outdoor experiments to reveal the practicality of the proposed system.

[Read more here.](#)

Multi-function Electric Scooter Assistant System for Seniors

Many countries are moving towards an aging society. Many elderly people live alone, and they need to take care of themselves. The purpose of this article is to increase the safety when elderly people ride on a scooter alone. When an accident occurs, their family can clearly know the location of the accident and can record the entire accident process.

This paper uses the IFTTT (If This Then That) system. When an accident occurs, IFTTT is used to send the location to the family LINE. The family can know the location of the elderly through remotely monitoring the real-time behavior of the monitored person.

Therefore, they can immediately understand the situation when the accident occurs. In addition, they can also know whether the elderly is riding the scooter through the pressure sensor. It can transmit GPS location immediately and start the camera to record.

[Read more here.](#)

A Study on Electric Scooters for the Elderly by Applying Fuzzy Theory

This research focuses on using fuzzy comprehensive evaluation to guide the design process of electric scooters for the elderly, particularly to enhance ride smoothness. It outlines a five-step process: first, a questionnaire is used to understand the key design factors considered by designers. Next, hierarchical analysis is performed to determine the weight of each factor in the design process. This is followed by applying fuzzy hierarchical analysis to summarize the evaluation results based on the designers' experience. All influencing factors are then comprehensively considered to arrive at a final judgment.

The research culminates in the creation of fuzzy rules as a method to improve traditional scooter designs for the elderly. The study highlights that among the factors affecting smoothness, travel speed had the most significant influence, accounting for 24.98% of the total effect.

[Read more here.](#)

The Conceptual Design of the Electric Scooter's Steering-by-wire System

Nowadays, big cities are faced with aging of the population and increasing physically disabled people caused by accidents. When those elderly people and disabled patients need others' support, assistance and care because of stiff knuckles, electric scooters show their advantages for being energy-saving and convenient. Therefore, electric scooters are developed as a mainstream.

In the article, according to the controlling strategies of the system, a proper scheme controlled by the steering-by-wire system is confirmed. The controlling model for electric scooters driven by dynamo is developed and tested on the sample car.

[Read more here.](#)

Application of synergic electric power supply in hybrid electric scooter

To improve efficiency and distance of electric scooter, synergic electric power supply was studied. Full-digital DC-DC converter based on ADSP2188+FPGA was used to transfer energy between Synergic electric power supply and motor. Experimental results indicate that synergic electric power supply with full-digital DC-DC converter can be used in hybrid electric scooter power storage system, Which can improve energy using efficiency of HES greatly.

[Read more here.](#)

Towards Accessible, Sustainable and Healthy Mobility: The City of Barcelona as Case Study

Sustainable mobility and circular economy are fundamental pillars in the fight against the climate crisis, covering all modes of transport with minimal or zero impact on the environment. The sustainable mobility of people and goods allows access to education, culture, housing, work, leisure, and food, it is part of millions of people every day and is one of the factors that most influence the path towards decarbonization, reduction of the greenhouse, gas emissions, improving the health of citizens and providing economic benefits. For this reason, it is essential to rethink mobility towards a more sustainable one by exploiting data and existing and in-the-field sensors.

This project aims to build a platform capable of helping contemporary cities in the transformation towards sustainable, resilient, and healthy cities through the exploitation of data, both existing and sensors in the field. The paper proposes to build a 2-layer platform committed to (1) quantitative data processing, which can be merged, processed, and visualized, using Big Data processing techniques to display relevant data and extract relevant information in the field of urban design, and (2) strategic system, which will assist in the definition of criteria to help citizens and regional governments to solve the problems derived from the design of contemporary cities.

[Read more here.](#)

System-Level Approach to Designing a Smart Wireless Charging System for Power Wheelchairs

New technology design and its integration into a social environment in a noninvasive way are recognized as one of the main challenges of the rapidly growing technology world. The design complexity is amplified if the system is intended for a sensitive user category, e.g., persons with disabilities and aging adults. A high percentage of power wheelchairs (PWCs) users rely on caregivers or family members to charge their PWC units.

In this article, a design methodology is presented that describes a system-level approach for designing a 1-kW smart wireless charger for PWCs. This article describes how power electronics, communication, automation, software, and internet technologies are integrated to deliver a functional hands-free, free-position PWC charging solution. The proposed solution utilizes a multicoil transmitter pad to achieve a free-positioning feature and dual-side control to regulate the power.

The researchers adopted a human-in-the-loop approach to seek feedback from end-users and tailor the final design through multiple generations of prototypes. Moreover, some existing technical solutions regarding pad design and stray field shielding are adapted or advanced to meet the application requirements, and their effectiveness is validated on a 1-kW prototype.

[Read more here.](#)

3.3 Good practices

RESOLVE Project

Compact electric vehicles (ELVs) may be a cornerstone of the transition towards smart and green mobility in EU cities, but they are not quite ready for mass appeal. Besides a lack of infrastructure, the vehicles themselves are still not convenient enough for use in cities, and they are also restrained by expensive batteries with reduced range and long recharging time. To thrive, the sector needs to reduce production and use costs, as well as provide a more enjoyable experience to drivers.

The ELV prototypes designed under the RESOLVE (Range of Electric Solutions for L-category Vehicles) project aim to meet these requirements. These four-wheel scooters revolve around low-cost, modular and scalable LV-specific electric powertrains and battery architectures, and they have been designed specifically with urban use in mind.

The prototypes are safer, more dynamic and quicker to recharge thanks to the possibility of easily swapping batteries, require less energy and cost less than existing ELVs. The icing on the cake is that they also include a multi-wheel vehicle control algorithm that improves handling and stability, along with an innovative, user-friendly HMI that addresses 'range anxiety'.

[Read more here.](#)

INDIMO Project

The proliferation of smartphones and digital data collection have produced an expanding array of digital solutions for the management of mobility and logistics. This multitude of digital solutions for mobility has enabled the emergence of the connected traveler, who can independently plan travel routes, modes and departure times just by using a smartphone.

The EU-funded INDIMO project developed the Inclusive Digital Mobility Toolbox that addresses this issue by providing guidelines and recommendations to the key stakeholders in digital mobility thanks to the co-creation of tools that can help developers, operators and policy makers to generate an inclusive, universally accessible and personalized digital transport system. The INDIMO project main ambition was to break the barriers that people face in accessing digitally interconnected transport systems.

[Read more here.](#)

TRIPS Project

Over 80 million Europeans have a long-term disability, which may include physical, mental, sensory or intellectual challenges. Disabled citizens are at high risk for social exclusion, and mobility issues represent one of the greatest barriers to accessing all a modern society can offer. The EU-funded project TRIPS addressed this issue by involving disabled persons in the design of future transportation solutions.

TRIPS will conduct research on needs and attitudes towards future mobility solutions; review the state-of-the-art on accessibility, mobility and related digital and assistive technologies and policies and devise an index to measure mobility.

TRIPS stands for “TRansport Innovation for Persons with disabilities needs Satisfaction”. The project aims at making public transport more accessible for persons with disabilities, elderly voyagers and really everyone.

[Read more here.](#)

G MOTIT Project

Causing peaks in pollution, wasted time and noise nuisance, traffic jams are one of the greatest challenges to overcome for the majority of large cities around the world. It’s a problem that affects the richest countries and developing countries alike, and the possible solutions are as slow to put in place as they are difficult to enforce. Moreover, the reduction of global greenhouse gas emissions is one of the major challenges of the 21st century. These facts highlight the need of efficient and environmentally sustainable urban mobility services that do not generate CO2 emissions and ease traffic congestion.

Within this context, an innovative service has been developed in order to solve mobility problems in the city of Barcelona and potentially major metropolitan areas in Europe. MOTIT is a unique and innovative electric scooter sharing service, in which users may pick up and drop off vehicles wherever and whenever they want. MOTIT allows users to reserve a scooter with their smartphone, and some minutes before the start of the trip he receives a notification on his smartphone with the position of the vehicle assigned. Vehicle positioning performance is key for the success of the service, since the user is informed on where to pick up his vehicle based on this source.

During initial pilot operations, supported by European Commission R&D funding , GPS-based solution (embedded on the tablet device of the vehicle) has proven not to be a reliable solution because of the lack of availability in certain areas of the city (deep urban) and positioning errors misleading scooter location information to user. Therefore, G-MOTIT project aims to overcome these problems by developing and integrating an EGNSS-based location technology. The location solution will be validated both functionally and operationally through a small-scale demonstration in Grand Paris region.

[Read more here.](#)

DREEM Project

A resource-efficient, climate-friendly, environmentally sustainable, safe and seamless transport system is a key objective of the EU. However, there are several challenges facing the attainment of sustainable mobility, one of which involves the use of different and optimally combined transport modes in a seamless way. One solution for greater sustainability in smart city transport systems is intermodal passenger transport. More specifically, light, low-occupancy vehicles with smart features appear to be a key element in achieving intermodality within a city.

The use of different and optimally combined transport modes in a seamless way is one of the key challenges to achieve greater sustainability in smart cities transport systems. Each mode of transport has its own advantages and satisfies different mobility purposes and needs. The core of new electrified micro-vehicle concept is to combine design and user needs for an easier usage within traditional transportation modes (e.g. public transport) in both urban and suburban areas.

DREEM aimed at finalizing and testing a safer and modular e-kick scooter for personal urban and suburban mobility in three different pilot cases while exploring the feasibility of innovative business models and circular economy.

[Read more here.](#)

Bettery Project

Electric vehicles are poised to replace the high-polluting gasoline transport, driven by international policies aimed to reduce greenhouse gas emissions. Nonetheless, market uptake of electric cars is still low, less than 1% of automotive sales in 2016. The adoption of electric vehicles is hindered by long recharging times (on average 4 hours) and limited autonomy (max 300 km), due to performances constraints of the Li-ion batteries, the state-of-art in e-vehicles.

After 4 years of research, BETTERY has developed NESSOX, a patented new class of batteries that allow for fast recharge of the battery and outstanding performances in terms of autonomy, size and weight.

The core technology is the patented design NESSOX, based on combining the lightness and high performances of the Li/O₂ technology with the modularity of flow batteries, and a proprietary semi-solid catholyte based on a carbon nanoparticles, which assure flexibility and high performances.

NESSOX intend to introduce a new paradigm in electric vehicle transportation, by finally freeing e-drivers from the inconvenience of long recharging stops and limited duration of the battery, thus unleashing the market adoption of e-vehicles.

BETTERY plans to initially target the small vehicles market (e-bikes and e-scooters), and then move to the automotive sector. Global leaders in the automotive supply sector expressed their interest in collaborating for product development and distribution.

[Read more here.](#)

eHUBS - Smart Shared Green Mobility Hubs

eHUBS are on-street locations that bring together e-bikes, e-cargo bikes, e-scooters and/or e-cars, offering users a wide range of options to experiment with and use in various situations. The idea is to give a high-quality and diverse offer of shared electric mobility services to dissuade citizens from owning private cars, resulting in cleaner, more livable and pleasant cities.

eHUBS can vary in size (minimalistic, light, medium, large), type of location, and type of offer. They can be small and located in residential areas, with just one or two parking spots, or bigger and positioned

close to stations and major public transport interchanges, but, in the end, the key is that they should always be where supply and demand meet.

[Read more here.](#)

ACCESSIBLE MAPS Project

Barrier-free maps to improve the occupational mobility of people with visual or mobility impairments. The project Accessible Maps aims to make indoor mobility more accessible for people with disabilities in the occupational context through the providence of accessible, individual building and floor plans, enriched with accessibility information. In particular, the availability of accessible floor plans should be improved through an automatic generation process.

For this purpose, an approach is going to be used in which floor plans are automatically generated from existing escape plans using innovative computer vision and deep learning methods. These plans will then be enriched with accessibility information.

The generated maps are made available in a barrier-free web application. The information on the maps should be individually adaptable to the current situation and the needs of the target group. Thus, all relevant route information can be researched independently, routes can be planned or a barrier-free representation of the building maps can be created in order to use them visually, tactilely or in spoken form at home or during the journey.

[Read more here.](#)

3.4 Implemented solutions

The following solutions have been identified for their critical contributions to enhancing mobility and independence for individuals with disabilities and the elderly. Each of these innovations supports the goals of the project by promoting accessible transportation, fostering social interaction, and ensuring safety within smart cities and environments. Collectively, these vehicles and technologies aim to create a more inclusive society, empowering users to navigate their surroundings with confidence and ease.

Exelentia Kyburz DX2

Kyburz DX2 is the electric tricycle that enhances individual mobility and autonomy in travel, even for the elderly. With a maximum speed of 45 km/h and a range from 46 to 91 km, it is an electric vehicle designed to visit relatives and friends, make small purchases or errands.

Simple and safe to handle, it can be driven with a license AM. The DX2 asynchronous motor allows you to overcome even slopes, while modern lithium batteries ensure zero-emission travel.



[Read more here.](#)

GaloxScooter Faster

“Faster with roof” is a 4-wheel electric scooter designed for the elderly and people with mobility difficulties. As it is not subject to road approval, it does not require a license to be used. The vehicle is exempt from paying road tax and it is not necessary to take out insurance, although we recommend third-party insurance for any damage.

This electric scooter offers exceptional performance, with a range of about 45-60 km, a powerful 1000W motor, and the ability to tackle inclines of up to 30%. With a load capacity up to 160 kg, it is equipped with a complete lighting system, including low beam/high beam, taillights and directional indicators, as well as full and independent suspension.

The roof provides shelter from the sun and weather, while the windshield effectively protects against the wind. “Faster with roof” is regularly registered with the Ministry of Health as a medical device.



[Read more here.](#)

KYMCO Healthcare K-LITE FE

K-Lite FE has a personal wireless key-fob remote which enables you to fold & unfold your scooter automatically. There are also fold & unfold buttons under the controls just in case users misplace or lose their wireless key-fob remote.

A multitude of special features has been developed to provide the most innovative solutions to improve not the users mobility, but their ability to take their scooter with them, wherever they wish to go. When folded, this little scooter can be stored in any handy locations, making travel more convenient & trouble-free.

K-Lite folding scooters are made from special lightweight aluminum with a 1.64 kg ultralightweight lithium battery pack. You can carry your battery pack indoors to charge it conveniently.

A simple, quick release & removable seat has been incorporated to enable users to create an even lighter package to lift. For



convenience an “under-your-seat” storage bag has been added, allowing users to keep their valuables conveniently close to hand.

[Read more here.](#)

Rascal Veo Sport

The Veo Sport is fully loaded with features. A modern, sporty design with class leading all-round suspension. With 22Ah batteries, a superb capacity for a scooter of its size, affording a range of up to 13.5 miles. A padded delta tiller and luxury seat, detailed with unique white accent stitching, the Veo Sport is a real pleasure to ride.

The Veo Sport's easy and robust take apart mechanism allows you to store or drive away with it in the boot of your car, so it is very practical yet with its distinctive looks, exclusive all-round suspension.



[Read more here.](#)

CareCo AirLite X

This lightweight scooter easily separates into five parts, so you really can take it and store it anywhere. The heaviest part weighs in at just 14.5kg (32lb), meaning it's relatively easy to lift into a car boot or storage space. All this convenience demands no compromises in performance or comfort and the AirLite X has a range of almost 12km (7.5 miles) between charges.



[Read more here.](#)

Wayability

It increases personal autonomy, giving the possibility to recharge one's electric wheelchair even when away from home. Wayability can be used from any public charging station equipped with a 3A type socket.

[Read more here.](#)



Disabled parking management

Smart Parking Systems® administrators and users can manage, book and assign disabled parking bays. Technology helps to provide advanced services: the Bluetooth recognition allows users to be automatically recognized by the sensor which communicates with the car or smartphone.

[Read more here.](#)



Aena Maps

With AENA Maps, AENA and Telefónica's application developed with Carto technology and Situm's indoor platform, indoor location for airports is turned around. The Spanish airport network is positioned as a world reference in the implementation of solutions for passenger guidance. The SDKs and API Rest included in Situm IPS indoor location platform have been key to the development of the application.

[Read more here.](#)



3.5 Economic and business information

The European Commission presented in 2020 the '[Sustainable and Smart Mobility Strategy](#)' together with an Action Plan of 82 initiatives that will guide our work for the next four years. This strategy lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. As outlined in the [European Green Deal](#), the result will be a 90% cut in emissions by 2050, delivered by a smart, competitive, safe, accessible and affordable transport system.^{6 7}

To achieve sustainable mobility, the plan involves increasing the adoption of zero-emission vehicles, vessels, and airplanes, as well as renewable and low-carbon fuels and related infrastructure, such as installing 3 million public charging points by 2030. It also includes creating zero-emission airports and ports by promoting sustainable aviation and maritime fuels, making interurban and urban mobility healthy and sustainable by doubling high-speed rail traffic and expanding cycling infrastructure over the next 10 years, greening freight transport by doubling rail freight traffic by 2050, and implementing carbon pricing and better incentives for users through comprehensive measures for fair and efficient pricing across all transport.⁸

⁶ European Commission. (2020). [A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives.](#)

⁷ European Commission. [European Green Deal.](#)

⁸ European Commission. [Mobility Strategy.](#)

3.6 Market reports

Supporting healthy urban transport and mobility in the context of COVID-19

Supporting healthy urban transport and mobility in the context of COVID-19 is part of the World Health Organization's sustained effort to provide up-to-date guidance on COVID-19 to Member States. It explains ways through which existing WHO guidance on physical distancing and hygiene measures can be implemented in the transport sector. Some examples are:

- Manage and optimize the road space and services to cater for walkers, cyclists and other nonmotorized transport users by creating or improving pedestrian paths, dedicated bicycle lanes and secure bicycle parking places, and by providing bike-share schemes.
- Continue with or start integrated transport and land-use planning so that essential living needs are accessible by walking and cycling.
- Provide financial incentives to support the purchase and maintenance of bicycles (including e-bikes) and other zero-emission vehicles.
- Review traffic light timing to prioritize pedestrians and cyclists, and intelligent traffic light systems to promote cycling.
- Provide parking facilities for private and shared bicycles to facilitate commuters' use of multiple modes of transport and cyclists' access to public transport.

[Read more here.](#)

Convergent Agenda for Sustainable Mobility and Health

The Pan American Health Organization/World Health Organization (PAHO/WHO) is dedicated, among other actions, to cooperating with Member States in the implementation of public policies and programs in favor of health, with a view to guaranteeing economic, social and environmental sustainability, through initiatives that promote healthy communities and spaces.

[Read more here.](#)

Sustainable Mobility and Smart Connectivity

The 2030 Agenda for Sustainable Development, with its 17 Sustainable Development Goals (SDGs), provides an ambitious and comprehensive framework that opens new perspectives for policymaking and international cooperation. While progress in its implementation is being made, current efforts are far below the scale needed to deliver the SDGs within the next 10 years. Ambitious action becomes even more important in the context of the response to the COVID-19 pandemic: the SDGs are vital for a recovery that leads to greener, more inclusive economies and stronger, more resilient countries.

[Read more here.](#)

3.7 Trends news

Sustainable mobility trends for 2024

As the world continues to grapple with the challenges posed by climate change and environmental degradation, the imperative to reshape our approach to transportation has never been more pressing. In the pursuit of a sustainable future, the mobility landscape is undergoing transformative changes, marked by innovative technologies, evolving consumer preferences, and proactive government initiatives. In this dynamic environment, a confluence of trends is shaping the trajectory of sustainable mobility.

From the electrification of vehicles to the integration of renewable energy sources, the following trends are poised to redefine how we move, commute, and navigate our urban and rural spaces. This exploration delves into ten key trends that are not only revolutionizing the transportation sector but also embodying a collective commitment towards a more sustainable and eco-conscious future.

[Read more here.](#)

These are the best European cities for sustainable mobility

Some day-to-day examples of sustainable mobility are issues such as how to ensure that transport is non-polluting, uses renewable energies, and is adapted to the physical needs of everyone, and to develop an efficient, healthy and sustainable interurban transport system. Other more concrete examples consist in allowing foldable bicycles and scooters in public transport; and encouraging the use of these forms of mobility versus other more polluting options like cars, by implementing bus lanes throughout the city among other measures.

The commitment of cities to the well-being of their residents must entail the improvement of sustainable mobility, making it more accessible, clean and safe for everyone. We look at the situation in Europe and why many of its cities are leading examples at this level.

[Read more here.](#)

Why Cities Need to Invest in Active Mobility for the Climate and Economy

Current urbanization trends, rising incomes, and increased vehicle ownership are steering global cities toward a future with 40% less travel done by walking, cycling, and public transport by 2050. This trend poses a significant threat, foreshadowing a substantial 33% increase in greenhouse gas (GHG) emissions from the urban transport sector. This projection underscores the urgent need and challenge for cities to decarbonize their transport systems while preserving equity and livability for all communities.

Solutions exist, however—cycle infrastructure networks, for example, are one of the most cost-effective strategies for reducing GHG emissions from urban passenger transport. By scaling up active mobility infrastructure, cities can generate climate and health benefits and strengthen investments in

public transport, providing a compelling environmental and economic alternative to the current subsidies supporting motorized transport..

[Read more here.](#)

Italdesign extending to indoor transport the concept of sustainable and inclusive mobility

After premiering the WheeM-i demonstrator with Etisalat (multinational in the telecommunications sector) at Gitex 2019, the first example of sustainable and inclusive urban smart mobility for people moving around cities onboard their wheelchairs, Italdesign continues searching for solutions to confirm the right of everyone to mobility and extends the concept to a proposal for indoor transport to meet the needs of people with reduced mobility.

For the new model, animated by the technologies resulting from ALBA Robot's expertise, more advanced and performing than on prior models, Italdesign developed the aesthetic research, set up the package and ergonomics, carried out the feasibility studies and built the demonstrator on display.

[Read more here.](#)

Mastering mobility: understanding the health benefits of active mobility

In an era defined by the drive towards decarbonized transportation, active mobility is often highlighted as a crucial part of the solution. But active mobility, which encompasses modes of human-powered transportation such as walking, cycling, skateboarding, rollerblading, running, etc; is more than just a way of getting from one place to another sustainably.

Active mobility not only helps to decarbonize transportation, but also has numerous health benefits; acting as a pathway to improved physical, mental and social well-being; both individually and collectively.

[Read more here.](#)

3.8 Regulations

- [ISO 6469-1:2019](#) Electrically propelled road vehicles — Safety specifications Part 1: Rechargeable energy storage system (RESS).
- [ISO 6469-2:2022](#) Electrically propelled road vehicles — Safety specifications Part 2: Vehicle operational safety.
- [ISO 6469-3:2021](#) Electrically propelled road vehicles — Safety specifications Part 3: Electrical safety.
- [ISO 6469-4:2015](#) Electrically propelled road vehicles — Safety specifications Part 4: Post crash electrical safety.

- [EN 61851](#) Electric vehicle conductive charging system.
- [EN 15722:2020](#) Intelligent transport systems - ESafety - ECall minimum set of data.
- [EN 16072:2022](#) Intelligent transport systems - ESafety - Pan-European ECall operating requirements.
- [EN IEC 63110-1:2022](#) Protocol for management of electric vehicles charging and discharging infrastructures - Part 1: Basic definitions, use cases and architectures.
- [EN 15194:2017+A1:2023](#) Cycles - Electrically power assisted cycles - EPAC Bicycles.
- [UNE 41501:2002](#) Symbol of accessibility for mobility. Rules and grades of use.

3.9 Summary and Key Insights

This section emphasizes the critical role of inclusive and sustainable mobility in addressing the dual challenges of accessibility and environmental impact. By advancing zero-emission vehicles, improving accessibility in transportation, and scaling up shared mobility services, the foundation is laid for creating cleaner, more equitable cities. The alignment of these efforts with European regulations on mobility and sustainability provides a robust framework for continued innovation

The section "Healthy and Sustainable Mobility" delves into various technological solutions, patents, and best practices that aim to improve both accessibility and sustainability in urban mobility. The focus is on creating eco-friendly, efficient, and inclusive transportation systems, primarily through innovations in electric and autonomous vehicles, shared mobility hubs, and the integration of renewable energy sources.

Current urbanization trends are threatening active mobility, which includes walking, cycling, and public transport, with projections indicating a 40% decline by 2050. This shift could lead to a 33% increase in greenhouse gas emissions from urban transport. To counter this, cities must invest in active mobility infrastructure, such as cycle networks, which are among the most cost-effective strategies for reducing emissions. By expanding active mobility options, cities can promote climate and health benefits while enhancing public transport investments.

Key solutions highlighted include the Kyburz DX2, an electric tricycle designed for the elderly, offering safe and autonomous travel with zero emissions. The GaloxScooter Faster is a four-wheel electric scooter tailored for people with mobility challenges, featuring a roof and windscreen for protection against the elements. This scooter can navigate inclines of up to 30% and is exempt from road tax and insurance requirements, showcasing an efficient and accessible mobility solution.

The review also covers several promising patents, such as those for barrier-free indoor maps that aid individuals with mobility impairments. These maps are enriched with real-time accessibility information, which can be adapted to user needs. Another patent relates to electric mobility aids, offering personalized route guidance and continuous monitoring of road conditions, providing tailored solutions for vulnerable users.

To support the development of healthy urban transport systems, the World Health Organization (WHO) emphasizes the importance of optimizing road space and services to cater to non-motorized transport users. Recommended strategies include creating or enhancing pedestrian paths and dedicated bicycle lanes, establishing secure bicycle parking, and promoting bike-share schemes.

From a market perspective, the document explores a growing emphasis on shared mobility services such as eHUBS. These hubs provide a diverse range of electric vehicles (e-bikes, e-cargo bikes, and e-scooters), aimed at reducing car ownership and promoting cleaner, more livable urban spaces. The integration of electric mobility is seen as a key factor in the transition to healthier, greener cities.

Furthermore, market reports underscore the importance of inclusive mobility solutions, with a focus on integrating personal autonomy into transport systems, reducing reliance on caregivers, and fostering an equitable transport landscape.

Efforts like the G MOTIT Project seek to overcome challenges such as traffic congestion and pollution by developing innovative electric mobility services. The DREEM Project targets the seamless integration of different transport modes, while the BETTERY Project focuses on advancing battery technology to enhance the market appeal of electric vehicles.

These insights indicate that there is significant progress in both digital and physical accessibility technologies. Nevertheless, while the analysis highlights strong individual solutions (e.g., smart showers, web tools), AccesS might need to address the integration of these solutions into a cohesive, user-friendly system within smart cities. This means combining multiple accessibility technologies (digital and physical) into one seamless framework, which could be a direction for innovation.

As AccesS continues to innovate, focusing on integrating these solutions into cohesive systems that address various aspects of user experience—comfort, accessibility, and inclusivity—will be key. Moreover, expanding user involvement through co-design and ensuring solutions address sensory, cognitive, and physical challenges will help shape smarter, more inclusive environments for all.

The innovations reviewed provide strong groundwork for accessible e-mobility. However, AccesS may need to consider that scaling these solutions to entire smart cities and integrating them into larger mobility networks to ensure seamless mobility from buildings to urban environments could be very challenging. Nevertheless, cities could explore integrating these technologies with public transportation systems or creating universal mobility hubs where e-mobility vehicles (like the Kyburz DX2) could be easily rented, charged, or parked.

The following table provides an overview of gaps and challenges identified for promoting healthy and sustainable mobility in smart cities based on the findings of this report, linked with the project's operational areas.

Table 2. Gaps in healthy and sustainable mobility in smart cities.

AccesS Operational Areas	Identified Gaps
User-centered design for accessibility	• Lack of inclusive, universally accessible, and personalized transportation systems that fully accommodate individuals with different types of disabilities (physical, cognitive, sensory), resulting in gaps in usability and acceptance. • Transportation systems often do not address the multiple stages of the user journey in an accessible manner, from planning (e.g., accessible maps and real-time updates) to usage (e.g., easy boarding, seating, and safety), leading to incomplete solutions.

Digital innovations for accessible and inclusive built environments	• Gaps in identifying barriers, such as insufficient infrastructure for charging electric vehicles and micromobility devices, or the high cost of smart accessibility devices, hinder the development of comprehensive solutions that can support users with physical limitations for inclusive and safe mobility. • Public charging systems are not widely available, restricting the autonomy of users with electric mobility. • While there are innovations in mobility, such as smart scooters and eHUBs, they may not fully consider accessibility throughout the entire journey, for example, from home to public transportation. • Insufficient integration between mobility devices and monitoring systems that track health indicators (such as heart rate or fall detection) and notify caregivers or emergency services in case of an accident. • Affordable access to electric mobility solutions remains underexplored, especially its impact in less developed areas of smart cities.
Inclusive and sustainable design	• Lack of specific research on the intersection of mobility and sustainability solutions that specifically addresses accessibility challenges. • While sustainable mobility systems are advancing, they are still not fully adapted to the needs of older and disabled populations, often lacking flexible, personalized measures and enhanced safety features for those with reduced physical or cognitive abilities.
Standardized Framework for Inclusive Environments	• Fragmentation in accessibility standards and a cohesive regulatory framework among different mobility solutions and environments hinder the integration of digital and physical accessibility features in public transportation and shared mobility systems. • Many innovations and solutions lack the integration of standardized frameworks that could make them interoperable across regions, cities, or transportation systems. • Lack of a unified approach to incorporate sustainable mobility options (e.g., micromobility, electric vehicles) into urban planning with accessibility as a central focus. • Insufficient urban infrastructure for active mobility (bike lanes, pedestrian zones). • Individuals with disabilities are often underrepresented in the planning processes of public transportation systems, which can lead to the omission of their needs and preferences in mobility solutions.
Innovation, Public Awareness, and Industry Collaboration	• Lack of comprehensive collaboration between the public sector, private innovators, and end users results in a slow adoption of mobility innovations and limited public awareness, causing many solutions to exist in silos. • There has been slow progress in meeting Sustainable Development Goals related to sustainable transportation and connectivity due to the impact of the pandemic.

Universal Accessibility	• Limited integration of accessibility technologies within a cohesive smart city framework creates gaps in the user experience, with some areas (typically newly constructed ones) being more accessible than others. • Despite advancements in electric mobility, some cities still do not adequately address the dual challenges of accessibility and large-scale environmental impact. • The high costs associated with sustainable transportation options can discourage their use among those who could benefit the most, including the elderly and people with disabilities. • Lack of universally accessible transportation options limits their freedom of movement and opportunities for social inclusion.
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4 Energy consumption and greenhouse gas emissions

Energy consumption and greenhouse gas emissions are critical areas for reducing the environmental impact of urban development. This includes advancing energy-efficient practices and minimizing emissions in buildings and transportation systems, which aligns with sustainable city goals. This section will explore patents, scientific articles, good practices, implemented solutions, economic data, market reports, trends, and regulations. These resources provide stakeholders with practical, regulatory, and market insights to foster sustainable, low-emission urban infrastructure and offer comprehensive knowledge on energy-saving technologies and policy compliance, which are essential for creating eco-friendly, accessible cities.

4.1 Patents

Method and system for energy consumption prediction

The patent is about a method to identify outliers in personal energy consumption of households. The method generates a dynamic forecast model per household about energy usage patterns, taking into consideration time series data and environmental conditions. The model aims to calculate the delta between the forecast modelled value and the actual value that exceeds a predefined threshold for a determined amount of time.

Applicant: Noa Rimini, Daniel Adrian

Patent Number: WO2017183029A1

[Read more here.](#)

Method for measuring weekly and annual emissions of a greenhouse gas over a given surface area

A method to measure weekly and annual greenhouse gas emissions over a predetermined geographical area, and to a measurement system implementing the method.

Applicant: Tanguy Griffon

Patent Number: WO2011064730A1

[Read more here.](#)

System And Methods for Quantifying Greenhouse Gas Emissions Via Measurement and Modelling of Traffic Data and For Influencing Traffic Signaling to Reduce Such Emissions

This patent is related to a method and a system to quantify greenhouse gas emissions associated with vehicle traffic. The method includes the data collection from heterogeneous sensors located in

different locations in a traffic network, then used to determine the trajectory of vehicles and evaluate the corresponding emissions using a quantification methodology.

Applicant: Miovision Technologies Incorporated (Kitchener)

Patent Number: 20230290247

[Read more here.](#)

Energy management system and method

The patent is about a demand response system able to modify the operational conditions of a network device working at a side by using location-based services. This way, users can clearly visualize the causes of energy consumption in their homes, and also automatically reduce the use of energy based on the location of the user and the energy management data.

Applicant: Kevin R. ImesJames Hollister

Patent number: US11550351B2

[Read more here.](#)

An electrical energy power consumption monitoring device and an energy management system

This patent is related to a device, composed by a shunt resistor, electrical circuits and processing means, to calculate the electrical power consumption of a domestic consumer unit it is connected to.

Applicant: EMPOWER ENERGY SYSTEMS LTD [GB]

Patent number: GB2512400A

[Read more here.](#)

4.2 Scientific articles

Power and energy measurement devices: A review, comparison, discussion, and the future of research

This paper presents a detailed survey on power and energy measurement devices capturing the overall progress over the decades in the associated field of instrumentation. The working principle of several devices along with their applications and advantages/disadvantages are provided in this review work.

The implementation of wattmeter in a single-phase system along with three-phase system is also given. An appropriate apparatus is extremely important for proper evaluation of power transfer and energy consumption within a network. The development of energy measurement instruments from simple machines to complex computational structures with data transmission and processing ability is also discussed.

A thorough description of smart meters and the internet of energy (IoE) follows thereafter. Finally, the future of the power sector in view of the present technology and the current situation of energy theft is also provided. This paper not only presents information but also indicates future direction for inquisitive researchers.

[Read more here.](#)

Carbon and Greenhouse Gas Emissions from Electricity Consumption in European Union Buildings

The buildings sector is the single most important end-user of final energy in the European Union and a significant contributor to carbon and greenhouse gas emissions. This work focuses on a review of available data that are used to calculate the annual emissions from electricity generation in the European Union and quantify indirect emissions from the use of electricity in the buildings sector. Historical data since 1990 are used to derive simple empirical correlations for the time evolution of emissions factors related to electricity production in each Member State of the European Union.

More recent trajectories using data from the last ten years are also presented. The derived correlations can be easily integrated in building stock modeling and national studies to facilitate forward-looking projections of emissions from electricity use in buildings..

[Read more here.](#)

Quantifying the impact of energy consumption sources on GHG emissions in major economies: A machine learning approach

This paper describes the methodology followed to quantify the impact of different energy consumption sources of GHG emissions in three main global economies (USA, China and EU) by applying Machine Learning techniques as Artificial Neural Networks and Gradient Boosting.

The findings have significant implications for policymakers, as they suggest that effective strategies to reduce GHG emissions must be tailored based on the energy utilization sources of each country. This study's originality lies in the use of machine learning techniques to identify the key energy consumption sources driving GHG emissions in the three major economies, as well as its specific recommendations for reducing emissions.

[Read more here.](#)

Energy consumption analysis and carbon footprint of a building of the University of Milano-Bicocca: starting point for a sustainability report

This paper is a report on the analysis on energy consumption conducted on a University building in order to provide examples of a correct energy management of a building to reduce waste and energy consumption and improve economic and environmental performance of the building.

This study was carried out in order to provide scientific data allowing to take decisions for a correct energy management of the building, with the aim of reducing waste and energy consumption and improve environmental (lower emissions) and economic performance of the buildings of the University.

The preliminary results of the questionnaire and the analysis of energy consumption have shown that an effective reduction of wastage can be achieved through measures on the management of air conditioning and lighting of common areas (hours of operation, improved efficiency, proper maintenance), and by raising awareness in the users to behave more sustainably.

[Read more here.](#)

A review on buildings energy consumption information

This paper reviews the information available on energy consumption in buildings, with a particular reference to HVAC systems, to compare different countries and types of buildings and related users, to understand if the information necessary to measure the consumption is available when required.

Energy consumption of buildings in developed countries comprises 20–40% of total energy use and is above industry and transport figures in EU and USA. However, available information is clearly insufficient and not proportional to its importance. It is not considered as an independent sector and there is a lack of consistent data which makes it difficult to understand the underlying changes that affect energy consumption in this sector. It is essential to make available comprehensive building.

[Read more here.](#)

4.3 Good practices

EU Building Stock Observatory

The main objective of the EU Building Stock Observatory (BSO) is to provide transparent and reliable information and data on the EU's building stock. This supports the monitoring of current EU energy policies and measures and will contribute to future policy making.

The BSO covers a broad range of energy-related topics and provides data on buildings-related areas: building stock, energy consumption, building elements and technical building systems installed, energy

performance certificates, nearly zero-energy buildings and renovation rates, but also energy poverty and financing aspects. The BSO will be upgraded regularly to expand the data and improve user experience.

[Read more here.](#)

BUILD UP

The BUILD UP web portal is the largest portal and principal reference point for energy efficiency and renewable energy related to the building and construction sector in Europe. It aims at exchanging information and bringing together the interests of practitioners and professional associations working in the sector.

It is a portal to foster knowledge about the sector, to share case studies and highlight working practices, as well as to transfer tools and resources within the whole BUILD UP Community. The portal also features the latest events, news, and developments at both the technical and practical level, policy legislation, financial issues and aspects, and much more.

[Read more here.](#)

Deep renovation: New approaches to transform the renovation market

Renovating Europe's building stock offers great potential for meeting its climate commitments. The most challenging aspects are how to increase the rate, quality and effectiveness of building renovation. This CORDIS Results Pack highlights the work of 13 EU-funded projects that helped to foster the renovation and upgrade of buildings in Europe to make them more energy efficient.

[Read more here.](#)

EnergyMate Project

EU-funded project in which a smart solution was developed to provide users information about their energy consumption in an easily understandable format, suggesting personalized recommendations to optimize consumption. This way, the energy consumption are being reduced by 25% and the user satisfaction improves by 30 %.

[Read more here.](#)

BuildHEAT

BuildHEAT focuses on systemic solutions and innovative technologies for the deep renovation of residential buildings. These innovative solutions are costly, so financing models are needed. The objective of BuildHEAT is to mobilize private investment through European funds to encourage

renovation. The initiative involves the entire building chain, from owners to investors, addressing technical, cultural and economic aspects, in order to raise awareness and promote energy efficiency in buildings.

[Read more here.](#)

4.4 Economic and business information

In Europe, the built environment accounts for 40% of energy consumption and 36% of greenhouse gas emissions, largely due to inefficient energy use. Today, roughly 75% of the EU building stock is energy inefficient. This means that a large part of the energy used goes to waste. Such energy loss can be minimized by improving existing buildings and striving for smart solutions and energy efficient materials when constructing new houses⁹.

Renovating existing buildings could reduce the EU's total energy consumption by 5-6% and lower carbon dioxide emissions by about 5%. Yet, on average, less than 1% of the national building stock is renovated each year.

The EU's goal of carbon neutrality by 2050 has led to policies like the Energy Performance of Buildings Directive, pushing for smarter, more energy-efficient renovations. Improving energy efficiency in buildings could reduce emissions by 5%, yet renovation rates remain low. The EU aims to double these rates to meet its 2030 targets of 32.5% energy efficiency.

The European market for energy-efficient buildings is growing, driven by EU policies promoting emissions reductions and energy savings. The sector offers economic opportunities, with energy efficiency investments forecasted to save billions in energy costs while creating jobs. The "Renovation Wave" aims to accelerate retrofitting, addressing the 75% of inefficient buildings.

Financing instruments, like the European Green Deal and NextGenerationEU, support the transition. However, high upfront costs and slow renovation rates challenge market expansion, though energy performance contracts and public-private partnerships offer potential solutions^{10 11}.

To boost the energy performance of buildings, the EU has established a legislative framework that includes the revised [Energy Performance of Buildings Directive](#) (EU/2024/1275) and the revised [Energy Efficiency Directive](#) (EU/2023/1791). Together, the directives promote policies that will help

- Achieve A Highly Energy Efficient And Decarbonised Building Stock By 2050.
- Create A Stable Environment For Investment Decisions.
- Enable Consumers And Businesses To Make More Informed Choices To Save Energy And Money.

⁹ European Commission. [In focus: Energy efficiency in buildings](#), 17 February 2020.

¹⁰ European Environment Agency. (2023). [Greenhouse gas emissions from energy](#).

¹¹ European Environment Agency. (2020) [In focus: Energy efficiency in buildings](#).

The revised [Energy Performance of Buildings Directive](#) (EU/2024/1275) entered into force in all EU countries on 28 May 2024 and helps increase the rate of renovation in the EU, particularly for the worst-performing buildings in each country.

Additionally, [Efficient Buildings Europe](#), as the leading European industry association dedicated to advancing energy efficiency in European buildings, stated that digitalization is also playing a pivotal role in the transformation of buildings. Technologies like digital twins, energy-efficiency metering technologies, submeters, and building automation control systems are revolutionizing the way we gather data and optimize building operations but also how we design buildings¹².

Regarding software tools to design buildings and evaluate their impact on energy, in previous sections, two widely used solutions in the industry have been detailed, such as [Autodesk Revit](#) software and its associated plugins (e.g. [Dynamo](#), [Insights](#)) to exploit BIMs for monitoring and simulating energy and comfort levels, as well as [EnergyPlus](#) and [OpenStudio](#) for energy modelling.

4.5 Implemented solutions

Glass to Power IPTG (Insulating Photovoltaic Transparent Glass)

Patented technology to produce electricity from the sunlight. It made by photovoltaic double-glazing glass integrating as well thermal/acoustic insulation to reduce energy consumption and generate energy from RES in nZEB buildings.

[Read more here.](#)



Energy Usage Tools

DTE energy created a set of tools, for both residential and business clients, to analyze the energy usage by the hour, monitor the energy consumption of appliances and simulate the cost of charging an electric vehicle or predict new energy bills based on habits changes on energy usage.

[Read more here.](#)



Building Automation System (BAS)

¹² Efficient Building Europe. [EUSEW2024 – Europe’s industrial revolution for efficient buildings: shaping the future](#), 11 January 2024.

Integrated system to allow operators to access, control and monitor building systems in a centralized fashion. It can allow access and control on networked electronic devices and sensors deployed in a building, ensuring an optimal and automatic compromise between comfort and energy consumption.

[Read more here.](#)



Energy efficiency monitoring tool

The tool, deployed by Paessler, allows users to monitor and optimize their energy consumption and usage, identify trends and spikes in energy consumption and detect unnecessary waste of energy to reduce costs.

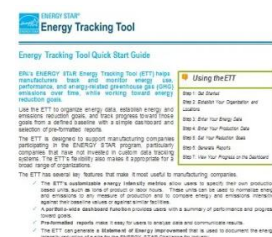
[Read more here.](#)



Energy Tracking Tool

The tool, developed by Energy Star and mainly targeting manufacturing facility managers, aims to track the energy performance, use, cost, intensity and greenhouse gas emissions to apply an energy management strategy and meet cost and emission saving goals.

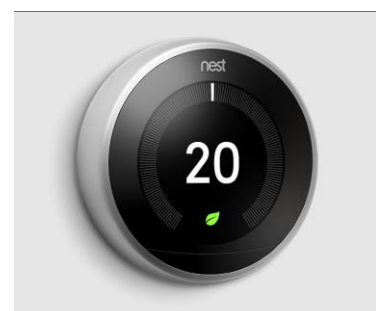
[Read more here.](#)



Nest Thermostat

The Nest thermostat remembers the temperatures you like when you're at home and automatically lowers the heating when you're away to save energy. You don't have to program it ; just change the temperature whenever you want during the first few days after installation. It will remember the temperatures you like and when you change them. Then, it programs itself and creates a weekly temperature schedule. It also remembers how long it takes for your house to heat up and cool down.

[Read more here.](#)



4.6 Market reports

Decarbonising the built environment in the EU

Climate change poses the most significant environmental challenge of our era, as the rapid increase of human-generated greenhouse gas (GHG) emissions is already leading to adverse environmental, social and economic impacts worldwide. This policy paper addresses the pressing need to decarbonize the built environment, which accounts for approximately 40% of energy consumption and 37% of CO₂ emissions in the EU, advocating for policy and regulatory enhancements to accelerate the decarbonization of buildings in the EU by drawing upon the esteemed standards of RICS.

[Read more here.](#)

Building Europe's Net-Zero Future

Europe can dramatically reduce its need to import gas from overseas, by undertaking a wave of climate friendly renovations and heating upgrades that will also create many thousands of new jobs. This study explores various scenarios for reducing gas consumption in European buildings to hit the EU's climate goals and finds that doing so could cut annual spending on gas imports by €15 billion within a decade.

This study, based on modelling by Cambridge Econometrics, assesses the socio-economic impacts of different scenarios to reach zero-emission in the residential building stock in the EU and the UK.

[Read more here.](#)

Building energy simulation software market size and share analysis – growth trends and forecasts (2023-2030)

This report examines the global building energy simulation software market, which was valued at \$4.80 billion in 2023 and is expected to reach \$10.7 billion by 2030 at a Compound Annual Growth Rate (CAGR) of 12.1%. Government mandates for energy-efficient buildings, the development of green buildings, and advances in BIM and simulation technology all contribute to market growth. The study divides the market by components, applications, end-use industries, deployment models, organizational size, and geography, with North America being the largest market. Autodesk Inc., IES, and DesignBuilder Software Ltd. are among the industry's major players.

[Read more here.](#)

Building Materials And The Climate: Constructing A New Future

The buildings and construction sector is by far the largest emitter of greenhouse gases, accounting for a staggering 37% of global emissions. The production and use of materials such as cement, steel, and aluminum have a significant carbon footprint.

Solutions to mitigate the buildings "embodied" carbon emissions – originating from the design, production, and deployment of materials such as cement, steel, and aluminum – have lagged. To effectively address this challenge, international action and collaboration must bring together all stakeholders from across the entire lifecycle of the buildings sector, both within informal and formal settings.

[Read more here.](#)

4.7 Trends news

Why making buildings greener is crucial to countering climate change

Alongside the hum of traffic, the soundtrack of most cities includes the noise of construction workers drilling, hammering and digging as they furiously erect new buildings. In 2022, energy-related carbon dioxide emissions from building operations and construction hit a new high, rising to 10 gigatons, according to a recent report from the United Nations Environment Programme (UNEP). That is 37 per cent of global carbon dioxide emissions. This article analyzes how buildings are feeding the climate crisis and how to make them greener.

[Read more here.](#)

The Built Environment and Energy Retrofits

Commercial facility owners in the United States remain focused on green energy-saving retrofit and upgrade activities, either on their own or pushed by government mandates, which offer enormous opportunities to decarbonize the economy. Electrical distributors are an important cog in the wheel to help enable these green transformations to occur — these distributors must source inventory and efficiently distribute the components needed for much of the work underway in our nation's office buildings, factories, malls and sports arenas, homes and other structures.

[Read more here.](#)

Let there be light – churches installing solar panels on roofs to combat climate crisis

The Church of England is installing solar panels on churches and cathedrals to address the climate crisis and support community projects. Notable examples include Gloucester and Salisbury Cathedrals, along with smaller churches like St John's in Manchester, which has generated significant electricity, helping

fund local initiatives. These efforts align with the church's commitment to achieving carbon neutrality by 2030, highlighting the dual benefits of environmental sustainability and financial savings.

[Read more here.](#)

Supermarkets are tackling emissions from their freezer aisles

Snaking through every American supermarket are miles of refrigerator piping, keeping unsold food cold in the fridges of the dairy, meat and frozen food aisles. Those pipes contain some of the most potent global warming chemicals produced by any industry on earth. The hydrofluorocarbons (HFCs) within them are typically between 1,400 and 4,000 times more powerful as greenhouse gases than carbon dioxide.

[Read more here.](#)

Circular economy: How 'lighthouses' in the built environment can drive value

For the first time in history, COP28 recognized the Circular Economy as a solution to tackle climate change in its global stock take. Particularly in the built environment, which accounts for about 26% of global CO₂ emissions, there is an opportunity to transition from the current linear to a more sustainable circular approach. However, even though a circular built environment could not only reduce greenhouse gas (GHG) emissions, but also unlock substantial business opportunities, the circular transition is missing pace and scale.

The World Economic Forum and McKinsey & Company have led an initiative to find Circularity Lighthouses. An independent expert panel has awarded the first three of these lighthouses, which are industry-leading solutions to enable the shift towards circularity and serve as aspirational models that can inspire others to follow suit.

[Read more here.](#)

How to Reduce Energy Consumption in Commercial Buildings

In the modern world, where energy consumption has a significant impact on both the environment and the bottom line of businesses, finding ways to reduce energy usage in commercial buildings is of utmost importance. According to CIBSE Guide M 2014b, over 50% of the energy used in commercial buildings can be attributed to heating and hot water. This not only puts a strain on natural resources but also leads to higher energy costs for businesses.

Fortunately, there are several strategies and technologies available that can help commercial building owners and managers reduce energy consumption and improve overall efficiency. In this comprehensive guide, we will explore various methods to achieve energy efficiency in commercial buildings, ranging from HVAC system maintenance to the utilization of smart building technology. So let's dive in and discover how you can make your commercial building more energy efficient.

[Read more here.](#)

4.8 Regulations

- [ISO 52018-1:2017](#) Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features Part 1: Overview of options.
- [ISO/TR 52018-2:2017](#) Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features Part 2: Explanation and justification of ISO 52018-1.
- [ISO 52127-1:2021](#) Energy performance of buildings — Building management system Part 1: Module M10-12.
- [ISO/TR 52127-2:2021](#) Energy performance of buildings — Building automation, controls and building management Part 2: Explanation and justification of ISO 52127-1.
- [ISO 52010-1:2017](#) Energy performance of buildings — External climatic conditions Part 1: Conversion of climatic data for energy calculations.
- [ISO/TR 52010-2:2017](#) Energy performance of buildings - External climatic conditions Part 2: Explanation and justification of ISO 52010-1.
- [CEN/TS 16628:2014](#) Energy Performance of Buildings - Basic Principles for the set of EPB standards.
- [CEN/TS 16629:2014](#) Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards.
- [EN 17423:2020](#) Energy performance of buildings - Determination and reporting of Primary Energy Factors (PEF) and CO2 emission coefficient - General Principles, Module M1-7.

4.9 Summary and Key Insights

The section underscores the critical importance of integrating advanced energy management technologies and renewable energy solutions to reduce energy consumption and GHG emissions. By focusing on innovations like BAS and photovoltaic glass, alongside strategic energy monitoring tools, the built environment can significantly contribute to achieving global emissions reduction goals.

The alignment with European regulations and directives, such as the revised Energy Performance of Buildings Directive (EU/2024/1275) and the Energy Efficiency Directive (EU/2023/1791), further supports the path towards sustainable, low-carbon cities, with goals to decarbonize the building stock by 2050 and double renovation rates by 2030.

The focus is on implemented solutions, patents, and innovations targeting the reduction of energy consumption and greenhouse gas (GHG) emissions, particularly in buildings and infrastructure. The section delves into technological advancements and regulatory frameworks that promote energy efficiency and emissions reduction, ultimately contributing to the development of more sustainable built environments.

Key technological solutions discussed include the Building Automation System (BAS), which enables centralized control and monitoring of building systems. This system optimizes the balance between comfort and energy consumption through networked electronic devices and sensors, ensuring an automatic and efficient use of energy. Another innovative solution is the Glass to Power IPTG, a patented technology that integrates photovoltaic transparent glass to generate electricity from sunlight while providing thermal and acoustic insulation, ideal for nearly zero-energy buildings (nZEB).

The section also highlights several energy management tools, such as the Energy Efficiency Monitoring Tool by Paessler, which helps users track energy consumption trends, identify inefficiencies, and optimize energy usage. Similarly, the Energy Tracking Tool developed by Energy Star enables manufacturing facilities to monitor energy performance and GHG emissions, thereby implementing effective energy management strategies.

Although many projects do not conduct thorough lifecycle assessments to evaluate the long-term environmental impacts of building materials and designs, particularly concerning energy consumption and emissions.

From a patent perspective, methods for predicting energy consumption and measuring GHG emissions are emphasized. One patent describes a system that analyzes personal household energy usage patterns to identify anomalies, helping users optimize their energy consumption. Another patent outlines a method for measuring weekly and annual GHG emissions over specific geographical areas, facilitating the tracking of emissions in urban environments.

The integration of smart technologies, such as the Nest Thermostat, adds another layer of efficiency to energy management in buildings. The thermostat uses machine learning to remember user preferences and automatically adjusts heating and cooling to optimize energy use. It not only learns the household's preferred temperatures but also reduces energy consumption by adapting to occupancy patterns, contributing to energy savings without requiring manual programming.

The economic and business landscape is also examined, particularly the role of the built environment in energy consumption and emissions. Buildings are significant contributors to energy use, accounting for 40% of total energy consumption in Europe and 36% of GHG emissions. To boost the energy performance of buildings, the EU's legislative framework includes the revised Energy Performance of Buildings Directive (EU/2024/1275). The EU's goal of carbon neutrality by 2050 has led to directives that push for smarter, energy-efficient renovations, aiming to double current renovation rates to meet energy efficiency targets by 2030.

Additionally, Efficient Buildings Europe highlights the growing role of digitalization in transforming buildings. Technologies like digital twins, submeters, energy-efficiency metering, and building automation control systems are revolutionizing the way data is gathered and used to optimize building operations. These tools not only improve energy efficiency but also influence how buildings are designed, making them more adaptable and sustainable in the long term.

In conclusion, the combined effort of advanced technologies, regulatory frameworks, and smart digital tools positions the built environment at the forefront of global emissions reduction initiatives. These innovations are essential for meeting energy efficiency targets and driving the transition toward sustainable, low-carbon cities.

The following table provides an overview of challenges identified for moderating energy consumption and greenhouse gas emissions in smart cities based on the findings of this report, linked with the project's operational areas.

Table 3. Challenges in reducing energy consumption and greenhouse gas emissions in built environments and smart cities.

AccessS Operational Areas	Identified Challenges
User-centered design for accessibility	• Lack of consideration for the needs and circumstances of individuals with physical or cognitive disabilities, as well as elderly adults, when designing products for energy savings or energy consumption control in the home.
Digital innovations for accessible and inclusive built environments	• Issues with the integration between accessibility technology and energy-efficient devices. • Limited integration of digital innovations, such as digital twins, with traditional building design and management systems. • Underutilization of data analysis to enhance accessibility features. • Lack of integration of advanced energy management technologies, such as Building Automation Systems (BAS) and energy monitoring tools, to improve energy efficiency.
Inclusive and sustainable design	• The current focus in the energy sector is primarily on sustainability, placing inclusion on the back burner. • Lack of research on how to integrate accessibility with energy efficiency, missing the opportunity to examine how accessibility solutions can impact energy consumption or how energy-efficient systems can be more inclusive and accessible. • High upfront costs, slow renovation rates, and technical challenges in integrating sustainable technologies into existing buildings, especially those of older construction. • Lack of interdisciplinary collaboration between sustainability experts and accessibility advocates to create comprehensive and cross-cutting guidelines that effectively address both issues. • Failure to integrate energy management systems with accessibility requirements to create environments that optimize energy use without sacrificing accessibility or comfort for vulnerable groups.

Standardized Framework for Inclusive Environments	• No widely accepted framework that connects energy efficiency with accessibility in built environments. • Inconsistencies in regulations across different regions. • Inconsistent data on energy management practices in various types of buildings and limited access to detailed information about energy consumption in buildings, particularly regarding HVAC (Heating, Ventilation, and Air Conditioning) systems. • Regulations are slow to adapt to emerging technologies and practices. • Gaps in data collection methodologies that do not include all types of buildings (e.g., residential and small buildings), making it difficult to conduct a comprehensive analysis of the building stock.
Innovation, Public Awareness, and Industry Collaboration	• Insufficient collaboration between stakeholders in the construction industry and disability advocates, which can hinder the development of comprehensive solutions. • Limited public understanding/awareness of how energy efficiency practices can support accessibility, leading to missed opportunities for community engagement and collaboration.
Universal Accessibility	• Insufficient rates of renovation and implementation of accessible designs and energy efficiency improvements, especially in buildings with the worst energy performance. • Lack of energy measurement and savings devices that are universally designed, incorporating features that enhance accessibility for all users, especially those with reduced mobility, limited vision, learning disabilities, or cognitive challenges.

5. Conclusions

The operational objectives of the AccesS project are the cornerstone of the conclusions of this report, which are aligned to support the project's overall mission to improve inclusivity, accessibility, and sustainability within Smart Cities in general and within smart buildings and constructed spaces in particular. In summary, eighteen (18) Patents, nineteen (19) Scientific articles, twenty (20) Good practices, twenty-four (24) Implemented solutions, ten (10) Market reports, seventeen (17) News articles on current trends and twenty-six (26) Regulations were screened within this report to provide the following conclusions.

User-centered design for accessibility

The technologies included in this report demonstrate how adaptive, user-centered solutions can empower people with disabilities and those with reduced mobility, improving their autonomy and ensuring their dignity. These innovations form the foundation on which the user-centered design approach must be built, which is crucial to ensuring a high degree of inclusion in today's Smart Cities. Their adoption clearly highlights the key importance of creating environments where accessibility is an integral component of technological innovation, always with a socially-focused, people-centered approach.

Digital innovations for accessible and inclusive built environments

The exploration of technologies that guarantee accessibility underscores the power of digital innovations to facilitate autonomy in daily life interactions. The integration of artificial intelligence and other digital tools into the design and operation of buildings holds enormous potential to provide real-time solutions that enable the creation of inclusive environments. The ability to automatically adapt and personalize services in already constructed environments is fundamental to achieving inclusive and accessible spaces through technology.

Sustainable and Inclusive Mobility Management

The mobility technologies evaluated, such as electric scooters and electric wheelchair chargers, promote the development and adoption of adaptive solutions to improve mobility within cities and to encourage these cities to become increasingly smarter and more accessible. By fostering personal autonomy and reducing dependence on external assistance, these innovations are vital to maintaining inclusive mobility systems that consider the needs of people with disabilities and the elderly.

Standardized Framework for Inclusive Environments

This report also highlights the need to establish standardized frameworks that can guide the design and development of accessible and inclusive environments, particularly within the context of the European Union. The adoption of data visualization tools or regulatory frameworks for buildings underscores the importance of developing and adopting standards that ensure both accessibility and sustainability are prioritized during the design and operational phases of smart buildings.

Fostering Innovation, Public Awareness, and Industry Collaboration

By presenting examples of projects funded by the European Commission, this report emphasizes the importance of collaboration among the various actors that make up the quintuple helix of innovation for the development of technological solutions that address current and future societal challenges in terms of inclusion, accessibility, and sustainability. To achieve this, not only is transnational cross-collaboration crucial, but also cross-industry and cross-sector fertilization. Sharing knowledge and encouraging co-creation among stakeholders, users, and policymakers are essential to ensuring that built environments are accessible, innovative, and sustainable.

Evaluation of Universal Accessibility Initiatives

This report clearly demonstrates the feasibility of scaling solutions and tools that facilitate universal accessibility in smart cities. The successful demonstration and evaluation of the technologies presented in this report across various urban settings provide a roadmap for implementing customized solutions to achieve accessibility in both small- and large-scale urban projects.

This report concludes that by integrating user-centered design, digital innovation, adaptive mobility management, and standardization efforts, the AccessS project can effectively support the creation of accessible and sustainable Smart Cities and Smart Buildings across the European Union.

Enhancing Accessibility and Sustainability in Smart Cities and Smart Buildings: The Universal Accessibility Suite Initiative



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