INTESA SANPAOLO
INNOVATION CENTER

GRINS
FOUNDATION

INDUSTRY TRENDS REPORT
INFRASTRUCTURE CONSTRUCTION SECTOR
SMART AND CIRCULAR BUILDINGS

INTESA SANPAOLO INNOVATION CENTER

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EXECUTIVE SUMMARY

A smart building is a technologically advanced structure that utilizes interconnected systems, sensors, and data analytics to optimize its operations, enhance occupant comfort, and improve overall efficiency.

In this context, digital transformation is essential for the development of intelligent buildings that are responsive, efficient, sustainable, and capable of meeting the demands of modern occupants. Here, IoT (Internet of Things) plays a crucial role in the management and operation of smart buildings, impacting many smart buildings' core functions. Furthermore, Artificial Intelligence (AI) is revolutionizing smart buildings by transforming traditional smart buildings into cognitive buildings.

Buildings account for approximately 35% of global energy consumption and contribute about 40% of global carbon dioxide (CO_2) emissions. Therefore, decarbonization practices and energy efficiency features became one of the most relevant focus areas in the building sector and smart buildings innovations are at the forefront of reducing the environmental footprint of the building sector.

Although this sector is facing various challenges acting as barriers to achieving decarbonization targets. However, various factors are enabling and supporting the sector's path to sustainability, including energy-efficient designs and smart building management systems and governments incentives and regulatory frameworks.

The growing demand for energy-efficient and smart buildings is acting as a market growth catalyst in the building automation systems market. Furthermore, the increasing importance for the health, wellness, comfort, and business productivity of occupants is driving change in buildings' status quo. Moreover, the rising adoption of digital solutions in buildings is also a growth enabler. High capital expenditure (CapEx) requirement and cybersecurity risks can hinder building automation systems market's development.

The market is entrenched with multinational giants such as Honeywell, Siemens, Schneider Electric and Johnson Controls covering around 60% of total revenue shares. Smart buildings are focusing on different aspects to ensure its efficiency through advanced technological developments. Security-wise, automated fire detection systems and real time data analytics play an important role in fire resilience. Furthermore, IOT sensors, AI systems and safehub platforms are utilized in smart buildings for earthquake resilience.

Smart occupancy management is another area of interest in smart buildings, which focuses on optimizing the use of space and resources in buildings to enhance occupant experience and operational efficiency.

Emerging technologies such as IoT, mobile apps, and smart building portals facilitate enhanced connectivity and convenience for building occupants. Here, Irisys (US) is offering its solution "True Occupancy", a software system that captures occupancy data via sensors and provides data analysis that shows buildings' space utilization performance and supports decision-making.

AI-driven noise reduction technologies are increasingly being implemented in schools and hospitals to enhance acoustic environments and improve overall well-being. Here, Quietyme

(US) offers an AI-powered solution designed to monitor and reduce noise levels in hospital settings. Moreover, integrating smart soundscaping into smart buildings enhances occupant experience by creating acoustically optimized environments. Tangram Interiors (US) implemented Moodsonic's soundscaping solutions to improve workplace acoustics.

Smart cooling and smart heating remain critical technologies in smart buildings due to convenience and energy efficiency benefits of these technologies. By integrating AI algorithms with building management systems, AI-Cure's (US) solution optimizes heating and cooling operations, leading to improved energy performance and sustainability. Danfoss, a Danish company, offers Hydronic Intelligence™, an advanced solution designed to optimize heating and cooling systems in both residential and commercial buildings. Moving forwards, a recent study in 2024 from researchers at the University of California suggest that buildings with zigzag-patterned walls could be cooler by up to 3°C compared to those with flat walls.

The decarbonization of buildings covers many segments such as lighting, critical building equipment, smart building management, facility management, smart homes and construction management.

In the European building sector, Germany holds the first position in GHG emissions (783 Mt of CO_2), followed by the France (430 Mt of CO_2) and then UK (426 Mt of CO_2). And the US is ranked first in GHG emissions in North America with 6017 Mt of CO_2 in 2024. Here, many growth drivers for accelerating decarbonization emerge such as technological innovations and climate resilience strategies.

Market leaders are actively integrating smart ventilation and air purification technologies to enhance Indoor Air Quality (IAQ) in smart buildings. Here, BrainBox (Canada) AI's ARIA platform utilizes artificial intelligence to optimize HVAC systems in large commercial buildings.

Johnson Controls (Ireland) has implemented its OpenBlue IAQ solutions in various facilities to monitor and improve air quality. Furthermore, Market leaders are actively implementing smart lighting technologies in smart buildings to enhance energy efficiency, occupant comfort, and operational flexibility.

Here, Siemens (Germany) has significantly advanced its Smart Infrastructure (SI) division, focusing on building automation systems that integrate smart lighting solutions. GE Lighting (US) introduced the Cync Smart Undercabinet Fixtures, offering customizable, low-glare lighting solutions controllable via smart home platforms like Alexa and Google Assistant. Philips Lighting (Netherlands), a leader in the smart lighting market, has expanded its offerings to include Lighting as a Service (LaaS).

Smart water management technologies are also one of the most important areas of decarbonization is smart buildings, aiming at enhancing sustainability in public and commercial buildings. In Nevers Agglomeration, a region in central France, a comprehensive smart water management system was deployed to modernize its public water infrastructure. The Daphne Cockwell Health Sciences Complex (DCC) at Toronto Metropolitan University (TMU) serves as a pioneering example of developing a digital twin for the interior water distribution system.

Furthermore, EMC Insurance (US) collaborated with LAIIER (UK) to implement early water leak detection solutions in schools. WINT Water Intelligence (US) offers AI-driven solutions specifically designed to address water management challenges in the hospitality sector. The Hitchcock Center for the Environment (US), a public educational facility, has achieved water independence through innovative systems including greywater Treatment and rainwater Harvesting.

As global cities face increasing pressure from climate change, population growth, and aging infrastructure, urban redevelopment and re-urbanization have become essential strategies for building resilient, low-carbon environments. Urban regeneration is deeply influenced by the broader dynamics of urbanisation and re-urbanisation, as these processes shape the physical, social, and economic conditions of cities.

Urban regeneration is an opportunity for the renewal of city real estate assets. Here, "The New European Bauhaus" is a key initiative for the implementation of the Green Deal, aiming to combine sustainability, aesthetics, and inclusiveness in shaping future living spaces. The NEB facility, launched in 2024, is a funding and support mechanism to advance the New European Bauhaus initiative in line with the European Green Deal. The 2025–2027 roadmap outlines key priorities and actions to scale up NEB projects and integrate its core principles across EU policies and programs.

The cybersecurity in smart buildings market is expected to grow rapidly in terms of spending going from $262.5 b in 2024 to $1172.5b in 2030 with a CAGR of 27.3%. Potentially, the smarter a building becomes, the more susceptible it is to cyberattacks.

Indeed, there are many potential risk areas for cyberattacks in smart buildings around network infrastructure, access control systems and other elements. Therefore, the need for cybersecurity in smart buildings is necessary for prevention of unauthorized access, data protection, and mitigation of physical risks. To reduce these risks, stakeholders in smart buildings are taking several measures and initiatives in this regard.

Artificial Intelligence (AI) is revolutionizing cybersecurity as a main enabler in public and commercial smart buildings, providing real-time threat detection, automated responses, and predictive security measures. Among best practices in cybersecurity for smart buildings, Forescout (US) offers comprehensive cybersecurity solutions around device discovery, assessment and control. Here, Palo Alto (US) also offers innovative cloud-delivered security services with solutions such as machine learning powered firewalls and IoT security. Fortinet's security fabric (FortiGate Next-generation firewall) is an integrated cyber security platform that provides comprehensive protection across the entire digital attack surface. Furthermore, Schneider Electric (France) and Claroty's (US) cybersecurity solutions for buildings encompass a smart approach to asset discovery, risk assessment, remote access control, and threat detections and response.

Moving forwards, with the growing complexity of building's cybersecurity, new business models are emerging in this area such as Cybersecurity-as-a-service (CaaS). Furthermore, zero trust security framework will be the cornerstone of smart building cybersecurity in the future, and blockchain-based identity management for IoT devices will enhance trust and transparency in smart buildings.

INTRODUCTION

PRINCIPAL
ABBREVIATIONS

3D	*3 dimensions*	**IFM**	*Integrated Facility Management*
AI	*Artificial Intelligence*	**IOT**	*Internet of Thing*
APAC	*Asia and the Pacific*	**IRA**	*Inflation Reduction Act*
AR	*Augmented Reality*	**ISO**	*International Organization for Standardization*
B	*Billion*	**IWBI**	*International WELL Building Institute*
BAS	*Building Automation System*		
BEMS	*Building Energy Management System*	**JRC**	*Joint Research Centre*
		KG	*Kilogram*
BIM	*Building information modelling*	**LED**	*Light Emitting Diode*
BMS	*Building Management System*	**LEED**	*Leadership in Energy and Environmental Design*
C	*Celsius*		
CaaS	*Cybersecurity-as-a-Service*	**LLLC**	*Luminaire-Level Lighting Control*
CAGR	*Compound Annual Growth Rate*	**LLMs**	*Large Language Models*
CO2	*Carbon Dioxide*	**M&A**	*Mergers & Acquisitions*
EPBD	*Energy Performance of Buildings Directive*	**Mt**	*Megatonne*
		NEB	*New European Bauhaus*
eq	*Equivalent*	**OT**	*Operational technology*
EU	*European Union*	**OTA**	*Over-The-Air*
GHG	*Greenhouse gases*	**SOC**	*Security Operations Centre*
HITL	*Human-In-The-Loop*	**UK**	*United Kingdom*
HVAC	*Heating, Ventilation, and Air Conditioning*	**US**	*United states*
		UV	*Ultraviolet*
IAQ	*Indoor Air Quality*	**UV-C**	*Ultraviolet-C*
ICT	*Information and Communication Technology*	**VPN**	*Virtual Private Network*
		VR	*Virtual Reality*
IEC	*International Electrotechnical Commission*	**W**	*Watt*
IFC	*Industry Foundation Classes*		

ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact
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