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The path to sustainable future buildings: trend watching foresight 2050



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Abstract

Buildings contribute approximately one-third of global greenhouse gas emissions, significantly exacerbating climate change and resource depletion. Future trend watching is invaluable in addressing environmental issues related to buildings as it enables stakeholders to identify emerging patterns, technologies, and practices that can enhance sustainability. This research utilises foresight analysis based on the PESTLE methodology and analyzed insights from 70 worldwide experts (Europe, Africa, USA, Asia, Middle East, CIS countries, Latin America, Australia, and New Zealand), in addition was investigated trends of the building industry and theoretical scientific reports (Ermolaeva & Minakova, 2025). According to experts, technological trends in the green building industry primarily depend on digital transformation, including Building Information Modelling (BIM), augmented reality, digital twins, artificial intelligence (AI), automation and robotics. Innovations in energy production and consumption are also centred on renewable energy sources, as well as advancements in grid technologies, HVAC systems, and energy storage solutions. Furthermore, building design technologies such as building-integrated photovoltaics (BIPV), biophilic design, dynamic facades, 3D printing, modular housing and circular approaches are gaining traction. Economic trends are characterized by increasing investments and the growth of green jobs within the green building industry, alongside a variety of green economy instruments such as green loans, tax incentives, public-private partnerships, collaborative economic ecosystems, carbon credits, grants and subsidies, which vary across different regions based on the development levels of sustainable construction. Stricter regulatory frameworks can enhance the effectiveness of green initiatives, ulti-

mately leading to a more sustainable and energy-efficient built environment. Social policies require detailed framework. Instruments can be categorized into: globally oriented instruments (regulations, zero emissions goals, commitments, international standards); specific instruments and agreements related to energy efficiency policies and technologies (governmental policies, benchmarking, building programs, financial models); socially oriented instruments (public-private partnerships, reporting frameworks such as ESG or sustainability reports, inclusive design). There is a strong emphasis on reducing carbon emissions, enhancing energy efficiency, and integrating green buildings into sustainable urban planning through circular economy principles. However, successful implementation requires addressing barriers and adopting a holistic approach coordinated across sectors. The future of sustainable construction looks promising but it necessitates immediate and coordinated efforts across various sectors and disciplines. The main barriers to sustainable construction, consequently, effective energy management in green buildings include inconsistent regulations, which vary across regions and create confusion and inefficiencies for developers, design team and construction companies. Concerns about over regulation, lack of clear measurable standards, short-term economic goals, limited engagement with stakeholders, lack of education in sustainable practices restricts innovation. Lastly, competing interests and inequalities among stakeholders and regions further complicate efforts, diluting legislative measures and hindering access to sustainable technologies. There are three types of the legislative instruments that was determined by experts: development of the environmental law, strengthened building codes and green certifications, liability and accountability policies. By weaving together innovative technological trends with actionable strategies and identifying key barriers, the study paints a vivid roadmap for transitioning to carbon-neutral built environments, ultimately inspiring a collaborative vision for a sustainable future where buildings play a transformative role in combating climate change and optimizing resource use.

Keywords: Sustainable building, Foresight, Energy saving, Circular economy, Social sciences.

References

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Bio

Yulia Ermolaeva

Is an interdisciplinary researcher specializing in sustainable development, with over 15 years of experience across various fields. She has published more than 80 articles in peer-reviewed journals and several scientific monographs. Currently, Yulia serves as the Head of the research center at "ESG-Expert" LLC company, where she also provides consulting services in sustainable development. In 2025, she founded Future Compass Sustainability Coaching, a project where she acts as a coach for professionals in the sustainability sector.

Anna Minakova

Is CEO ESG-expert, LLC, co-founder of CLEVER, pioneering green building certification system in Russia. She has certified 1,000,000+ sq m of office spaces in Russia, with two projects showcased as best-practice case studies by BRE Global. Her expertise spans global sustainability frameworks, evidenced by credentials: BREEAM Assessor (NC, In-Use, RFO), LEED GA, WELL AP, Fitwel Ambassador, GRI Reporting andGRESB Rating expert. As a lecturer at the British Higher School of Design, she bridges industry practice and education, fostering ESG knowledge.