RECENT J. (2025), 78:404-408
https://doi.org/10.31926/RECENT.2025.78.404

Competency Frameworks for Sustainable Facility Management: Advancing Skills for Energy Efficiency and Circular Economy in the Built Environment

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Abstract
Achieving sustainability in the built environment is essential for reducing energy consumption, greenhouse gas emissions, and operational costs, particularly in public and commercial buildings. Facility managers play an important role in this transition, requiring a combination of technical, managerial, financial, ecological, and social competencies to implement energy efficiency, circular economy practices, and climate-action strategies effectively. This paper reviews established competency frameworks and guidelines to identify the knowledge, skills, and behaviours essential for sustainable facility management. Findings highlight the importance of interdisciplinary, holistic approaches that integrate technical expertise with non-technical skills such as communication, governance, stakeholder engagement, and systems thinking. Aligning education, professional development, and continuous training programs is crucial to equip current and future professionals with the competencies needed to plan, implement, and sustainably innovate across public and private building portfolios.

Keywords
sustainability, facility management competency framework

1. Introduction

In 2021, the European Union (EU) declared its intention to be the world's first carbon-neutral region by 2050 [1]. A key factor in achieving the EU's climate objectives is the building sector [2]. Buildings in the European Union account for approximately 40% of total energy consumption and 36% of CO_2 emissions, with public buildings representing a significant share of this demand [3]. Transforming buildings can improve users' health and well-being, and at the local level, influence social surroundings and contribute to social cohesion. To achieve sustainability goals, the European Commission has launched the "Renovation Wave" strategy to upgrade existing buildings and has proposed several legislative measures to enhance energy efficiency.

Building decarbonization involves reducing carbon emissions from buildings through energy efficiency upgrades, electrification, the use of renewable energy, and sustainable materials. Improving the energy performance of buildings is widely recognized as one of the most effective and economically efficient strategies for enhancing Europe's energy security, reducing greenhouse gas emissions, and stimulating economic activity. In line with this, the public sector is expected to assume a leading role in upgrading the building stock, especially given the EU Parliament's requirement that all public buildings achieve near-zero energy Building (nZEB) standards. However, progress toward these goals has been constrained by persistent structural challenges. Public administrations often depend on annual budget cycles for financing, which restricts the scale and continuity of energy-efficiency interventions. Simultaneously, organizational capacity limitations—especially staffing and technical expertise—hamper institutions' ability to design, procure, and manage comprehensive energy upgrades. Mechanisms such as Energy Performance Contracting (EPC) offer potential solutions, but their effective use requires specialized knowledge and skills.

Besides renovations and green retrofitting, reducing energy and material consumption during building operation and maintenance is crucial for true decarbonisation. To align with recent national and EU regulations and policies, the Facilities Management (FM) sector needs to update its practices and processes, to engage with a sustainable development agenda [4, 5]. The International Facility

Management Association (IFMA) describes Facility Management as "an organizational function which integrates people, place and process within the built environment with the purpose of improving the quality of life of people and the productivity of the core business" [6]. According to the International Organization for Standardization, facilities management is the organizational function that integrates people, place, and process to create and maintain efficient, safe, and adaptable built environments [7, 8]. FM therefore influences environmental, social, and corporate governance issues [6]. Opoku and Lee [5] highlight that Facilities management (FM) is presently moving its focus towards a long-term perspective by implementing maintenance and operational strategies that take into account the social, environmental, and economic advantages of every business decision. Sustainability and the circular economy are gaining significance in the FM sector. Sustainable facilities management focuses on reducing energy consumption, decreasing waste and water usage, promoting recycling, and using environmentally friendly materials. These practices aim to reduce buildings' carbon footprint, lower operational expenses, create healthy indoor environments, and enhance occupants' well-being.

In this context, the role and competencies of facility management managers become critically important. Facility managers increasingly serve as key actors who bridge technical, organizational, economic, and regulatory domains. Energy managers, in particular, are professionals responsible for optimizing and managing the energy consumption of buildings, facilities, or organizations. Their responsibilities extend from identifying and assessing energy-saving opportunities to managing complex procurement procedures, evaluating contractual models such as EPC, interpreting regulatory requirements, overseeing monitoring and verification of energy performance, and facilitating cross-departmental coordination. Despite their centrality, the expectations placed on energy managers often exceed the formal training and resources available to them within public institutions.

The slow dissemination of environmentally friendly and energy-efficient building construction and operation practices can be attributed to gaps in the professional competences required for their implementation. In the following section, we will investigate the key competencies of Facility managers. There are several frameworks and guidelines for developing sustainability competence applicable to the built environment sector. These describe the skills, knowledge, behaviours, and outcomes necessary for individuals working in roles related to construction, design, management, operation and maintenance of the built environment to achieve sustainable outcomes.

2. Competencies for sustainable facility management

The European sustainability competence framework (GreenComp) was developed by the European Commission's Joint Research Centre (JRC) as part of the European Green Deal's policy actions [9]. Describing Sustainability as the act of "prioritising the needs of all life forms and of the planet by ensuring that human activity does not exceed planetary boundaries", GreenComp proposes a set of 12 sustainability competences, spanning four competences 'areas', to be used as a reference in educational and lifelong-learning contexts. The four competence areas of GreenComp include: Embodying Sustainability Values, Embracing Complexity in Sustainability, Envisioning Sustainable Futures, and Acting for Sustainability. Its aim is to help people "think, plan and act with empathy, responsibility, and care for our planet and for public health."

Stressing the interdisciplinary perspective on sustainability, Wrase et al. [10] identified six dimensions of Cubic sustainability in real estate that real estate professionals need to be taught to manage sustainability more broadly and the transformation toward the circular economy in real estate: social, economic, processual, technical, empirical, and ecological. These dimensions cover societal contribution, financial knowledge, lifecycle process understanding, digital technology integration, data-driven management, and resource-efficient, environmentally friendly building practices. Together, they enable holistic and sustainable real estate management.

The European PPP Expertise Centre (EPEC) developed practical guidance regarding technical skills and project risks in public buildings [11]. EPEC identified four main challenges for EE investments in public buildings: technical, economic, budget, and Legal and institutional challenges. The report concludes that effective technical, managerial, financial, and collaborative competencies are critical for stakeholders implementing energy-efficiency measures in public buildings.

In the USA, the U.S. Department of Energy (DOE), in collaboration with the National Institute of Building Sciences (NIBS), developed the Better Buildings Workforce Guidelines (BBWG) [12]. This is a voluntary national guideline designed to improve the quality, consistency, and credibility of training and certification programs for key energy-related jobs in commercial buildings. The guidelines focus on four key job titles: Building Energy Auditor, Building Commissioning Professional, Energy Manager, and Building Operations Professional. Although the BBWG mainly focuses on technical competencies, each of the covered job roles (Energy Auditor, Commissioning Professional, Energy Manager, Building Operations Professional) includes non-technical skills that apply across roles. These were outlined in the Advanced Commercial Buildings (ACB) Energy Management Competency Model developed by the Consortium for Building Energy Innovation (CBEI) to support the advanced commercial building workforce (ACBW) [13]. The ACB competency model features the following tiers: Personal Effectiveness Competencies, Academic Competencies, Workplace Competencies, Industry-Wide Technical Competencies, and Industry-Sector Technical Competencies.

Similarly, the UK Construction Industry Council (CIC), comprising professional institutions and organisations active in the construction and property industries, proposed a Climate Action Plan covering both the natural and built environments [14]. The Action Plan presents a crucial roadmap to support Professional Institutes/Institutions and wider industry actions. It includes a range of short-, medium-, and long-term commitments for raising climate literacy across the built environment sector.

The Climate, Environment, Infrastructure & Energy (CEIE) Technical Competency Framework [15] published by the Foreign, Commonwealth & Development Office (UK Government) identifies the technical competencies required across four clusters: Climate & Environment, Climate & Nature Diplomacy, Infrastructure & Urban, and Energy. The CEIE Framework emphasizes the combination of technical expertise, governance understanding, and cross-sector coordination needed to implement energy efficiency and sustainability measures. Facility managers in public buildings need a range of competencies, including technical, managerial, financial, and collaborative skills, to effectively implement energy efficiency and sustainability programs.

The Cross-Industry Action Group, an initiative created to unite industry professionals and academics in enhancing their collective capacity for climate action, developed the Climate Framework [16]. Its purpose is to create common ground, define a shared language, and identify the comprehensive knowledge and skills necessary for all participants in the built environment to deliver sustainable solutions both today and in the future. The Climate Framework is structured around six key themes directly influenced by the built environment, along with common threads shared across all themes: “Human Factors” addresses the role of people, behaviours, and well-being in shaping environmental outcomes, while “Circular Economy” focuses on resource efficiency, material cycles, and waste reduction across a building’s lifecycle. “Energy and Carbon” involves understanding energy systems, decarbonisation strategies, and emissions management, while “Water” covers sustainable water use, conservation, and resilience to water-related climate risks. “Ecology and Biodiversity” highlights the need to protect habitats, support ecosystem services, and integrate nature-based solutions, whereas “Connectivity and Transport” examines the relationship between mobility, urban form, and low-carbon transport options. The Framework emphasises the need for a holistic approach to avoid unintended consequences and acknowledges the importance of addressing challenges in both local and global contexts, tailored to specific social, economic, and environmental circumstances.

3. Discussion

Overall, achieving sustainability in the built environment demands a wide range of skills, including technical, managerial, financial, ecological, and social. The relevant frameworks emerging from Europe, the US, and the UK, such as GreenComp, Cubic Sustainability, EPEC guidance, BBWG, CEIE, and the Cross-Industry Climate Framework, underscore the need for interdisciplinary, comprehensive strategies that link energy efficiency, circular economy approaches, and climate action. While these frameworks differ in focus, they converge on the importance of combining technical expertise with critical non-technical skills, including communication, teamwork, governance, and stakeholder engagement. The widespread need for building renovations and operational optimisation demands advanced skills in planning,

technical assessment, lifecycle monitoring, and stakeholder coordination. Currently, many public building interventions remain fragmented due to gaps in facility managers' skills, standardised methods, and tools. Technical skills alone are insufficient. Clearly defining and strengthening facility managers' competencies beyond technical expertise, to include financial literacy, regulatory knowledge, project management, and communication, is essential. Enhancing these capabilities will enable more effective energy efficiency measures and advance the transition toward a sustainable, energy-efficient built environment.

A common theme among these frameworks is the promotion of holistic and systemic thinking, which encourages responsibility and care for both the environment and public health. Effective implementation requires alignment among education, professional development, and policy instruments. This implies the establishment of a shared language, common knowledge, and multi-stakeholder collaboration, including industry, academia, professional education, and building users [17], is essential for achieving impactful and sustainable outcomes in the built environment. Aligning research with higher education and with continuous training programs is essential for equipping professionals in the built environment with the necessary sustainability competencies. By integrating up-to-date technical skills, interdisciplinary knowledge, and non-technical capabilities, education and training can prepare graduates and practitioners to effectively implement innovative energy-efficiency measures, circular-economy practices, and climate-action strategies. Furthermore, this alignment should extend to lifelong learning to bridge the gap between academic knowledge and practical application.

The emerging competency frameworks and guidelines can help establish organised pathways for workforce training, to enhance climate awareness, and support tailored solutions that integrate environmental, social, and economic considerations. Such is the case of the ACBW and the CEIE competency models, and the Climate Framework. Ultimately, these initiatives can help prepare professionals to effectively design, implement, and innovate sustainably in both public and private facilities and urban systems.

4. Conclusions

Sustainability in the built environment positions both public and commercial buildings as key contributors to energy efficiency, the adoption of circular-economy principles, and broader sustainability practices. Facility managers and real estate professionals play a crucial role in this effort, requiring a blend of technical, financial, managerial, and ecological skills.

This paper explored the competencies required for effective facility management by reviewing established frameworks and guidelines. The aim is to support the upskilling of advanced facility management professionals in sustainability and energy efficiency, outlining the necessary information, knowledge, and professional skills. These competencies are particularly valuable for defining role specifications and enhancing the training and operational capabilities of facility and energy managers in the public sector.

The analysis concluded that existing frameworks can provide a structured foundation for identifying the essential technical, managerial, financial, and collaborative competencies needed by facility managers responsible for improving the performance of public buildings. By exploring their scope, alignment, and applicability, this paper aims to clarify the competency requirements that support effective energy-saving and sustainability-promoting initiatives within public-sector building management portfolios.

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Paper presented at The 17th International Conference
"STANDARDIZATION, PROTYPES and QUALITY: A means of Balkan Countries' collaboration"