

## 탄소중립도시 조성요소의 규제 샌드박스 도입 현황 및 과제

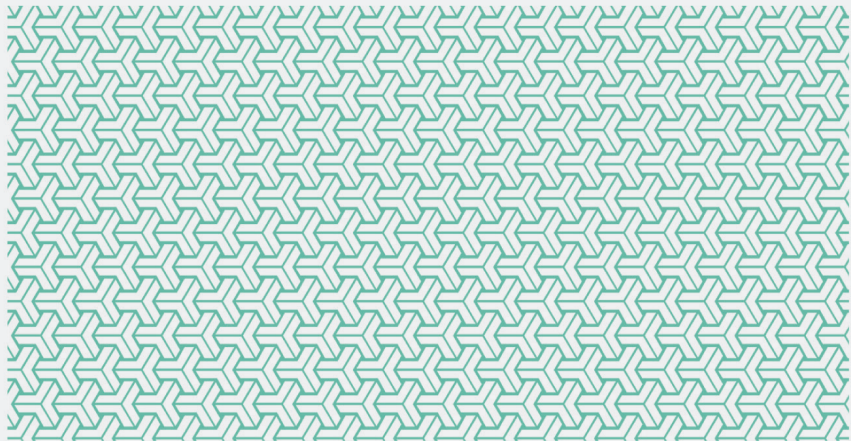
Current Status and Challenges of Regulatory Sandboxes for  
Spatial Elements in Building Carbon-Neutral Cities

이은석 Lee, Eunseok  
박종훈 Park, Jonghoon  
지석환 Ji, Seokhwan

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References



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## 1. Introduction

This study aims to establish the technical and institutional foundations required to create carbon-neutral cities. Despite the implementation of the Carbon Neutrality Framework Act in 2021, clear concepts and institutional standards for transitioning existing cities into carbon-neutral ones remain lacking. To address this gap, this research proposes regulatory easing measures and policy directions to support the transition. The main objectives are to identify essential spatial elements for building carbon-neutral cities, analyze their current adoption status, and propose actionable directions for achieving carbon neutrality through regulatory sandboxes.

The scope of the study is divided into three dimensions. The temporal scope spans from the announcement of the 2021 Carbon Neutral Scenarios to the target year 2050. The spatial scope focuses on technologies and applications relevant to carbon-neutral cities at national and local government levels. The institutional scope encompasses key laws such as the Carbon Neutrality Framework Act, the Green Building Act, and the Special Act on Designated Areas, alongside regulatory frameworks for easing restrictions.

The research methodology includes listing relevant technologies and spatial elements for carbon-neutral city development, analyzing urban planning facilities linked to carbon neutrality, assessing adoption status through local government case studies, and identifying tasks and directions for regulatory sandbox utilization. This approach enables an analysis of technical readiness and regulatory conditions for carbon-neutral cities and suggests improvements to laws and policies for effective implementation.

## 2. Deriving Spatial Elements for Carbon-Neutral Cities

This chapter identifies and categorizes carbon-neutral technologies, examines their connections to urban planning facilities, and derives

spatial elements for creating carbon-neutral cities. To compile a list of carbon-neutral technologies, sources such as the Korean Green Taxonomy and the Top 100 Carbon Neutral Technologies were reviewed. These technologies were then analyzed for their relevance to policy initiatives for carbon-neutral cities.

Urban planning facilities, as defined in the Urban Planning Facility Rules under the Carbon Neutrality Act, provided a framework for analyzing these spatial elements. Technologies identified as both carbon-neutral and relevant to urban planning facilities include hydrogen supply and storage facilities, electric vehicle charging stations, green buildings, waste recycling facilities, and green infrastructure. However, some technologies, such as CCUS (Carbon Capture, Utilization, and Storage), fall outside the current scope of urban planning facilities.

Key insights include the recognition of technologies like hydrogen storage, green buildings, and waste recycling facilities as either existing urban planning facilities or having high potential for integration. Many carbon-neutral technologies, however, are not yet included in urban planning regulations, underscoring the need for regulatory support such as special exemptions. Strengthening these technologies through regulatory frameworks can support local government projects and promote their integration into urban environments.

### 3. Analysis of Adoption Cases in Local Governments

This chapter examines the adoption of carbon-neutral city spatial elements by local governments. Projects were categorized into three areas: greenhouse gas reduction in energy, carbon absorption, and climate adaptation. Findings reveal that energy-related technologies account for more than half of the projects, followed by carbon absorption, waste management, and infrastructure.

Analyzing these projects through the urban planning facility framework established in Chapter 2 highlighted several trends. Adoption of advanced technologies, such as hydrogen and ammonia-based solutions,

remains limited due to concerns over practicality, safety, and cost-effectiveness. National pilot projects are essential to build a foundation for local governments. Emphasis on renewable energy expansion underscores the centrality of energy efficiency in achieving carbon neutrality.

Most projects rely on proven, existing technologies, while innovative solutions face regulatory and safety hurdles. These constraints highlight the need to enhance local governments' understanding of advanced technologies through training and expert collaboration to foster adoption and scalability.

## 4. Current Status of Regulatory Sandboxes for Carbon-Neutral Spatial Elements

This chapter evaluates the application of regulatory sandboxes to carbon-neutral spatial elements and outlines directions for their utilization. Key findings show that regulatory sandboxes address challenges such as unclear standards, regulatory barriers, and commercialization support. Hydrogen-related technologies constitute a significant portion of sandbox applications.

Emerging technologies like EV battery reuse, energy storage systems, and CO<sub>2</sub> recycling face barriers due to a lack of clear regulatory standards, making sandboxes essential for their development. A three-stage approach for utilizing regulatory sandboxes is proposed:

Research and Development: Sandboxes facilitate easing regulations, establishing standards, and fostering innovation.

Implementation in Urban Projects: Focus on renewable energy, waste recycling, and green infrastructure.

Realization of Carbon-Neutral City Models: Tailor city-level strategies to greenhouse gas reduction, climate adaptation, and circular carbon economies.

## 5. Conclusion

This study identifies technical and institutional challenges in creating carbon-neutral cities and highlights the potential of regulatory sandboxes as a solution. It systematically analyzed national and local adoption gaps for carbon-neutral spatial elements and proposed measures to address regulatory needs.

Key recommendations include utilizing regulatory sandboxes to close gaps in standards, enhancing local governments' capacities through training and expert collaboration, and supporting national pilot projects to validate and demonstrate the viability of innovative technologies. The study provides a roadmap for developing the technical and institutional foundations needed for carbon-neutral cities and serves as a valuable reference for policymakers. It is expected to contribute to achieving carbon neutrality by promoting technology adoption and regulatory easing. Future research should focus on governance structures, region-specific strategies, and sustainable urban models tailored to carbon neutrality goals.

### Key words

Carbon Neutrality, Carbon-Neutral City, Spatial Elements for Carbon-Neutral Cities, Regulatory Sandbox