

The study is performed by:

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School of the Future — A Feasibility study

Decarbonising Warsaw school complex

Abstract:

This feasibility study explores the transformation of schools into future-proof, sustainable learning environments through a holistic approach that integrates urban, physical, social, and educational needs alongside technical requirements. The study focuses on **Zespół Szkół nr 12 im. Olimpijczyków Polskich in Warsaw**, providing innovative solutions that can be replicated across other schools.

The study is structured around six key dimensions identified by the city of Warsaw: energy efficiency, biodiversity, water retention, sustainable transportation, user comfort/air quality, and circular economy. By addressing these areas, the project aims to foster climate neutrality, reduce absenteeism, increase the sense of belonging, and achieve an overall reduction in CO₂ emissions.

Key recommendations include the following:

- **Energy Efficiency:** Implementing intelligent systems for daylight optimisation, LED lighting, improved insulation, calibrated water pumps, and data-driven monitoring. Renewable energy sources, such as solar roofs and mechanical ventilation with heat recovery, are also recommended.
- **Biodiversity:** Preserving existing natural elements, maintaining soil health, and introducing green learning spaces with diverse plant life to support ecosystems and year-round greenery.
- **Water Retention:** Utilising permeable surfaces, retention ponds, and rainwater harvesting systems for reuse in toilets, irrigation, and cleaning, reducing dependency on external water sources.
- **Sustainable Transportation:** Establishing car-free zones, safe crossings, and well-lit pathways for students, alongside accessible and weather-protected bicycle parking to promote cycling as a primary mode of transport.
- **User Comfort & Air Quality:** Integrating data monitoring (indoor climate sensors) and qualitative feedback from users to optimise heating, ventilation, and air circulation. This includes mechanical ventilation with heat recovery, strategically placed windows for natural airflow, and modern heating systems.
- **Circular Economy:** Enhancing building envelopes with improved insulation, energy-efficient windows, and green roofs. Flexible layouts and outdoor learning spaces further ensure long-term adaptability and community integration.

By implementing these strategies, the study provides a roadmap for decarbonising schools and enhancing their resilience against climate change, ensuring healthier and more efficient educational environments for the future.

ZSNR12

Students and staff completed a questionnaire, highlighting key challenges such as overcrowding and poor indoor climate. To address these issues, an additional floor is proposed. These new spaces are designed with flexible layouts to support diverse teaching methods. In addition, more social spaces are created, both indoors and outdoors, to encourage interaction and provide access to fresh air.

In the proposal, the outdoor areas are elevated to encourage students and staff to spend more time outside. Existing sports facilities are preserved, and the landscape is redesigned with a focus on water management and protection of existing trees. The school courtyard is cleared of waste management and vehicles and transformed into an inviting outdoor social space and a potential learning area.

To enhance accessibility and create an inviting environment, it is proposed to remove parts of the fence. A part of the building is transformed into a public library, fostering community engagement and providing a cool space for neighbors during heat waves. Flexible pavilions are introduced, serving as public spaces after school hours and extending the life of the school beyond its educational use.

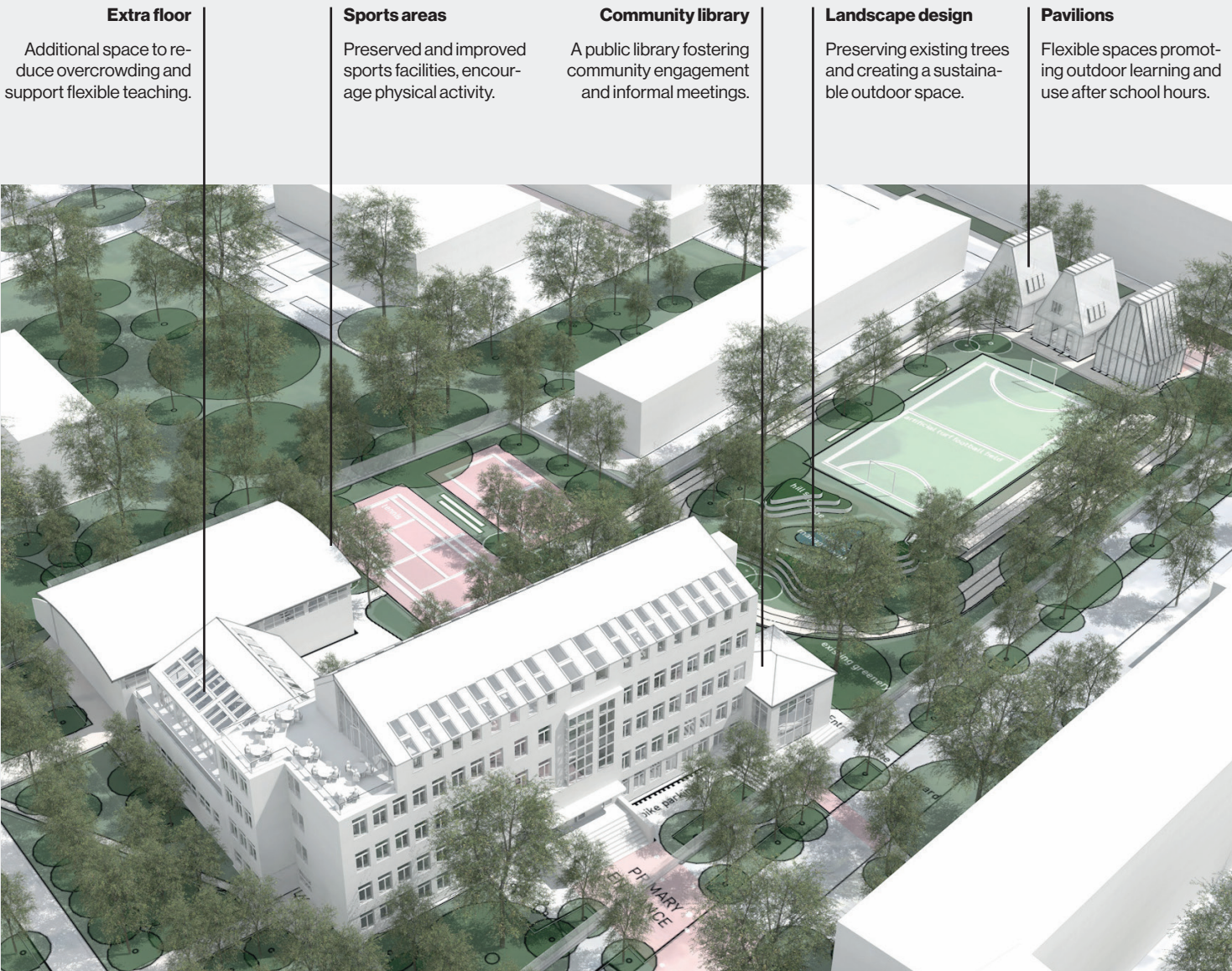


Illustration of the school building and its context with the proposed improvements.

Through the work with the school, the focus areas have been explored, leading to a toolbox of recommendations that can be replicated in other schools undergoing transformation. In addition to these recommendations, specific technical improvements have been developed, which impact student's health and well-being, as well as the building's energy performance.

Focus areas:

ENERGY EFFICIENCY

BIODIVERSITY

WATER RETENTION

STREETS FOR STUDENTS

COMFORT FOR USERS

CIRCULAR ECONOMY

Toolbox:

Implement intelligent systems.

Care for existing elements.

Harvest and use water in systems.

Enhance safety.

Involve the users.

Optimise the building envelope.

Integrate renewable energy sources.

Introduce new environments.

Implement water in landscape design.

Enhance accessibility.

Optimise the building systems.

Introduce flexible layouts.

Technologies:

The diagram illustrates a multi-story school building with various sustainable technologies integrated into its design. It shows a cross-section of the building, highlighting the roof, walls, and interior spaces. Arrows indicate the flow of air, water, and energy, demonstrating how these technologies work together to improve the building's performance and user comfort.

Roof windows
Roof windows provide passive solar heating and natural daylight to reduce need for artificial light.

Mechanical ventilation
With heat recovery, supporting atmospheric comfort and reducing energy consumption

Heating system
Intelligent heating system, utilizing rainwater and returning energy to reduce energy consumption.

Solar roof
Solar roof replaces a traditional roof and provides renewable energy to foster climate neutrality.

Post insulation
With mineral wool supports thermal comfort and reduces energy used for heating.

Natural ventilation
Intelligent ventilation system reduces the risk of over-heating and energy used by mechanical ventilation.