

SDG 9 Report

Industry, Innovation, and Infrastructure

Comprehensive Infrastructure Actions and Progress

1. Introduction

Beirut Arab University is firmly committed to advancing Sustainable Development Goal 9 (SDG 9): Industry, Innovation, and Infrastructure, through systematic investments in resilient, sustainable, and innovation-oriented campus infrastructure. Building on initiatives launched in previous years, BAU has expanded and enhanced its infrastructure strategy during 2025–2026, transitioning from planning and optimization toward large-scale implementation and integrated design solutions.

2. Renewable Energy Infrastructure - Solar Energy Systems

2.1 Beirut Campus

Solar photovoltaic capacity increased from 310 kW to an effective operational output of approximately 435 kW through system rehabilitation, maintenance, and optimization. Following these improvements, the photovoltaic system now operates at approximately **96% of its installed rated capacity**, reflecting a substantial enhancement in system performance and operational efficiency.

To further increase the contribution of renewable energy within the campus energy mix and reduce dependence on conventional power sources, BAU has approved an expansion plan to increase the total installed photovoltaic capacity to approximately 800 kW through the installation of an additional 576 photovoltaic panels, equivalent to nearly 350 kW. The proposed installation will be implemented above the parking area adjacent to the Main Building, maximizing land-use efficiency while simultaneously providing shaded parking infrastructure

SDG 9 Contribution

- Optimization and rehabilitation of renewable energy infrastructure
- Improved operational efficiency and asset utilization
- Alignment with SDG 9.1 and 9.4

2.2 Debbieh Campus- Innovative Solar Integration

The planned renewable energy project at the Debbiah Campus includes the installation of an integrated photovoltaic system with an estimated capacity of approximately 1.6 MWp, comprising around 2,727 solar panels. The project will also incorporate a Power Conversion System (PCS) with a 1 MW output capacity and a Battery Energy Storage System (BESS) with a storage capacity of approximately 2 MWh. This integrated system is designed to enhance energy resilience, maximize renewable energy utilization, and substantially reduce reliance on conventional power generation. In addition, part of the photovoltaic installation will be implemented using elevated

canopy structures above parking areas, creating shaded pedestrian pathways and vehicle parking while optimizing land use and improving campus functionality.

This innovative configuration allows solar panels to:

- Generate renewable electricity
- Serve as shaded pedestrian pathways
- Protect students and staff from sun exposure and rainfall
- Optimize land use without additional construction footprint

By integrating energy generation with daily campus mobility, BAU demonstrates innovation-driven, human-centered infrastructure design, fully aligned with SDG 9's vision of inclusive, resilient, and sustainable infrastructure systems.

SDG 9 Contribution

- Innovative infrastructure design (SDG 9.5)
- Climate-resilient public space integration (SDG 9.1)
- Clean energy deployment (SDG 9.4)

2.3 Beqaa Campus

At the Beqaa Campus, the solar energy project underwent a major design upgrade. The original plan of 100 kW with battery backup was expanded to:

- 250 kW solar capacity
- 500 kWh battery storage

The system is designed to supply electricity to existing facilities and newly planned campus buildings, enhancing operational continuity and energy security. Project completion is scheduled for September 2026.

Based on the current design targets, the planned renewable energy systems are expected to reduce the operation of diesel generators by approximately half of the year, potentially decreasing fuel consumption and associated carbon emissions by nearly 50% compared with existing operating conditions. Quantitative verification will be performed after a full operational cycle using actual performance data.

SDG 9 Contribution

- Hybrid renewable energy and storage infrastructure
- Enhanced resilience under grid instability
- Supports SDG 9.1 and 9.4

3. Carbon Emission Reduction and Power System Optimization

Beirut Campus

BAU has designed a dedicated project to reduce emissions from backup power generation through the installation of:

- Cyclone systems
- Diesel particulate filters on generators

Testing and phased implementation are currently underway, targeting reductions in carbon emissions and particulate matter, while maintaining operational reliability.

Debbieh Campus

Electrical cable rerouting and network optimization have enabled the disconnection of two generator units, with alternative energy sources now feeding campus loads. This directly reduces fuel consumption and emissions.

SDG 9 Contribution

- Cleaner industrial processes
- Emission-reduction technologies
- Alignment with SDG 9.4

4. Water Infrastructure and Resource Efficiency

Potable and Drinkable Water- Beirut Campus

BAU has undertaken a phased upgrade of its Reverse Osmosis (RO) water infrastructure. At the Hariri Building, the RO plant capacity increased from approximately 7 US gallons per minute (gpm) to 15–18 gpm, significantly enhancing the availability of treated potable water for laboratories, clinics, blood testing facilities, and other academic and healthcare functions. In parallel, the Main Building RO system is currently being upgraded to extend service coverage to additional faculties, particularly the Faculty of Dentistry, with a targeted production capacity of approximately 20 gpm upon completion and commissioning.

In parallel, all metal pipes are being replaced with PPR piping (Polypropylene Random Copolymer) piping. They are modern thermoplastic pipes widely used in potable water systems, RO plants, heating networks, and institutional infrastructure (hospitals, universities, laboratories). Instead of being joined with glue or threads, PPR pipes are heat-fused, creating a single continuous, leak-proof system.

The replacement of metal piping with PPR (Polypropylene Random Copolymer) systems represents a strategic upgrade of water infrastructure, enhancing durability, water quality, and long-term resource efficiency. This intervention strengthens infrastructure resilience, reduces maintenance and material consumption, and aligns

with SDG 9 targets on sustainable and reliable infrastructure development (Targets 9.1 and 9.4).

Water Conservation- Debbieh Campus

An artificial lake was constructed to collect and store rainwater for irrigation, supporting water conservation and sustainable land use.

SDG 9 Contribution

- Modernized water infrastructure
- Improved efficiency and resilience
- Supports SDG 9.1

5. Building Durability, Waterproofing, and Structural Resilience

At the Beirut Campus, BAU is implementing:

- Comprehensive rooftop waterproofing
- Preventive maintenance to mitigate corrosion
- Façade restoration following observed cracks and structural degradation

These interventions extend building lifespans, reduce long-term repair costs, and enhance infrastructure resilience.

SDG 9 Contribution

- Preventive infrastructure maintenance
- Long-term asset protection
- Alignment with SDG 9.1

6. Energy-Efficient Lighting Systems

BAU continues its campus-wide transition to LED lighting systems. Replacement levels progressed from 15–40% coverage, with ongoing implementation expected to reach approximately 80% coverage by the end of 2026.

This initiative reduces energy consumption, lowers operational costs, and supports efficient infrastructure modernization.

SDG 9 Contribution

- Energy efficiency upgrades
- Reduced carbon footprint
- Supports SDG 9.4

7. Innovation, Digital Transformation, and Sustainable Design Infrastructure

At the Debbieh Campus, **beehives** were installed to support pollination and local biodiversity. This initiative integrates environmental stewardship into campus infrastructure planning and reflects environmentally sound development practices.

SDG 9 Contribution

- Environmentally responsible infrastructure
- Supports SDG 9.5

8. Digital Innovation and Sustainable Architectural Infrastructure

8.1 Digital Transformation in Architectural Education

As part of its commitment to fostering innovation and resilient digital infrastructure, Beirut Arab University has fully integrated the digital submission and presentation of architectural design projects within the Faculty of Architecture-Design & Built Environment. Adopted for several years, this approach replaces conventional paper-based workflows with cloud-supported digital platforms and electronic repositories, enabling efficient project hosting, review, archiving, and interdisciplinary collaboration.

The digitalization of the design submission process strengthens the University's technological ecosystem by promoting data sharing, remote accessibility, and interactive learning environments while equipping students with advanced digital competencies required by the architecture, engineering, and construction sectors. Moreover, by substantially reducing large-format printing and physical material consumption, the initiative promotes resource efficiency, minimizes waste generation, and contributes to more sustainable academic and infrastructure practices.

SDG 9 Contribution

- Accelerates digital transformation and smart educational infrastructure.
- Promotes innovation through cloud-based collaboration and digital repositories.
- Enhances resource efficiency by reducing paper and printing waste.
- Supports the development of a future-ready, technology-driven workforce.
- Aligns with **SDG 9.1, 9.4, and 9.5** through resilient digital infrastructure and technological advancement.

8.2 Advancing Sustainable and Innovative Design Education

In alignment with the objectives of SDG 9, the Faculty of Architecture – Design & Built Environment embeds principles of **innovation, resilient infrastructure, and sustainable industrial development** across its academic studios and research activities. Design projects and research initiatives regularly address themes including:

- Sustainable architecture and green buildings
- Energy-efficient building systems and low-carbon construction
- Urban resilience and adaptive reuse strategies
- Smart construction technologies and digital fabrication
- Sustainable mobility and public space design
- Climate-responsive architecture and landscape integration
- Digital innovation, computational design, and Artificial Intelligence (AI) applications in architectural practice.

By integrating these themes into the educational process, BAU fosters an innovation-oriented academic environment that prepares graduates to contribute to the planning, design, and implementation of sustainable infrastructure solutions at local and regional levels.

SDG 9 Contribution

- Strengthens research and technological capabilities in sustainable design.
- Promotes innovation-driven solutions for resilient infrastructure.
- Supports the development of highly skilled professionals equipped for the digital and green economy.
- Directly advances **SDG 9.5** through applied research and technological innovation.

8.3 Campus Physical Models for Resilient Infrastructure Planning

To support evidence-based campus planning and long-term infrastructure resilience, BAU recently completed **four detailed physical masterplan models**, at a **1:1000 scale**, representing the University's four campuses and their existing built and natural environments. Developed using advanced digital modeling and precision fabrication techniques, these models accurately document the spatial organization of academic buildings, infrastructure networks, circulation systems, landscape elements, topography, green spaces, and campus facilities.

Beyond their educational value, these models serve as strategic analytical and planning tools that facilitate the visualization and assessment of future campus developments, infrastructure upgrades, and expansion scenarios. By enabling informed decision-making and integrated planning, they contribute to the development of resilient, efficient, and sustainable university infrastructure systems.

SDG 9 Contribution

- Supports evidence-based infrastructure planning and decision-making.

- Integrates advanced digital and fabrication technologies into campus development.
- Enhances the resilience and sustainability of future infrastructure investments.
- Reinforces BAU's commitment to innovation-led infrastructure management in alignment with **SDG 9.1 and SDG 9.5**.

9. Conclusion- SDG 9 Impact Statement

Through coordinated investments in renewable energy, emission reduction, water systems, building resilience, energy efficiency, and innovative infrastructure design, Beirut Arab University demonstrates a measurable, scalable, and forward-looking implementation of SDG 9.

BAU's infrastructure strategy reflects a clear evolution from optimization to innovation, positioning the University as a national model for resilient and sustainable higher-education infrastructure in Lebanon, while directly contributing to global sustainable development objectives.

Beyond physical infrastructure development, BAU integrates digital transformation, smart campus planning, sustainable architectural education, and advanced technological applications into its institutional strategy, reflecting a holistic approach to SDG 9 implementation.

Report prepared by Hania Nakkash, BAU, SDG 9 lead, 12 June 2026.