

Data-informed Bio-solar Vertical System

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Human-induced greenhouse gas emissions are the most likely cause of global warming. The energy sector is solely responsible for at least two thirds of these emissions. Efforts to fight global warming are centered at increasing renewable energy penetration, improving energy efficiency, innovating carbon capture technologies, and preserving forests and green areas acting as natural carbon sinks.

The American University of Beirut (AUB) has been actively carrying out efforts to reduce its carbon footprint through generating 11% of its electricity needs from renewable energy sources, installing energy efficient equipment and maintaining green areas. However, achieving net zero on campus faces practical challenges related to space constraints for traditional rooftop photovoltaic (PV) capacity and limited data availability.

In this proposal, we respond to the Masri Institute call for “innovative solutions in coordination with campus units” to overcome AUB’s net-zero challenges. We focus on serving Theme 3: “Innovative and smart solutions in utilization of buildings and outdoor spaces towards net-zero” while we also contribute to Themes 1: “AI for energy sustainability” and 2: “Clean energy generation”. We propose the design and development of a data-informed bio-solar vertical system. Our project serves two interlinked objectives: 1) to establish an integrated real-time monitoring system for energy-related indicators in a selected AUB building for tracking, and storing energy data at a granular level, and 2) to use the collected data in designing a visually integrated modular system composed of a PV panel and a green wall to be installed on one or more of the facades of the target building. Building on the synergies observed between PV panels and green roofs in terms of improved PV panel efficiency caused by the cooling effect of plants, and enhanced plant performance thanks to the protection of the PV panel, we propose an extensive experiment to test if these synergies hold in the vertical system setting. We choose Bechtel building as our case study, and we focus on developing an integrated design that also considers functionality, structure and environmental needs. Additionally, we plan to develop algorithms that use the collected data from Bechtel building to detect energy leakage and optimize the energy activities.

Our interdisciplinary research team is composed of four researchers with combined expertise in modeling energy systems, developing green roofs and green spaces in urban areas, and designing hybrid architecture embedding ecology and infrastructure. Additionally, we team up with the MSFEA Operations Unit to execute the planned activities. We propose carrying out our project over two years with a total budget of 50,000 USD allocated for material cost and research assistants.