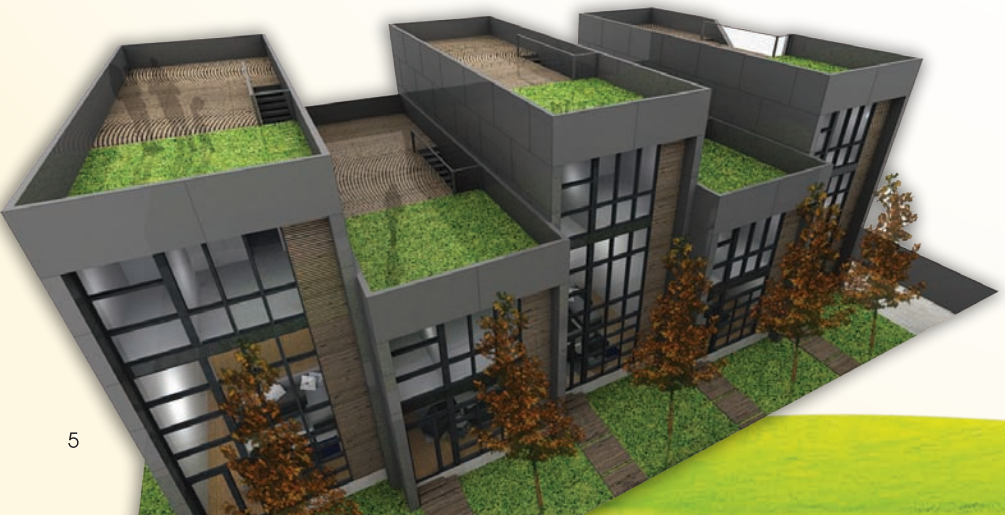
Case Studies of Impact

Green Roofs to Conserve Energy

The green roof and associated green wall (vertical greening) research projects were initiated in 2006 and sustained by generous donations and grants. Thus far, eight field experiments have been established: (a) a green roof on the University's Runme Shaw Building; (b) a green wall on the Runme Shaw Building; (c) a native woodland on the CLP substation in Lai Chi Kok; (d) a large-scale public building site on the Tai Po Railway Station; (e) a public housing-estate site at Tseung Kwan O; (f) a large-scale plant species trial site on the University's Library Building; (g) a setup to evaluate hydrological benefits on the Library Building; and (h) a large-scale green wall combining environmental assessment and species trial at the Drainage Services Department's Shatin site. These experiments are well equipped with state-of-the-art environmental monitoring sensors and data loggers to acquire long-term data related to microclimatic, thermal, energy and hydrological performance.

The experimental study has been extended to territory-wide assessments based on remote sensing images, geographic information systems, digital image analysis and field work. They cover: (a) the urban-fabric factors accounting for green roof distribution; (b) the potential sites for green roof establishment; (c) the macro-scale benefits in terms of suppressing the urban heat island effect, enhancing carbon sequestration and hence reducing carbon footprint, curtailing greenhouse gas emission, and trimming energy consumption; and (d) a game-theory simulation to find the best strategy to promote green roof adoption.

The study's impact includes fourteen scientific papers in high-ranking international journals and presentations at eight international conferences. The innovative studies, key research findings and original contributions to knowledge have helped to elevate the University to the status of a world-class centre for green roof research. The impacts include ascertaining the thermal-energy effects of green roofs in relation to critical factors, including vegetation type, biomass structure, soil moisture content, soil thickness, irrigation regime, individual and combined influences of microclimate parameters, diurnal and seasonal meteorological conditions, and energy conservation. The results also identify plant species with good growth performance for use on green roofs and green walls. A city-wide plan has been developed for green roof installation by districts and land use types.



Besides contributions to science, the study aims squarely at linking the gown to the town by transferring the research-based knowledge to the community for direct adoption and application. A popular-science bilingual book was written to disseminate relevant information and advocate the idea. The most notable knowledge-exchange activity is the Green Roof for School Project. A donation from the Hongkong Bank Foundation permitted fourteen green roofs to be given to local schools to promote teaching and learning about nature and healthy outdoor activities. As a result of the pioneering project, over 50 schools and NGOs have obtained grants from the government's Environment and Conservation Fund to establish their own green roofs. Due to the stimulating ripple effect, other green roofs have since been built using alternative resources. It is anticipated that many more schools and organizations will adopt the innovation in due course to realize the multiplier goal.

Other publicity activities were organized from time to time, including nineteen public lectures and seminars on green roofs to professional bodies, corporations, government departments and the general public, three of which were delivered at the Central Library. In addition, the ideas have been publicized through numerous interviews solicited by newspapers, magazines and television stations. The advocacy has drawn the government's attention. In his 2006 policy address, the Chief Executive included in paragraph 55 the following policy statement: "The Government will adopt the concept of greening of rooftops whenever practicable in the design of new buildings. We are studying the wider application of the concept with a view to encouraging more projects to adopt this approach".

In comparison with a bare roof, a green roof can reduce heat absorption and transmission with a notable passive cooling effect due to three processes: (a) shading by the green roof; (b) thermal insulation due to the green roof material layers; and (c) heat absorption due to the combination of evaporation and transpiration. The magnitude of cooling varies significantly in response to key extrinsic and intrinsic factors such as weather condition, vegetation type, soil thickness, irrigation regime, and thermal behavior of green roof materials. On average, the surface temperature on the green roof on a hot summer sunny day can be reduced by 15-20^{o}C, as well as air temperature above the green roof by about 3-4^{o}C, and indoor temperature by about 1-2^{o}C, resulting in corresponding air conditioning electricity savings of around 10 percent.

The research projects have been recognized by two awards in 2012 in an open competition organized by the HKSAR Government Development Bureau in conjunction with seven professional institutions. They are: (a) Skyrise Greenery Awards 2012: Merit Award for Schools and NGO Projects: Green Roof for Schools Project; and (b) Skyrise Greenery Awards 2012: Merit Award for Planning and Research Project: Study of Climbing Plant Species for Vertical Greening.

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