SUSTAINABLE BUILT ENVIRONMENT PROGRAM

Wanger Institute for Sustainable Energy Research (WISER)
Illinois Institute of Technology

Vision

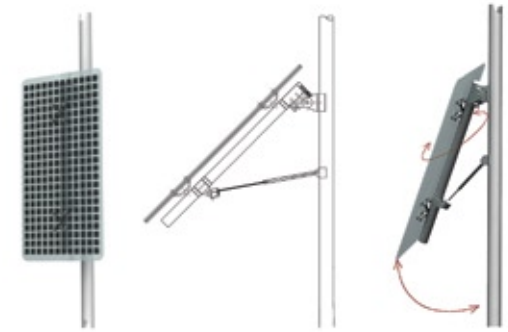
To lead the development of a new paradigm in Sustainable Built Environment at Illinois Institute of Technology with a vision toward the most efficient and smart buildings with the minimum energy grid requirement.

Goals

The goals of the IIT Sustainable Built Environment program are threefold:
1) to achieve maximum possible renewable-energy generation, including wind, solar, and geothermal, for tall and wide-span buildings at their sites; 2) to design the most efficient buildings by minimizing energy and water consumption, and waste; and 3) to make environmentally safe buildings with the lowest carbon footprint—both in operation and construction.

Strengths

The strengths of the IIT Sustainable Built Environment Program include a strong interdisciplinary team of architecture and engineering faculty with expertise in fundamental research, practical applications, and conceptual models in three core areas: solar and wind energy; energy efficiency, conservation, and storage; and environmental issues.



(top) Triple tower with upper-level wind turbine and side-mounted building-integrated photovoltaic (BIPV) arrays on heliotropic mounts

(bottom) BIPV array on heliotropic mount

—Solar and Wind Energy

WISER researchers have demonstrated expertise in integrating wind, solar, and geothermal energy in one building or complex, conducting research focused in the following areas:

- Extraction of energy from the wind using both horizontal and vertical axis turbines on tall and horizontal building structures for commercial or residential use. The surfaces of these structures are shaped to accelerate wind flow and focus flows onto turbine rotors to increase efficiency and power output. The wind component of the optimization phase is being carried out using computational fluid dynamics (CFD). The results are first verified by measurements on wind intensity using small accurate models in our wind tunnel facilities, followed by assessment of design choices for wind-turbine integration with buildings, both for retrofits as well as new designs. The wind turbines are connected to high-efficiency generators. Machines with optimal power density and high-efficiency, compact power-electronic converters are designed utilizing advancements in semiconductor and computational capabilities.
- Incorporation of building-integrated photovoltaics (BIPV) into the exterior surfaces of the buildings, including windows. Design of heliotropic mounts to planar and non-planar surfaces on tall and wide-span structures to focus and obtain optimum solar interception angles and maximum power output from solar electric and concentrated solar thermal (CST).

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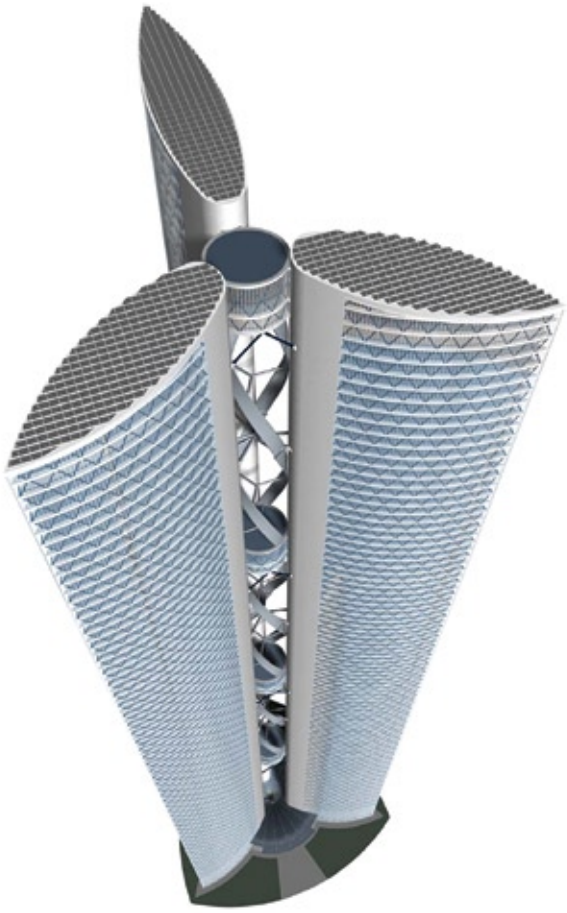

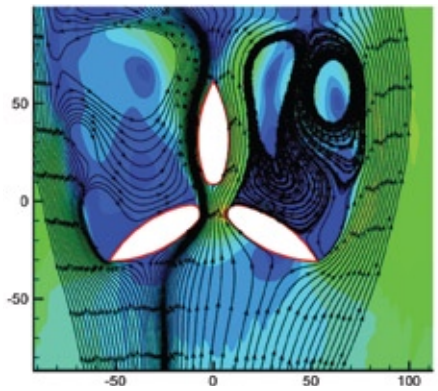

(top) Triple-component tower with center wind turbine and upper-level BIPV arrays

(bottom) Computational fluid dynamics (CFD) analysis of wind flow patterns near the tower for design optimization studies

—Energy Efficiency, Conservation, and Storage

WISER's Sustainable Built Environment Program is based on a strong faculty team with research and development expertise in energy efficiency, heat transfer, smart-control and thermal systems and devices, plug-in hybrids, and energy storage. Specific research strengths include:

- Implementation of innovative energy-recovery systems such as energy recovery from wastewater in tall buildings.
- Implementation of intelligent controls in which the electrical system includes heating and cooling of select portions of the building while maintaining any unused sections at an acceptable temperature. The intelligent sensing system will detect and adjust an open door or window that would otherwise lead to unnecessary power usage.
- Design and optimization of efficient district heating and cooling.
- Design and development of a solar, grid-linked electric charging station in parking areas for plug-in hybrid and electrical vehicles, and storage of excess electricity in batteries or use of excess electricity to electrolyze water into hydrogen. The produced hydrogen may be used in fuel cells to generated electricity as needed.

—Environmental Issues

WISER's Sustainable Built faculty team possesses significant expertise and research in environmental issues, including the following:

- Improving building environment by providing an efficient and robust indoor air quality, efficient air circulation, day lighting, and control systems.
- Addressing potential noise generation and "birdkill" from wind turbines.
- Creating a cultural paradigm shift that makes the individuals' activities an integral component of the sustainable development of buildings. Developing a system that accounts for resource flows from the ecosystem into the building and from the building back to the ecosystem.

WISER

WANGER INSTITUTE FOR SUSTAINABLE ENERGY RESEARCH

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