

“LOOP IN THE SKY”

01. Fundamental

For the world's growing population, the future is urban. It's estimated that by 2030 there will be 41 “megacities” with more than 10 million inhabitants. The people in these cities will consume 81% of the world's resources. Current projections suggest that, by 2050, population growth and urbanization will generate a two- to three-fold rise in global energy use for the building sector. Cities present many opportunities to tackle environmental challenges through sustainable architecture.

Sustainable architecture is about designing and constructing buildings to limit their environmental impact, achieving energy efficiency, positive effects on health, comfort, and improved liveability for inhabitants; all of this can be achieved through the implementation of appropriate technologies within the building. Sustainable architecture means being able to satisfy consumers' requests making the space and materials employed entirely reusable.

“Loop in the sky” is a hybrid building, halfway between architecture and infrastructure. It is an architecture able to produce energy and sociality, as well as a space for the community that integrates public function and technologies to capture and produce energy. The concept arises from a computational design process based on parametric architecture. The computational design allows the modification of parameters at the basis of the project to start a research process, optimizing the spatial relationships at its best and expanding the useful surface for energy production. Formal research has led to a hyperbolic structure with a circular plant to improve energy production.

02. Concept/ Functions

The building is 280 m high, and is divided into three parts connected by the elevator system: the base, middle, and top. It is a building that dissolves upwards and presents a compact base where there are public functions. The ground floor hosts the main entrance and hall.

From the first to the 10th floor there are activities related to productivity, such as shops, offices, library, and co-working spaces. Meanwhile, the middle - floors 11 to 24 - contains a think tank as well as leisure functions such as a wellness centre, an urban garden, areas for landart, and a park.

The top is the space dedicated to energy production, where there are innovative technologies for sustainable energy production. Innovative technologies start from the middle with a green facade system called biophotovoltaics (BPV) used as a renewable energy source. BPV uses the natural process of photosynthesis to generate electrical energy. At the top are located some technologies that use sun and wind power: a photovoltaic system and wind turbine system.

03. Sustainable Technologies

Wind Energy | Wind Turbine Facade

Each panel is stacked on top of each other to form a spiral on center that can install on any vertical or horizontal surfaces. The spiral serves as a vertical-axis wind turbine to catch wind. Because panel is light, small amount of wind can drive the spiral to spin. The angle between each module defines an aliasing pattern. This pattern creates a visual interest when the screen is not turned on or when there is no wind. They are functional patterns for light difusing purpose and also help to create architectural identify.

Solar Energy | Adaptive Solar Facade

The Adaptive Solar Facade (ASF) is a dynamic facade of thin film photovoltaic modules with soft pneumatic actuators for solar tracking and daylight control. We illustrate the general design process for the ASF. Steps (1) and (2) relate to the positioning on the building and on the facade. After this, in step (3), a suitable support structure has to be defined. Steps (4)–(6) define the panel shapes and patterns, as well as materials (colors and transparency). Finally, in step (7), the control granularity of the ASF is chosen, by defining whether all modules move together, or in bands, or individually.

Biophotovoltaic | Moss Green Facade

The Moss Green Facade is a system that explore how moss might be used as a source of renewable energy and how it can be implemented to the urban scale. This technology is called biophotovoltaics (BPV) which uses the natural process of photosynthesis to generate electrical energy. In this process plants using light energy consume carbon dioxide and water from the environment to convert it into organic compounds. Some of these organic compounds are released into the soil, where bacteria breaks down the organic compounds releasing electrons. Electrons are captured by the conductive materials creating anode.