

The construction industry is facing major global challenges in dealing with the consequences of climate change and an increasing shortage of natural resources. The resulting requirements are evident around the world at large and particularly in metropolitan areas such as New York. In combination with changing user behaviors and architectural trends, a building's functionality becomes obsolete sooner than developers might expect. Against this background, there is a great need for fundamentally new approaches and concepts in the building industry.

EVOCON

Towards a diverging evolution
in façade construction

EVOCON façade meets this challenge and proposes a modular structure of building envelopes in the mindset of a product-as-a-service by presenting a flexible system that can be adapted according to the evolution of a building's needs. Over the life span of the façade, usage patterns, building physics requirements, and the availability of new material technologies change. As a result, in many cases the façade needs to be renovated as a complete system, even though many of its elements and components are still functional. In this context, most existing façade systems do not do justice to the idea of a circular economy. Non-reversible connections and hybrid materials lead to a large amount of special waste at the end of the building's construction lifetime.

New York regulations are considered into the design of the hypothetical building.



Zoning Regulation
The site is located in Subdistrict A of Hudson Square.



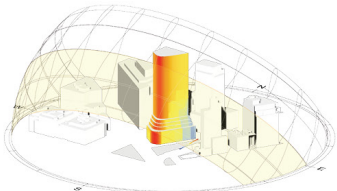
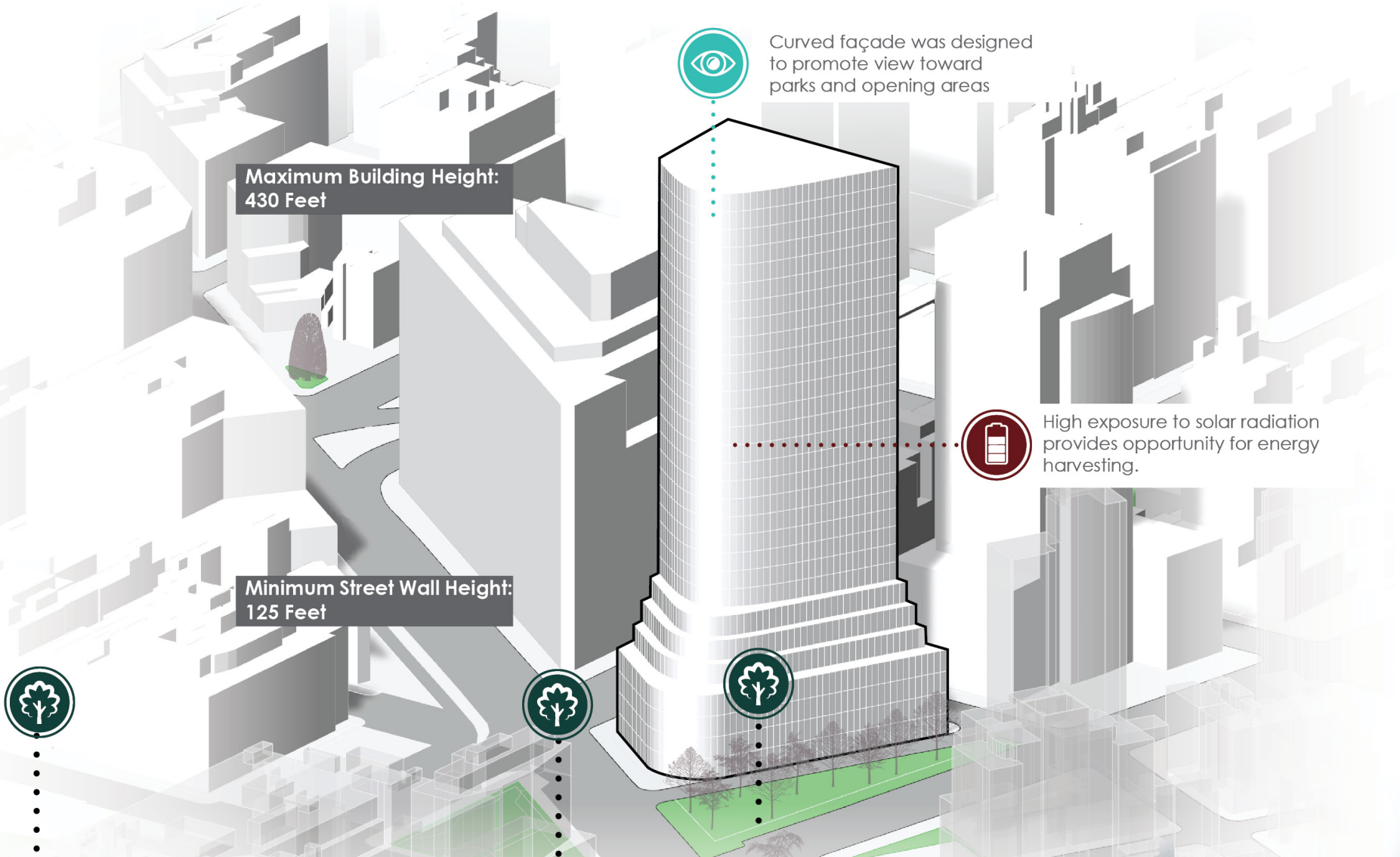
Window to Wall Ratio (WWR)
Under New York's building code "Fenestration Area" section a Maximum WWR is considered at 40%. When WWR is >40% Energy Code compliance must be demonstrated.



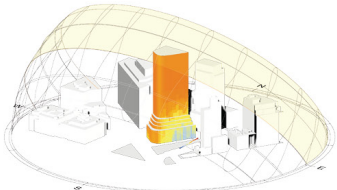
Thermal Performances
New York's building code established an effective U-value requirements on various building elements notably:
Fixed Fenestration
U-value = 0.28
SGHC = 0.34

Building Site Analysis

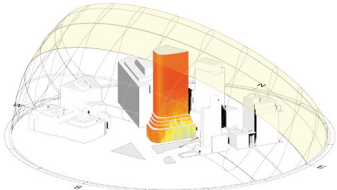
The hypothetical project site is located in New York City's Lower Manhattan, in the Hudson Square neighborhood, Subdistrict A. It is bounded by Canal Street to the south and Varick Street and 6th Avenue to the west and east. The New York City Development Plan for the district envisions a multifunctional area with a vibrant neighborhood of resident businesses, retail and housing. The ongoing evolvement of the area becomes visible by recently revised zoning regulations, emphasized also by upcoming architectural trends, e.g. new cladding materials, increased building transparency, and new energy harvesting façade products. The specific case of the building site in the Hudson Square district illustrates the correspondingly multifaceted requirements for a highly adaptable architecture and façade design.



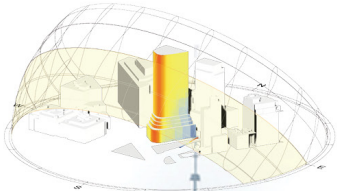
21 Dec. - 21 March



21 March - 21 June



21 June - 21 Sept.



21 Sept. - 21 Dec.

+4 °C

Temperature differences between rural areas and the urban core



Urban Heat Island

56.5 million tons

CO₂ emission has drastically increased since the industrial revolution



High CO₂ Emission

3000 deaths/yr

While NYC PM2.5 level meets the standard, numbers of hospitalization cases can still be much reduced



Air Pollution

70-85 dB(A)

Average noise level in Midtown Manhattan



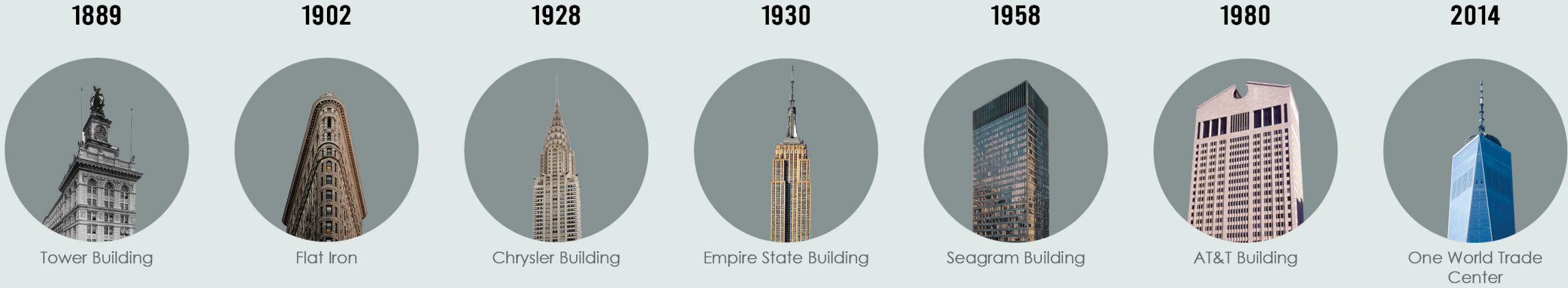
Noise Pollution

1800s

1900s

2000s

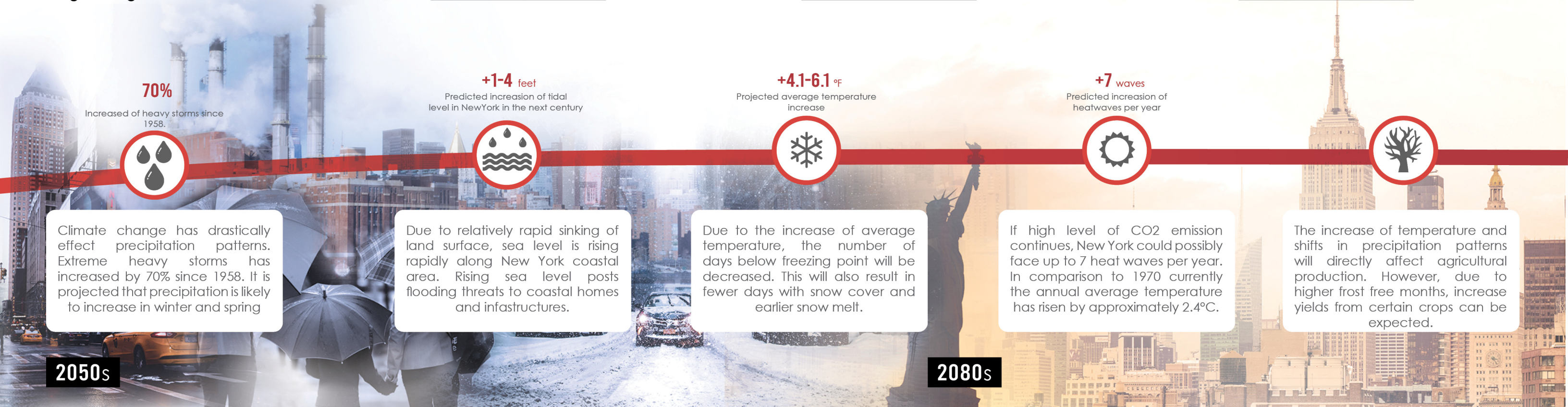
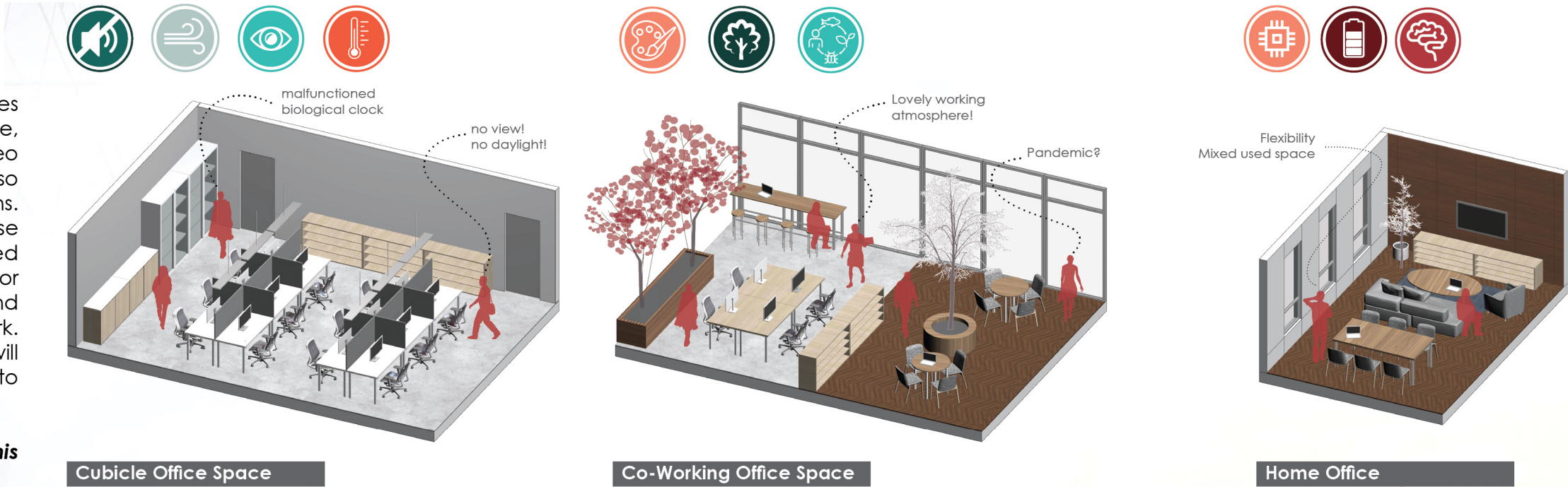
New York's architecture reflects the various influences of past centuries. This is particularly evident in striking building projects that have become icons of their time. While building culture in the 19th century was characterized by the use of ornament and massive construction, the architectural language has developed strongly in the direction of lighter building structures with a higher degree of transparency.



Future Projection

Over the years, changes in the office spaces resulted mainly due to the changing work culture, the development of new technologies (e.g., video conferencing, computers, etc.), and recently also the Covid19 pandemic with its contact restrictions. The development has led to today's highly diverse office culture, in which everyday work is not limited to cubicle office spaces alone, but also allows for variable solutions such as flexible-use desks and offices in co-working spaces and home office work. It can be assumed that the work environment will continue to change in the future and will give rise to new, previously unknown forms of work.

How do buildings and façades accommodate this usage change?



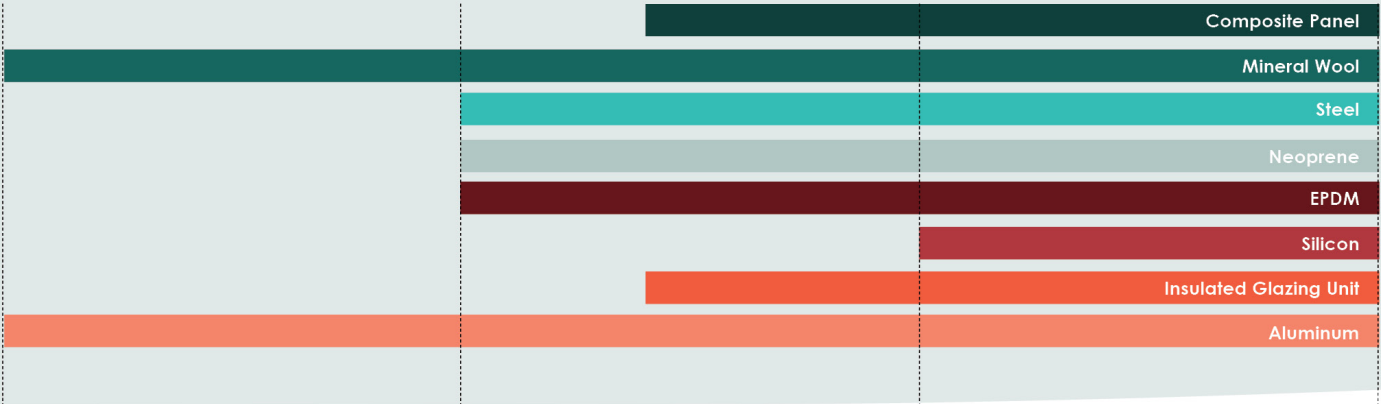
In general, the façade life expectancy is approximately 25 years. However, more than half of façade components could last longer than that. The short life material, if applied on façade without being replaceable, could cause an irreversible problem, that could lead to an early end of façade life.

Degree of Adaptation

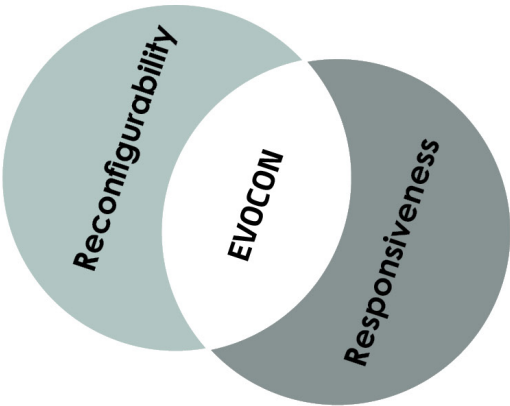
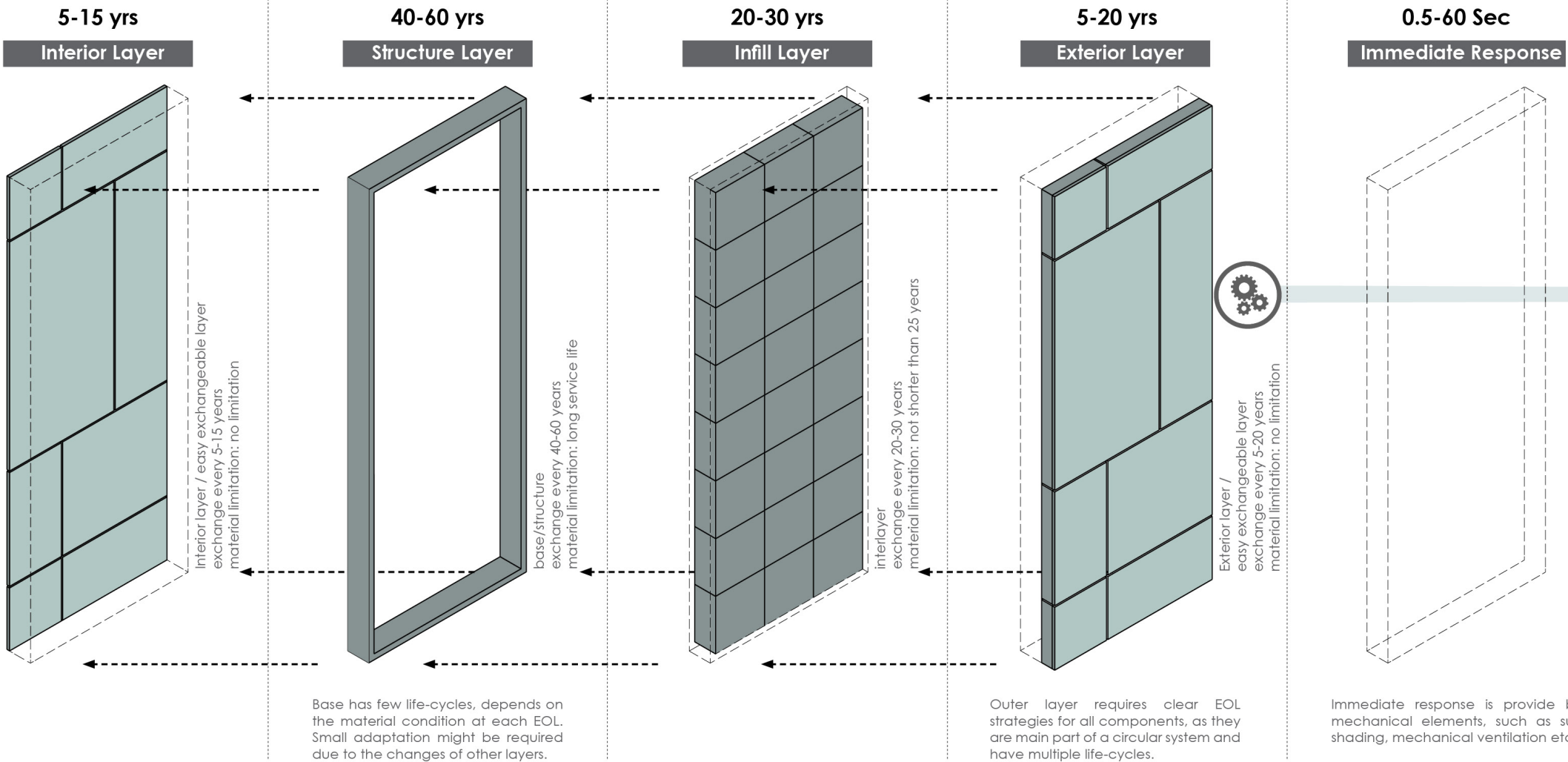
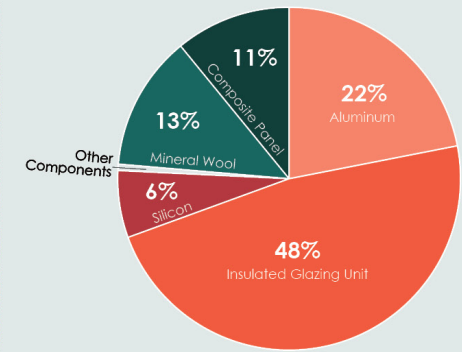
With a twofold understanding of the term adaptability in construction, EVOCON proposes a new perspective on reconfigurable façade constructions, offering both long-term conversions of the façade structure by allowing replacements according to components lifespans and immediate responses to the environmental stimuli. Responsiveness is considered as form of immediate adaptation in the timeframe of seconds.

Under the idea of a reconfigurable façade, the concept classifies the façade into 4 main categories: Structural Layer, Infill Layer, Interior Layer and an Exterior or the Architectural Layer. The Base or Structural Layer fulfils the structural integrity of the façade till the building's end of life with long-life materials. The Infill Layer includes the integrated components between the frames or the structure layer. The Exterior or Architectural Layer incorporates the short life materials in the modular design for easy replacement based on the changing user needs. Following this concept, after their service in a specific project, these components can be reused in other projects.

Comparison of Material Lifespan



Material Usage in Façade



Interior Components

Interior components are part of short-term adaptation. In EVOCON, they are included but only the components that contain function related to the exterior layer.

Long to Mid-term Adaptation

Long to Mid-term adaptation includes the exchange of components in the inner layer which have longer service-life.

Short-term Adaptation

Short-term adaptation applied only at outer layer and interior layers, which are easily interchangeable. There is no limitation in material selection, since the usage period is short and ends before reaching EOL. The adaptation of this layer is occurred due to changes of occupants, tenants, requirements, regulations or technologies.

Immediate Response

Immediate Response provides the final touch to the user comfort. It could respond dynamically to the exterior and interior condition. The immediate respond could be fully automated, or automated but can be overwritten by users, or fully manual operated by users.

The Building Blocks

The “EVOCON catalog” contains individual function façade modules which fulfill the requirements of specific users and reacts to the environmental context. Each module within the catalog plays a crucial role as a building block to create a multifunctional Plug and Play façade system. Due to the rapid changes of trends, user behaviors, technological advancement, and climate change, the EVOCON catalog will be continuously growing to cope up with the future demands.



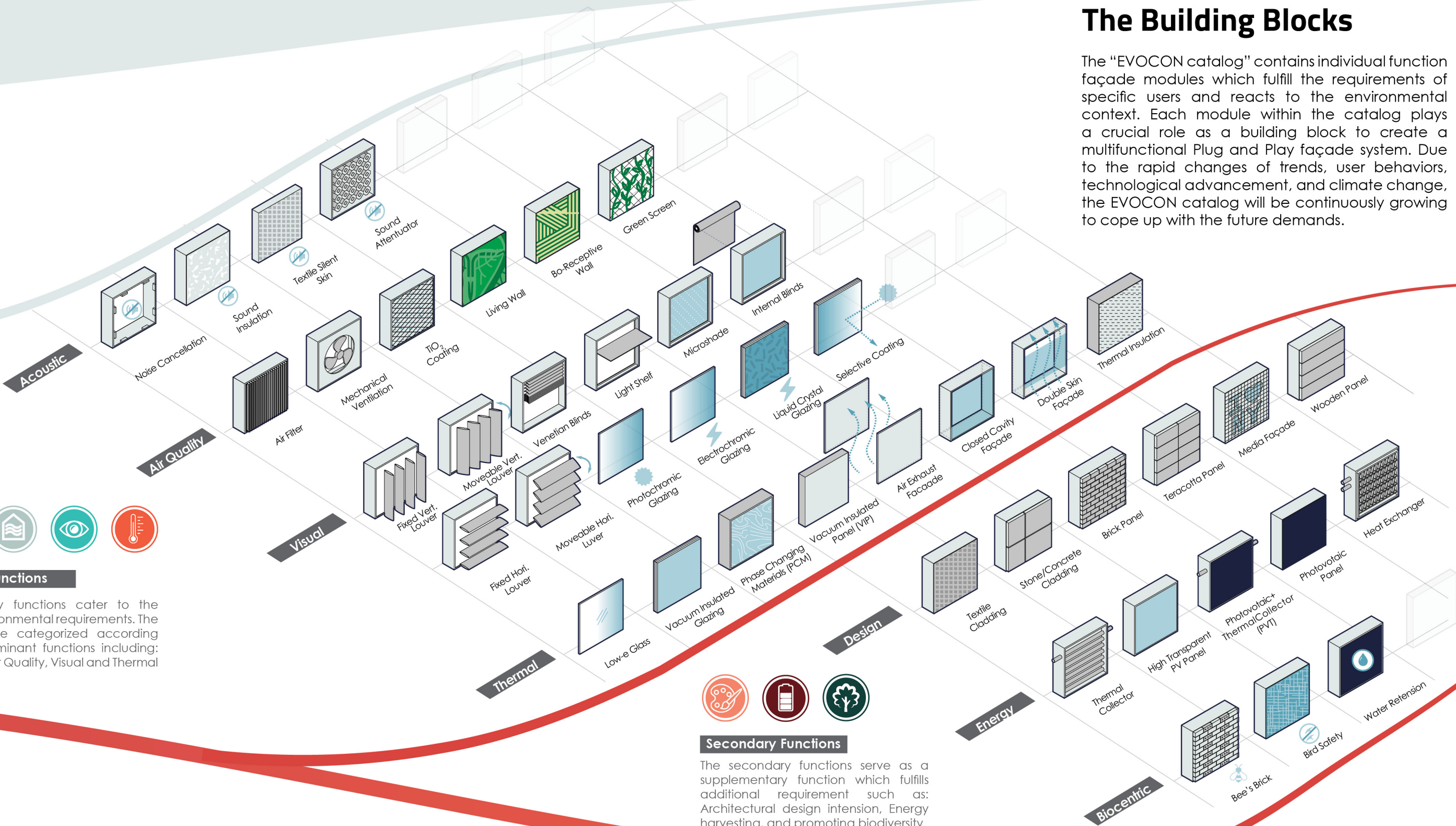
Primary Functions

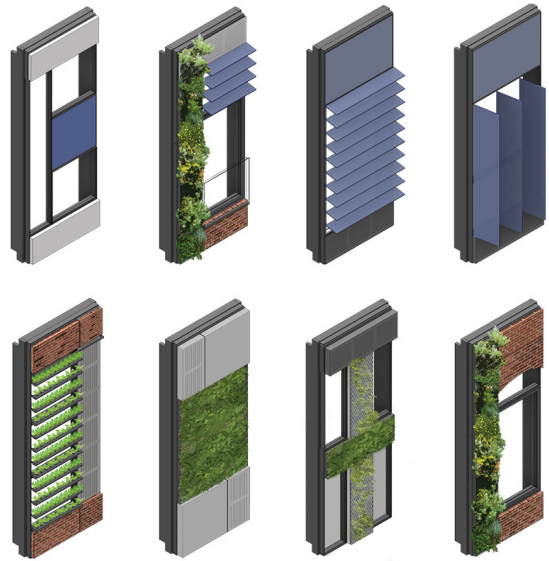
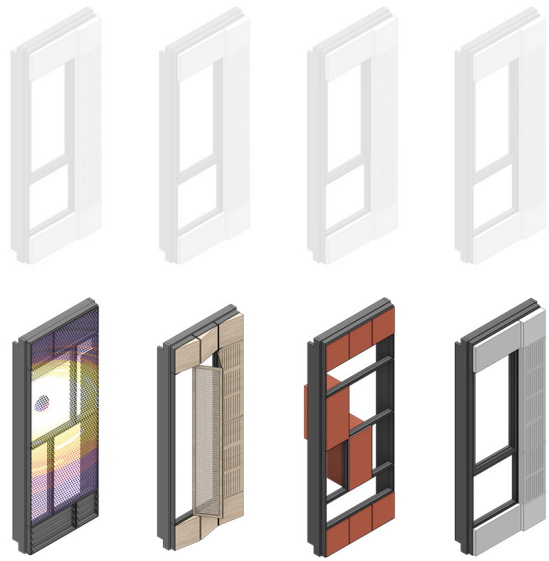
The primary functions cater to the indoor environmental requirements. The modules are categorized according to their dominant functions including: Acoustic, Air Quality, Visual and Thermal comfort.



Secondary Functions

The secondary functions serve as a supplementary function which fulfills additional requirement such as: Architectural design intension, Energy harvesting, and promoting biodiversity





Multi-functional Façade

The plug and play strategy offers an endless possibility in the configuration of the façade modules with various functions. With the combination of the different functions, the façade system can be fine tuned and tailored to specific demands of the users.

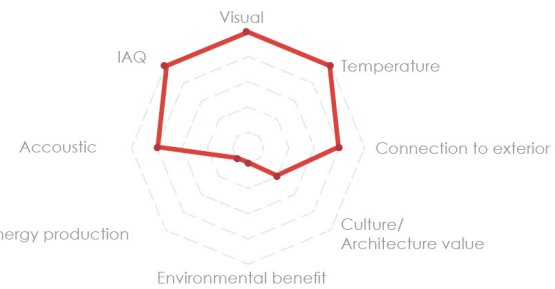
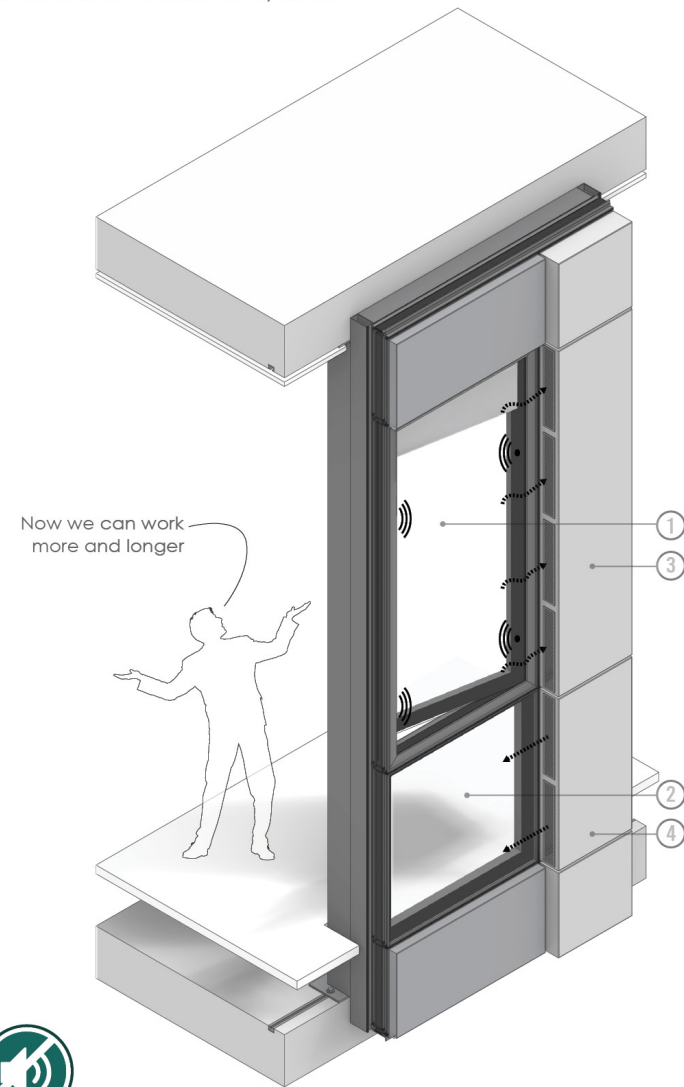
IEQ improvement façade

Office space, high demand of work efficiency

Winter, window closed, ventilation through mechanical ventilation system (3)(4) integrated with filter and heat exchanger.

Summer, ventilation through opening window integrated with noise cancellation. Photochromic glass and IGU integrated venetian blind ensure light quality interior (1).

Summer, no wind, high exterior air pollution, ventilation through mechanical ventilation system.



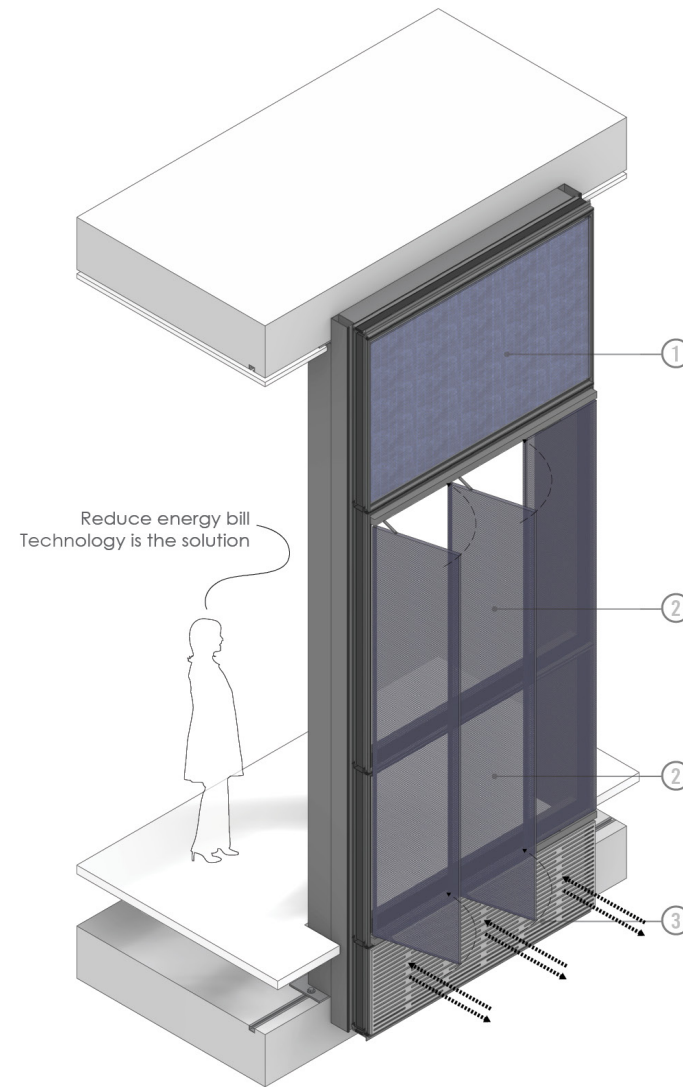
Energy production and decentralized façade

Office space, façade with high solar radiation exposure

East & west façade, ventilation through mechanical ventilation (3). Solar thermal collector fins (2) follow solar direction.

South façade, ventilation through mechanical ventilation (3). Solar thermal collector fin (2) must be in horizontal orientation, which follow solar direction.

Photovoltaic (1) produces electricity for operation of mechanical ventilation and fins.

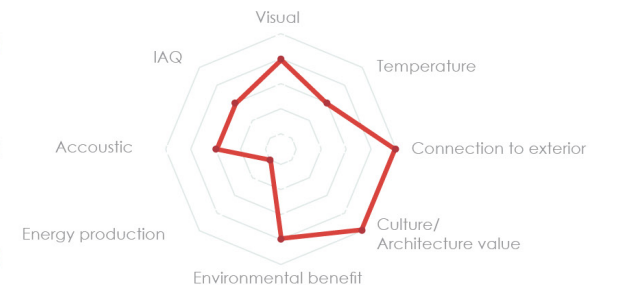


Environmental and Architectural respond façade

Mixed used, wellness lifestyle

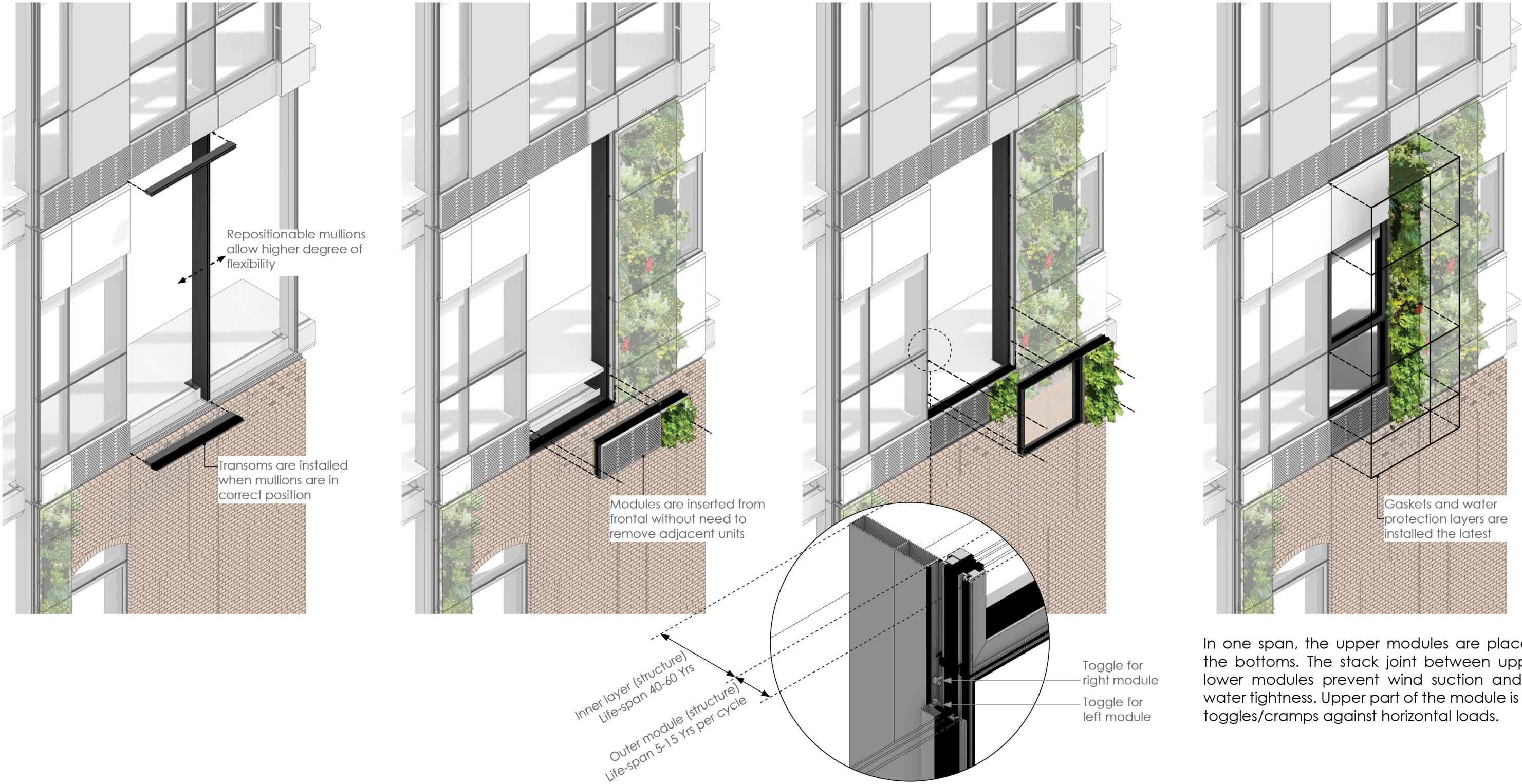
Cladding answers surrounded architectural style (4). Full height window opening (1) promotes the transition of space between interior and exterior.

Living wall (1) increases city green surfaces. Bee brick (2) provides place for bee and improves the pollination in the area, promoting biodiversity.



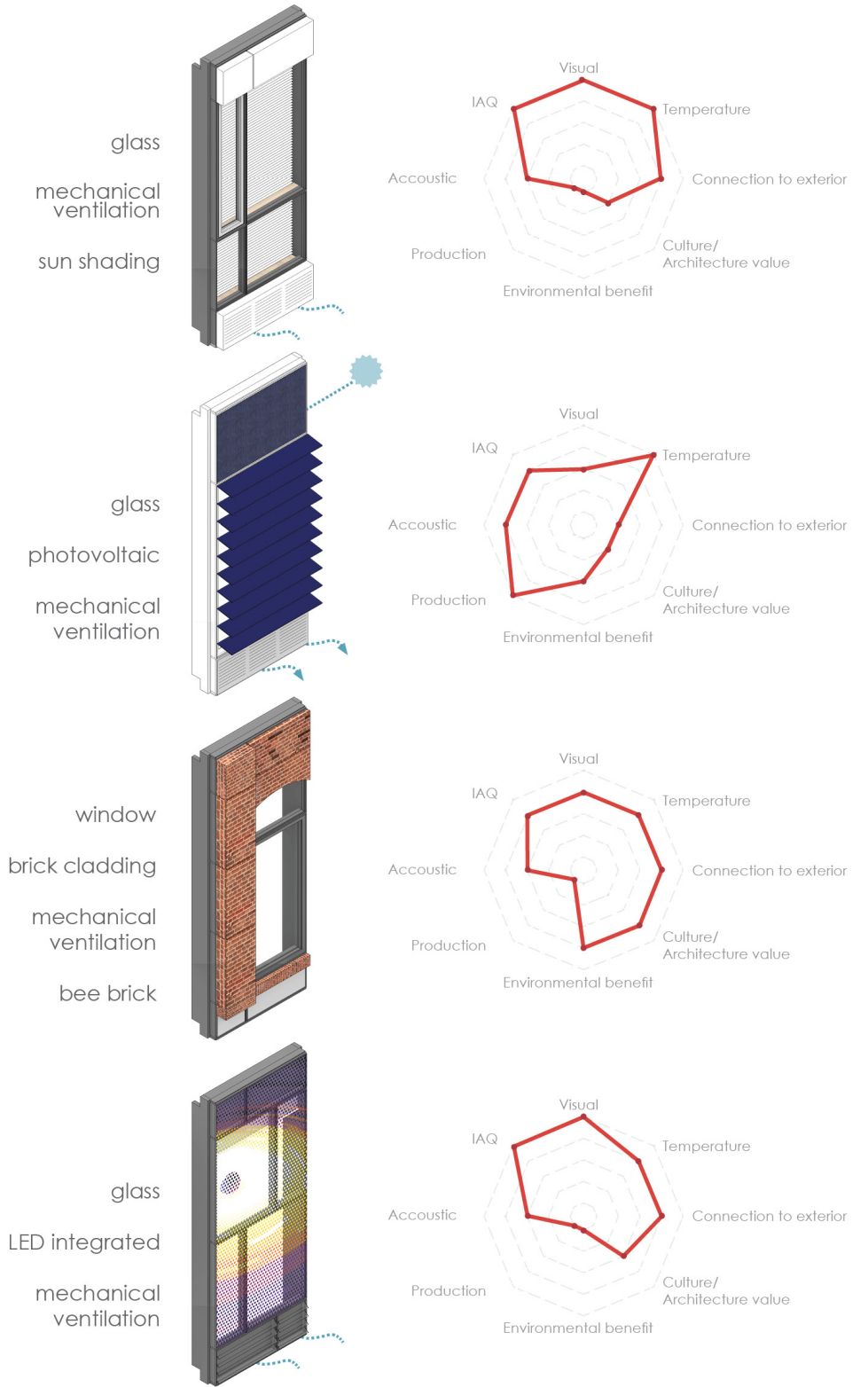
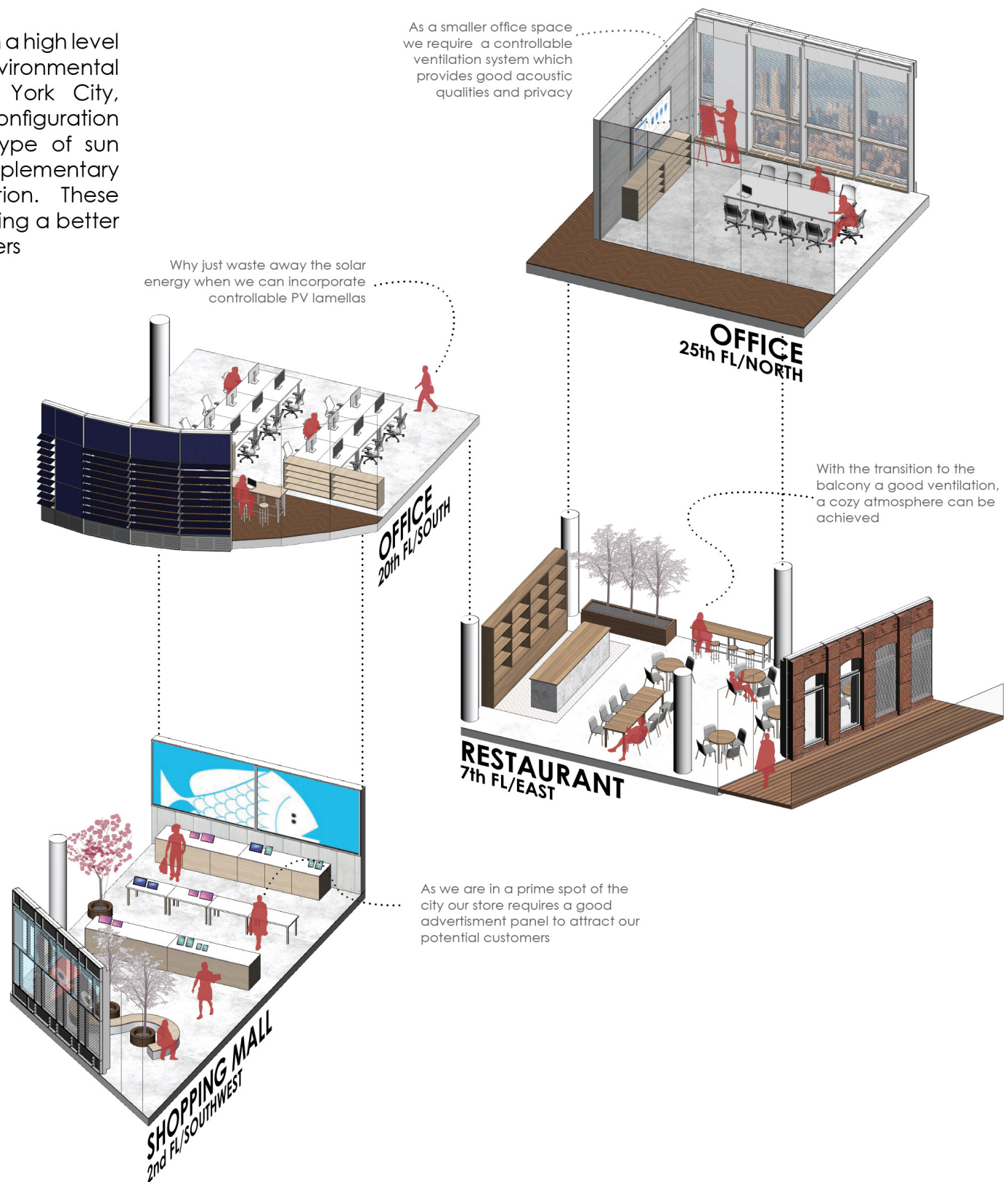
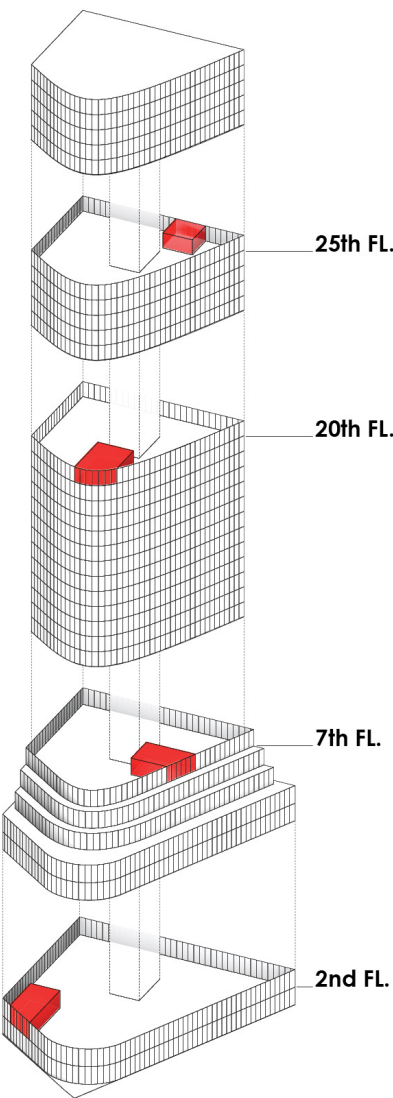
Plug and Play System

EVOCON utilizes the “Plug and Play” strategy with modular components allowing specific parts of the façade to be dismantled and exchanged as each layer are independent of each other. This offers ease in maintenance while also extending the overall façade lifespan.



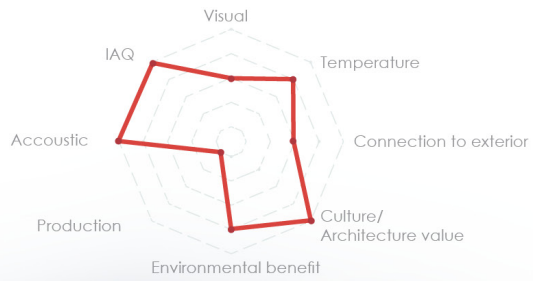
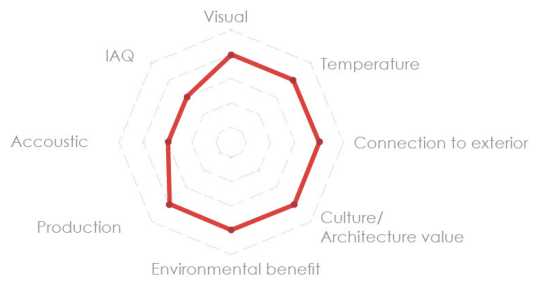
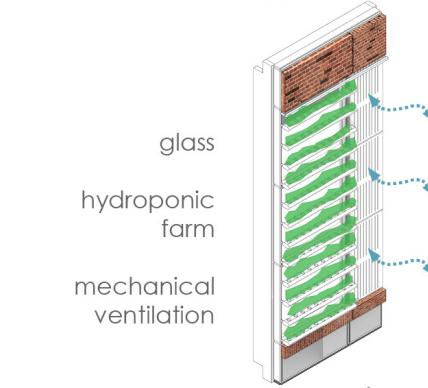
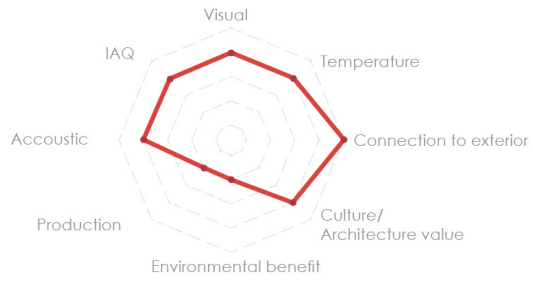
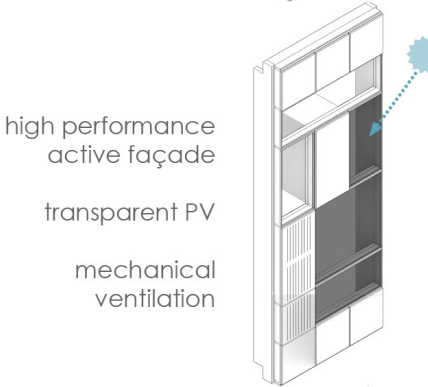
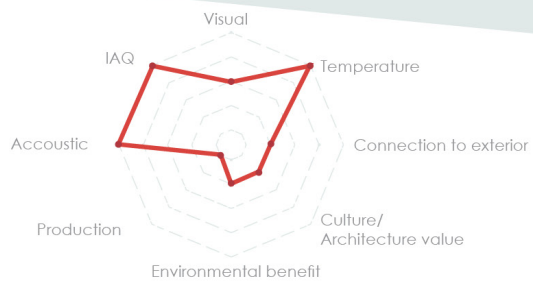
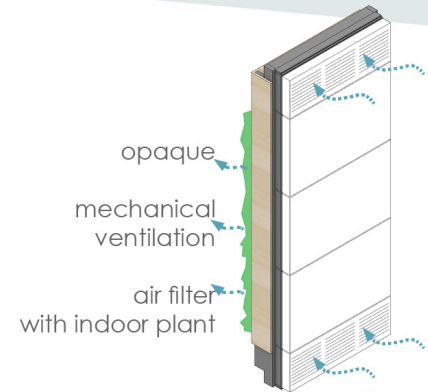
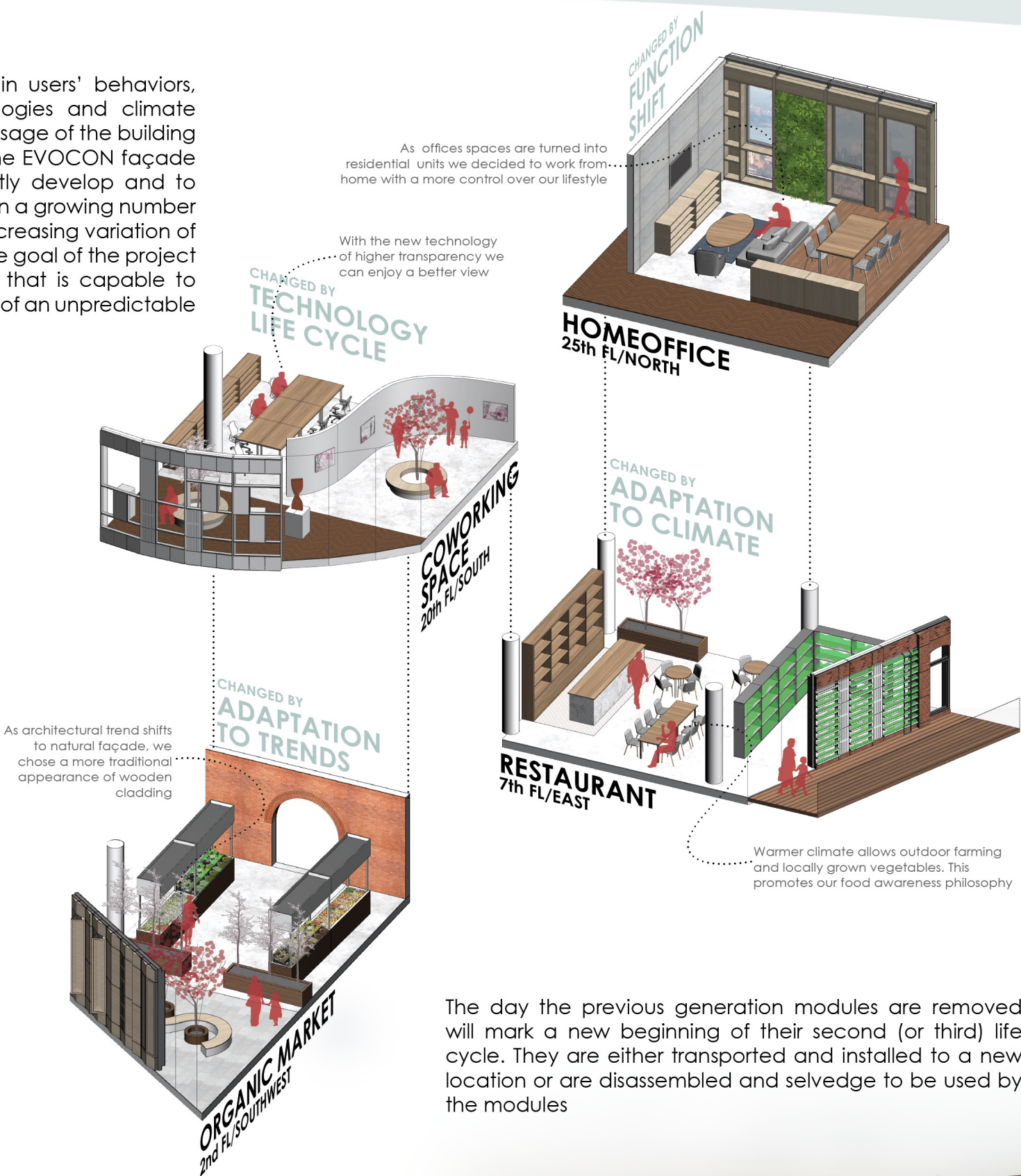
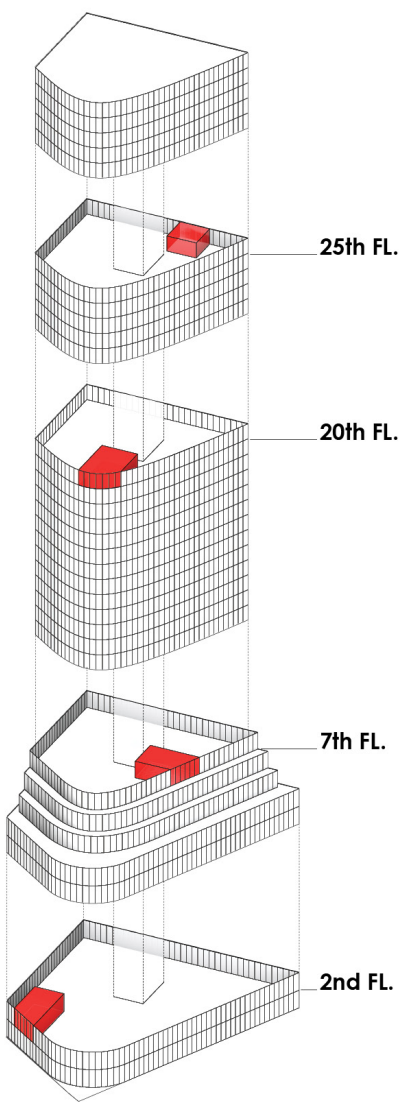
Present Day 2025

EVOCON provides a façade system with a high level of resiliency. In response to both the environmental and architectural context of New York City, the façade system offers various configuration parameters including opening size, type of sun shading, ventilation rate, as well as supplementary functions such as energy production. These configurations also contribute in providing a better indoor environmental quality for the users



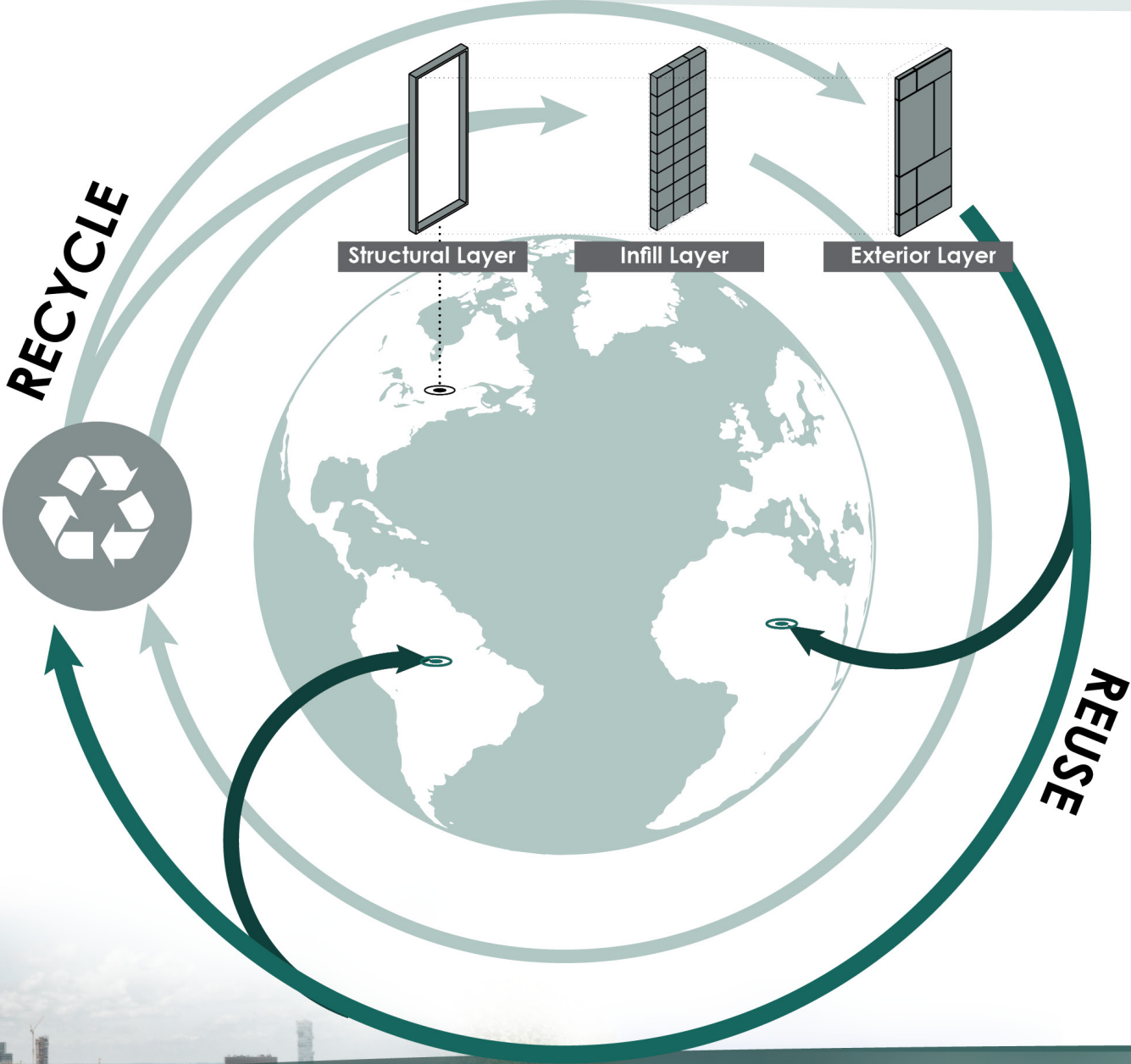
Envisioning 2050

Reflected by the current trends in users' behaviors, zoning regulations, new technologies and climate change, it is undeniable that the usage of the building with change in the near future. The EVOCON façade concept is imagined to constantly develop and to expand its contents, which results in a growing number of applicable products and the increasing variation of possible façade types. The ultimate goal of the project is on a resilient platform solution that is capable to meet any upcoming requirements of an unpredictable future.



"It is not the strongest of the species that survives, nor the most intelligent it is the one that is the most adaptable to change."

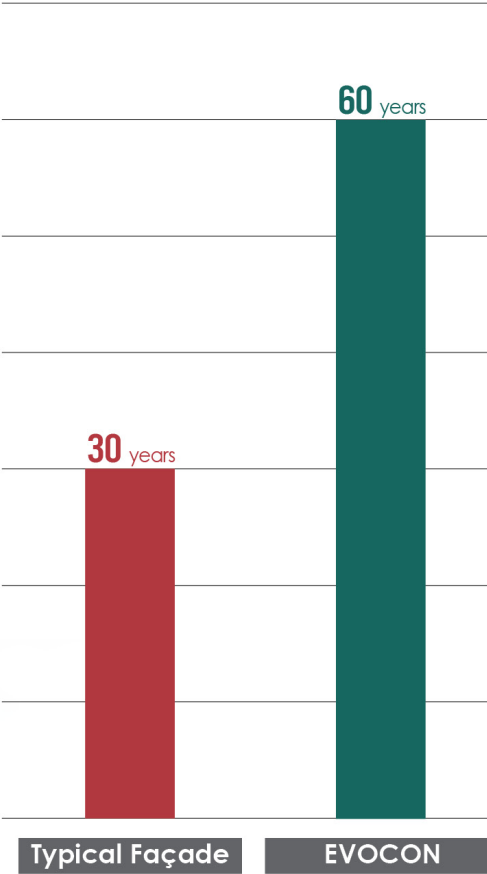
Charles Darwin



Beyond Conventional Life-Cycle

Responsive and reconfigurable: A façade that adapts to its environment and is customizable to the demands of its users beyond conventional life cycles.

As a modular system, EVOCON façade provides a site-specific design for the façade at a predefined building site in Lower Manhattan. The layout is tailored to the needs of different usage profiles within the framework of its system boundaries. Based on the assumption that the city of New York, its residents' expectations towards their built environment, the building physics requirements, as well as the technical possibilities will continue to alter in the upcoming decades, the EVOCON provokes a rethinking of façade design in the direction of a modular, product-oriented solution. The modular structure with a "Plug and Play" system allows the façade to be continuously customized to accommodate changing requirements and demands, even in the context of low-threshold partial renovations and refurbishments. In this thinking of an ever continuing process of change, the façade evolves beyond its lifespan with its city and users. Intended as reusable products within a circular economy, dismantled façade components do not become waste, but are reused - emphasizing the cradle to cradle philosophy.



Lifespan comparison between typical façade and EVOCON

