

# HOW BUILDINGS & CITIES CAN BECOME **A FORCE FOR RESTORING NATURE**

Biotonomy is a holistic & nature-based approach for transforming cities & buildings to actively restore nature. We provide groundbreaking and nature-based solutions that go beyond passive & green-building certification standards. Together with interdisciplinary collaboration, we work to accelerate the recovery of natural ecosystems by bridging the gap between ecology & architecture. Our vision is for nature-based solutions to become a natural part of the way we design & build our future.



Biotonomy's mission is to advance the development, uptake, and upscale of nature-based solutions for buildings & cities. Our design principles can help to:

- 1 - Eliminate carbon emissions during the operation phase.
- 2 - Reduce operating cost up to 95 %
- 3 - Minimize the energy consumption for heating & cooling up to 100%.
- 4 - Decrease water consumption up to 75 %
- 5 - Reuse wastewater for indoor food production & restoring ecosystems
- 6 - Provide organic food & clean water security
- 7 - Build resilience for our societies and ecosystems.
- 8 - Reconnect people with nature & enhance human wellbeing.

## **BACKGROUND**

Research indicates that the Earth's climate is changing at a rate that has exceeded most scientific forecasts. The crises of climate breakdown and biodiversity loss are the most serious issue of our time. Delayed efforts to respond to our changing climate will have negative and irreversible consequences for all life on the planet.

When air pollution is mentioned, we tend to imagine vehicles or industries releasing emissions into the atmosphere. However, buildings have a higher environmental footprint than the industry & transportation sector, although it is less evident. Buildings account for 40 percent of climate change emissions and are the fastest-growing source of emissions. The industry is in second place with 32% of emissions, and transportation is in third place at 23%. Buildings contribute towards climate change not only through air pollution but also by depleting groundwater and by pouring sewage into rivers and streams. The high level of water extraction and sewage contamination has degraded water ecosystems around the world and resulted in a massive loss of biodiversity. Over 80% of the world's wastewater is still released to the environment without any treatment. The devastating impacts that buildings & cities have on the environment is due to the power, water & sewage infrastructure.

## **INFRASTRUCTURE & CLIMATE CHANGE**

Infrastructure has helped us develop comforts our ancient ancestors couldn't have imagined. Yet, today, we are at a turning point in developing our physical world. Besides the fact that infrastructure has a devastating impact on the environment, it is also threatening our safety and wellbeing. During the last decade, infrastructure has become extremely vulnerable due to the rise of global conflicts and extreme weather events associated with climate change. Floods, droughts, tropical hurricanes, tornadoes, wildfires, etc have displaced millions of people around the world and left many more without power,

water, sanitation, and access to food. Reports warns that the climate crisis could displace 1.2 billion people by 2050, and leave many more without access to their basic needs.

We should not continue designing cities and buildings to depend on distance resources. The transportation of power, water & sewage is built on a complex grid construction that is both vulnerable and dangerous to climate change. Infrastructure also requires a lot of capital, resources, and energy to develop & operate. It is an outdated & unsustainable approach that will no longer serve our evolution. To adapt to the new conditions, we must look into solutions that will increase security and reduce environmental impacts by using on-site resources & methods.

## **GREEN BUILDING CERTIFICATION & THE ENERGY PERFORMANCE GAP**

The green building movement originated from the need and desire for more energy-efficient and environmentally friendly construction practices. Green buildings have become increasingly popular in the last several decades. However, there are growing concerns about a gap between predicted energy consumption levels in green buildings and the actual measured energy consumption in operation. There are evaluations from multiple institutions showing that most green buildings do not live up to their certifications. Some of the worlds “leading-edge green buildings” have reported to use 3.5 times more energy than their design prediction. Analysts call this “the energy performance gap”.

The main problem is that green building certifications such as LEED, Energy Star, BREEAM, etc are only based on theoretical modeling systems that fail to capture how buildings work in reality. Today's energy modeling software is not as developed as most people believe. Green building certifications have turned into a profitable business that unfortunately serves the economy much more than the ecology. Another issue is that many green projects have difficulty merging new technologies. Green buildings are designed to look like environmentally on the surface with greenery but in the background, they still operate

on unsustainable infrastructure. We cannot continue pretending that green building certifications are sustainable.

## **PASSIVE HOUSES**

The concept of passive design dates back to ancient times. Passive House is therefore not a brand name, but a construction concept that can be applied by anyone. Passive houses are built to optimize solar gain and minimize thermal losses. This means that the energy required to heat a passive house can be between 70 - 90% lower than that of conventional buildings. Passive homes, therefore, do not rely on traditional heating sources like furnaces or boilers. Instead, they use other types of mechanical solutions such as geothermal energy or heat pumps.

The problem with passive house certification criteria is that it still relies on mechanical heating & cooling and water & sewage infrastructure. Passive designed buildings has caused us to start scratching the surface of integrating nature-based solutions in our designs. Even though this is a step closer in the right direction, we still have a long way to catch up with the climate emergency. To take the climate breakdown & biodiversity loss seriously we need to do better than just energy-efficient performance.

## **AUTONOMOUS BUILDINGS WITH MECHANICAL SOLUTIONS**

An autonomous building is a building designed to be operated independently from infrastructural support services such as the electric power grid, gas grid, municipal water systems, and sewage treatment systems. The three main advantages of autonomous buildings include reduced environmental impacts, increased security, and lower costs of ownership. Autonomous buildings are safer and more comfortable during climate crises or military attacks. For example, autonomous buildings would not lose power, water, or sanitation services if public infrastructures are destroyed.

Building autonomous buildings with purely mechanical solutions can be a complex and expensive process and is not always environmentally friendly. Most research and published articles concerning autonomous building focus on single residential homes. There is therefore a growing need for more research & development projects regarding large-scale autonomous projects.

## **BIOTONOMY - AUTONOMOUS BUILDINGS WITH NATURE-BASED SOLUTIONS**

The natural system is the only real model that has worked over long periods. After about 3.8 billion years of research and development, nature has developed some of the most profound solutions for sustaining life on earth. Every ecosystem in nature is designed as an autonomous system, where resources are produced & managed onsite.

If we can look too and learn from the wisdom of nature, we can find all kinds of solutions that we never before imagined possible. By implementing nature-based solutions rather than purely mechanical & technical solutions we can develop buildings & cities to become a force for restoring air, water, and soil instead of degrading it.

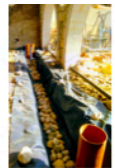
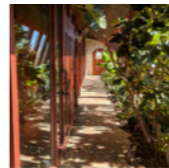
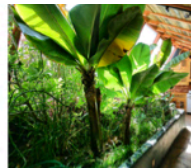
Autonomous buildings with nature-based solutions are designed to produce & manage all their resources and waste naturally without polluting the environment. By combining passive design, thermal physics, and microclimates, buildings can naturally heat and cool themselves. This means that solar gain can be stored during warmer periods inside the building, and be used during colder periods. Autonomous buildings with nature-based solutions, therefore, do not rely on any mechanical or external heating system.

To reduce human pressure on water bodies and related ecosystems, we design our buildings to produce their water & process the sewage onsite. The freshwater is harvested

from rain & snowmelt and stored in underground water tanks. Inside the building, the water is cleaned with a simple filtration system that can produce drinking water standards. Once the water is consumed by humans it is automatically reused a second time for an indoor-food production system. This system is based on a biological sewage treatment that both cleans the water & produces organic food. The excess water from this biological system is then captured and reused for a third time to flush the toilet. The sewage from the toilet is then turned into liquid and reused for the fourth time to help restore ecosystems outside. With this system, we can reduce the water consumption for each household with up to 75 %. And eliminate sewage pollutions by reusing the waste-water four times.



## BIOLOGICAL SEWAGE TREATMENT



Autonomous buildings with nature-based solutions will reduce our environmental footprints significantly as they neither release carbon emissions or wastewater into the environment. They will also help us to conserve water and provide healthy food & water security. It will also reduce the demand for developing & investing in unsustainable infrastructure, which in return will save a lot of ecosystems and help build a stronger economy.



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