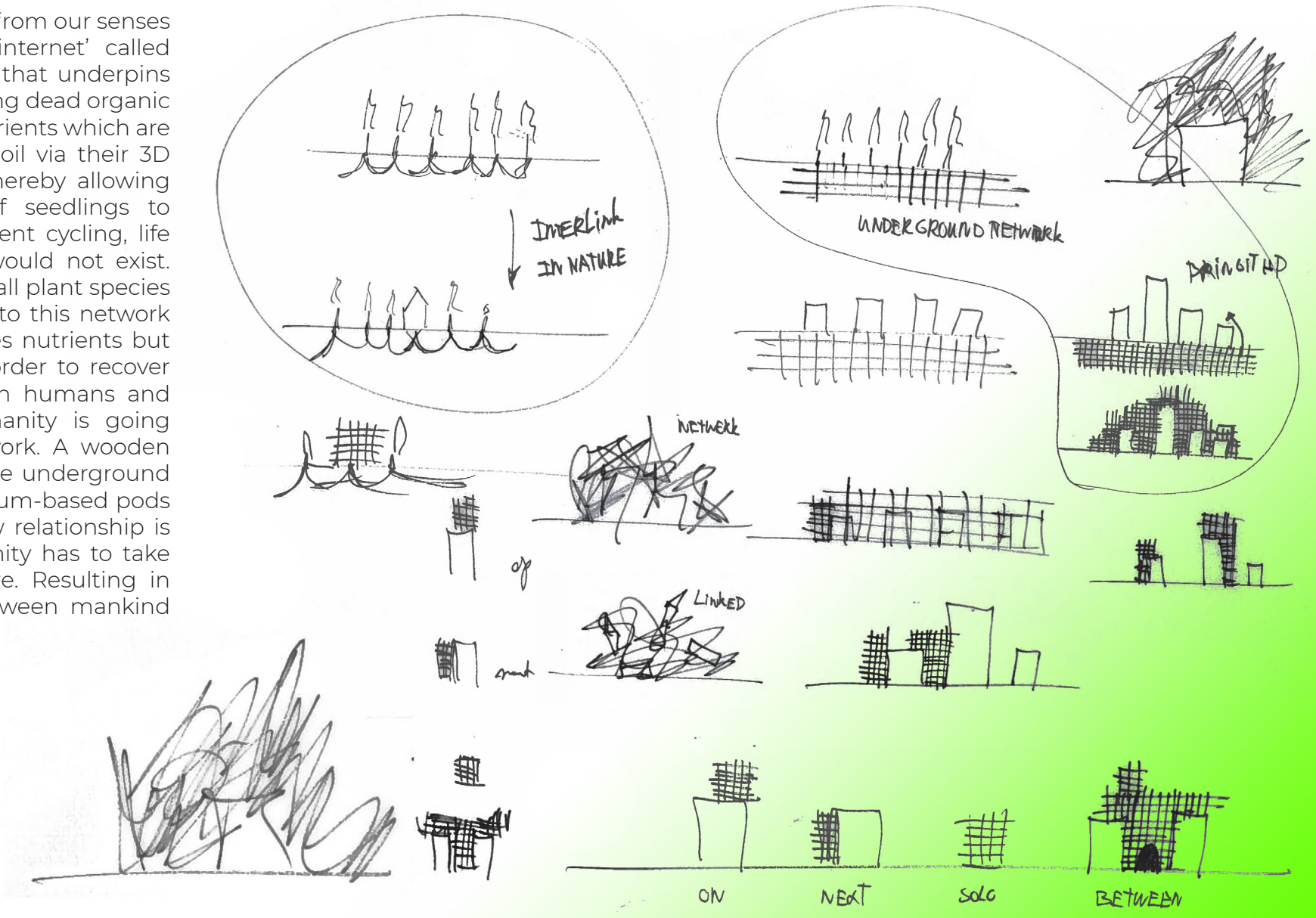
Interlink.

Introduction.

The relationship between humanity and its environment is broken. For centuries, humanity has dominated this relationship to enter a stage in which further temperature rise towards 1,5 Celsius would have irreversible consequences towards earth's valueble ecoystems. One of the main contributors to this cause is our current way of building, that results in high carbon dioxide emissions, raw material depletion and is often a linear process. In contrast to mankind's 200.000 years of depletion, Mother Nature has been innovating for 3.8 billions years true trial and error, forming closed loops with beneficial consequences to planet earth. Therefore, an opportunity arises for mankind to break through its fixed-minded ideas and become part of nature's closed loop ecosystem.

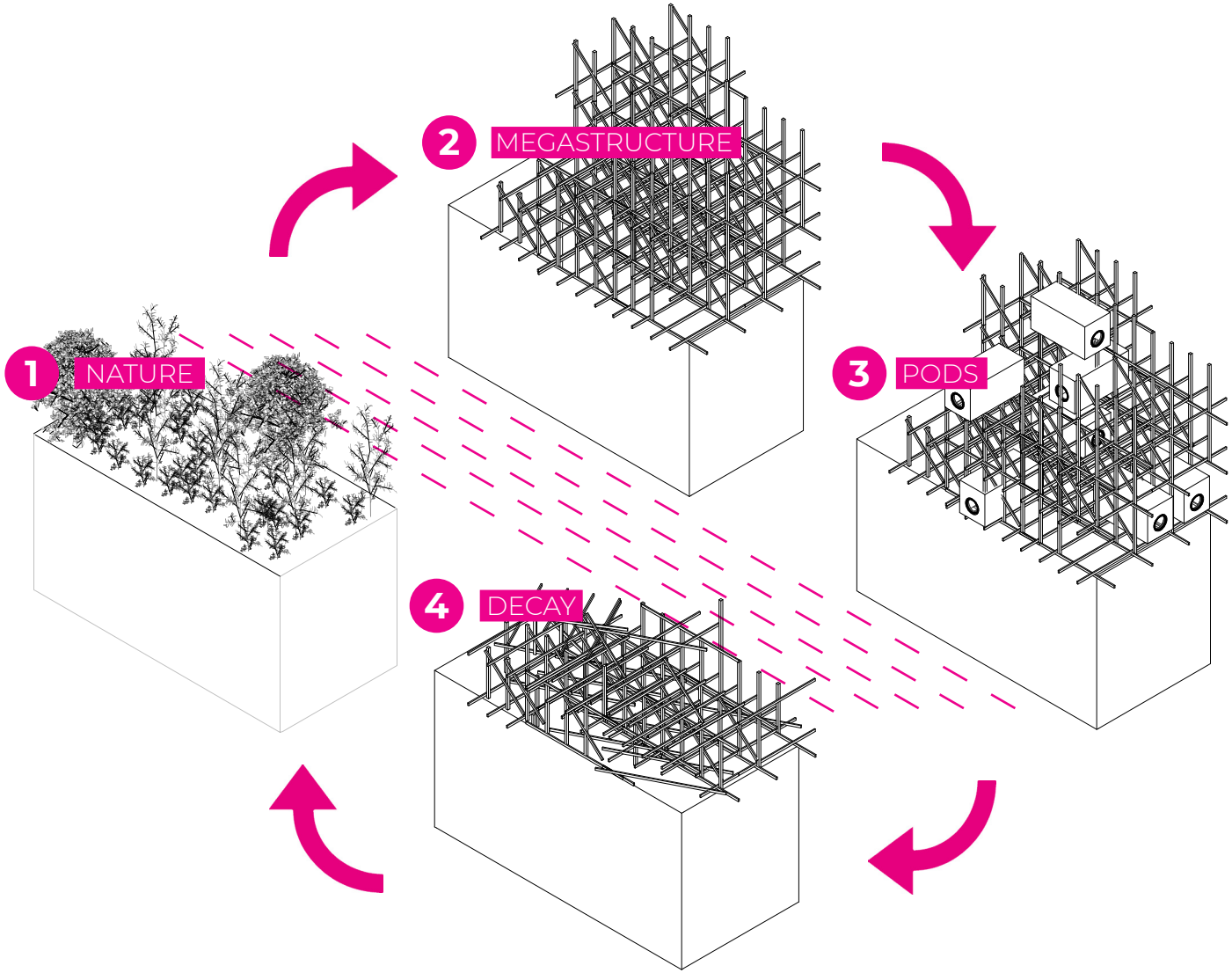
Interlink.

Under the soil - far away from our senses - lives earth's 'natural internet' called mycelium. An organism that underpins all life on earth by recycling dead organic matter into key plant nutrients which are released back into the soil via their 3D dimensional network. Thereby allowing the next generation of seedlings to grow. Without this nutrient cycling, life on earth as we know would not exist. More than 92 percent of all plant species are dependelty linked into this network that does not only shares nutrients but also communicate. In order to recover the relationship between humans and their environment humanity is going to interlink in this network. A wooden mega structure raises the underground network in which mycelium-based pods are implemented. A new relationship is created in which humanity has to take care of their architecture. Resulting in a equal relationship between mankind and its environment.



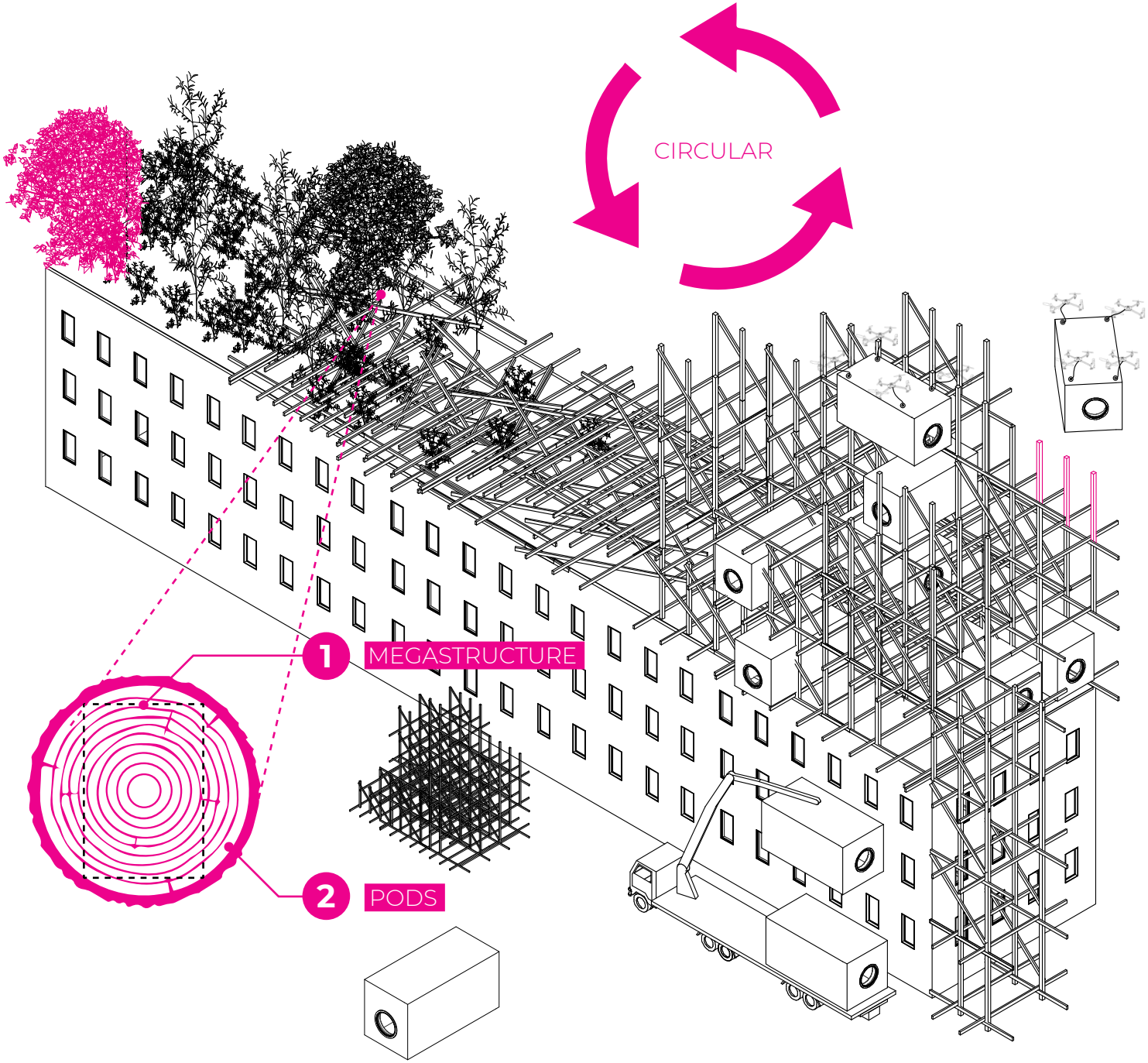
Constant temporarily.

The only constant is change. So why build static buildings? Let us embrace temporality. Mankind has lost its knowledge of and respect for the laws of nature. We remove algae from our facades, we idealize eternal life and are afraid of death. This system is designed to restore the realtion between humanity and nature. In the first phase, the 3D network of mycelium is raised. In phase 2, mycelium-based pods are interlinked, resulting in a temporary functional advantage where usability depends on human maintenance. Creating a direct relationship between nature and architecture. The user must look after his home or office like a plant. When the user no longer needs the space, he can no longer feed it. This puts the pod in phase 3, decay. Death is celebrated by openly displaying the cycle of life. Just like the phoenix that has risen from the ashes, phase 4 is introduced. In which decaying matter attracts microorganisms, worms, birds and seeds. Phase 4 completes the cycle of life that results in a complete ecosystem in which biodiversity can crawl. The created wood is used for the mega structure and pods in, creating a closed loop system.



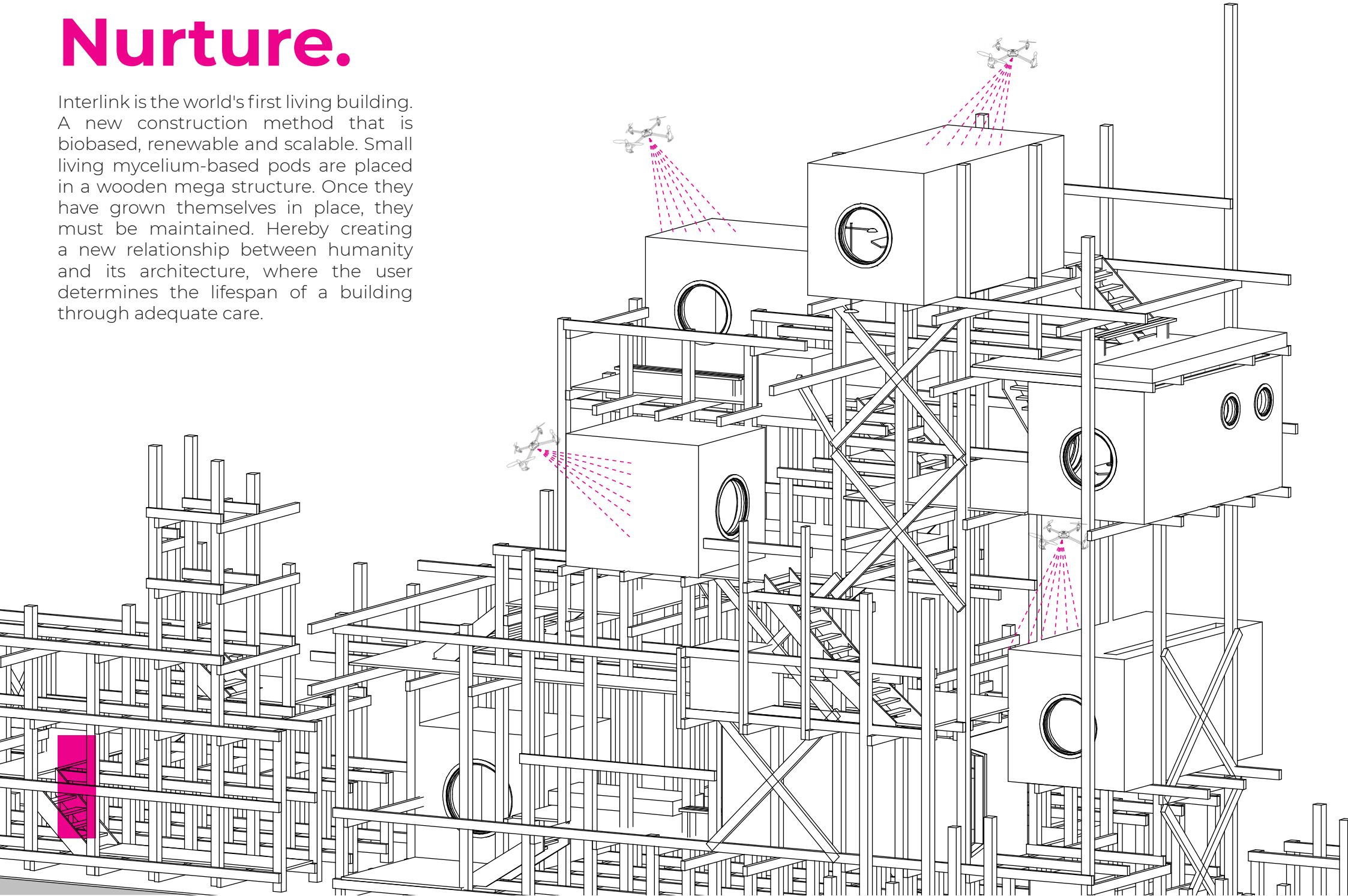
Closed loop.

Being part of the earth´s natural ecoysytem comes with great benefits. Similar to the closed cycles of nature, this building system dissolves into the soil after use. Resulting in fertile soils instead of waste. Hereby enabling new seedlings to flourish that will be utilized for the next generation of megastructures. Creating a closed loop system also reduces logistical pressure by keeping the circle as small as possible. The created forest of the first decayed megastructure provides the 'food' for the new megastructure. The trees are manufactured with the minimum amount of interventions to create a scalable system. The beams and columns of the megastructure are made based on the heartwood of the tree (1), which is the inner circle. The rest of the wood (2) is chopped into small pieces and used for the mycelium based composite pods. Not only does this system result in a new generation of renewable and living architecture, it is also an opportunity for humanity to restore their parastic relationship with nature.



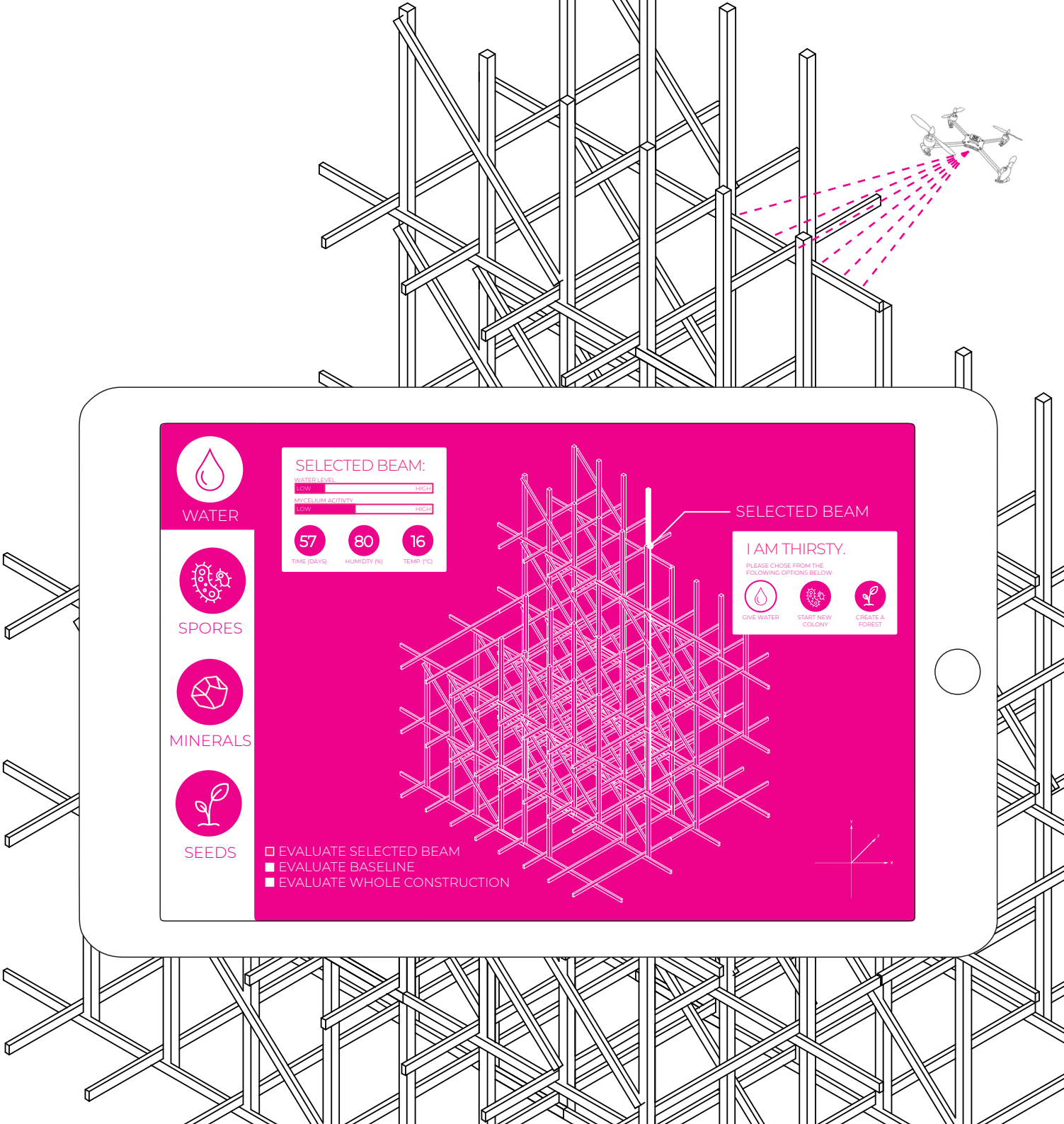
Nurture.

Interlink is the world's first living building. A new construction method that is biobased, renewable and scalable. Small living mycelium-based pods are placed in a wooden mega structure. Once they have grown themselves in place, they must be maintained. Hereby creating a new relationship between humanity and its architecture, where the user determines the lifespan of a building through adequate care.



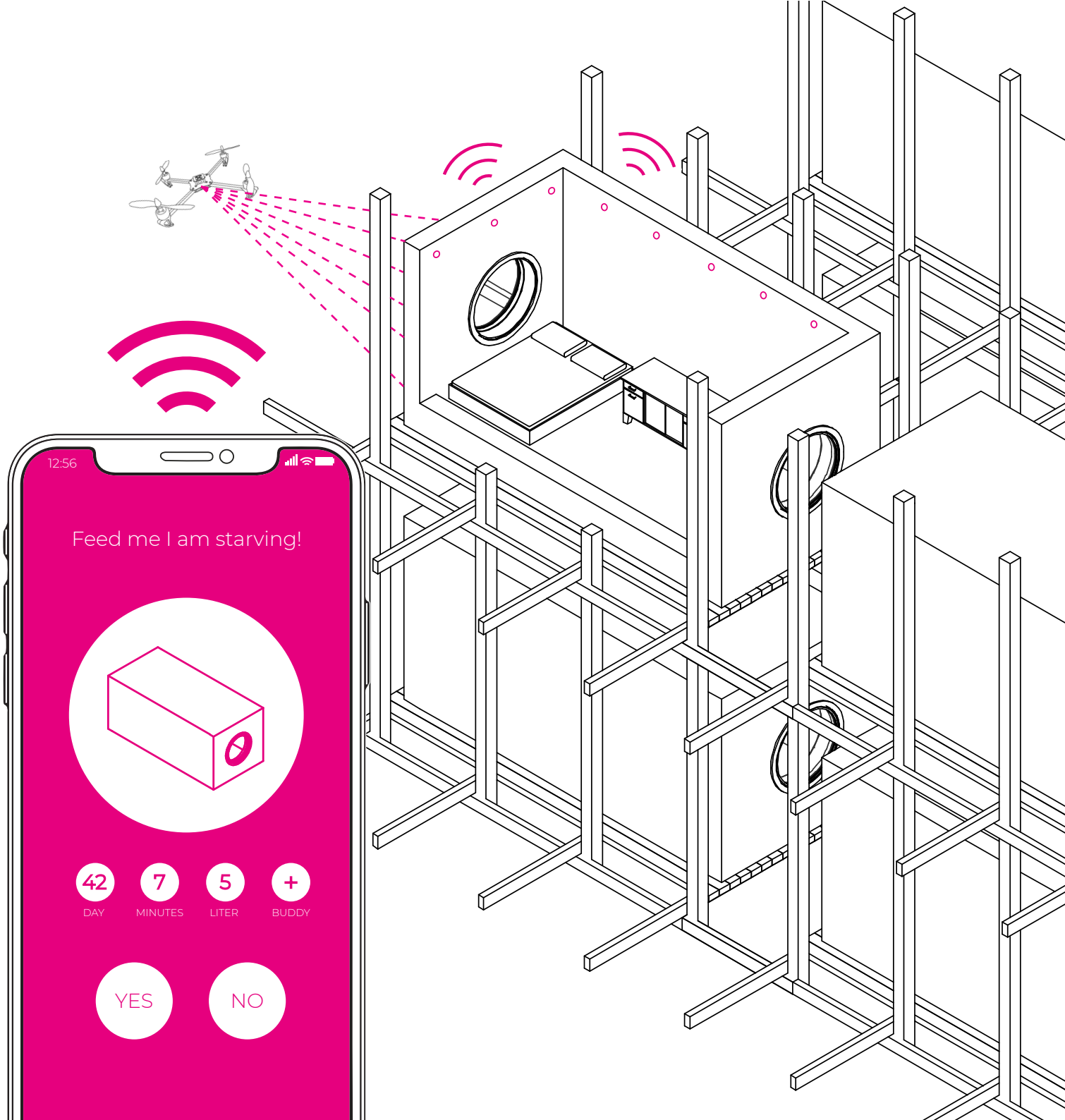
Megastructure.

Living architecture results in a new relation between user and environment. The lifetime of a building depends on the nurturing of the user. In order to maintain the megastructure, humidity and temperature sensors are placed on the wood which calculate the mycelium activity, water needs and remaining days of the megastructure. Via a digital application the caregiver can determine the lifespan of the wooden megastructure. Autonmous drones can be activated to nozzle water, spores, minerals and seeds onto the surface. Water is given to maintain the current mycelium growth or to excel the decaying process of parts of the megastructures that are being divested. Water can also be given to the plants growing on the megastructure. Spores are used to expand the mycelium growth in order to start the decaying process of a part of the megastructure. Minerals are nozzled on the construction to enable seedlings to flourish. Seeds are sprayed upon the surfaces covered with minerals in which they can start sprouting and attracting insects & birds. Via minerals and seeds the biodiversity in cities can be increased.

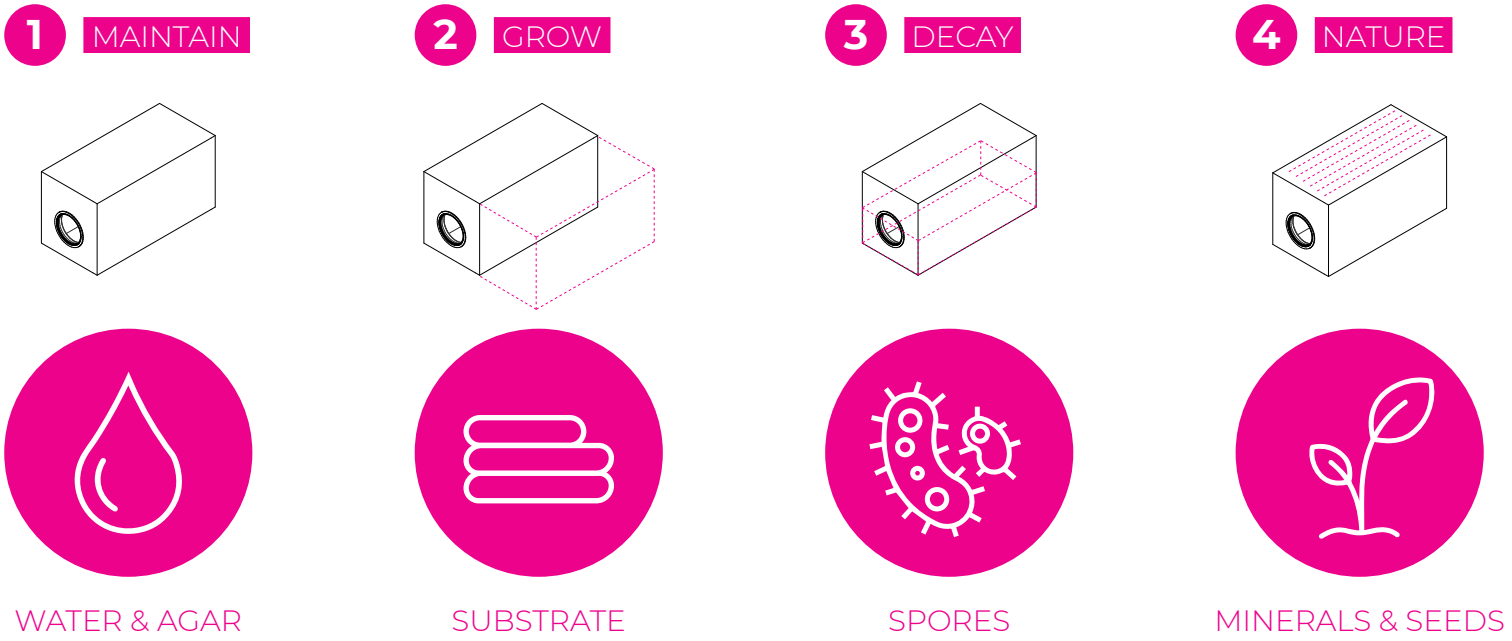


Pods.

In order to recover the parasitic relationship between humans and their environment a new concept is introduced in which users have to nurture their home. A mobile application is used to strengthen the relationship between inhabiter and habitat. The goal is to create more consciousness about the ecosystem in which we are interlinked and the biological life-cycle. Because the user has to nurture its environment in order to extend the stay gratitude is practiced. Resulting in a new symbiotic relationship just like the clown fish and its anemone. Sensors in the pod measure the temperature and humidity. When a low value arises the intelligent system checks the weather forecast and determines if it needs water or food. The user gets a push notification on their mobile phone in which they have the choice to nurture their home. When 'yes' is pressed, pre-programmed drones are activated and will nozzle a solution of water and agar on the surface of the pod. When 'no' is pressed, the drones will stay put. After several missed nurture moments the pod will start its decaying process. On average the drone will nozzle 5 liters per 7 minutes flight. Depending on the season the user needs to nurture their home 2-7 times a week.

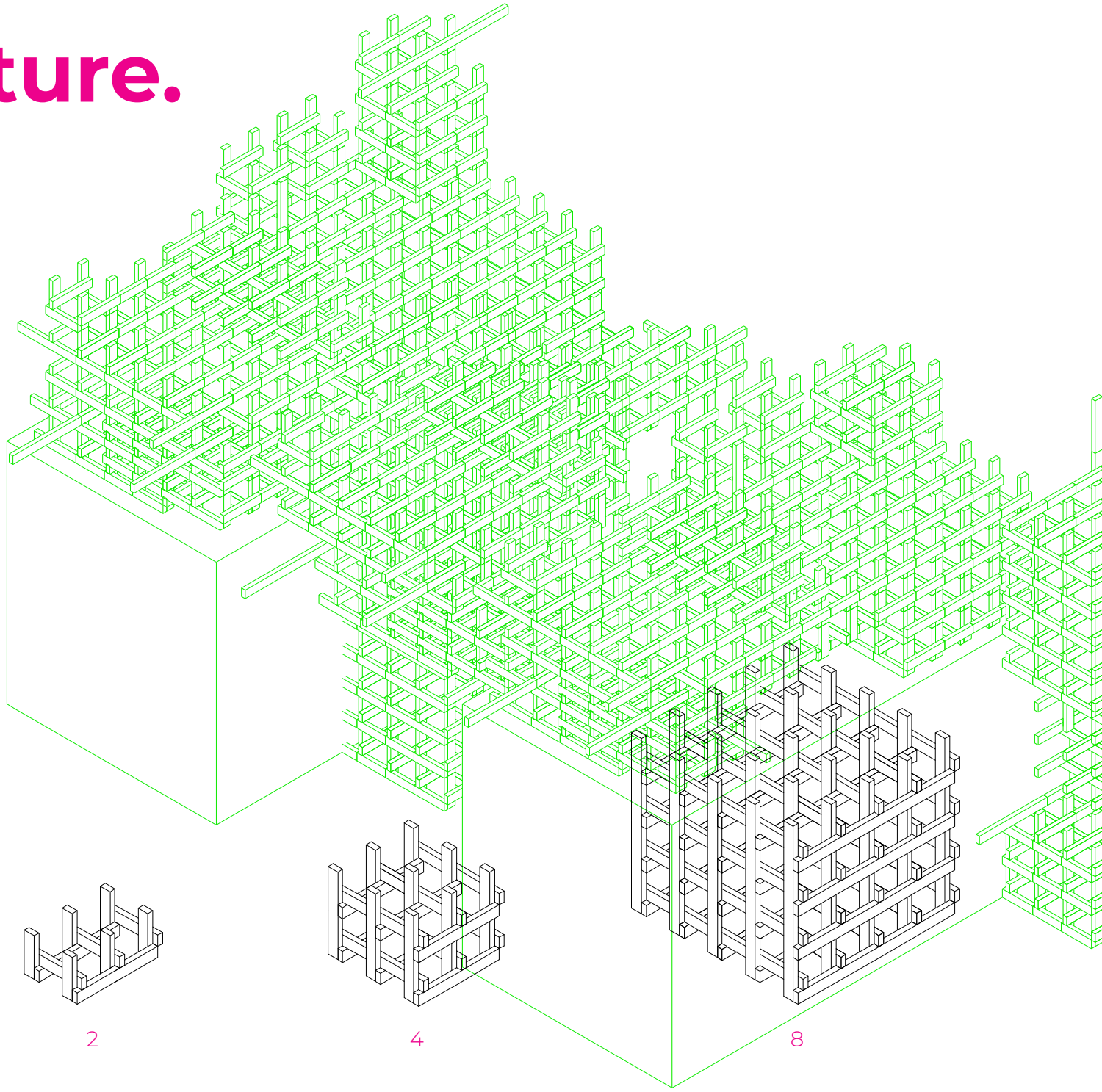


Possibilities.



Megastructure.

When cities are seen as organisms that changes at various rates, it reflects our feelings that human society must be regarded as one part of a continuous natural entity that includes all animals and plants. Inspired by the post-war Japanese architectural movement Metabolism, a wooden mega structure is proposed to uplift the underground mycelium network. It is meant to replace the mechanical analogy of orthodox modern architecture it compared buildings and cities to an energy process found in all of life, the cycle of change. The constant renewal of and destruction of organic tissue. The destruction rate can be influenced by either human nurturing or choise of wood. A short lifespan is achieved by the usage of softwood while hardwood results in a longer lifecycle. The exponential growthrate of nature determines the grid of the mega structure. A dowel dry lock connection makes the megastructure transform and scale at various rates.



1

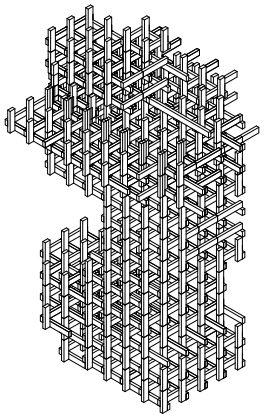
2

4

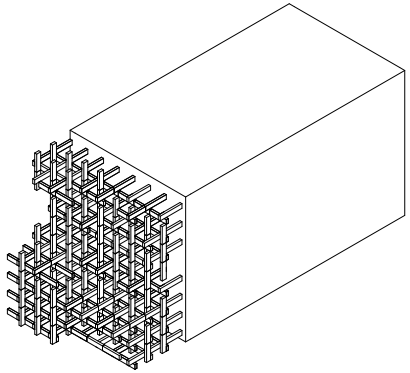
8

Habitat.

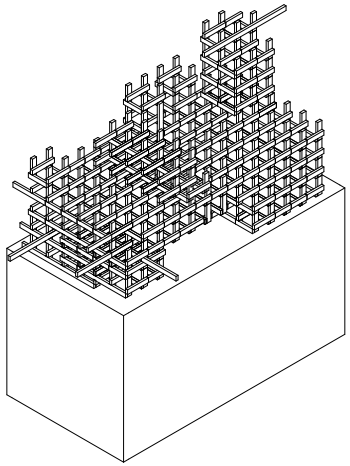
The megastructures live in ever-changing environments. They are particularly attracted to abandoned and remaining spaces within cities, resulting in symbiotic relationships with existing structures. The solo line is capable of creating self-sufficient settlements, while the next line subtly contributes to existing architecture. A new social level can be created by placing the structure on or through the built environment. Enabling a new level in which nature and humanity live in a symbiotic balance.



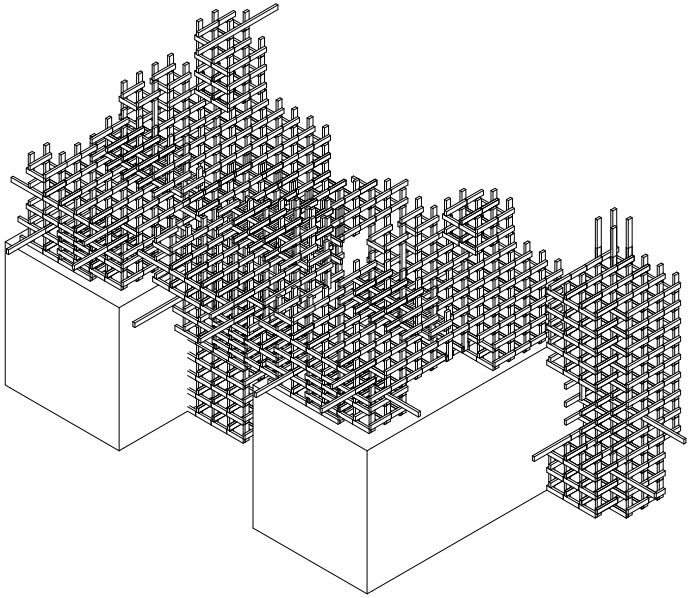
Solo



Next



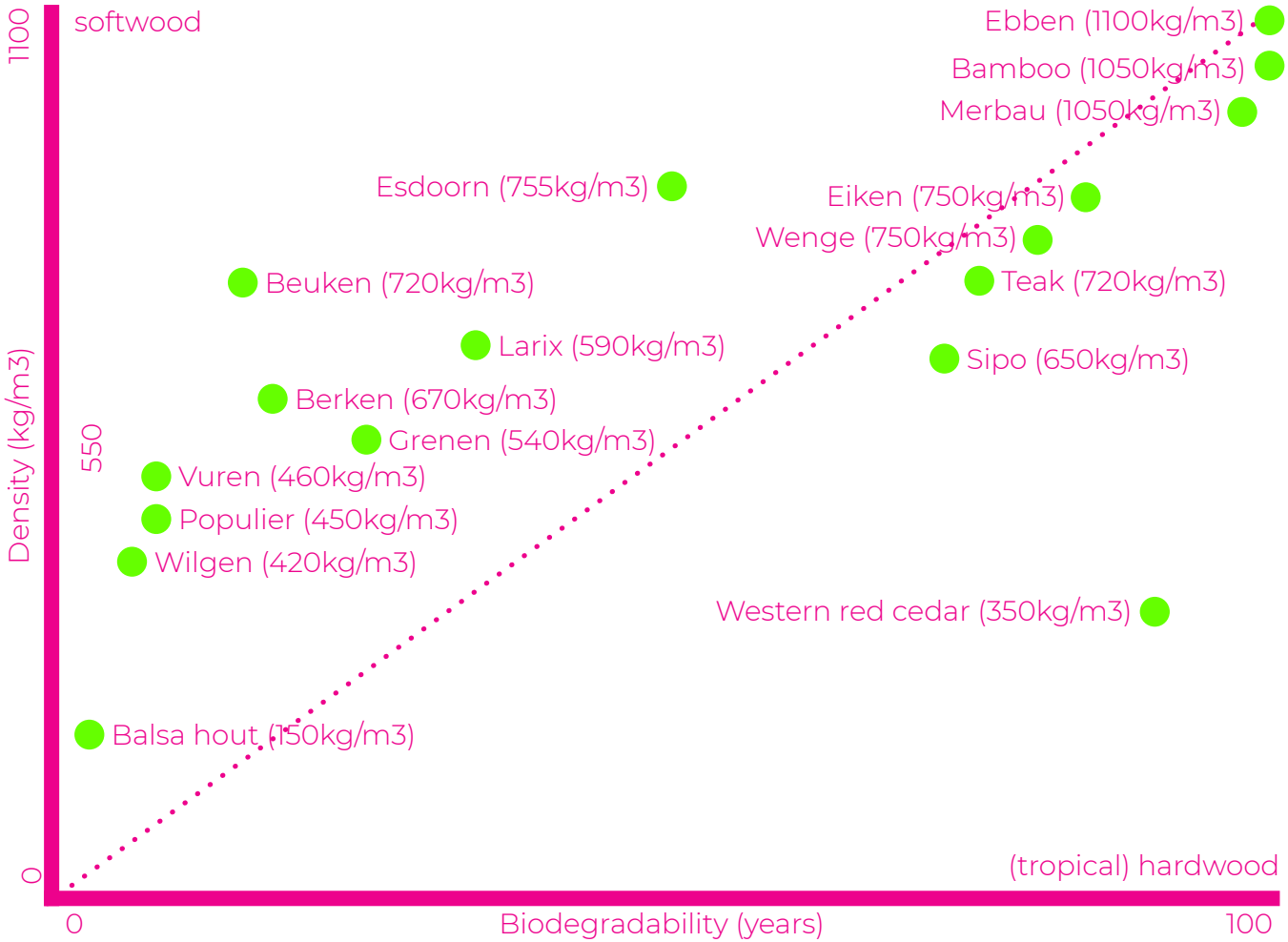
On



Through

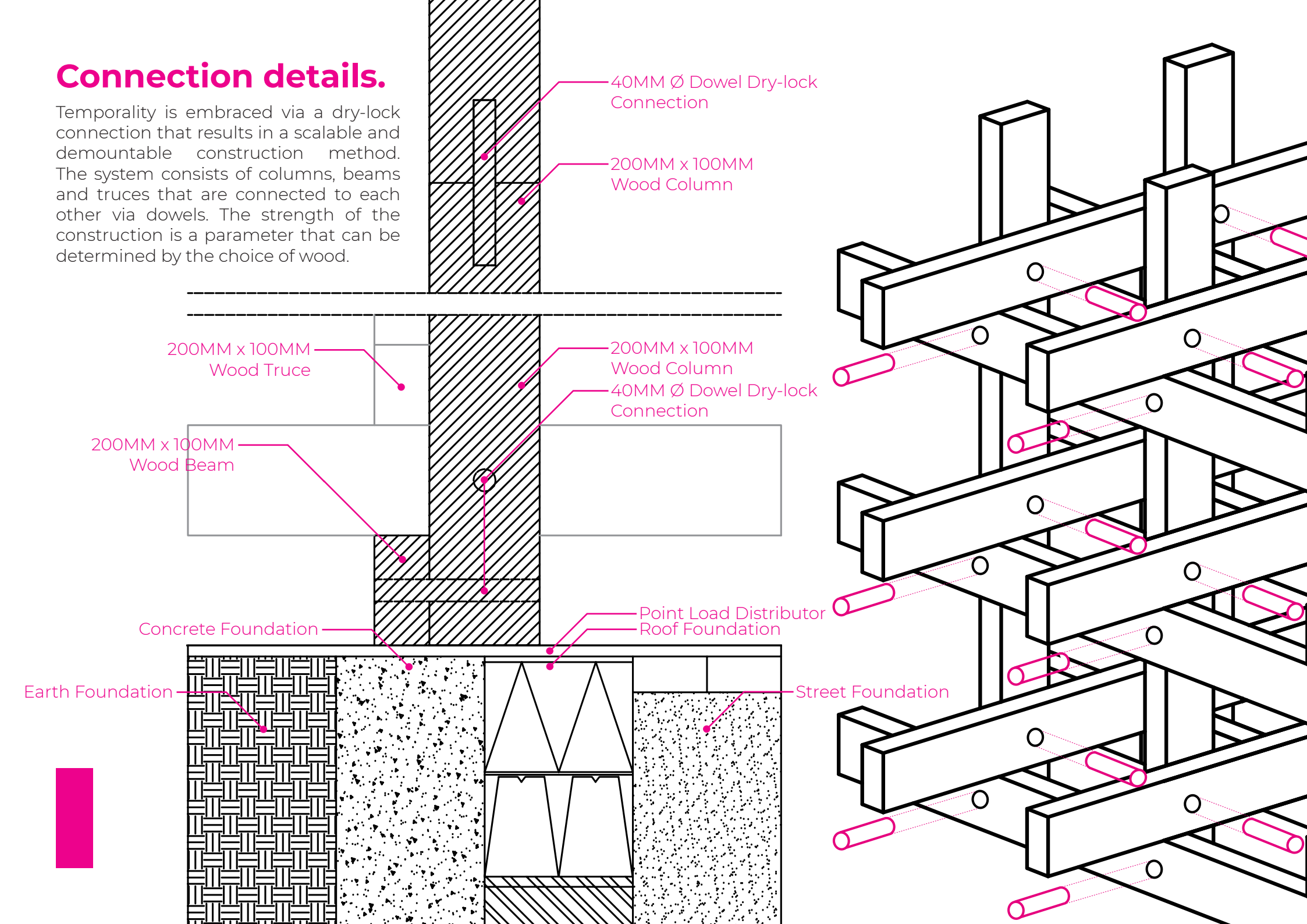
Wood.

The mega-structure is made up of the porous and fibrous structural fabric that is found in the stems and roots of trees called wood. Due to its renewable nature, circular building methods can be applied that enable humanity to become part of the life cycle. The type of wood determines the duration of the mega-structure. For example, a hardwood can have a lifespan of 100 years if it is properly cared for, while softwood such as Balsa lasts a maximum of 1 year. Different types of projects require different types of wood. Softwood and hardwood distinguish themselves botanically in terms of their reproduction, not by their end use or appearance. The amount of sugar in it is a major influence on the biodegradability of wood. It can usually be said that the more sugar inside, the faster it is broken down. And the more xylose the slower it is broken down. Due to the slow growth, hardwood species often have a high density, making them 'harder', but this is not always the case. Fiber also plays an important role in the hardness of wood. The shorter the fiber, the harder the wood. Hollow fibers also provide a perfect entry for mycelium to decompose the organic matter, while high density hardwood does not allow them to penetrate.



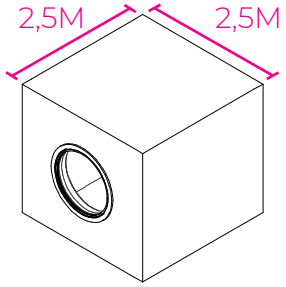
Connection details.

Temporality is embraced via a dry-lock connection that results in a scalable and demountable construction method. The system consists of columns, beams and truces that are connected to each other via dowels. The strength of the construction is a parameter that can be determined by the choice of wood.



Pods.

Living mycelium-based pods are linkedin the megastructure. Almost like a science fiction film, the pods attach themselves to the wooden skeleton within a few days. After a week the pod can be entered by its new user. In contrast to the current architecture, a new mutualistic relationship is created between the user and his architecture. Just like the clown fish and its anemone, the resident must nurture his environment to successfully retain its shelter. The pods are produced by the technology of injection molding, prefab molding or 3D printing. This production process can take place both on site and in the factory. The advantage of using an injection mold is that large scalability can be achieved, but this requires a large investment. Prefab molding has the advantage that the pod finalizes its production process in the mega structure by 'gluing' itself. Moreover, the prefab element results in simpler logistics. The different production methods result in a variety of forms, from geotmetric to organic. The size of the pot depends on the grid size of the mega structure in which it is inhabits.



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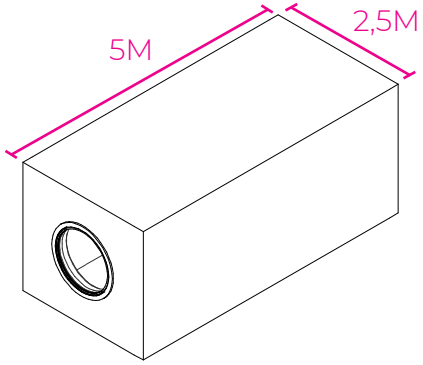
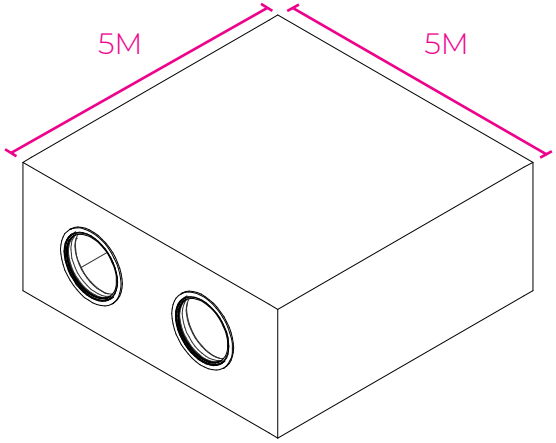


M



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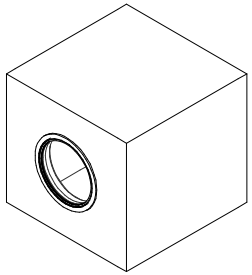
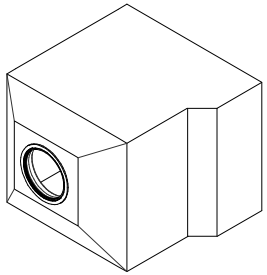
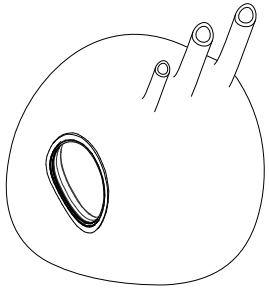


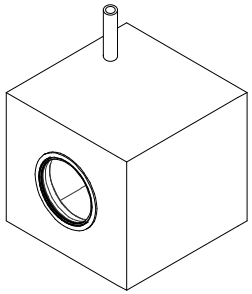
Geometric



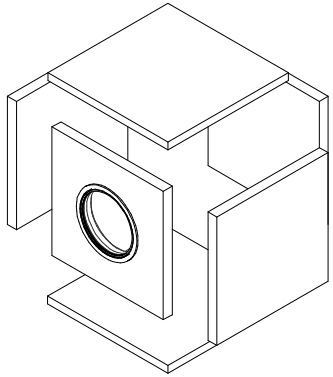
Starwars



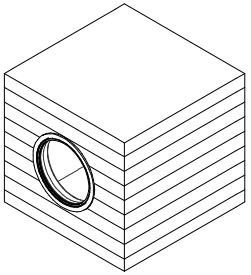
Organic



Injection molding



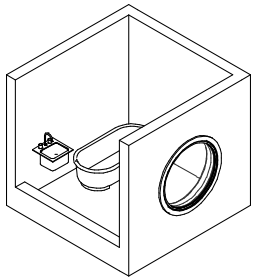
Prefab molding



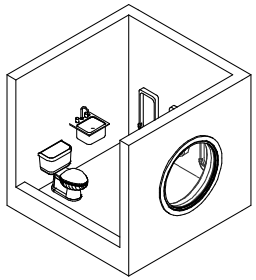
3D printing

Functions.

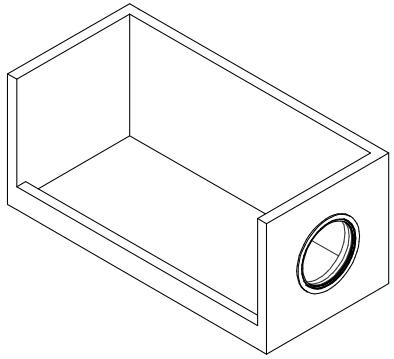
The pods each have their own specific functionailty that creates architecture with a changeable purpose through the spectrum of time. By embracing continuous change, small pods can be connected to each other and disconnected with the megastructure. Functions may differ per project, but some examples are pods for swimming, visiting the toilet, sleeping, working, dining, exercising or staying. Various temporary functions can be designed depending on the duration of the project.



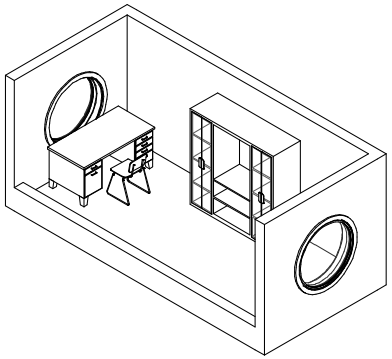
Bath



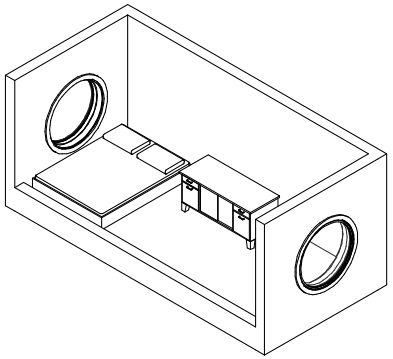
Toilet



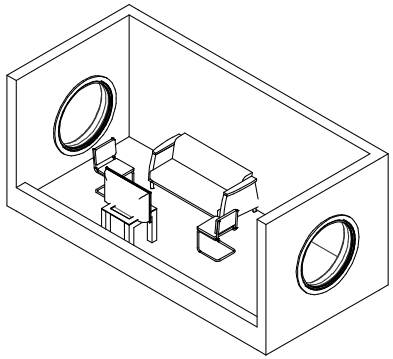
Free



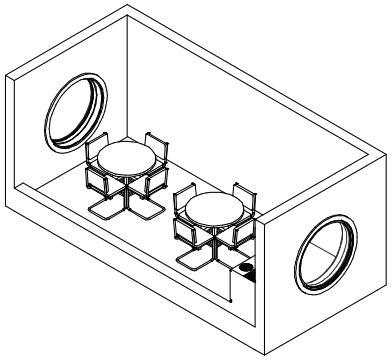
Work



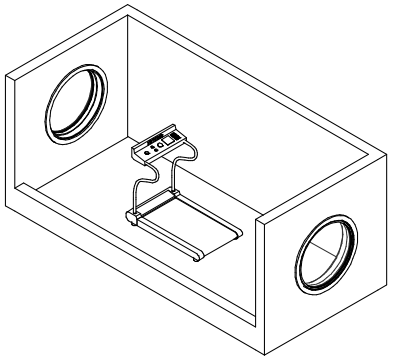
Sleep



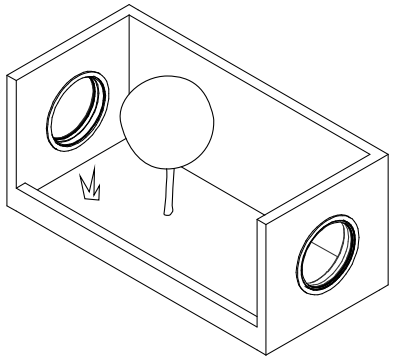
Chill



Eat



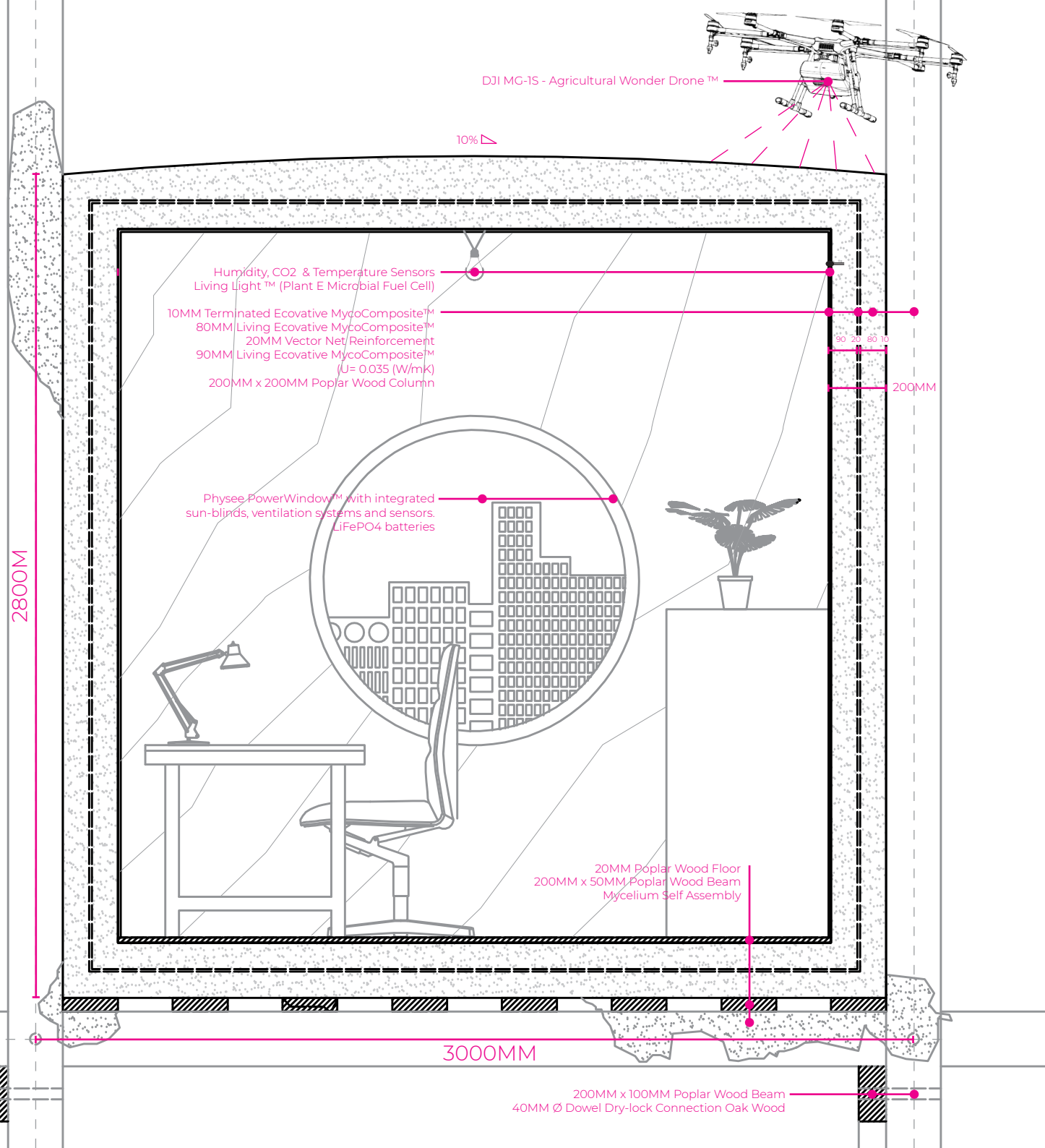
Sport



Nature

Connection details.

The pods are made out of Ecovative's patented MycoComposite™ material that is a mixture of organic hemp and mycelium of the ganoderma fungi. The pods are reinforced with a 20MM vector net made out of biodegrable materials such as rope or PLA. Once the pods are placed in position the mycelium will grow onto the megastructure hereby interlinking itself in position via a natural connection. Mycelium materials are naturally water resisting in order to guide the water downwards to the soil the roof has a bulging of 10%. The pod is a breathing organism, hereby allowing a flow of air whihch results in a natural ventialtion system. Active microorganisme in the wall create heat due to their activity. This stable temperature results in a passive heating and cooling system that requires no energy. In a similar way microorganism shine light upon the space with the technology of plant microbial fuel cells that are patented by Plant E. Sensors inside the pod will give direct feedback towards a mobile application, which enables the user to decide weither or not to feed its pod. If it is chosen to feed the pod a DJI MG-1S - Agricultural Wonder Drone gets activated and sprays a water and agar solution on the surface.



Energy.

Energy for light is generated in a passive way via a Plant Microbial Fuel Cell (P-MFC). In the mycelium-based composite, sugars are broken down, releasing electrons and protons. The electrons are collected in the anode (the negative pole) which transfers the electrons through a wire to a smart chip that allows an increase in voltage to make an LED lamp light up. A cathode (the positive pole) makes the flow of electrons possible. Creating a closed loop system. The windows in the pods actively generate the excess amount of electricity through triple Physee PowerWindows that convert sunlight into green energy through an integrated high-efficiency metal wrap through mono c-Si solar cells in window-spacer. LiFePO4 batteries are integrated in the window-spacer that will create an efficient DC Grid. Active generation of energy takes place with the help of solar panels.

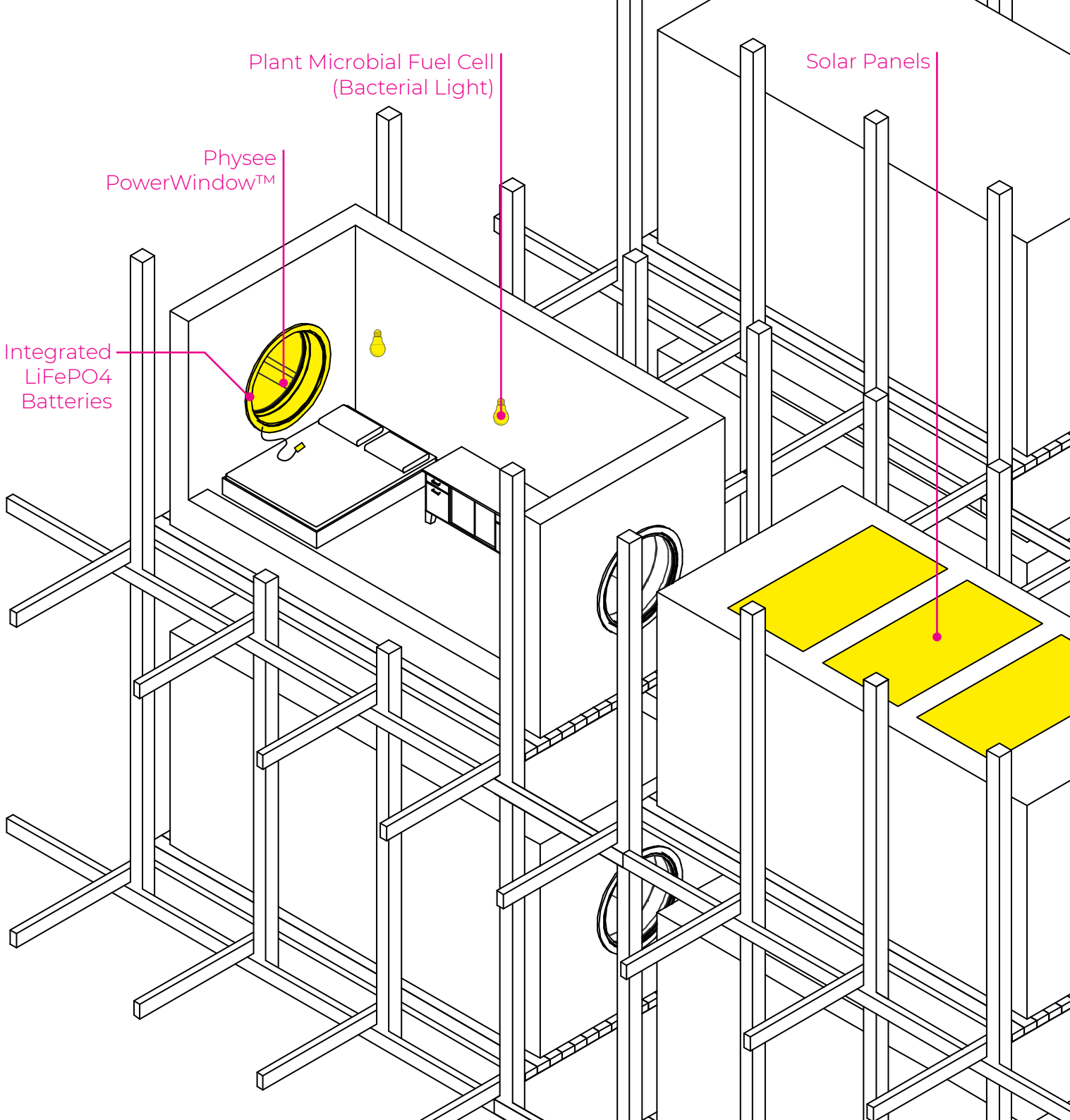
Required amount of heat: Qin = Quit, Quit = Qtransmission + Q vent

*Qtransmission = U * A * ΔT*
Rvalue= d / lambda = 0,3/0,035=8,6 m2k/w + 0,17 = Rtot = 8,74 m2k/w
Rvalue= 1/U, Therefor U= 1/8,74 = 0,11W/m2k
*A(surface)= 4 * (6m*3m) + 2*(3m*3m)= 90m2*
*Qtransmission = U * A * ΔT = 0,11 * 90 * (21-3) = 185W*

*Q vent= P(air) * C(air) = 1,2 * 1000 / 3600 = 300W*

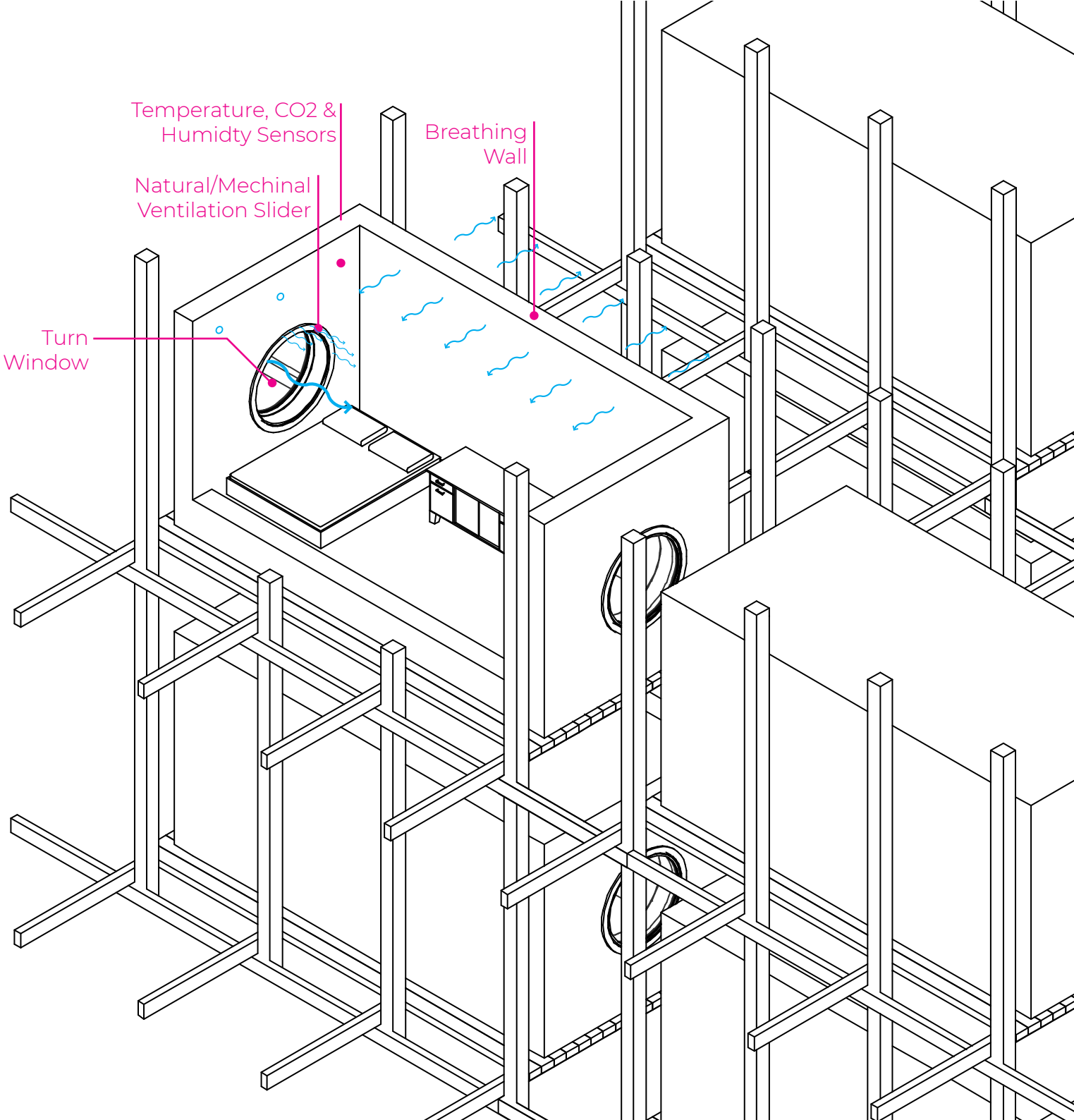
Quit = Qtransmission + Q vent = 185W + 300W = 485W

Generated:
-Microbiological heating: 567W
-Physee Power Window: 50W per window
-Solar panel: 250W per panel (in case of shortage)



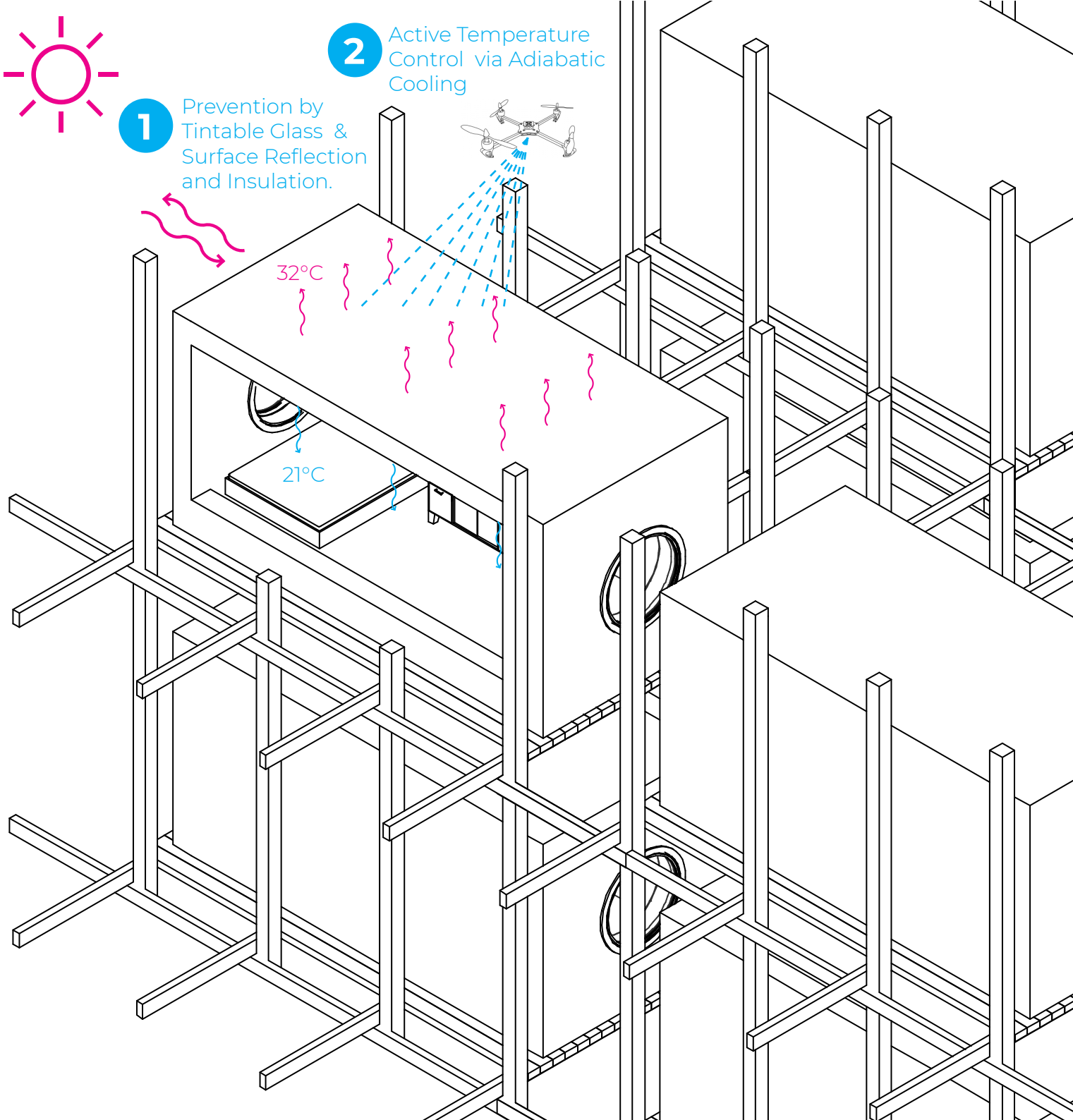
Ventilation.

In order to maintain a healthy indoor climate, sufficient ventilation is required. Although the mycelium wall is an organism and is therefor exchanging air via 'breath', this amount of air transport is not enough to support human occupation. Therefor the pods are automated or manually ventilated. The round windows can be opened in order to allow a large amount of fresh air to enter. The ventilation sliders that are incorporated in the window frame let in a smaller amount of fresh air. To maintain control over the indoor climate, the air quality is continuously measured via temperature and humidity sensors. When a low air quality is detected, a notification will be communicated towards the user via a mobile application. The user settings can be either automatic or manual.



Cooling.

During high outdoor temperatures the indoor climate is regulated to maintain comfort. Therefor hot air is fend of in a passive and active way. Passive cooling is achieved due to physical factors such as the insulation value (U= 0.035 (W/mK) the color of the pod, which partly reflects sunlight, and the color of the windows, which is able to change its color due to electronically tintable glass. When the outdoor conditions result in high outdoor temperatures (>30°C) the passive cooling system might not be sufficient to maintain the indoor climate. Therefor the user gets a notification on its mobile phone when the indoor humidity and temperature sensors measure an indoor temperature above 25°C. The user then has the option to activate the adiabatic cooling system. Depending on the desired indoor temperature and weather forecast a calculation is made in which is the amount of water (L) is determined. Autonomous drones will then be activated via a digital connection and nozzle water on the exterior surface of the pods, hereby extracting heat from the indoor climate of the pod.

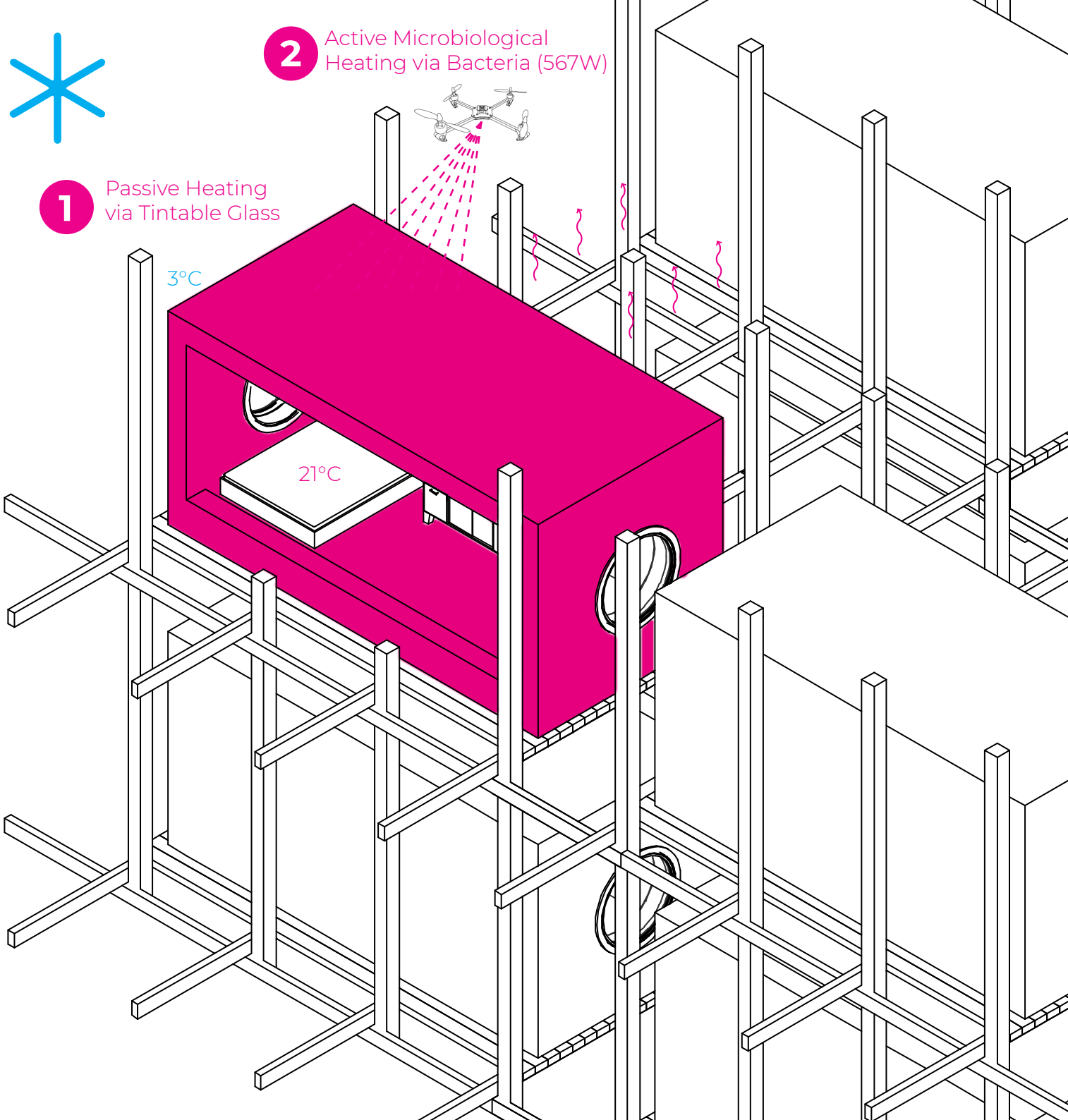


Heating.

During low outdoor temperatures the indoor climate is regulated to maintain comfort. Therefor cold air is fend of in a passive and active way. Passive cooling is achieved due to the changeable physical factors of the windows which are able to change their color via electronically tintable glass. When the outdoor conditions result in low outdoor temperatures (<0°C) the passive heating system might not be sufficient to maintain the indoor climate. Therefor the user gets a notification on its mobile phone when the indoor humidity and temperature sensors measure an indoor temperature above 15°C. The user then has the option to activate Microbiological Heating system. Depending on the desired indoor temperature and weather forecast a calculation is made in which is the amount of bacteria solution (L) is determined. Autonomous drones will then be activated via a digital connection and nozzle the bacteria solution on the exterior surface of the pod. The bacteria contain sacharose which react with mycelium and hereby releases heat to retain a comfortable indoor climate.

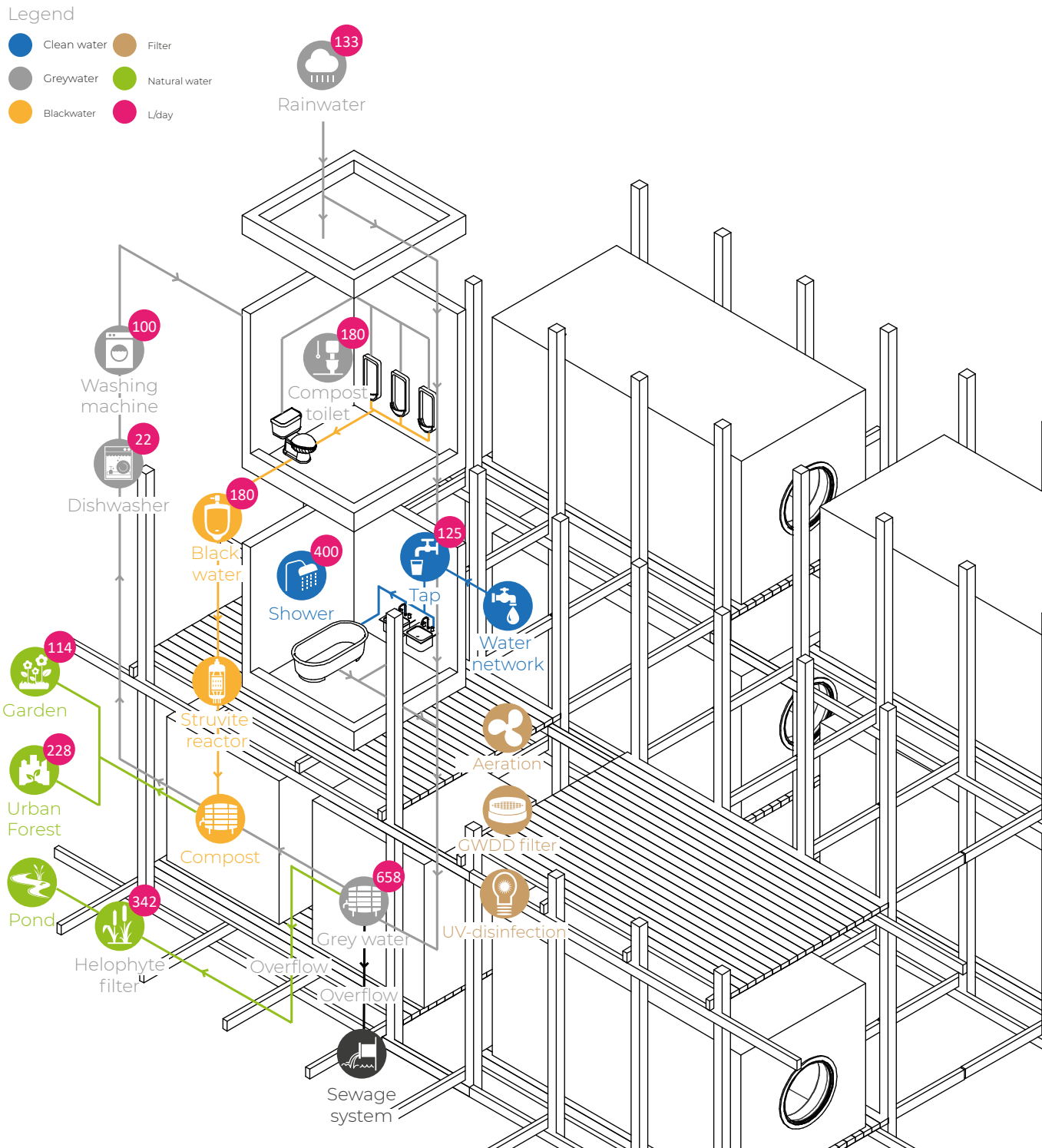
Calculation of heat generated by objects:
*People: 2 * 80W = 160W*
*LED light: 2 * 6W=12W Heating*
PC: 150W

Total: 322W



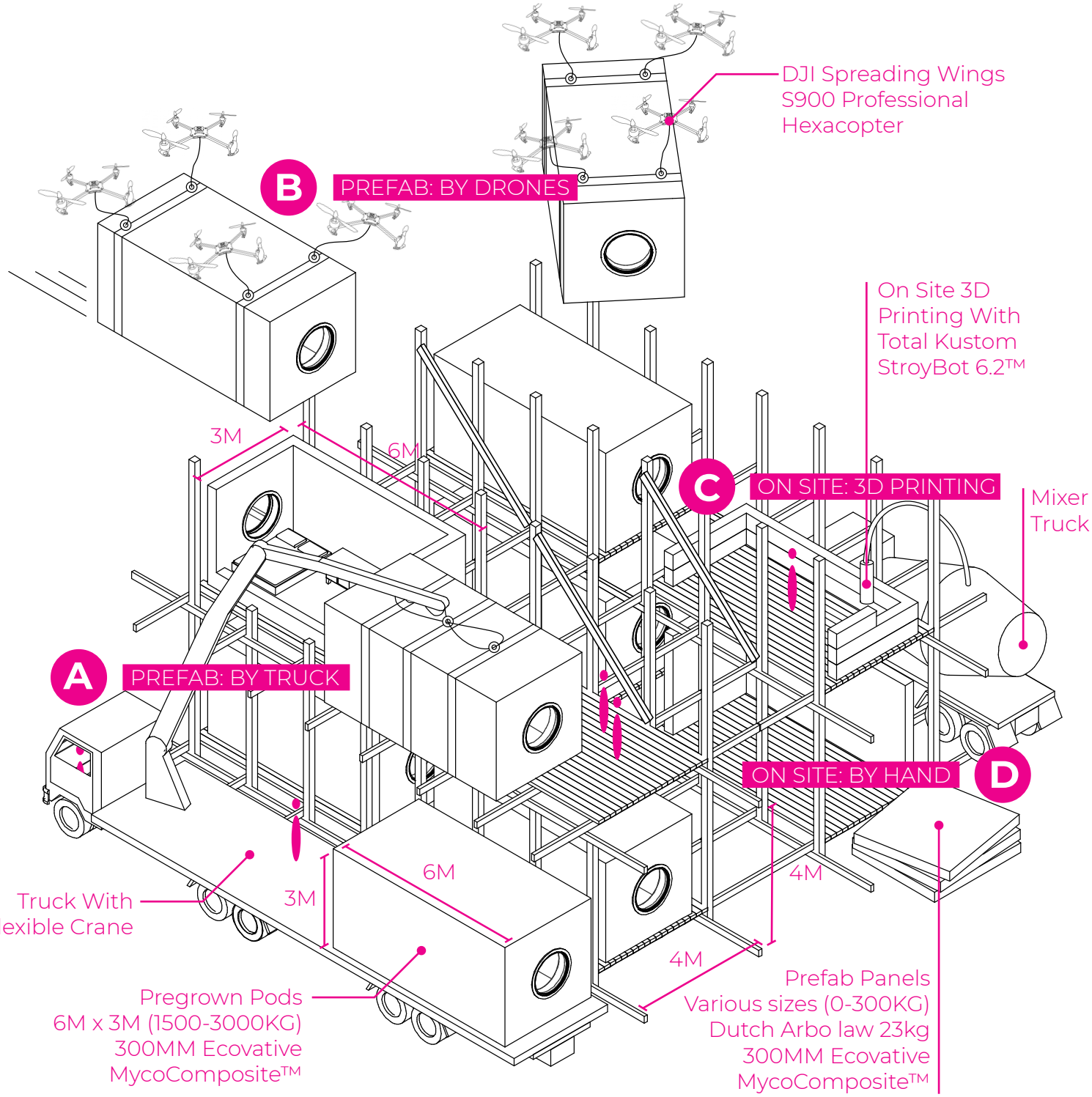
Water.

Water is the main resources for human survival. Due to climate change cities have to deal with extreme weather conditions such as extreme droughts and extreme rainfall. Therefor it is important for a building method to take the water housing into account. In the new building method water is part of the ecosystem. Rainwater is used for toilets and ends up in a compost reservoir that will serve as nutrients for new seedlings to flourish. Clean water enters the system via the water network and facilitates showers and tap water. After usage this water will be filtered though a process of aeration, 4 Stage Filtration unit (gwdd) and UV disinfection to serves as grey-water. In a reservoir the grey-water can either be transferred to the sewage system (in case of an overflow) or to be used for the dishwasher, washing machine and toilet facilities. Hereby creating a (almost) closed loop system in which water is reduced, reused and renewed.



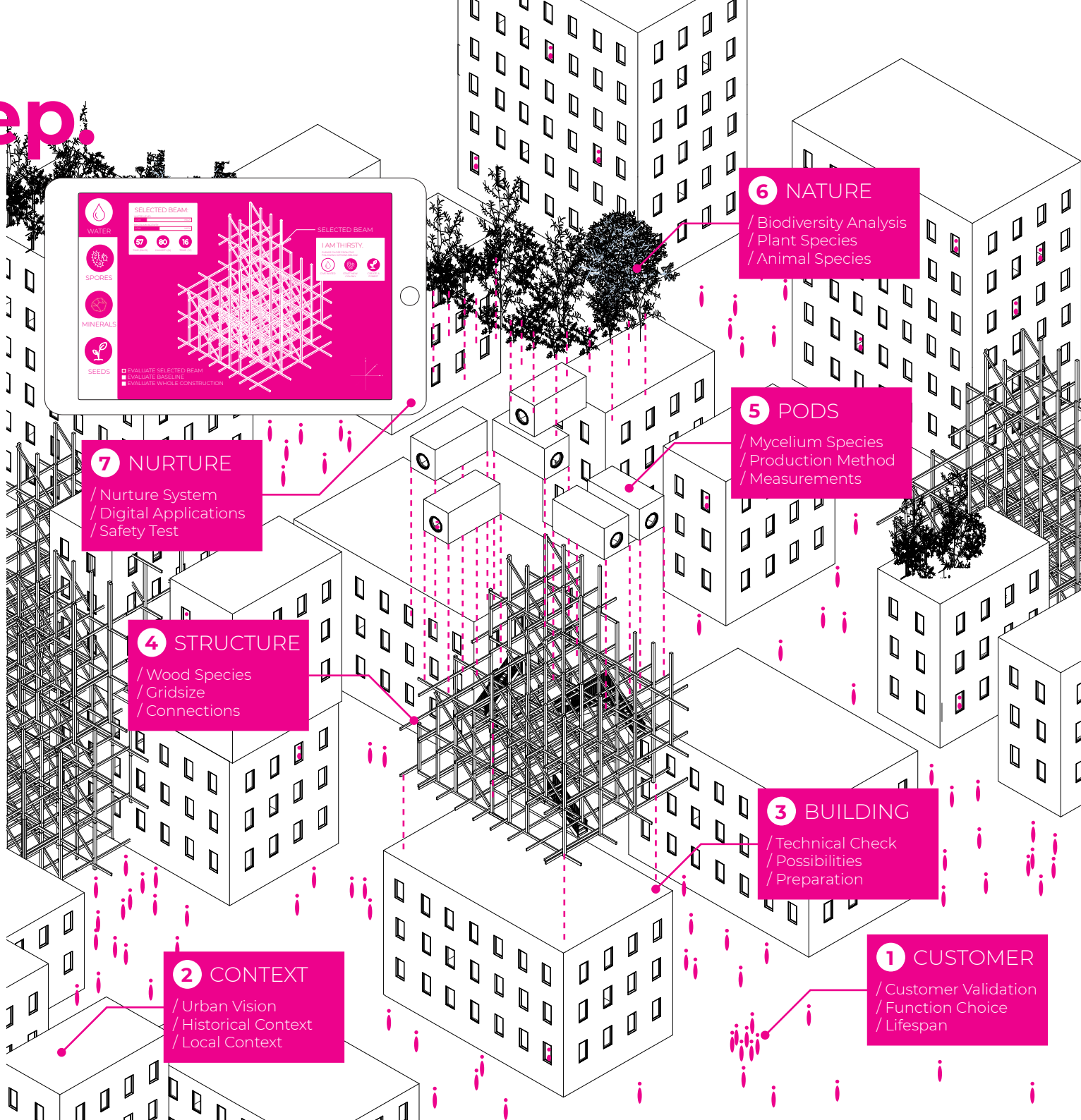
Logistics.

Once the megastructure is successfully placed the pods can be interlinked. The weight of the pods varies between 1500-3000 kilograms, depending on the size. There are multiple ways of achieving an interlinked pod. The pods can be fully grown in the factory and transported via a truck with a flexible crane (A) or professional hexacopters (B). It is also possible to achieve on site manufacturing with a 3D printer (C). A possibility inbetween above mentioned methods is creating small pregrown panels that can be assembled on site (D). Once on location the pods will interlink themselves into the megastructure by expanding their mycelium network on the wood. Hereby creating a solid connection that does not require additional attachments.



Step by step.

Architects, designers, governments and real estate developers can use this step by step guide to create their ideal living system. The 1# step is to know the audience. Hereby validating assumptions and determining the function and lifespan. The 2# step is to analyze the context via historical data, urban development plans and local resources. The 3# step focuses on the existing building that will be part of the living system. A technical check will result in the possibilities which require preparation for the 4# step: the megastructure. Here the wood species, grid and connections are chosen. In step 5# a specific mycelium species is chosen to design the pod accustomed to the user. Step 6# focuses on the recovery of nature in the specific location. Therefor a biodiversity analyses is performed to determine the plant and animal species. Once the whole system is in place step 7# comes into play by nurturing the living system via safety tests and digital applications.




On.


Next.

Through.


Solo.