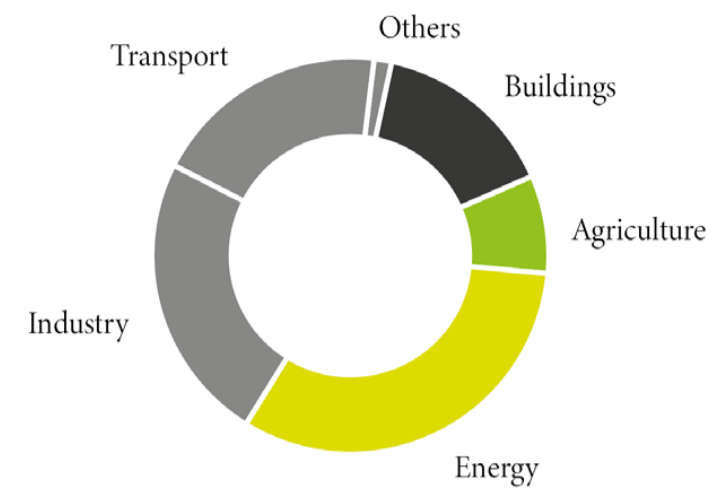


# Chapter Two: A dance of Agrivoltaics and Vertical Farming.

**Greenhouse gas emissions in Germany 2021:**  
Source: Umweltbundesamt 2022.



According to the Federal Environmental Agency's preliminary report for 2021, greenhouse gas emissions from the energy sector alone accounted for 32.4% of the total emissions that year. The agricultural sector accounted for 8%. That means that combined, those two sectors produce 40% of all the CO2 generated by the productive sectors of Germany.

In order to address this issue, we need to find a way to tackle both problems simultaneously in a sustainable and environmentally friendly way that considers the cultural and environmental characteristics of Mannheim, and Germany as a broader context.

## Agrivoltaics:



Agrivoltaics combines the benefits of energy generation through photovoltaic panels with agriculture in a symbiotic manner that benefits both sectors. Photovoltaic panels are placed above crops at a height that allows planting and harvesting to be comfortably done on the ground. The crops benefit from the shade provided by the panels, which protects them from excessive solar heat, thus allowing them to better retain water while also being able to perform photosynthesis. This saves substantial amount of water and, in turn, the humid and cool environment generated by the crops beneath the panels cools them down, thus enhancing their performance and total energy output.

## Vertical farming:



Vertical farming is an incredibly efficient and sustainable way to produce high quality food in large quantities. Crops are stacked vertically, exponentially multiplying the productivity of a given plot of land and consuming up to 250 times less water than traditional farming. Because the crops are grown vertically with virtually no contact with soil, there are no pesticides or agrochemicals involved in the process, and the free-hanging roots can absorb as much water and oxygen as needed. This all means the crops grow healthier and without the contingencies associated with traditional farming. Crops are typically grown in modular cylindrical towers made out of plastic that can be placed indoors or outdoors and are irrigated from within.

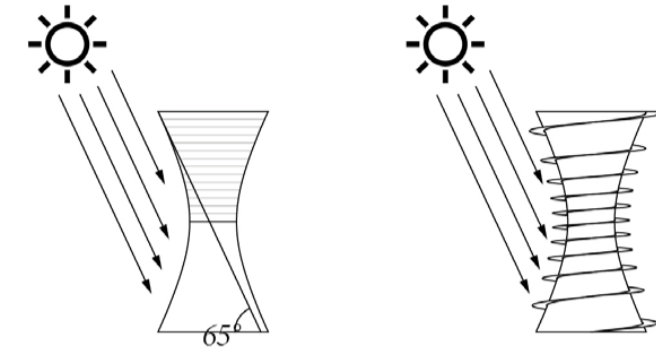
## A Hyperbolic Garden

Symbiosis taken to the next level!

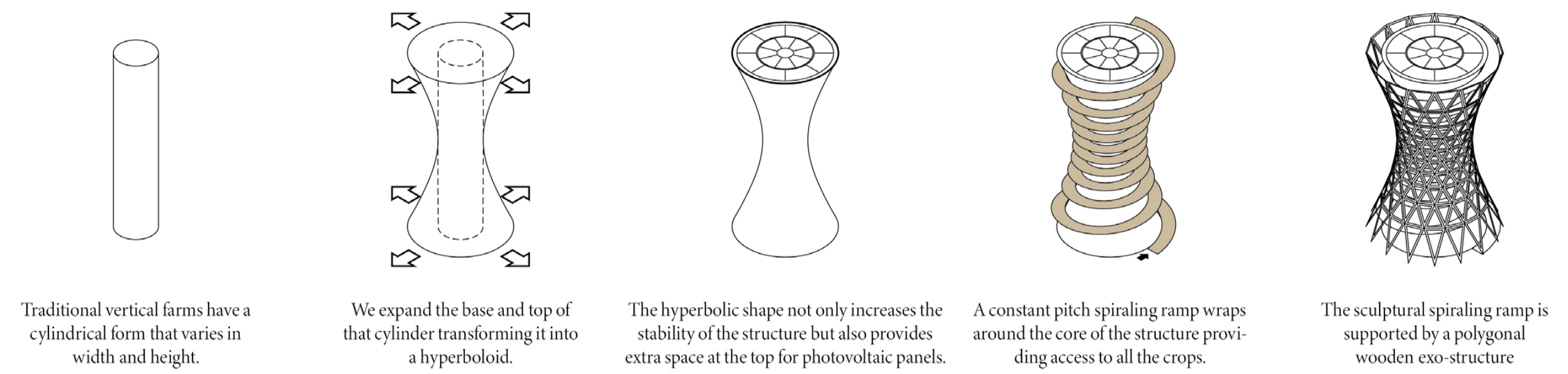
We want to combine the benefits of vertical farming with agrivoltaics in a design that maximizes public engagement and interaction. The idea is to elevate the concept of "community garden" to create an urban landmark that generates sustainable energy for the city of Mannheim while fostering social collaboration and imagination. Can we tackle the CO2 emissions from the energy, agricultural and construction sectors simultaneously combining the wisdom of nature, the latest advancements in robotics, and the traditions of the German people?

## A Hyperbolic brise soleil

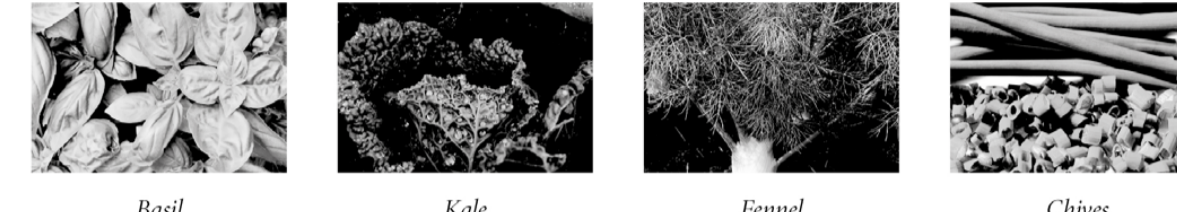
Protecting the crops through design.



Fragile crops with less sunlight requirements are placed on the top half of the structure in a tangential position relative to the sun. Crops with higher sunlight requirements are placed at the bottom of the hyperboloid in a more perpendicular position relative to the sun. The ramp also provides additional shading to the crops by acting as a brise soleil.



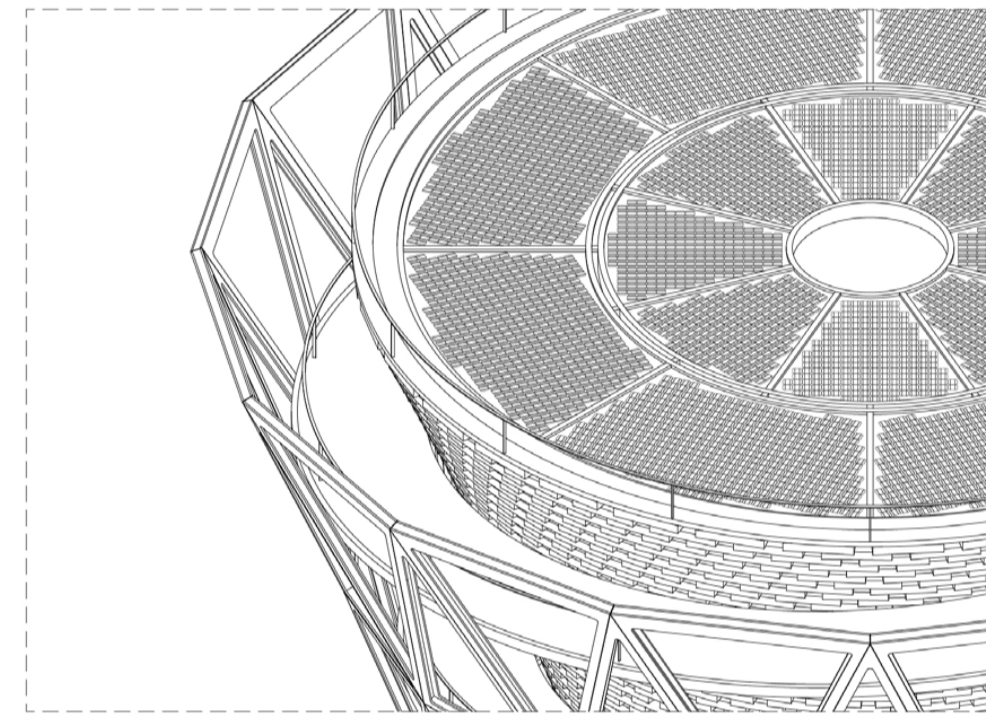
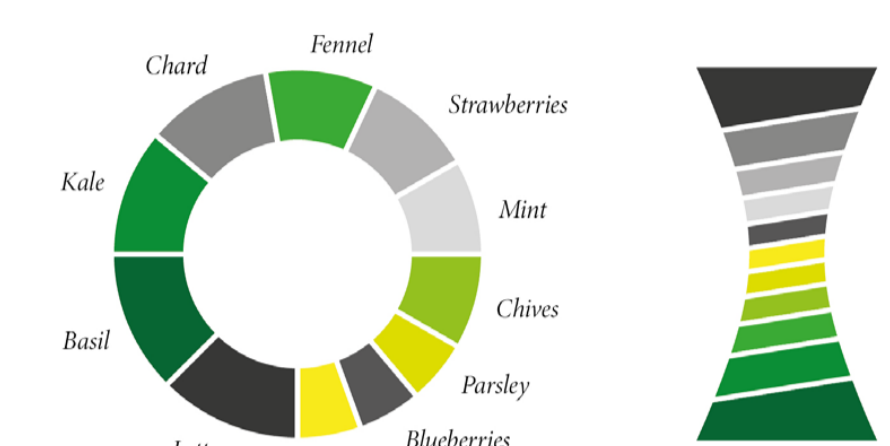
## Crops with higher sunlight requirements.



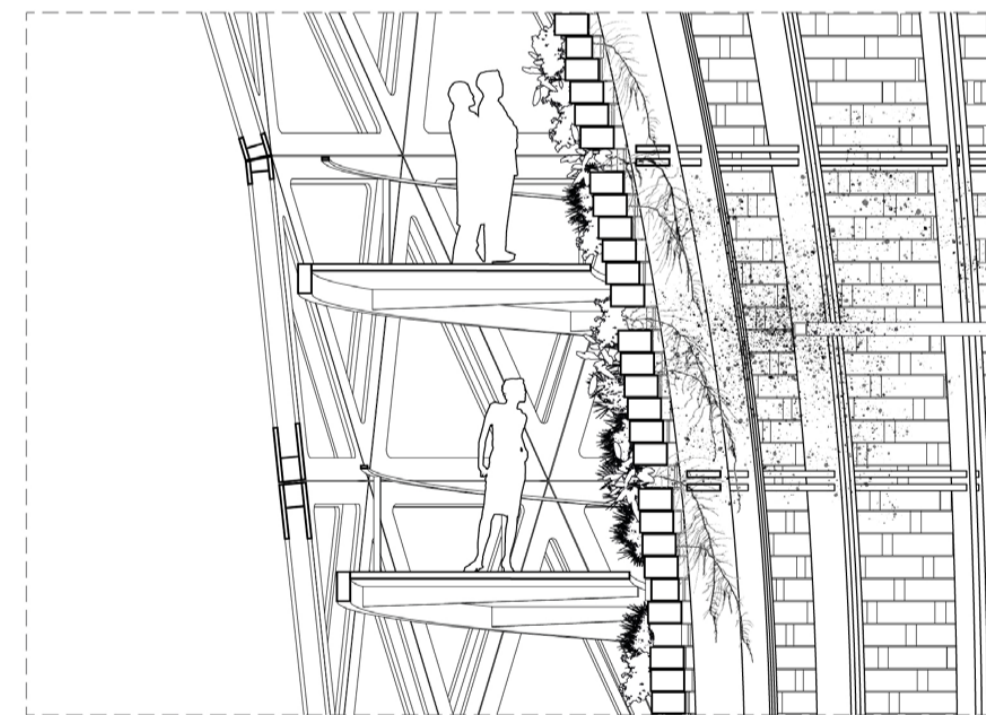
## Crops with less sunlight requirements.



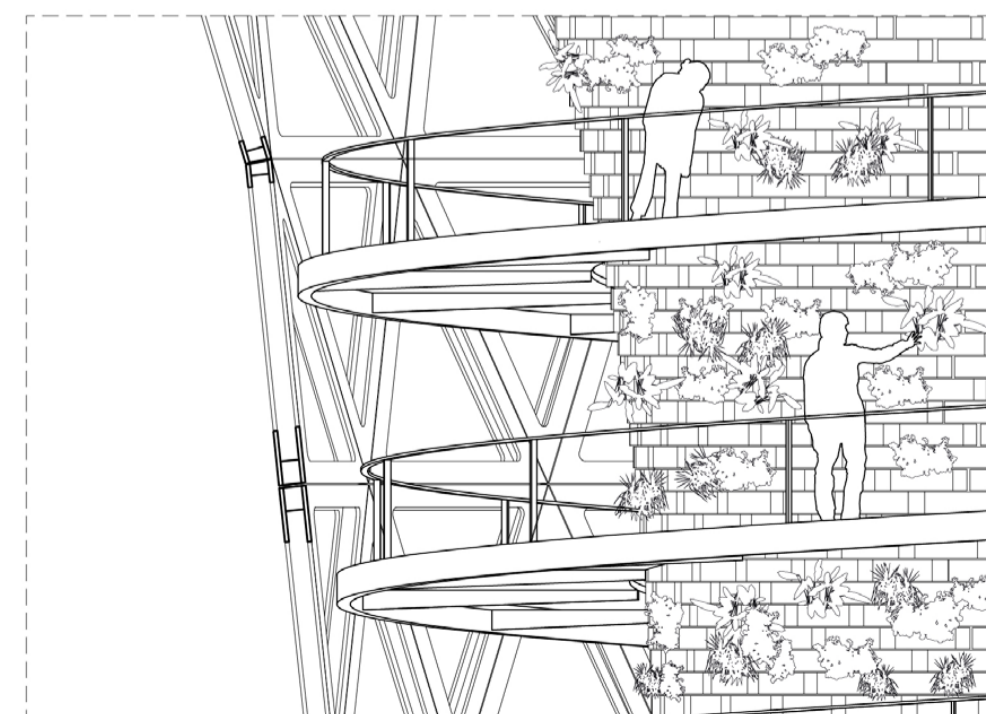
## Crop distribution within the tower.



125 120-cell Mono-Crystalline PV panels on top of the structure's mycelium core provide 112.8MWh of electricity per year. A minimal amount of that is used to run the pump that keeps water flowing through the structure to water the crops.



The roots of the crops hang freely inside the core and are watered by a sprinkler system that saves up to 250 times the amount of water required in traditional farming. The system maximizes the amount of oxygen and water absorbed by the crops.



The core of the structure is built using Mycelium bricks. The gaps between the bricks is where the crops are planted. The ramp wraps around the core and provides access to the crops.

