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GROWING CITIES: AGRITECTURE AS A POSSIBLE SOLUTION

A PROPOSAL FOR C40 REINVENTING CITIES - MILAN

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Il mondo si trova oggi ad affrontare difficili sfide ambientali e sociali: crescita demografica, fame crescente, diminuzione della qualità della dieta globale, aumento degli sprechi alimentari, danni ambientali e cambiamenti climatici. Allo stesso tempo, il nostro sistema alimentare globale è in crisi: un terzo di tutto il cibo viene sprecato, e molte persone nel mondo soffrono di insicurezza alimentare. Il cibo è uno dei principali fattori della crisi climatica globale.

C'è una forte ricerca di sistemi alimentari alternativi e più sostenibili. Tra questi, emergono varianti locali che mirano a migliorare gli aspetti sociali, ambientali, economici e di salute nutrizionale di un'area specifica.
Il 70% del cibo mondiale e il 70-75% delle risorse che generano danni all'ambiente sono consumati nelle città, che hanno quindi il potere di apportare un cambiamento trasformativo. Ma ogni città ha le proprie esigenze locali, il proprio mercato e il proprio clima. È importante determinare soluzioni adeguate a queste considerazioni per evitare errori costosi e creare impatti sociali, economici e ambientali positivi nell'area specifica. Da un lato, i primi progetti architettonici si sono spesso rivelati utopici, ignorando le realtà delle operazioni agricole di successo. Dall'altro lato, le imprese agricole spesso non hanno colto le opportunità di progettazione, estetica e integrazione ambientale e sociale nella realizzazione delle fattorie urbane.

Agritecture può svolgere un ruolo importante nella soluzione di questi problemi, integrando le pratiche agricole con quelle del design urbano in modo da rendere i progetti pratici, sostenibili e allo stesso tempo ben progettati.

Per l'individuazione di possibili soluzioni sostenibili da adottare nelle aree urbane, la ricerca parte dall'analisi degli obiettivi di sostenibilità individuati dall'Agenda 2030, dall'Accordo di Parigi, dalla Commissione EAT-Lancet e dalla dichiarazione C40 Good Food Cities, al fine di individuare indicatori relativi alla sostenibilità degli interventi suddivisi in: ambientali, sociali ed economici.

Allo stesso tempo, lo studio dei progetti passati ha fornito l'opportunità di identificare indicatori di performance urbana relativi a: integrazione, qualità spaziale e sistema alimentare urbano.

I progetti di Agritecture già realizzati sono stati analizzati, adottando gli indicatori identificati, per comprendere i principali problemi e le opportunità ad essi correlati. Allo stesso tempo, hanno fornito una comprensione delle diverse componenti che definiscono possibili strategie di progettazione efficaci.

La ricerca mira a creare un kit di strumenti di progettazione per identificare la strategia di progettazione più adatta allo sviluppo di un progetto specifico. Partendo dall'identificazione dei bisogni locali, la metodologia proposta guida il progettista passo dopo passo alla definizione di una tipologia e poi delle componenti del progetto, al fine di progettarlo e valutarne gli impatti. La metodologia e le conoscenze tratte dai casi di studio sono state infine testate nella progettazione di una proposta urbana per la riqualificazione del cavalcavia del Corvetto, a Milano, uno dei territori promossi dal programma C40 Reinventing Cities.

ABSTRACT

The world is facing difficult environmental and social challenges today: population growth, growing hunger, decreasing quality of the global diet, increasing food waste, environmental damage and climate change.
At the same time, our global food system is broken: one third of all food is wasted, yet many people around the world suffer from food insecurity. Food is a major factor in the global climate crisis.

There is a strong search toward alternative, more sustainable food systems. Among these are emerging local variants that aim to improve social, environmental, economic and nutritional health aspects of a specific area.
70% of the world's food and 70-75% of the resources that generate environmental damage are consumed in cities, which gives them the power to bring about transformative change.
The urban farming and food movement is growing rapidly in cities around the world. But each city has its own local needs, market and climate. It is important to determine appropriate solutions to these considerations to avoid costly mistakes and create positive social, economic and environmental impacts in the specific area. On the one hand, the first projects of urban planners often turned out to be utopian, ignoring the realities of successful agricultural operations. On the other hand, agricultural enterprises often missed design, aesthetic, and environmental and social integration opportunities in the implementation of urban farms.

Agritecture can play a major role in the solution to these problems, integrating agricultural practices with those of urban design in a way that makes projects practical, sustainable and well-designed at the same time.

For the identification of possible sustainable solutions to be adopted in urban areas, the research stems from the analysis of the goals for sustainability identified by the 2030 Agenda, the Paris Agreement, EAT-Lancet Commission and the C40 Good Food Cities declaration in order to identify indicators related to the sustainability of intervention divided into: environmental, social and economic. At the same time, the study of past projects provided the opportunity to identify indicators for urban performance regarding: integration, spatial quality and urban food system.

Already implemented Agritecture projects were analyzed, adopting the identified indicators, to understand the major problems and opportunities related to them. At the same time, they provided an understanding of the different components that define possible effective design strategies.

The research aims to create a design toolkit in order to identify the most suitable design strategy for the development of the specific project.
Starting from the identification of local needs, the proposed methodology guides the designer by step to the definition of a typology and then of the components of the project, in order to design it and evaluate its impacts.
The methodology and the knowledge drawn from the case studies were finally tested in the design of an urban proposal for the redevelopment of the Corvetto flyover, in Milan, one of the territories promoted by the C40 Reinventing Cities program.

1 - UN-SUSTAINABLE FOOD SYSTEMS

1.1 - Overview of food systems

- What are food systems

The **food system** has been broadly defined as:

> 'The set of food-related activities and the environments (political, socio-economic and natural) within which these activities take place.' (Pinstrup-Andersen and Watson, 2011)

> 'Food systems encompass the entire range of actors and their interlinked value-adding activities involved in the production aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry, fisheries, and parts of the broader economic, societal and natural environments in which they are established.' (FAO, 2018)

Food systems are complex and consist of various sub-systems, such as farming, waste management, and input supply. These sub-systems are intertwined with other vital systems, such as energy, trade, and healthcare. Finally, food systems are ubiquitous: every human being on earth is part of some kind of food system. Food systems can be considered as socio-ecological systems, complex and integrated systems in which humans are part of nature, which exist and function at multiple scales of space, time and social organisation.

As illustrated in **Figure 1**, a food system includes all activities related to the production, distribution, processing, sale, disposal and consumption of food that affect human nutrition and health:

1. **Production** includes factors such as the use of land for productive purposes, the distribution of land holdings within communities and regions (land tenure), land management, livestock breeding and management, and harvesting.

2. **Food processing & packaging** involves a number of post-harvest activities, including processing, storage, transport and packaging.

3. **Retail & market** refer to the promotion and sale of food products, as well as other household-related buying power activities. These can include cultural traditions surrounding food consumption, such as child feeding practices, food gifting, and the public distribution of food.

4. **Preparation & consumption** of food include those involved in the preparation, processing and cooking of food, as well as household decisions about food, household food distribution practices, cultural and personal food choices and access healthcare, sanitation, and nutritional information. There is substantial overlap and interconnection between the components of the food system, e.g. food processing, communication and education.

5. **Disposal of food residues** takes place both at household and community level. Excess food is reintroduced into the food system through appropriate territorial policies and residues are disposed of or transformed into organic matter for the production of new food.

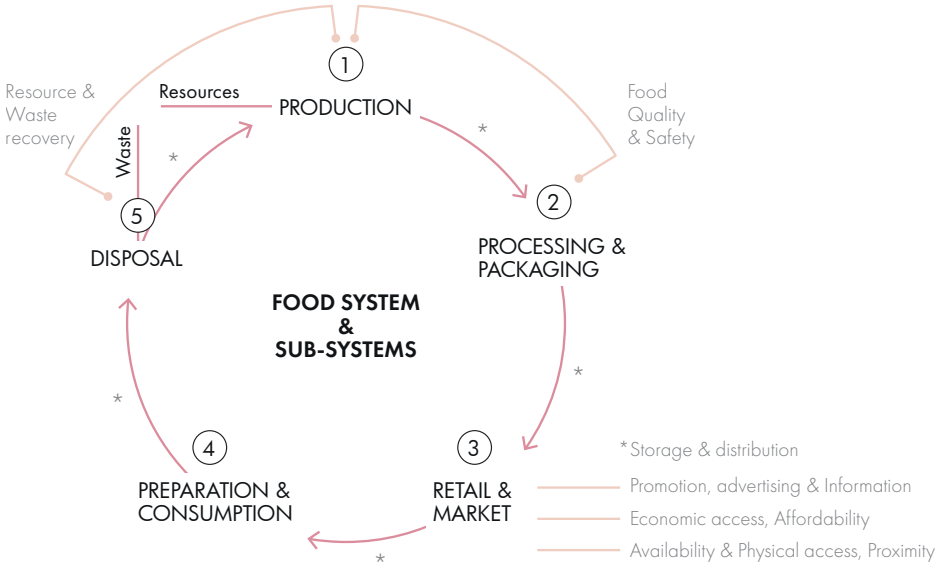


Figure 1: Food System and Sub-systems.

Food systems involve processes at multiple scales that ultimately have major impacts on the local scale as well. The criteria by which food systems are to be analysed are their ability to provide nutrition and health outcomes, as well as sustainability in the use of natural resources and in relation to territories. Levels of environmental sustainability and health depend on how natural and land resources are used. These outcomes define the success of achieving food security and sustainability as access to adequate and healthy food.
Sustainable food system is described as:

'Food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.'
(FAO, 2018)

The three fundamental aspects that make up a sustainable food system are:
environmental, social and economic sustainability.

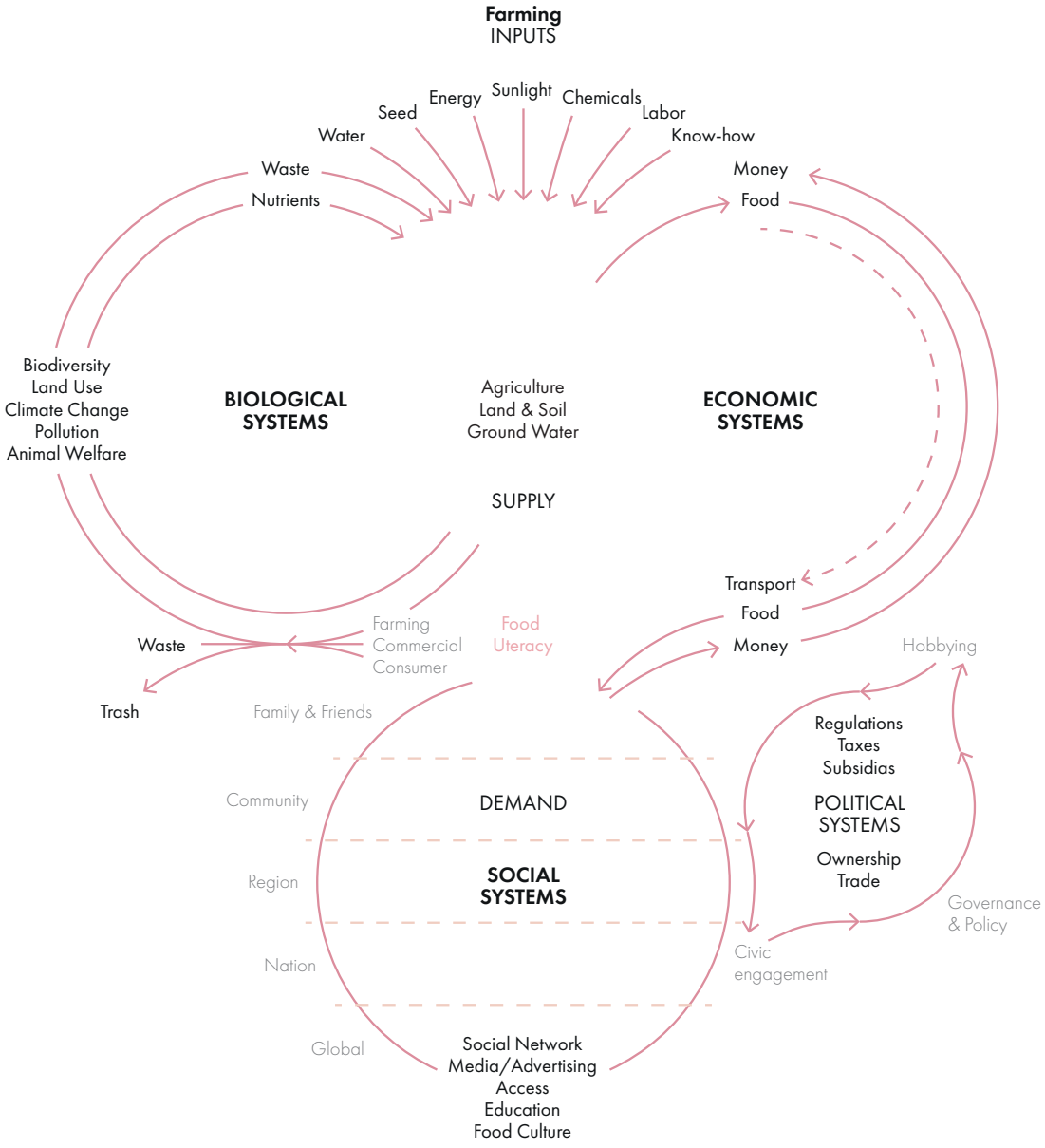


Figure 2: Food system relation with Environmental, Social and Economic Sustainability. (Rete Rurale Nazionale, 2019)

= Food systems scales: global, regional and local

One of the possible ways to organise an understanding of the complexity of food systems is to divide them between spatial scales. In this case between **global**, **regional** and **local** scales. Another way is the classification of different types of food systems by function, importance or other attributes. Subsequently, a classification is introduced based on production and the scale at which it occurs, the portions of society it involves in production and distribution, and finally the motives that drive production, distribution and consumption.

The globalized corporate food system

The globalised corporate food system:
A food system in which promoted products largely originate from major national and global production regions and are transported over long distances. Overall, very large quantities of food move through this system. There is an emphasis on efficiency in this system, with the introduction of technological innovations that improve processes at different stages.
Many of the products within this system are considered 'commodities': generic products with a standard national and global price framework. Examples are corn, different varieties of rice and pork cuts.
Production for this system takes place in many cases on family farms such as thousands of dairy and grain micro-farms. For example, family farms still account for 97% of agricultural activities in the United States even though the acreage and turnover of large farms is greater. Many family businesses are pushed to become larger and larger to take advantage of economies of scale (increased production efficiency, lower cost of goods,...).
This system is referred to as global and corporate because despite the fragmented production fabric, the organisations that coordinate, demand and organise processing and distribution seek to obtain benefits for their shareholders.
This system also generates large-scale product investments, investing in food exchanges, which generates sustainability problems. The predominant objective is return on investment and not food security or social-environmental sustainability.
Local businesses operate in this system mainly only as producers selling on the commodity market, alongside farms. The global system is mainly responsible for selling prepared food, replacing fresh and whole-grain products in diets.

Smallholder food system

Approximately 500 million smallholder farms of less than 2 hectares (5 acres) support the nutrition and livelihoods of about two billion people globally (IFAD, 2013).
Smallholders thus constitute a significant sector of the global food system, producing up to 80 per cent of local and regional food supplies in sub-Saharan Africa, South/Southeast Asia and China. Household livelihood strategies in this system seek to overcome risks and secure livelihoods and cash income. These 'semi-subsistence' farming systems tend to be intricate for this reason.
An example of the complexity of 'semi-subsistence' farming systems can be demonstrated when these systems integrate agriculture, livestock and agro-forestry food production with non-agricultural livelihood activities that overlap with the consumption of the globalised food system. Most of the food is consumed on the farm where it is produced or locally and regionally, with transport and distribution handled by relatively short-distance networks.

= Towards a sustainable food system: global and local variants

Alternatives to the modern globalised food system, termed 'quasi-parallel' movements, as well as food production and distribution strategies have recently been developed with the intention of addressing sustainability issues. The term 'quasi-parallel' is used because global and local variants focus on different strategies and scales within the food system and aim for different outcomes, even though both (global and local variants) believe they are responding to the sustainability challenges of the modern food system, sometimes using similar practices at the farm level for crop and soil management. Furthermore, it is important to note that dividing all alternatives into two variants may not cover all cases. Both variants have advantages and disadvantages.

Globalised variants of alternative food systems

These variants seek to correct sustainability problems within the framework of global food production and food trade networks.
The term 'ecological modernisation' is used to describe this approach because it aims to improve specific aspects of corporate food systems, such as environmental effects and labor standards, without changing the main characteristics of the modern global system.
For example, large-scale production, long-distance distribution and harnessing the economic power of global investment to expand production and increase efficiency.
Proponents of this approach promote strategies such as the 'triple bottom line' for companies, which refers to the environmental and social benefits of a company's activities in addition to economic profitability (a triple bottom line that reflects the 'three-legged stool' of sustainability). Proponents also point to the fact that the globalised corporate food system has by far the greatest impact on levels of social equality and natural systems, and therefore reforming its activities and performance standards is a way to have a huge impact on global sustainability.
Critics of 'ecological modernisation', including advocates of community-based food systems, complain that these reform efforts leave unsustainable features of the system untouched, such as large-scale production that erodes local communities, or the marginalisation of small farmers within markets or, in some cases, in land distribution.
Notwithstanding this discussion, it's helpful to identify some principal characteristics and patterns of this globalized approach.
Like the community-based variant, the globalised variant has prescriptive objectives for the food system in response to the sustainability problems of the modern food system.
It advocates substitution with more sustainable food production methods, such as integrated pest management, organic methods, reduced tillage and protection of watersheds from pollution with improved farming techniques.
Certification schemes are promoted that impose higher standards on producers and distribution networks, such as organic certification (which generally has to comply with the standards of the country where the food is sold).
As another example, fair trade certification seeks to improve the price paid to local producers in regions of origin, who generally receive very low prices for their products, and thus shares the approach of strengthening local economies with community-based approaches, even though it uses global trade networks.

Community-based alternatives

Similar to their globalized counterpart, alternative community-based food systems establish specific objectives but resist several aspects of the corporate food system that is globalized. The Primer on Community Food Systems states that:

> 'A community food system is one in which the production, processing, distribution, and consumption of food are integrated to improve the environmental, economic, social, and nutritional health of a particular place.'
> (Wilkins and Eames-Sheavly, 2011)

Three examples of such prescriptive objectives within common components of community food systems are:

1. Organic farming as a way to reduce the contamination of food with pesticides and improve the health of the farm ecosystem.
2. Farmers' markets and community-supported agriculture programmes that enable consumers to support farmers' activities more directly.
3. Emphasis on supporting the activities of small and medium-sized producers and resisting the pressures on production and distribution companies to become bigger and bigger.

Many other examples of community-based food systems can be found, including efforts to link smallholder farmers and their food production systems as producers for growing urban markets in developing countries, thus replacing part of the supply of the globalised corporate food system in addition to the food that is already supplied by smallholder farmers to the cities of these countries. The total volume of food handled by these community-based food systems is generally much smaller than that of globalised or smallholder food systems. Nevertheless, advocates point out that the potential market for urban consumers relatively close to small producers around the world is potentially huge. Indeed, according to USDA-Economic Research Service, 2014, alternative food production and distribution channels (e.g. organic farming) are among the fastest growing sectors in terms of volume and economic value on a percentage basis, year after year.

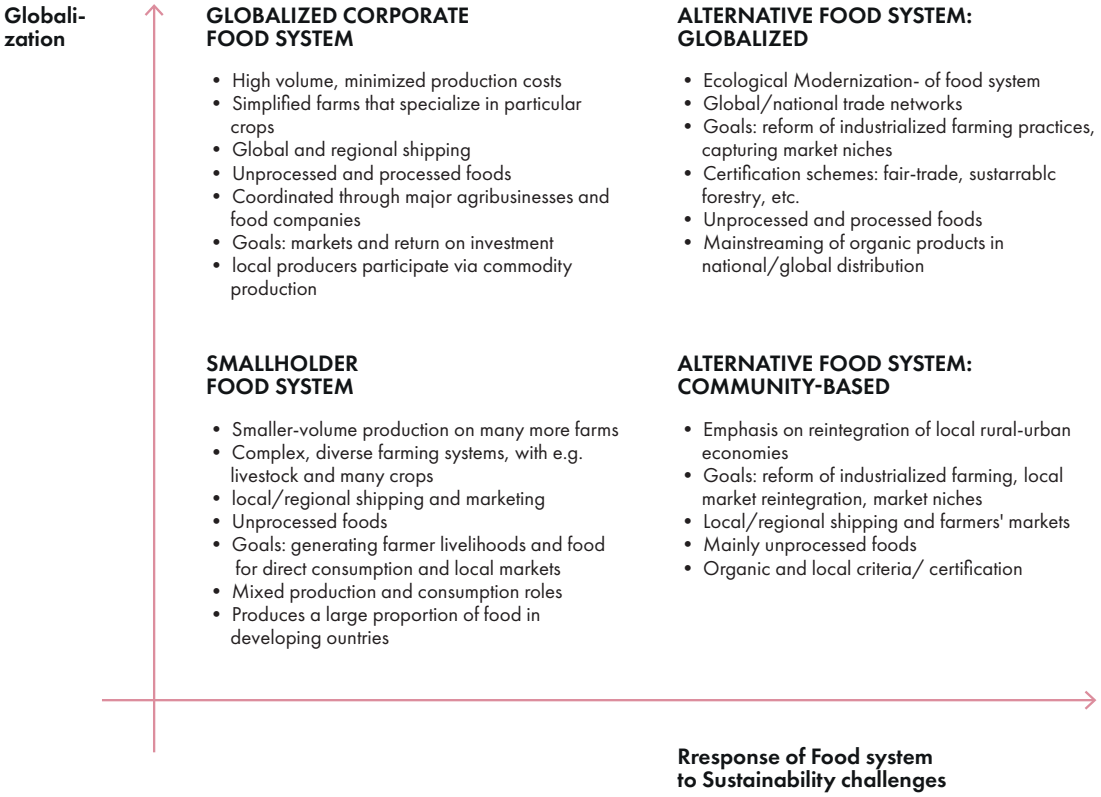


Figure 3: Alternative Food Systems in response to Sustainability challenges. (Vanek & Zimmerer, n.d.)

Input	Sub-Input	Output	Sustainable goal/action
ENVIRONMENTAL CAPITAL	• Waste • Nutrients cycle • Pest control • Biomass • Pollination • Water • Seed • Sunlight • Land & Soil • Ground Water	• Climate change (+GHG emissions) • Land use • Biodiversity • Waste • Trash • Deforestation and loss of habitat • Pollution (+Water pollution)	• Restoration of ecosystems • Conservation • Use renewable energy • Reduce pollution • Reduce waste
SOCIAL & WELL-BEING CAPITAL	• Social Network • Media / Advertising • Land access • Education - culture	• Animal welfare • Hobbying • Food culture • Health + Nutrition	• Food security • Health care • Education • Community and culture • Nutritious food • Civic engagement
GOVERNANCE-ECONOMIC CAPITAL	• Technological infrastructure - transport • Energy, fuels, fertilisers and pesticides • Research and development • Finance • Labor • Know-how • Regulations • Trades • Subsides • Ownership	• Employment • Renewable energy • Trade • Economic growth • Revenue • Profit and sales • Taxes • Salary • Jobs - Workplaces	• Employment • Profitable enterprises • Infrastructure • Fair Trade • Security • Good working conditions

Figure 4: Input/Output of food system and related sustainable actions-goals. (Rete Rurale Nazionale, 2019)

With reference to Figure 2, where the relationships between the food system and the environmental, social and economic sustainability were illustrated, the relationships between the components are shown in Figure 4. This component organisation highlights possible key actions for the development and/or modification of sustainable food practices.

1.2 - Why should we operate in cities? Main issues-challenges

It is assumed that compared to population growth, from the current 7.2 billion people in the world, an additional 2 billion people will impact the global food system in 2050.

Will it be possible to have the same eating habits in 2050?

There are several limitations in the global food system right now according to the UN Environmental Programme:

1. Growing hunger in the world

At least one in three people currently suffers from malnutrition.
794 million people suffer from hunger and at least 2 billion people do not have sufficient access to vitamins and minerals for their growth and development. Similarly, 1.9 billion people are overweight and 600 million of these suffer from obesity.
Consequently, more people are prone to diseases such as type 2 diabetes.

2. Decreasing quality of the global diet

Our food is too rich in fat, sugar, salt and various kinds of meat. This global diet has a direct impact on our health and the environment. For example, it can lead to an increase in heart disease and an increase in greenhouse gas emissions related to animal meat production.
Similarly, we are losing food diversity. 75 per cent of our food comes from 12 plants including rice, corn and hay and 5 animal species including cows, chickens and pigs.

3. Food waste

One third of the food produced is not used but wasted and thrown away.

4. Environmental damage and climate change

Our natural resources are in crisis. Fresh water sources are running out and existing water sources are becoming increasingly polluted. 33% of the soil is degraded causing a major threat to biodiversity, with tropical forests increasingly disappearing and many endangered plants and animals including bees. These environmental problems are further intensified by climate change.

These limitations of the global food system show us how it needs a major transformation. Every step including production, processing, distribution and consumption must be adjusted to ensure healthier food for the growing population and to reduce environmental impact. But first of all, coordination is deemed necessary among key stakeholders: government health authorities, producers, consumers and business people to break down silos of thinking and to work together to identify the actions needed to produce and eat food differently. For example, to reduce greenhouse gas emissions and to reduce the level of over-consumption.

Cities are experiencing a strong urbanisation phenomenon. It is estimated that "by 2050, 70% of the global population will live in cities, putting sustainable development and challenges including climate change and social inclusion at the centre of them" (UNHCR Innovation Service, 2016).
Currently, 55% of the population (4.2 billion people) live in urban areas, by 2050 an additional 2.5 billion people will move to cities, making the impact on city resources and infrastructure unprecedented. There are several factors that make a **transition to sustainable food systems necessary by putting cities at the centre of the issue**:

1. Food consumption in cities: concentration of demand

Food demand is set to increase by +70% by 2050, reaching peaks of +100% in developing countries.
The high amount of food that will be consumed in cities will also increase the amount of food waste and refuse.

2. The city as a place for food education and awareness-raising

Rapid urbanisation puts pressure on food supplies, fresh water, the environment and public health. Cities lend themselves to food education and awareness-raising in responsible purchasing, adoption of healthy diets and proper waste treatment-reduction. Local policies such as those concerning city canteens can achieve great results in educational terms.

3. Increasing food miles

Today, cities occupy less than 2% of the world's land but produce 80% of Gross Domestic Product (GDP) and over 70% of carbon emissions. According to experts, "increasing urbanisation makes the growing demand for transport of all food likely and consequently the increase in negative environmental and climate impacts" (European Environment Agency, 2021).
There is a need to reduce 'food miles', adopt sustainable energy systems and facilitate 'short supply chain' activities.

4. Land grabbing: loss of productive land

Over the past 40 years, 30% of the world's arable land has become uncultivable. Every year an area of land equal to the size of Italy becomes uncultivable. With the growing demand for food production and the lack of additional productive land, deforestation and productive displacement continue due to 'land grabbing' (GreenReport, 2007).
So far 129 million hectares of forest have been lost (equal to the size of South Africa) and food production is responsible for 80% of this phenomenon. A transition to 'sustainable agriculture' is needed.

1.3 - Future sustainable goals/agenda

In the panorama of policies put in place to make food systems more sustainable, there are several agreements that have been signed over time. Some of these relate directly to the food sector, while others represent a systemic vision of which food is a part. In order to better understand the objectives defined over time, the main agreements and actions undertaken to improve social, economic and environmental impacts at different territorial scales have been analysed.
They have followed over time:

1. Agenda 2030, September 2015 on 17 Sustainable Development Goals (SDGs) and 169 Targets to be pursued by 2030, signed by the Member States of the United Nations Framework Convention;

2. Paris Agreement, December 2015 on the reduction of greenhouse gas emissions by 2030 with updating of national plans and related commitments every five years, signed by the member states of the United Nations Framework Convention;

3. EAT-Lancet Commission. Commission Food in The Anthropocene; the EAT-Lancet Commission on Healthy Diets From Sustainable Food Systems, January 2019. Concerning the setting of concrete targets for the adoption of healthy diets from sustainable food systems globally by 2050.

4. C40 Good Food Cities Declaration, October 2019, updated to February 2022, regarding the implementation of local sustainable food policies to combat the global climate emergency by 2030, signed by 14 of the member cities of the C40 Cities Climate Leadership Group network.

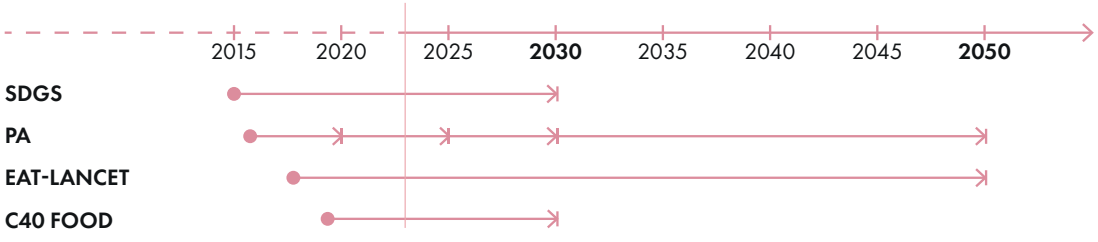


Figure 5: Timeframe of Future Sustainable Goals/Agenda.

= UN - SDGS by 2030

In September 2015, all member states of the United Nations Framework Convention came together to draw up a list of goals that aim to address environmental, social and economic challenges. The deadline for achieving the identified goals for a more sustainable future is 2030 (ESG360, n.d.).
The goals are also tools for systemic planning that enable dialogue between different actors in local and global policies. Understanding the links between the different goals and the relationships between them makes it possible to define levers for change on different territorial scales.
The second goal of the Sustainable Development Goals called '**Zero Hunger**' aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
Agri-food systems are at the heart of at least 14 of the 17 UN Sustainable Development Goals (SDGs) 2030. (United Nations, n.d.)

2,3 Access to healthy and nutritious food

2,4,11,12 Sustainable and balanced diets

2,3,11,14,15 Sustainable agro-ecosystems

2,12,15 Natural resources and eco-services

6,12 Food waste

2,5,8,10 Sustainable economic development

11,12,16 Governance models

8,11 Food, land and landscape

8,9,11 Improving urban-rural connections

1,8,9,11 Short supply chains and rural economy

Figure 6: Food Planning Goals and UN - Sustainable Development Goals (SDGs). (Rete Rurale Nazionale, 2019)

An estimated 690 million people worldwide suffer from hunger, the equivalent of 8.9 per cent of the population. The target set to achieve Zero Hunger by 2030 is hardly achievable. Following the trends, the population suffering from hunger in 2030 will be 840 million more. The main causes of world hunger and malnutrition are man-made conflicts, climate change and economic recession. In particular, COVID-19 has accelerated this growth.

In order to address the problem, of the additional 2 billion people who will populate the world by 2050, on top of the current 690 million people suffering from hunger, a profound change in the agri-food system is needed by implementing both agricultural productivity and sustainable food systems.

Eight targets related to Goal 2 - Zero Hunger were defined:

2.1 End hunger and ensure access by all people, by 2030, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.

2.2 End all forms of malnutrition, by 2030, including achieving, by 2025, the globally accepted targets for reducing stunting and wasting in children below the age of 5, as well as fulfilling the nutritional requirements of pregnant and lactating women, adolescent girls, and older individuals.

2.3 Double the agricultural productivity and incomes of small-scale food producers, by 2030, especially women, indigenous populations, family farmers, pastoralists, and fishers, by ensuring secure and equitable access to land, productive resources, inputs, knowledge, financial services, markets, and opportunities for value addition and non-agricultural employment.

2.4 Ensure sustainable food production systems and implement resilient agricultural practices which enhance productivity and increase production, by 2030, which aid in preserving ecosystems, reinforcing capacity for climate change adaptation, extreme weather conditions, droughts, floods, and other calamities, and gradually enhancing land and soil quality.

2.5 Maintain the genetic diversity of seeds, by 2020, cultivated plants and farmed and domesticated animals and their related wild species, by establishing well-managed and varied seed and plant banks at national, regional, and international levels, and encouraging the accessibility and just and equitable sharing of advantages resulting from the usage of genetic resources and associated traditional knowledge as agreed upon globally.

2.A Increase investment, by strengthening international collaboration in rural infrastructure, agricultural research and extension services, technology advancement, and seed and livestock gene banks to improve agricultural production capability in developing nations, particularly in the least developed countries.

2.B Correct and prevent trade restrictions and distortions in world agricultural markets, by simultaneously removing all types of agricultural export subsidies and export measures with comparable outcomes, following the mandate of the Doha Development Round.

2.C Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility.

- Paris Agreement by 2050

Paris Agreement on Climate Change, an international treaty concluded between the member states of the United Nations. The treaty was agreed on 12 December 2015 and covers the period from 2020. The main topics were the reduction of greenhouse gas emissions and finance (ESG360, n.d.).

The common goal of the 191 signatory states is the long-term containment of the global average temperature increase below the threshold of 2°C above pre-industrial levels and to limit this increase to 1.5°C.
The European Union and other developed countries will support climate action until 2025 by mobilising USD 100 billion per year.
The Katowice climate Package provides common rules, procedures and guidelines to make the Paris Agreement operational.
The agreement requires parties to create national plans to be reviewed and analysed every five years.

In 2020, the EU agreed to reduce emissions by at least 55% by 2030 compared to 1990 levels. The EU continues to play a leading role in the fight against climate change, taking the lead in international efforts.
The EU's ultimate goal will be to achieve climate neutrality by 2050.

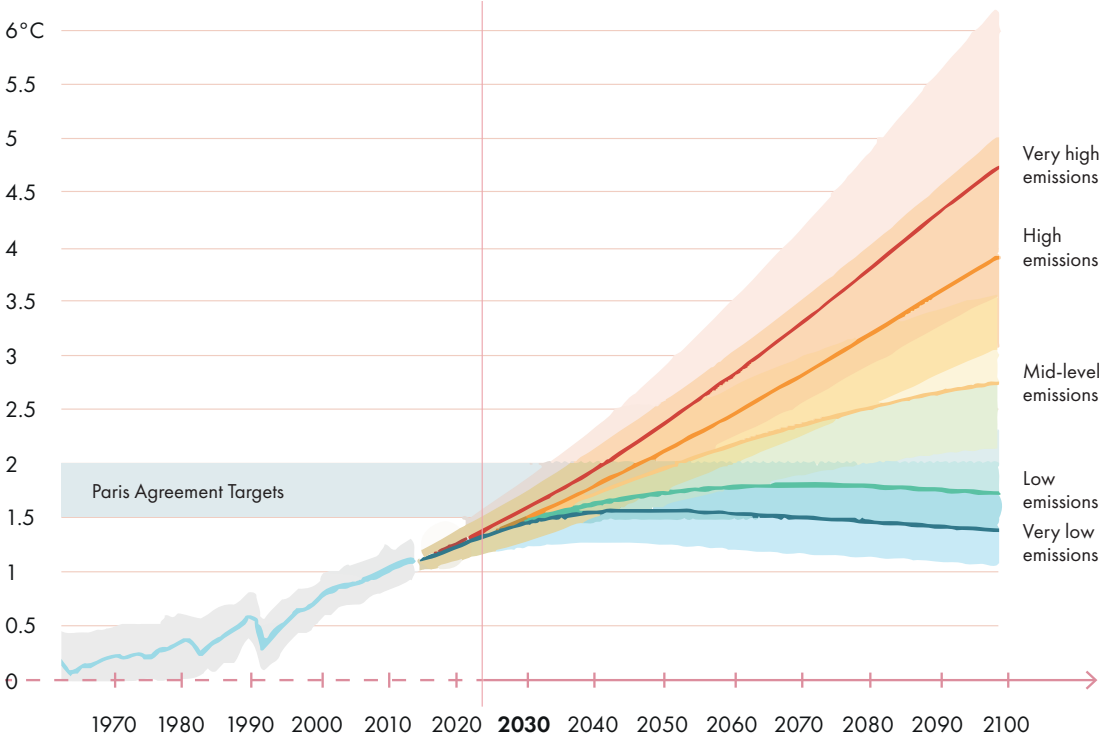


Figure 7: Trend of the Earth's surface temperature. (Duncombe, 2021)

= EAT Foundation - Planetary Health Diet by 2050

For the achievement of the UN Sustainable Development Goals (SDGs) and the Paris Agreement, scientific targets have been set for healthy diets from sustainable food systems for a population of about 18 billion people in 2050. The EAT-Lancet Commission convened a multidisciplinary team of 37 scientists to develop global scientific targets for healthy diets and sustainable food production. This was the first real attempt to set uviversal scientific goals for this objective. In order to achieve the goals, the EAT Foundation argues that a radical shift in the global diet towards a predominantly plant-based diet is necessary to confer overall health improvement and environmental benefits (EAT-Lancet Commission, 2019).

Two targets were therefore defined:

1. Healthy diets
The kind of global healthy diets to be adopted by 2050;

2. Sustainable food production
Sustainable food practices that should be adopted by 2030, in line with the SDGs and the Paris Agreement.

Healthy diets

Consist of a wide variety of mainly plant-based foods, less animal-based foods containing unsaturated fats and the elimination of highly processed foods.

This includes a major change from current global diets: a doubling of intake of healthy foods such as fruit and vegetables and halving the intake of less healthy foods including red meat and added sugars.
The shift to a healthier diet would mean a significant improvement in public health. It is estimated to prevent about 11 million deaths per year, or 19-24% fewer total adult deaths.

Figure 8 highlights the scientific goals for a planetary healthy diet, with possible ranges, for an intake of 2500 kcal/day.

	Macronutrient intake grams per day (possible range)	**Caloric intake kcal per day**
Whole grains Rice, wheat, corn and other	232	811
Tubers or starchy vegetables Potatoes and cassava	50 (0-100)	39
Vegetables All vegetables	300 (200-600)	78
Fruits All fruits	200 (100-300)	126
Dairy foods Whole milk or equivalents	250 (0-500)	153
Protein sources		
Beef, lamb and pork	14 (0-28)	30
Chicken and other poultry	29 (0-58)	62
Eggs	13 (0-25)	19
Fish	28 (0-100)	40
Legumes	75 (0-100)	284
Nuts	50 (0-75)	291
Added fats		
Unsaturated oils	40 (20-80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars All sugars	31 (0-31)	120

Figure 8: Global health diet. (EAT-Lancet Commission, 2019)

Earth system process	**Control variable**	**Boundary** (uncertainty range)
Climate change	GHG emissions	5 Gt CO_2-eq yr^{-1} (4.7 – 5.4 Gt CO2-eq yr^{-1})
Land-system change	Cropland use	13 M km^2 (11 – 15 M km^2)
Freshwater use	Water use	2,500 km^3 yr^{-1} (1000–4000 km^3 yr^{-1})
Nitrogen cycling	N application	90 Tg N yr^{-1} (65–90 Tg N yr^{-1}) (90–130 Tg N yr^{-1})
Phosphorus cycling	P application	8 Tg P yr^{-1} (6–12 Tg P yr^{-1}) (8–16 Tg P yr^{-1})
Biodiversity loss	Extinction rate	10 E/MSY (1–80 E/MSY)

Figure 9: Indicators of sustainable food production. (EAT-Lancet Commission, 2019)

Sustainable food production

The main processes in food production identified by the commission, for which quantifiable targets can be provided, recognised as necessary parameters for sustainable food production are six. For each, as illustrated in Figure 9, limits have been defined to reduce the risk of irreversible climate change, adopting as global targets those defined in the Paris Agreement.
Improving food production practices also includes the issue of reducing food loss and waste. In line with SDG target 12.3 we aim for a -50% difference in food loss and waste by 2030.

The Commission also drew up a list of five strategies for a successful transformation of food systems:

1. Seek international and national commitment to shift toward healthy diets
Making healthy food more affordable, available and accessible to the population.
Investment in information, marketing, education on sustainability.

2. Reorient agricultural priorities from producing high quantities of food to producing healthy food
Aiming beyond quantity at more sustainable and varied products that nurture human health and environmental sustainability, valuing biodiversity.

3. Sustainably intensify food production to increase high-quality output
Sustainability-driven intensification and system innovation.
The global food system must become a net carbon sink by 2040.

4. Strong and coordinated governance of land and oceans
Zero expansion policy of new farmland by reforestation of degraded land.
Half Earth' strategy: conservation of at least 80 per cent of pre-industrial species richness while protecting the remaining 50 per cent of the Earth as an intact ecosystem.

5. At least halve food losses and waste, in line with UN Sustainable Development Goals
Introduction of technologies in the supply chain and public policies to reduce food loss and waste by 50% globally, in accordance with the SDG targets.

= C40 - Good Food Cities Declaration by 2030

How cities are achieving the planetary health diet for all?
The summaries of the cities highlight the climate actions they are taking to achieve the goals of the declaration, emphasizing their focus on building a more sustainable, resilient, and equitable future through ambitious and urgent measures that span past, present, and future (C40 Cities, 2022).
They are working collaboratively towards this common goal.
Many cities have signed up to programmes with tough targets and concrete implementation steps to mitigate the negative impact of climate change. The goals to be achieved by 2030 aim to enable citizens to thrive. This is done by living streets that put citizens first, improving the quality of the air we breathe, creating low-cost, energy-efficient homes and dwellings, ensuring access to a balanced, nutrient-based diet that does not harm the planet, and moving towards zero-waste policies.
Food is a major driver of global environmental change.
This industry plays a major role in climate change, biodiversity decline, freshwater consumption, disruption of global nitrogen and phosphorus cycles, and alterations to the Earth's systems.
In 2017, emissions associated with food consumption in C40 cities accounted for 13% of the total greenhouse gas (GHG) emissions of cities. Emissions are also set to increase by 38% by 2050 if no action is taken.

The goals include achieving a 'Planetary Health Diet' for all by 2030, with a balanced and nutritious diet that reflects the culture, geography and demography of their citizens.

This will happen through healthier and more sustainable food systems by 2030 by including the following principles:

1. Adopting food procurement practices that are in line with the Planetary Health Diet, with a preference for sourcing from organic agriculture.

2. Encouraging a rise in the consumption of healthy, plant-based food in urban areas by moving away from unsustainable and unhealthy diets.

3. Reducing food loss and waste by 50% from a 2015 baseline.

4. Within two years of the endorsement of this declaration, collaboration will be established with citizens, businesses, public institutions, and other organizations to create a joint strategy for implementing the outlined measures and achieving the stated goals inclusively and equitably. This strategy will then be incorporated into the Climate Action Plan.

Most of the world's food is consumed in cities (80% of all food is expected to be consumed in cities by 2050).
The signing of the C40 Good Food Cities Declaration is an important step toward improving diet quality and increasing access to food.

The cities that signed the declaration are:

1. Barcelona
2. Copenhagen
3. Guadalajara
4. Lima
5. London
6. Los Angeles
7. Milan
8. Oslo
9. Paris
10. Quezon City
11. Seoul
12. Stockholm
13. Tokyo
14. Toronto

Figure 10: Signatory cities of the Good Food Cities Declaration.

Barcelona

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- More controls and restrictions on soup kitchens, kindergartens and zoo food services, updating the city's guidelines for public food procurement.
- Implementation of educational projects in schools to introduce sustainable nutrition.
- Community-wide sharing of healthy eating habits and emotional support. Creation of a project aimed at improving health through food. Weekly exchange meetings.
- Opening of sales centres for quality products in strategic public areas.

2. Reduction of food waste

- Opening of a local exchange centre to facilitate the direct sale of small and medium-sized farmers' products.
- Opening of a new food recovery centre that will double its capacity (to 3000 tons/year).
- Launch of the Ecowaste programme 4 Food, to reduce the spoilage of food at events, fairs and conferences.

3. Local food production

- Development of an Urban Agriculture strategy, with the creation of social, community and communal gardens in the city.

Copenhagen

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Inclusion of a 'climate weight' in tender documents for food procurement. Wholesalers are motivated to lower prices on climate-friendly products.

2. Reduction of emissions

- Training of staff in public canteens to prepare more climate-friendly meals. Over 1000 kitchens already trained in city's daycare centres, schools, nursing homes and social care services.
- Introduction of a new corriculum on waste sorting and circular economy in schools and institutions.

3. Reduction of food waste

- Ongoing data collection for future actions to reduce food waste in municipal kitchens and institutions.
- Creation of campaigns to reduce avoidable food waste in households.
- Creation of social food communities in public housing areas that recover and distribute fresh surplus food in partnership with a local NGO.

Guadalajara

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Changing the menus of public canteens to follow the planetary health diet. Education of staff working there.
- Creation of sustainable nutrition campaigns for adolescents. Teaching about the entire sustainable food chain. Adults were also involved in the awareness-raising programme for teenagers, teaching them about family gardens, healthy eating habits and how to reduce junk food consumption.

2. Reduction of food waste

- Family training on composting food waste.
- Future collection of organic waste still under development.

3. Local food production

- Creation of nine urban community gardens to provide breakfast food.

Lima

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Creation of an ordinance in October 2020 to reduce malnutrition and strengthen the sustainability of the local food system. Raising quality standards and actions will be taken by the Food Systems Council.
- Creation in June 2021 of an ordinance monitoring kiosks, municipal canteens and ensuring access to healthier food. Beyond a certain perimeter from the schools, trade of unhealthy food is prohibited.
- Creation of the 'Lima Eats Healthy' programme that promotes restaurants that respect national standards including displaying the calorie content of dishes.
- Bio-garden creation programme with 270 practical workshops in 369 common plots. The programme includes 1,759 home gardens and 92 community bio-gardens.

2. Reduction of food waste

- Creating campaigns against food waste in public markets.
- The same bio-garden awareness campaign also resulted in 307 home composters and 25 communal composters. Altogether recovering 4.47 tonnes of organic waste and more than 1985.73 m2 converted into productive soil.

3. Local food production

- Bio-gardens in Lima have been installed in several buildings including a shelter, a nursing home for the elderly, residential complexes and several streets in the city. Vegetables are harvested and consumed locally, bringing health and ecological benefits. Some converted spaces have generated public space and greenery by using reused material, while increasing citizens' sense of belonging to the local community.

London

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Awareness-raising through public meals (7 million per year) towards the purchase of healthier and more sustainable foods. Similarly, this is also causing a reduction in health inequalities.
- Within a 400m radius of the schools the quality of the food sold is controlled.
- Creation of projects promoting the sale of quality food products from local convenience stores.

2. Reduction of emissions

- Reducing food loss and waste and adopting a healthier diet could reduce emissions based on food consumption by 31% per year. Analysing the flow of materials from 2020. The analysis looked at the masses of materials flowing through the city and their emissions along the entire food and beverage supply chain. 6,347,000 tonnes of food per year are produced to supply London causing 15,483kt of CO2.

3. Reduction of food waste

- Future creation of plans to reduce food loss and waste. The analysis of movements in the city also showed that 836,000 tonnes of imported food is lost before reaching London and 931,000 tonnes are wasted by households.

Los Angeles

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- 6 million meals were provided to the elderly and most needy, working with 31 restaurants part of the Great Plates programme that provided fresh and nutritious produce, especially vegan and vegetarian meals.
- Agreement signed in which each restaurant or retailer must follow the Good Food Purchasing Programme.
- Establishment of 2 new Good Food Zones in departments without fresh and affordable produce.
- 65 corner shops in low-income areas are part of the Healthy Food Market Network programme by obtaining funding and training. In addition other funds are there for street carts selling healthy food.
- 1 million allocated for food relief organisations to spend on cold storage and food storage.

2. Reduction of food waste

- 18,000 households use bins to collect food waste.
- Large entities including airports are obliged to donate some of the unsold, high quality food to local NGOs.
- The RecycLA initiative (public-private partnership) served 8.5 million meals to the needy.
- 750,000 allocated to expand composting sites at farmers' markets.

3. Local food production

- USD 1 million allocated to assist food pantries located in the TFG.

Milan

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Since 2015, Milan has committed to its own Food Policy programme.
- With the Milano Ristorazione programme, a municipal public canteen, the city serves 85,000 meals a day, 17 million a year. There are 26 cooking centres that distribute meals to 760 canteens.
- Creation of educational kits for children and teachers including 'Linee guida sugli orti scolastici a Milano' and 'Una mela al giorno', educating families on healthy eating and sustainability.

2. Reduction of emissions

- Reduction, from 2015, of 20% of greenhouse gas emissions for food used in school canteens.

3. Reduction of food waste

- Each Milan Food Hub recovers 10 tonnes of food waste per day, 154,000 meals per year. Donations and surpluses arrive at the hubs and are redistributed.

Oslo

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- The Improvement and Development Agency was established to play a coordinating role and improve inter-sectoral collaboration to shift diets towards sustainable, plant-based and healthy food in the city.
- Creation of food projects including free school meals and staff training on sustainable nutrition.

2. Reduction of emissions

- Creation of Klimato, a menu planning tool that can calculate and communicate the climate impact of the meal served.

Paris

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Offering sustainable food in public canteens in line with the Sustainable Food Plan, created in 2010, in which it commits to having at least 50 per cent sustainable food used in its 30 million meals. By 2022, it aims to achieve 100% healthy and sustainable products.
- Contributions to a new agricultural economy: enhancement of short supply chains, proximity and sustainable practices for people and the environment.
- Creation of AgriParis, through a round table with citizens, for agro-ecological transition to initially support city canteens and then expand to commercial catering and food aid.
- Creation of collective kitchens and social and solidarity food shops.

2. Reduction of food waste

- Various educational actions were undertaken to reduce food waste in school canteens and remove the use of plastic in the latter.

Quezon City

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Adoption of a healthy public food purchasing policy in which the city's nutritional standards are set to which all suppliers must refer. Also purchasing fresh produce from urban farms.
- Creation of a city ordinance that strengthens food security and urban agriculture. Idle land is exempt from paying taxes if used for urban agriculture for a minimum period of 3 years.
- Through the Grow QC campaign, in addition to urban gardens, community canteens, vegetable nurseries and aquaponic technologies have been created as an alternative means of livelihood for citizens.

2. Reduction of emissions

- Installation of four biodigesters on model farms to experiment with the treatment of biodegradable waste from citizens. Each biodigester uses 25 kg of waste every 1/3 day for 3 months. The methane generated can be used for cooking on the farm while the waste becomes fertiliser.

3. Reduction of food waste

- A food waste analysis study is planned.

4. Local food production

- There are 303 urban gardens/community farms in the city. Among them are 7 model community farms where modern urban farming technologies/techniques are taught to citizens.
- Through Joy of Urban Farming, a local programme, 52,000 starter kits and seedlings have been distributed to encourage the creation of urban gardens. This has also strengthened the sense of community over the past 10 years.

Seoul

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Introduction of ecological food purchasing programmes for school meals. In 2020, 55% is.
- A Public Food Centre has been established in each of the 25 districts to allow direct purchase of eco-friendly food.
- Subsidies are created for the installation of fruit and vegetable vending machines to ensure citizens have access to healthy food. The city also checks the nutritional content of food.

2. Reduction of food waste

- Introduction of the 'Pay as you Throw' system and creation of campaigns to reduce food waste.

Stockholm

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Initiation of programmes to make canteen meals more sustainable including supply chain control and education of staff in charge.

2. Reduction of emissions

- Introduction of a digital tool to examine the CO2 emissions of food purchased by the city.

3. Reduction of food waste

- Introduction from 2021 of an obligation for all companies preparing food to collect all their food waste.
- More than 330 companies have signed a pact in which they commit to intensify their efforts in reducing food loss and waste.

Tokyo

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Promotion by the government in cooperation with municipalities and businesses to improve inhabitants' eating habits.
- Promotion of restaurants offering menus with ≥120g of vegetables per meal, of which there are currently 450.

2. Reduction of emissions

- In the 'Zero Emission Tokyo Strategy' programme, zero food waste is planned by involving companies at the forefront of ICT and AI technology and creating promotional/educational campaigns.

3. Reduction of food waste

- Aim to halve food waste by 2030 and reduce it to zero by 2050 in the vision of zero-emission Tokyo.
- Programmes to convert food waste into feed and fertiliser.

Toronto

1. Raising public awareness and facilitate the commercialisation of organic, local and short-chain food products

- Identification, with the Baselining for a Circular Toronto study, through an analysis of food system flows of opportunities and siphons for greater circularity and sustainability also in the food system.
- Promotion of various initiatives that support the cultivation of and access to healthy and culturally relevant food: City's Black Food Sovereignty Plan, Tkaronto Indigenous Prosperity Plan and Community Engagement & Entrepreneurial Development urban farms.

2. Reduction of emissions

- Presentation of a Net Zero Strategy for Toronto. This in relation to local food consumption.

3. Reduction of food waste

- Activation of the Urban Harvesting Programme to redistribute surplus food, training and education in food preservation practices.

Example or urban practices

Climate-friendly products
2,6,8,10,11,12

- Inclusion of a 'climate weight' in tender documents for food procurement.
- Introduction of systems to monitor CO2 emissions and nutritional values of food in the city.

Community creation & Food Security
1,2,9,10,14

- Community-wide sharing of healthy eating habits and health care support.
- Creation of social food communities in public housing areas.
- Creation of collective kitchens and social and solidarity food shops. Vegetable nurseries.
- Promotion of various initiatives that support the cultivation of and access to healthy and culturally relevant food.

Education projects in schools
1,2,8

- To introduce sustainable nutrition.
- Introduction of a new corriculum on waste sorting and circular economy.
- Distribution of educational kit like 'Guidelines on school gardens'.

Urban Agriculture strategies
1,3,4,7,10

- Creation of social, community and communal gardens in the city.
- Bio-garden creation programme with practical workshops in common plots. In schools, residential complexes, elderly housing and converted public spaces.
- Creation of urban community gardens to provide breakfast food.
- Creation of model community farms where modern urban farming technologies/ techniques are taught to citizens.

Educational campaigns
2,3,4,5,7,11,13

- Creation of campaigns to reduce avoidable food waste in households.
- About family gardens, healthy eating habits and how to reduce junk food consumption.

Control of public canteens.
1,2,3,4,5,6,7,8,9,11,12,14

- City's guidelines for public food procurement.
- Training of stuff in public canteens.
- Changing the menus of public canteens to follow the planetary health diet.

Proximity - Quality Food in strategic public areas
1,4,5,6,9,10,11,13

- Opening of sales centres for quality products in strategic public areas.
- Opening of a local exchange centre to facilitate the direct sale of small and medium-sized farmers' products.
- Beyond a certain perimeter from the schools, trade in unhealthy food is prohibited.
- Funds for street carts selling healthy food.
- Enhancement of short supply chains.

Food waste - Recovery
1,2,4,5,6,7,9,10,12,13

- Opening of a new food recovery centre.
- Data collection.
- Education and creation of home composters and communal composters.
- Installation of biodigesters on model farms to produce methane and fertiliser.

Cities (C40 Cities, 2022):

1	Barcelona	8	Oslo
2	Copenhagen	9	Paris
3	Guadalajara	10	Quezon City
4	Lima	11	Seoul
5	London	12	Stockholm
6	Los Angeles	13	Tokyo
7	Milan	14	Toronto

1.4 - Considerations: City food crisis

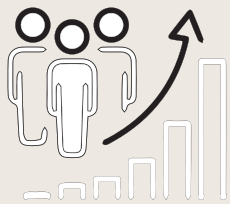
= WHY we should act

Towards a sustainable food system

The World today faces difficult challenges: climate change, rapid urbanisation. increasing inequalities, public health,... At the same time, our global food system is broken: one third of all food is wasted, yet many people around the world suffer from food insecurity. Food is a major factor in the global climate crisis.
The inefficiency of the current food system and climate change are some of the factors that, combined, have a major impact on the material and immaterial characteristics of cities, including the lack of healthy, sustainable and accessible food for all. The food system needs a major shift towards more sustainable practices.

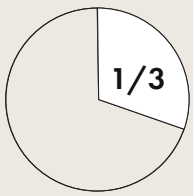
POPULATION GROWTH

It is assumed that compared to population growth, from the current 7.2 billion people in the world, an additional 2 billion people will impact the global food system in 2050.



GROWING HUNGER IN THE WORLD

At least one in three people currently suffers from malnutrition.
794 million people suffer from hunger and at least 2 billion people do not have sufficient access to vitamins and minerals.

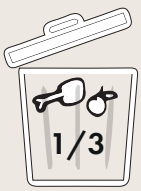


DECREASING QUALITY OF THE GLOBAL DIET

Our food is too rich in fat, sugar, salt and various kinds of meat. This type of global diet can lead to an increase in heart disease and an increase in greenhouse gas emissions related to animal meat production.

FOOD WASTE

One third of the food produced is not eaten but wasted and thrown away.



ENVIRONMENTAL DAMAGE AND CLIMATE CHANGE

Fresh water sources are running out and existing water sources are becoming increasingly polluted. 33% of the soil is degraded.

= HOW we should act

Sustainable Development Indicators

1. SOCIAL COHESION

What social qualities-impacts does it generate?

1.1 INCLUSIVITY
An intervention for all local communities.
"Who is it addressed to? What needs do citizens have?"
Mapping the needs of all users in the area.

1.2 HEALTHY AND SAFETY
Ensuring quality of life and food security for citizens. Improving health care through education and specific community interventions.
"Are there citizens with food/nutrition problems?"
Mapping awareness opportunities toward healthy diet adoption and the presence of health organizations.

1.3 ENGAGEABILITY
Involve citizens and support the transition to behavioural change in food culture. Creating an active and sustainable community.
"Which activities does it offer to involve?"
Local user journeys with touchpoints and provided experiences.

2. ENVIRONMENTAL VIABILITY

What environmental qualities-impacts does it generate?

2.1 CLIMATE RESILIENCE
Reduction of air, land and water contaminants. Reduction of waste, energy use and heat island by adopting nature-based solutions.
"How are climate challenges being addressed?"
Mapping actions taken in response to climate change.

2.2 CIRCULARITY
Land, energy, water, waste and nutrients preservation, re-use, recycling and/or recovery.
"Does it support circular economy practices?"
Mapping which circular economy actions have been taken.

2.3 REGENERATIVITY
Regeneration-preservation of soil and nutrients by adopting solutions to regenerate ecosystems, fostering biodiversity.
"Are there ecosystem regeneration actions?"
Mapping which actions have been taken to regenerate natural ecosystems.

3. ECONOMIC VIABILITY

What economic qualities-impacts does it generate?

3.1 PROFITABILITY
Support the activity and development of new sustainable enterprises.
"Does it generate a profit? Are there funds for development?"
Cash flow analysis and and financial opportunities.

3.2 ATTRACTIVENESS - ACTIVATOR
Ability to inspire, creating a service centre-ecosystem promoter of a green economy.
"Does it attract new investors/activities that generate work-projects with positive spin-offs in the area?"
Mapping possible evolutions of the business model and its scalability-replicability.

3.3 EMPLOYABILITY AND TRAINING
Promoting innovation and the exchange of knowledge by generating job opportunities.
"Does it generate jobs with good working conditions for citizens? Does it train new qualified workers?"
Local user journeys with touchpoints and provided experiences.

Sustainable Development KPIs

1.1 Inclusivity: a place for everyone. Involve the local communities in the decision-making process.
- % of residents considered and supported by design and planning choices in the neighbourhood.
- % of socio-community programmes to which the project gives continuity and importance.

1.2 Healthy and safety: sustainable living. Active food security programmes in the neighbourhood
- Percentage of food insecure households on the Food Insecurity Experience Scale (FIES).
- Percentage of people supported by food and/or social assistance programmes.
- Number of children and youth (under 18 years of age) benefitting from school feeding programmes with supplies from the urban agriculture project.

1.3 Engageability: experiences to engage and educate citizens in food culture.
- Level of involvement offered to the citizen.
- Number of experiences by type offered to citizens.

2.1 Climate resilience: reducing emissions to ensure the quality of local communities.
- Operational, embodied and consumption-based emissions in tCO_2e or tCO_2e/m^2.
- Estimation of carbon storage and sequestration.
- Number of trees planted during the project.
- % of the district surface (sqm) that is permeable.
- Estimated surface for the potential creation of energy from renewable sources e.g.: surface for solar/thermal panels, photobioreactors,...
- Estimation of the volume of rainwater and wastewater that can be collected and/or purified and reused.
- Number and type of Nature-Based Solutions to increase neighbourhood comfort e.g.: right to privacy, sound absorption and insulation, smell comfort,..

2.2 Circularity: exploit existing resources and reduce food waste by facilitating recovery.
- % of buildings repurposed or retrofitted in development (compared to those that are entirely new builds).
- Total annual volume of surplus food recovered and redistributed for direct human consumption.

2.3 Regenerativity: supporting natural ecosystems.
- % of nutrients for food production recovered without polluting the urban water system and land.
- Number of initiatives to restore ecosystems. e.g.; neighbourhood actions to restore flora/fauna.

3.1 Profitability: financial sustainability.
- Estimated annual profits.
- Public funding received and opportunities.

3.2 Attractiveness - activator: attraction of commercial support services by creating a green ecosystem.
- Number of new green businesses in the area, split by type.
- Number of premises certified with sustainability credentials e.g. BREEAM, LEED, Plan B, SBTis.
- Number of people who can benefit from the activities-services associated with the project.

3.3 Employability and training: promote decent employment, participatory education, training and research.
- Number of formal jobs related to the urban food system that pay at least the national minimum or living wage, split by demographic and type.
- Number of opportunities for food system - related learning and skill development.

Key ESG actions

Starting from the main global agendas, food-related actions/goals were compared in order to define systemic objectives for each component of the food system.

ENVIRONMENTAL

AIR - Reduction of atmospheric contaminants and monitoring of air quality

- Removal of volatile organic compound (VOC) pollution
- Reduction of air contaminants (PM, O3, NOx, SOx): • • Control the GHG emissions: -55% by 2030 and climate neutrality by 2050.
- Air quality monitoring

WATER - Reduction of fresh water use and contaminants, control of nutrient cycles and monitoring of water quality

- BOD and COD abatement
- Reduction of suspended solids (SST)
- Nitrogen abatement: • Control the Nitrogen cycling.
- Phosphorous abatement: • Control the Phosphorus cycling.
- First rainwater treatment
- Water quality monitoring: • Control the Freshwater use.

SOIL - Reduction of cropland use and regeneration-preservation of soil

- Ecological regeneration: • Control the Land-system change; • Strong and coordinated governance of land and oceans.
- Preservation of soil permeability
- Soil phytoremediation/bonification

BIODIVERSITY - Limiting losses, reduction of waste and restoration of ecosystems

- Biodiversity: • Maintain the genetic diversity of seeds; • Control the Biodiversity loss.
- Resource & Waste Recovery: • • At least -50% food losses and waste by 2030

SOCIAL & WELL-BEING

HEALTH AND WELL-BEING Education towards health diets to improve health care

- Psychophysical benefits
- Promoting, Advertising & Information for awareness: • Seek international and national commitment to shift towards healthy diets.
- Nutrition education: • Sustainability training and education.

FOOD - Produce more healthy and sustainable food providing food security

- Food Quality and Safety: • End all forms of malnutrition; • Reorient agricultural priorities from producing high quantities of food to producing healthy food.
- Economic Access, Affordability: • End hunger and ensure access to all people.
- Availability and Physical Access, Proximity
- Diversification of supply
- Continuity of production
- Economic benefit

COMMUNITY - Creation of sustainable cities and communities

- Civic engagement: • Opportunities for cooperation and community activities.
- Shared spaces: • Provide universal access to safe, inclusive and accessible, green and public spaces.
- Protect and enhance local values/culture: • Protect and safeguard cultural and natural heritage.

GOVERNANCE-ECONOMIC

FINANCE - Investments in the food sector

- Profitable enterprises: • Double the agricultural productivity and income of small-scale food producers; • Increase investments in agricultural sector.
- Infrastructure

POLICIES - Support of positive actions in the territory

- Fair trade: • Correct and prevent trade restrictions and distortions in world agricultural markets; • Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information; • Ensure sustainable food systems and implement resilient agricultural practices.

WORK - Good job opportunities

- Employment
- Good working conditions

ENERGY - Use renewable energy

- Use of energy from renewable sources.
- Use of energy-efficient systems and equipment.

Sources:

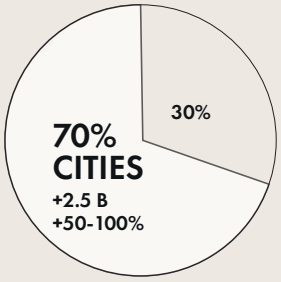
- SDGS
- Paris Agreement
- EAT - Health Diets

= WHERE we should act

The role of cities

The World today faces difficult challenges: climate change, rapid urbanization. increasing inequalities, public health,... At the same time, our global food system is broken: one third of all food is wasted, yet many people around the world suffer from food insecurity. Food is a major factor in the global climate crisis.
The inefficiency of the current food system and climate change are some of the factors that, combined, have a major impact on the material and immaterial characteristics of cities, including the lack of healthy, sustainable and accessible food for all. The food system needs a major shift towards more sustainable practices.

POPULATION

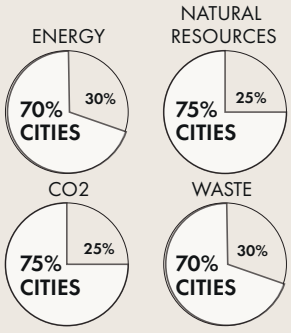


Cities are becoming the place where people meet and grow. An additional 2.5 billion people are expected to live there by 2050, causing an average population growth of +50% and peaks of +100% in the case of some developing countries. By 2050, megacities will be home to 70% of the global population (UNHCR, 2016).

FOOD CONSUMPTION

Cities consume up to 70% of nationally produced food despite the fact that 90% of people living in the suburbs of large urban agglomerations in developing countries suffer from food insecurity (FAO, 2018).

ENVIRONMENTAL IMPACTS



Cities are responsible for the greatest amount of environmental damage and climate change.
Today, about 60-80% of global energy consumption and more than 75% of natural resource consumption is borne by cities, where 75% of CO2 emissions and 70% of waste are produced despite occupying only 3% of the Earth's land.

Population growth and rapid urbanization place sustainability in urban areas as a central issue. The 2030 Agenda created a specific goal called 'sustainable cities and communities'.
Food with its ability to virtuously connect elements in response to poverty, food insecurity, unhealthy habits, wellbeing, health and citizens' sense of community makes the need and opportunity to work on the creation of a sustainable food system in cities.

= WHAT should we do?

Looking for a possible answer to the issue of un-sustainable food system

The World today faces difficult challenges: climate change, rapid urbanization. increasing inequalities, public health,... At the same time, our global food system is broken: one third of all food is wasted, yet many people around the world suffer from food insecurity. Food is a major factor in the global climate crisis.
The inefficiency of the current food system and climate change are some of the factors that, combined, have a major impact on the material and immaterial characteristics of cities, including the lack of healthy, sustainable and accessible food for all. The food system needs a major shift towards more sustainable practices.

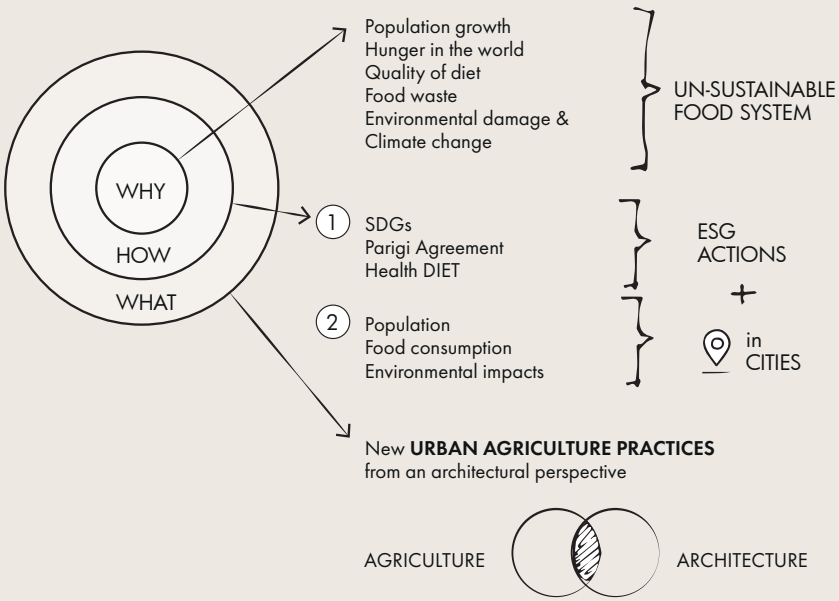


Figure 11: Golden Circle theory applied to the identification of a possible answer to the issue of un-sustainable food system.

Cities need to reconnect with agriculture to improve access, education and quality of food. New urban agriculture practices can emerge to foster educational-training activities, to restore green spaces for human and environmental health, and to create moments of exchange-interaction within communities.
The growing problems of cities combined with those related to the food system create the possibility of looking at agriculture through a new lens, from an architectural perspective in which agriculture merges with urban architecture.
Cities must move from being mere hubs of destination to catalysts of solutions for food and environmental sustainability (Barilla Center for Food and Nutrition, 2020).

2 - A POSSIBLE ANSWER: AGRITECTURE

2.1 - Overview - What is Agritecture

For centuries 'urban' and 'agrarian' have been two distinct categories placing the city and the countryside in stark contrast to each other. Only recently, thanks to the public's continued interest in accessible and healthy food and its production, distribution and consumption in a globalized world, have people begun to talk about agrarian production in cities. These are finally improving over time due to the spread of knowledge among scholars-planners and architects/urban planners. Agritecture is a term that refers to the use of architecture to create spaces for agricultural production in or near urban areas. It is a way to integrate agriculture into urban life and to make better use of the resources available in the city, such as soil, water, and sunlight.

Agritecture can take many forms, such as vertical gardens, rooftop greenhouses, urban farms, community gardens, and many others. It can be used both to produce food for local consumption and to create green spaces within the city. Agritecture has many benefits, such as reduced environmental impact, supporting local food production, creating job opportunities, and increasing biodiversity in cities. It can also help improve air and water quality, reduce carbon footprints, and create more cohesive and sustainable communities.

The most common definition of agritecture is:

> 'We define Agritecture as the art, science, and business of integrating agriculture into the built environment.'
> (Henry Gordon-Smith, 2011)

This term describes how cities can utilize agriculture to tackle environmental, social, and economic challenges while building robust food systems that can withstand the impacts of climate change. By definition, agritecture is about applying architectural thinking to the design of agriculture for the built environment.
Various designers have been challenged in giving a spatial quality to agriculture within urban systems from an architectural-design perspective. Agritecture is concerned with integrating the disciplines of agriculture and architecture so that urban farms can be practical and well-designed at the same time, seizing important design opportunities.
For multi-scale dialogue, from urban to housing, there is a need to create a specific shared language for the urban food system and urban design by planners and designers/architects.
In an attempt to bridge the gap between urban food systems planning and urban agriculture design Bohn and Viljoen in 2005 intruded spatial considerations viewed from an architectural and urban design lens.

Architects and urban farmers have different methods for integrating agriculture into the surrounding urban landscape. Architects frequently create impractical ideas for vertical farming and urban agriculture that disregard the practicalities of successful agricultural practices. Conversely, farmers and entrepreneurs often miss important design, aesthetic, and social integration opportunities when they develop urban farms. Agritecture is concerned with integrating the disciplines of agriculture and architecture so that urban farms can be practical and well-designed at the same time.

Figure 12 highlights the relationship between spatial dimension and environmental, social and economic relevance within the urban food system. The graph represents a first attempt to understand the implications for the form and structure of the city itself.

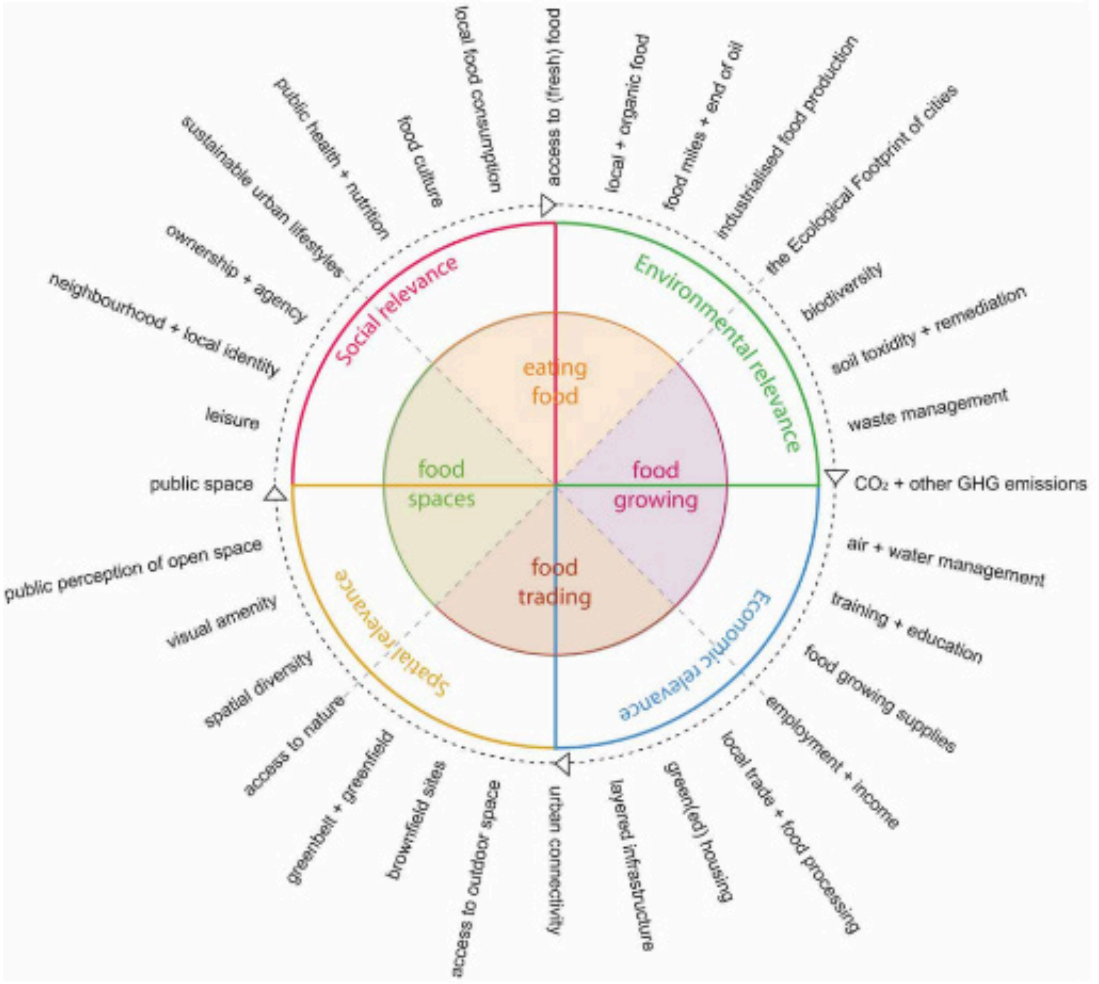


Figure 12: The urban food systems star. (Viljoen & Bohn, 2005)

2.2 - Opportunities - Why Agritecture is emerging

Market opportunities-Facilitators that are growing the Agritecture phenomenon:

1. Technology trends
- Vertical farming / Soil-less growing methods - Aeroponics, Hydroponics and Aquaponics.
- Indoor farming – provides protection and maintains optimal growing conditions
- Controlled-environment agriculture (CEA) – includes indoor farming and vertical farming

2. Urban site conditions
- Green and blue networks – Green corridor or Continuous Productive Urban Landscape (CPUL) to support Biodiversity
- Food proximity – Fresh food close to home
- Open space to gather – Ensure public and wide green spaces in the city

3. Social and cultural trends (WGSN, 2021)

Production:
- Ultra-urban agriculture - Hyperlocal production and sales
- Micro&Smart - Indoor, smart gardening
- SoLaWi - Do-it-yourself cultivation

Retail:
- Just-In-Time supply chain – Handling and producing food only when necessary
- GLocalism – Buy local and global only when not present in the area
- CSA - Community-supported Agriculture – Farmers' crop quotas in exchange for weekly boxes of fresh food
- Local market – The return of Neighbourhood markets

Consumption:
- Slow Food movement – Sustainable food
- Locavore movement – Eat local
- Reducetarianism – Constant reduction in consumption of meat, dairy products and eggs

Urban design:
- Biophilic design – physiological and psychological health benefits
- 15 minutes city model – Slow and active city

4. Socio-economic trends
- Huge demand – Of vegetables and fruits in cities
- Food security – Ensure food security to all the citizens by producing sufficient quantities of fresh nutritious food.
- Self-sufficiency / urban resilience – Reaction to economic shocks, environmental disasters, pandemics, wars
- Herbal health remedies and natural treatment facilities – Access and proximity to medically useful plants

Urban agriculture from a response to social, environmental and economic concerns is developing into a type of use of urban space that can scale and change it over time to make it more open, active and accessible.

From the perspective of urban integration, concepts such as **Agrarian Urbanism**, **Transition Towns** and **CPUL city** have been introduced in architectural design. To these, new thoughts of spatially integrated urban food production are emerging in design research.

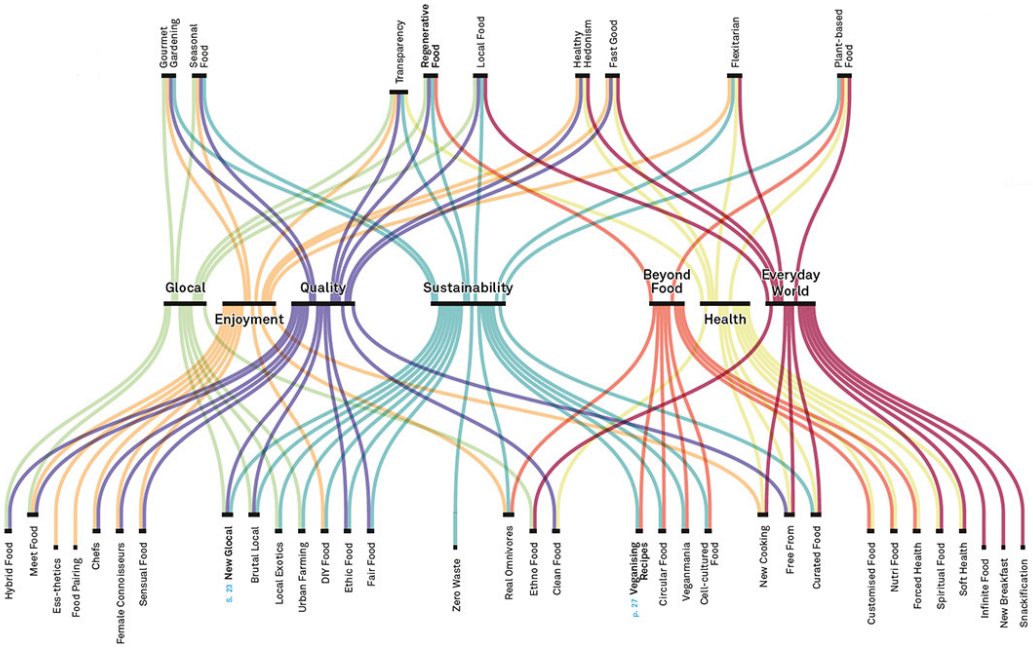


Figure 13: Food trend map 2023. (Rützler, 2023)

2.3 - Threats - What could endanger the development of Agritecture

Market trends and challenges to be addressed that could become a threat to Agritecture's deployment:

1. Technology
- Lank of knowledge and experience – There are few competent figures for new technologies

2. Urban site conditions
- Lack or high cost of space – There is very little if any land available for agriculture. Sometimes not even urban green space is present. If vacant land is present, the cost makes it unaffordable.

3. Social and cultural trends
- Greenwashing - Hyperlocal production and sales
- Gentrification - Indoor, smart gardening

4. Site-specific conditions
- Soil quality – Soil in urban areas is often contaminated with chemicals from cars and industry, which makes cultivation difficult. Increase health risk due to use of contamined water, soil and air.
- Water supply – In areas where there are water shortages, the high need for water for irrigation can be problematic. Reduction of city water supply.
- Heat island effect – This causes a rise in temperature in cities that may sometimes be unsuitable for growing vegetables.
- Insect pests and diseases – There are insects present in urban areas, which do not survive in rural areas, that can attack plants. Similarly, harmful agricultural practices such as the use of pesticides, harmful fertilisers can pollute soils to the point of making them less fertile or poisonous, pollute the air and release chemicals that flow into urban water systems causing health problems for the population.

= How to deal with lack or high cost of spaces

Planners in recent years are responding to this problem by discovering new places to grow food. New methods are emerging to expand usable space and reduce the cost of initial investment. Chief among these are the practices of Building-Integrated Agriculture (BIA), Zero-Acreage Farming (Z-Farming) and Farm Removability (Association for Vertical Farming, 2016). Among the most commonly used locations are unused spaces, roofs of large buildings such as warehouses and offices, and underutilized paved areas, gardens in residential complexes, or vertical cultivation without the use of soil.

Possible solutions are:

1. Use of unused land

2. Appropriation of planned or set-aside land - For other, normally for economic, purposes. The government must regulate the use of land to encourage farming when it is unmanaged and no economic rent is paid.

3. Land reclamation or revitalisation - In case of contaminated soil.

4. CPUL City - Continuous Productive Urban Landscape - Create a productive green corridor.

5. SPIN - Small Plot Intensive Farming - Here professional farmers grow crops in a cluster of borrowed or leased urban backyards.

6. BIA: Building-Integrated Agriculture - Interventions on existing or new buildings. Adoption of a bioclimatic approach to limit building energy waste.

7. Z-farming: Zero-Acreage farming techniques - Use soil-less growing methods such as aeroponics, hydroponics and aquaponics. Through these new farming technologies, the space occupied for cultivation can be greatly reduced.

8. Farm removability - The use of a plug-and-play or modular system allows the investor to move the plant to a new site.

= How to prevent gentrification

Gentrification is a complex phenomenon involving demographic, economic and social changes in a certain urban area.

There are some measures that cities and local communities can take to prevent or at least mitigate its negative effects, such as:

1. Developing long-term housing policies and affordable housing programs to ensure that low-income families can continue to live in the area.

2. Promoting local commerce and supporting existing small businesses to prevent the loss of jobs and neighborhood stores.

3. Strengthen community participation and resident involvement in decision-making processes regarding neighborhood development.

4. Adopt housing protection measures, such as fair rent laws, to prevent excessive rent increases.

5. Develop training and support programs to help residents move to other areas if they can no longer afford to live in the neighborhood.

6. Promote sustainable urban redevelopment projects that take into account the needs of the existing community and not just developer profit.

In addition, it is important for local authorities and governments to be transparent and accountable in their decisions regarding urban development so that gentrification does not become a tool to exclude low-income communities from living opportunities in higher-value neighborhoods.

= How to avoid greenwashing

To avoid greenwashing in architecture and urban regeneration, it is important to follow some best practices:

1. Use internationally recognized sustainable design criteria, such as LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Method).

2. Ensure that projects are sustainable not only in terms of energy but also in terms of their impact on the community, such as through the creation of accessible green spaces or the preservation of historic buildings.

3. Choose sustainable materials and technologies, such as using renewable energy sources or recycled materials.

4. Involve the local community in the design process and in setting sustainable goals so that residents' needs and desires are taken into account.

5. Ensure that the company or design team is transparent and accountable in their project sustainability statements, providing accurate and verifiable data and information.

In addition, it is important for public authorities to impose transparency and accountability standards on urban design and regeneration companies to ensure that projects are truly sustainable and not just a "green" façade.

2.4 - How Agritecture can influence the form and structure of the city

▫ Urban performance

Questioning how urban agriculture can affect urban form lays the groundwork for deepening the possibilities offered by Agritecture practices. Various architects, beginning with the radical visions of the modern period, have over time created a history of urban form perceived through the spatial, ecological and infrastructural import of agricultural production. The latter seen both as a foundational element of the city and as additional.

Agriculture will be investigated in history for its ability to determine the economic, social, ecological and spatial order of the city.

Beginning in the early 20th century, early urban planning proposals that included the importance of growing food close to where people live were inspired by the relatively decentralized model promoted by Henry Ford.
This caused spatial decentralization and the abandonment of the most dense cities. The proposed new settlements included residential units, with the efficient density of large cities, combined with residential manufacturing areas. Some historical events, such as the Great Depression, triggered major changes in planning. Industry was linked to agriculture with a rotational work system in which there was alternation between workers in factories and on collective farms (SOA Architects, 2019).

In this chapter, major cases of urban planning will be analyzed to understand how over time urban agriculture influenced the way of life and the shape of cities.
Consideration will be given to the **integration** of productive space with existing urban space both in terms of accessibility and connection to the urban fabric, the **spatial quality** that was being created by the new spatial planning, and finally the **urban food system** by understanding the motivations behind it and who was actively involved in it.

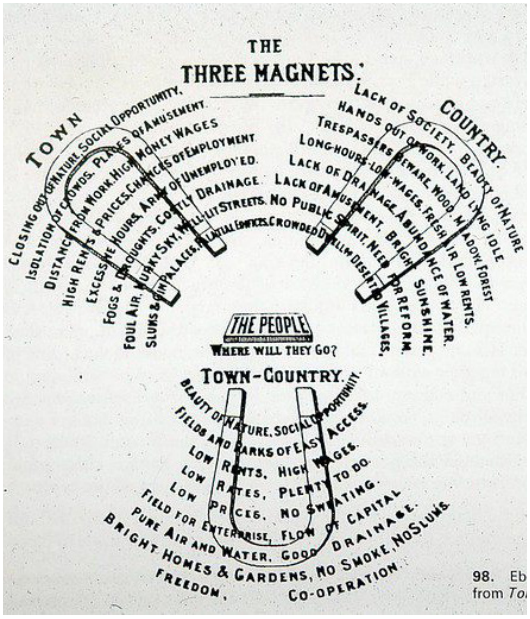
▫ Radical visions

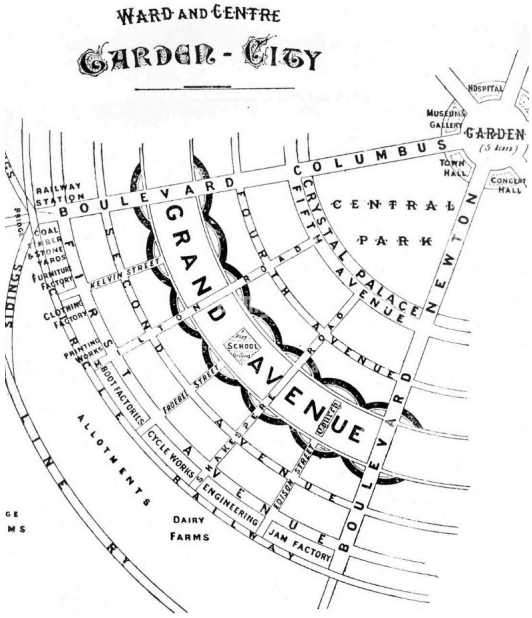
01 Garden City
by Ebenezer Howard - 1898~1902
02 Broadacre City
by Frank Lloyd Wright - 1930
03 La Ferme radieuse et le village coopératif
by Le Corbusier - 1935
04 New Regional Pattern
by Ludwig Hilberseimer - 1945~1949
05 Agricultural City
by Kisho Kurokawa - 1960
06 Berlin, green archipelago
by Oswald Mathias Ungers & Rem Koolhaas - 1977
07 Agronica
By Andrea Branzi - 1993~1994
08 Pig city
by MVRDV - 2001
09 Continuous Productive Urban Landscape (CPUL) concept
by Katrin Bohn & André Viljoen - 2005~2014
10 Capital Growth
by Sustain in London - 2008~on going
11 Almere Oosterwold
by MVRDV - 2011

Garden City.

By Ebenezer Howard - 1898~1902

The project aims at making the countryside attractive again, responding to urban overcrowding. In addition to urban and rural realities Howard conside a third one: a perfect combination of city life and the beauty of the countryside. He identifies the main advantages and disadvantages of city and rural life, while the Garden City appears to lack svatages. He envisions a scalable system with a central city and a series of other connected cities that are built as the population increases. Each city is divided into six radial sectors with a garden at the center (Howard, 1898, 1902).





Integration

Typology: New town planning project.
A central city with a series of towns connected by a circular rail network present in their outermost, productive ring.

Spatial quality

Sites: City+farmland. Urban farmland
Scale: 6,000-acre central CIty: 1,000 to building and 5,000 to farming. A scalable system with a modular settlement in which a new city is founded as the population increases.

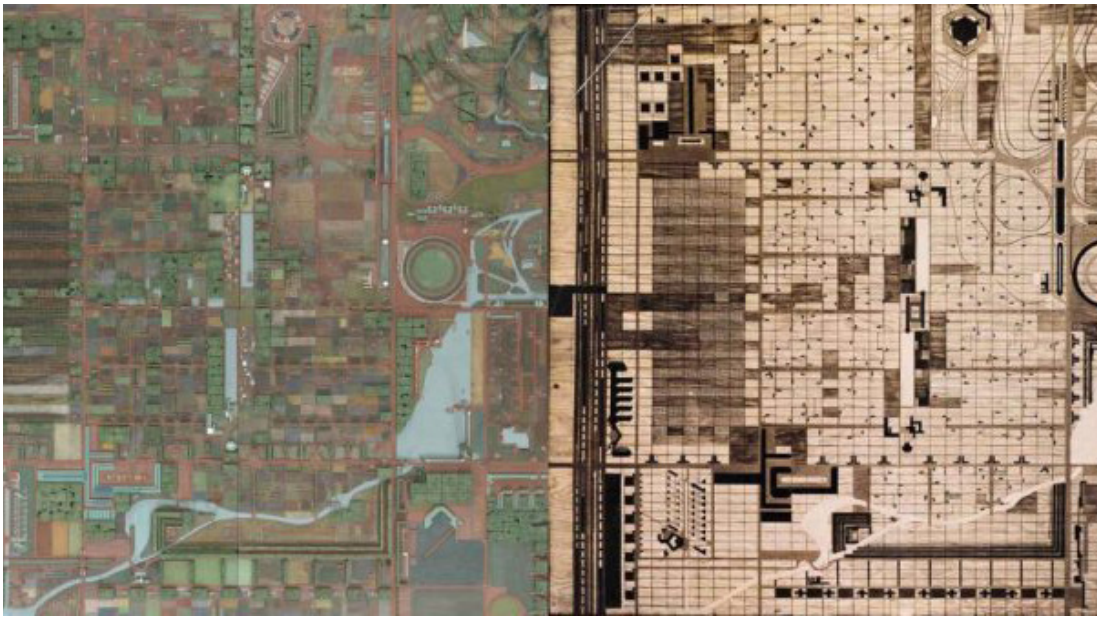
Urban food system

Growers: Citizens
Motivations: Against urban overcrowding and to the depopulation of rural districts. Attempt to identify 'attractions,' magnets that can redistribute the population in a spontaneous and healthy way.
Production entities: Collective

Broadacre City.

By Frank Lloyd Wright - 1930

A severe critique of the modern industrial city. It unites urban, agricultural and nature in a one-acre family plot on a continuum covering the United States and fixing a closed number of inhabitants. The project responds to a supposed lack of essential elements such as space, air, light and silence that Wright perceived as a major problem in modern cities. In the design he promoted individuality, making each man his own capitalist. Each family corresponded to an acre of land in which were placed their gardens, farms to provide for their sustenance.



Integration

Typology: New town planning project.

Spatial quality

Sites: City+farmland. Urban farmland
Scale: 1-mile grid. 1 private acre of land per person. Defer to the abstraction of the grid.

Urban food system

Growers: Citizen-landowners
Motivations: A city meant to be a respite from the incessant profit demands associated with the industrial city. Criticism of private property, conspicuous consumption and the accumulation of wealth associated with cities.
Production entities: Subsistence gardens, small-scale farms.

La Ferme radieuse et le village coopératif.

By Le Corbusier - 1935

Optimized, compartmentalized and cut off from the urban world, it registers the place of agriculture. A project that responds to that of the Ville radieuse, each cooperative village (white dot) connects a number of radiant farms (black dot). Villages are connected to cities but not to each other.
"Everything starts from the soil. Everything lives because of the soil. It is from the farm that life can be organized. Cities are first a function of the countryside that surrounds them, and then of the industry that equips the countryside." Everything is based on a principle of unity: housing, agrarian, rural, industrial and receptive.
The basic unit is the farmer and his home, the farm he guards. Multiple farms form cooperative centers where production processes take place and there are various services. The latter are connected to towns. Land is given to farmers on the condition that they produce and cooperate.

Integration

Typology: New town planning project.

Spatial quality

Sites: Periphery
Scale: Scalable.

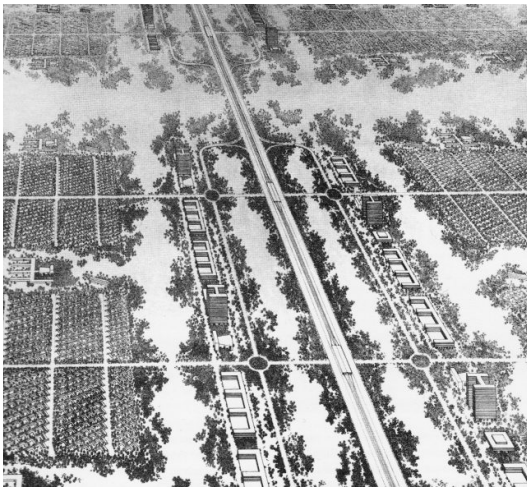
Urban food system

Growers: Farmers-residents
Motivations: Provide housing and workspaces for farmers while increasing agricultural productivity through modern technology and improved farming practices. Promotion of self-sufficiency, food imports reduction, and improvement of the quality of life for farmer-residents.
Production entities: Farming enterprises

New Regional Pattern.

By Ludwig Hilberseimer - 1945~1949

Like Flank Lloyd Wright, he aimed at the decentralization of cities as a remedy for the ills of the industrial city. He was also influenced by European precedents of the **garden city**, which he depicts in the drawing 'The Metropolis as Garden City.' His designs employ landscape and mixed-height housing to create low-density settlements. His concept of 'settlement units' was well understood in the strategy for low-density urbanization based on regional highways and natural environmental conditions, and he disseminated his ideas in 1949 in The New Regional Pattern: Industries and Gardens, Workshops and Farms.
Vision of a city as a continuous system of forces and directional flows, rather than a collection of objects.



Integration

Typology: Regional planning project

Spatial quality

Sites: City+farmland. Urban farmland
Scale: Scalable, modular.

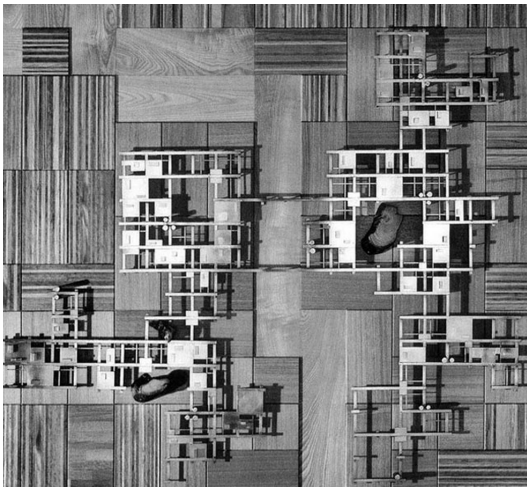
Urban food system

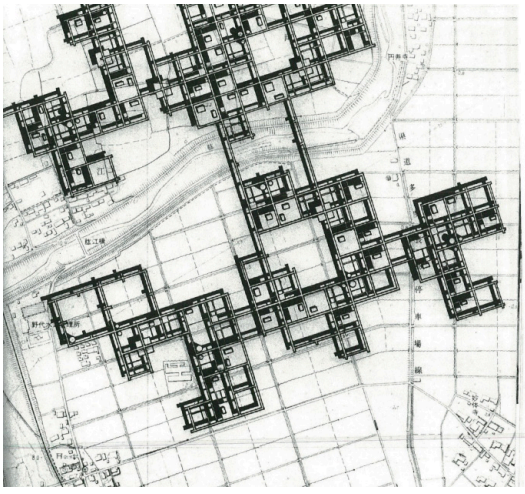
Growers: Farmers
Motivations: The project sought to rationalize land use and increase efficiency by promoting agricultural production in urban areas and designing modular agricultural plots. The aim was to create a more sustainable and efficient regional food system.
Production entities: Agricultural plots

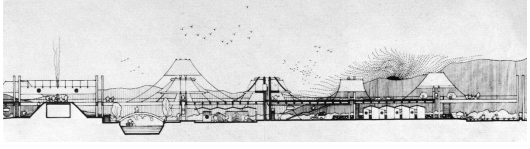
Agricultural City.

By Kisho Kurokawa - 1960

He superimposes the city on the fields. The Japanese architect proposed a city model with a structure raised above the ground to cope with and future flooding of the fields.
A system that allows natural growth of the agricultural city by grid streets containing primary pipelines.
Rural communities are towns whose means of production is agriculture. According to Kurokawa, agricultural towns have potential as cities of the future. Therefore, it is necessary to have a basic plan for their future expansion. The city is composed of villages, formed by the aggregation and connection of independent mushroom-shaped square units where different households are housed, and the underlying public services located at the level of the structure. The basic units multiply spontaneously.







Integration

Typology: New urban planning project.

Spatial quality

Sites: Urban periphery
Scale: Scalable.

Urban food system

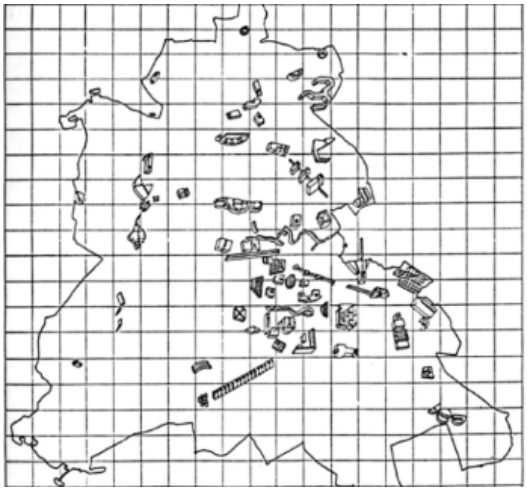
Growers: Farmers, agribusinesses.
Motivations: The project aimed to promote self-sufficiency and increase agricultural productivity by integrating agricultural practices into the urban fabric of the city. The design included a mix of agricultural plots and agribusinesses to create a more diverse and resilient food system.
Production entities: Agribusinesses, allotment gardens.

Berlin, green archipelago.

By Oswald Mathias Ungers & Rem Koolhaas - 1977

In contrast to the European reconstruction of the fallen Berlin, Koolhas proposed a multifaceted city.
The primary goals were:
- the preservation of the densest areas,
- the balancing of density with green areas in the densest ones and urban containers in the less dense ones,
- the creation of a green grid with disused factories at its center,
- green grid as a promoter of 'nomadism' among residents, a park with common services,
- new centers inspired by already validated urban models.

A condition of fragmentation of parts however connected with each other, with a common ground. An infinity of compositions weaving agriculture and nature among the preserved islets of a ruined city born out of the examination of crises, recessions and the phenomenon of demographic contraction.



Integration

Typology: New urban planning project.

Spatial quality

Sites: City center - periphery.
Scale: Scalable, modular.

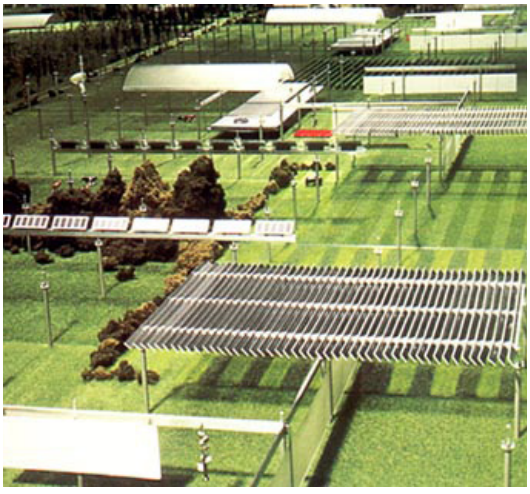
Urban food system

Growers: Urban farmers.
Motivations: The project aimed to promote urban agriculture and increase access to fresh, locally grown produce. The design included a network of green islands, or "archipelagos," throughout the city that would be managed by urban farmers. The motivation was to create a more sustainable and equitable food system while also improving the urban environment.
Production entities: Community gardens, urban farms.

Agronica.

By Andrea Branzi - 1993~1994

A continuous arrangement of agricultural and urban units caught in perpetual motion. Agricultural, urban and natural functions are tightly interwoven on a small scale to form a continuous, moving system.
A model of weak urbanization in contrast to modern movement, a new logic from aesthetics that thanks to technology becomes less recognizable, in a weak and diffuse form. An environmental transfer system capable of adapting to reversible programming. A self-regulated model of industrial production that provides a high level of flexibility through mobile building components dispersed in a semi-urbanized agricultural park.
Like Hilberseimer, he illustrates the city as a continuous system of forces and directional flows, rather than a collection of objects.



Integration

Typology: New town planning project - suburban settlent. Horizontal spread over a sparsely settled area and consequent 'weak urbanization'.

Spatial quality

Sites: New town planning project - suburban settlent.
Scale: Development with weak urban forms.

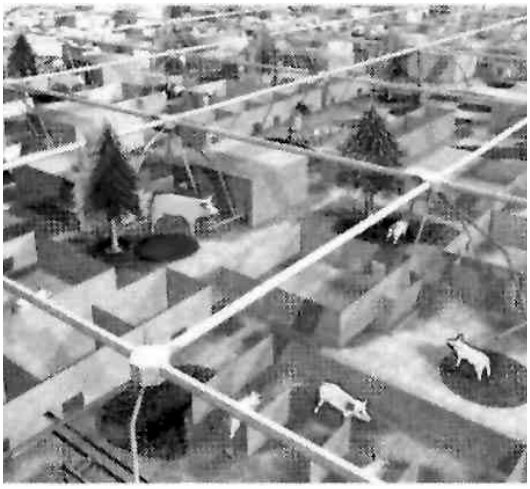
Urban food system

Growers: Mixed
Motivations: Social, cultural criticism of the intellectual but also economic, environmental and aesthetic world of much of design and planning.
Production entities: Farming enterprises

Pig city.

By MVRDV - 2001

Among the first vertical farming concepts. Beginning in the 21st century, the first proposals for vertical farm developments appear. However, they are mainly conceived as utopian-inspired skyscrapers in which the aesthetic and conceptual aspect of the proposal is emphasized. Missing from vertical farms projects in this period is the development aspect of real technical and financial feasibility. Some more practical projects begin between the 2000s and 2010s, however, which were never realized (MVRDV, 2001).



Integration

Typology: New urban planning project.

Spatial quality

Sites: Urban periphery.
Scale: Scalable, modular.

Urban food system

Growers: Pig farmers.
Motivations: Increasing the efficiency and productivity of pig farming by creating a vertical farming system that would utilize the waste products of the city. The design included a series of stacked pig pens that would be connected to the city's waste management system. Creation of a more sustainable and efficient system for pig farming while also reducing the environmental impact of pig waste.
Production entities: Pig farms.

Continuous Productive Urban Landscape (CPUL) concept.

By Katrin Bohn & André Viljoen - 2005~2014

In 2005, the book 'CPULs Continuous Productive Urban Landscapes' was published. CPUL City envisions the planned introduction of productive urban landscapes.
Quoting Viljoen & Bohn, the authors of this urban vision, The primary concept is the creation of networks of open urban spaces that provide a multifunctional, coherent and designed productive landscape that complements and supports the built environment.
The introduction of this urban modification also involves a major behavioral change in how citizens experience and interact with the productive landscape. The urban agriculture referred to is primarily related to fruit and vegetable production for higher yield per square meter, striving to incorporate the cultivation of local and organic produce (Bohn & Viljoen, 2014).

Integration

Typology: This is a system that can adapt to the city and integrate with it seamlessly. It combines productive use with interconnections to other urban uses on the same site, creating a physical and visual access to nature throughout the entire city.

Spatial quality

Sites: The environments that make up the productive landscape involve open spaces for cultivation, leisure, free movement and commerce of people, natural habitats, non-vehicular circulation routes and ecological corridors.
Scale: Adaptable and scalable, it connects open spaces in the city by creating productive corridors.

Urban food system

Growers: Mixed economy of farmers practising for and/or with the community.
Motivations: In addition to making urban food systems more sustainable, it also aims to introduce spatial quality within urban space.
Production entities: Integration with the local food network by seeking local mini-interdependencies.

Capital Growth.

By Sustain in London - 2008~on going

Capital Growth was a project launched in 2008 and promoted for the Olympic Games hosted in London in 2012. The initiative supported the creation of 2,012 new community food growing spaces throughout London by the end of 2012, the start of the Olympic Games (Capital Growth, 2008).
Currently, the initiative continues and stands as the largest food growing network in London. They offer support for those who grow, providing training, networking, simplified access to equipment and support for sales.

Integration

Typology: Integration into urban space by taking advantage of areas vacated or granted by various local organizations.

Spatial quality

Sites: Central London. Cultivable gardens scattered throughout the historic center.
Scale: Urban scale, flexible depending on sites granted.
99,000 people participated in growing community food within Capital Growth's 2,000 spaces.

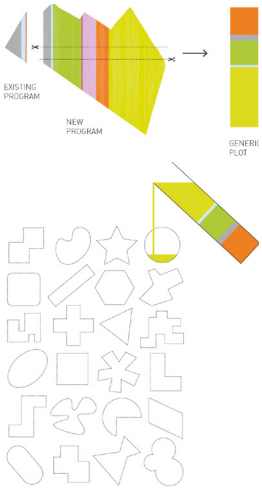
Urban food system

Growers: Citizens
Motivations: Arises to increase the amount of land used for growing food in London and encourage citizens to grow their own vegetables by gaining knowledge. More food and closer, which can also improve the urban environment and responds to a safe and reliable urban supply. Responds to the huge demand for allotments from citizens.
Production entities: Allotments - community gardens.

Almere Oosterwold.

By MVRDV - 2011

This project reimagines urban living with a strong emphasis on agriculture. The project seeks to integrate farming and agriculture into the urban fabric, creating a sustainable and self-sufficient community. With this innovative approach, Almere Oosterwold blurs the boundaries between rural and urban spaces. The project dedicates 59% of the land to urban agriculture and aims to establish a self-sufficient community. By creating a green ring and including public or private green space around each project, the project prevents the closure of the landscape and facilitates the development of a productive landscape for agriculture (MVRDV, 2011).



Integration

Typology: New town planning project.

Spatial quality

Sites: Periphery.
Scale: Scalable, modular.

Urban food system

Growers: Community members.
Motivations: Propotion of community and sel-f-sufficiency by empowering residents to create their own homes and gardens within a flexible, modular framework. The design included a mix of housing types and agricultural plots that could be customized by residents. Fostering a sense of community and promoting self-sufficiency while also creating a more sustainable and resilient urban environment.
Production entities: Community gardens, allot-ment gardens.

2.5 - Overall evaluation of urban agriculture system - SWOT Analysis

Strengths

The factors that make the project competitive and distinguish it.

- Reduction of atmospheric contaminants.
- Reduction of GHG emissions caused by food transportation.
- Produce more healthy and sustainable food providing Food Security and reducing malnutrition.
- Decresce of healthy food cost prociding Food Accessibility.
- Food proximity.
- Lands zoned for small agriculture
- Water security and indipendence

Weaknesses

The factors that penalize the development of the project or that is otherwise better carried out.

- Poor water availability - aging infrastructure.
- The use of pesticides and bad fertilizers can release harmful substances into the urban water network, pollute the air and soil.
- Insects in urban areas can attack plants.
- Soil quality.
- Land use. Lack of space and low-profit use.
- Expensive land.
- Energy demand.
- Lack of knowledge on new farming techniques.

Opportunities

External factors that provide opportunities for advantages.

- Decrease of heat island effect introducing green in the built environment.
- Leverage heritage & natural resources to build local urban food system
- Improve health outcomes through food
- Sequester carbon, and capture storm water
- Waste water reuse
- Huge demand for vegetables and fruits
- Waste water reuse, rainwater collection, water filtration and drainage.
- Use of unused land.
- Appropriation of planned or set-aside land.
- Land reclamation-preservation or revitalisation-regeneration.
- Z-farming to reduce land use.
- Creation of green corridors.
- Limiting biodiversity losses and restoration of ecosystems.
- Education towards health diets to improve health care.
- Urban agriculture as a tool for civic engagement, for the creation of sustainable cities and communities .
- Grow jobs in farming, food processing, distribution, and ecosystem services.
- Conversion of food waste into renewable energy or nutrients.
- Herbal health remedies and natural

Threats

External factors that may adversely affect the achievement of objectives.

- Green washing.
- Gentrification.
- Rapid land & warehouse development. Increase of prices.

2.6 - Considerations: Urban performance of Agritecture

= HOW we should act

Urban Performance Indicators

1. INTEGRATION

What impact-relationship does it generate with its surroundings?

4.1 CONNECTIVITY
Links with urban mobility.
"How does the area connect to the urban transport system?"
Mapping the connections to public mobility systems that have been developed.

4.2 GREEN AND BLUE NETWORKS
Relationship with natural interventions on an urban scale.
"What is the relationship with existing natural networks?"
Mapping how the intervention creates and/or fits within natural networks on an urban scale.

4.3 CONTINUITY
Creating continuity with the urban fabric through a direct relationship.
"Is there continuity with the urban fabric? Is the intervention in continuity or does it clash with the existing and become an exception?"
Development of an urban perception analysis to assess the relationship and impact of the intervention.

2. SPATIAL QUALITY

What qualities-relationships does it generate internally?

5.1 ACCESSIBILITY - PERMEABILITY
Everyone should be able to meet most, if not all, of their needs within a short bike or walk from home.
"Can citizens easily access the services on foot or by cycling within a short distance?"
Mapping the slow mobility system and how it has been enhanced.

5.2 COMPLETENESS
An ecosystem of connected services.
"What additional services does it offer and to whom?"
Mapping which additional services related to urban farming are promoted.

5.3 ACTIVITY - LIVEABILITY
Activities concentrated in a meaningful and dense space.
"Are the spaces flexible? Do they allow changes-mod over time?"
Chronoprogramme of services and activities, with spatial location and moments of interaction.

3. URBAN FOOD SYSTEM

What relationship does it generate with the urban food system?

6.1 FOOD PRODUCTIVITY
Ensure food security by producing sufficient quantities of fresh, nutritious food.
"Which agri-food production entity manages food production? Who is involved in the production process and for what purpose? How much can it produce?"
Define the production entity, their primary purpose and quantify food production.

6.2 FOOD DISTRIBUTION
Short supply chain, fair trade. Inclusion of products in an urban distribution system.
"What connections with the local distribution network and sales infrastructure are there?"
Mapping the network of connections for the sale and distribution of food.

6.3 EXCHANGE INTERFACE
Spaces for direct sales, exchange and catering.
"Where is the food sold or processed?
Do they include actions such as from farm to table?"
Mapping points of sale and interaction with consumers.

Urban Performance KPIs

4.1 Connectivity: public transport and digital infrastructure. BOOK

- Number of nodes for public transport interchange e.g. metro to train, bus to metro.
- % of the area covered by public transport.
- Number of workstations for working remotely in public spaces, internet cafés and coworking spaces with access to fast and reliable broadband services, e.g. the EU Digital Agenda.

4.2 Green and blue networks: green corridors. BOOK

- % of residents that can access a high-quality open green space within 15 minutes (by walking or cycling).
- Number of green plots and urban parks connected to create an ecological corridor.

4.3 Continuity: visual impact.

- Number of urban visual axes given continuity or prominence with the project.
- Verification through a perceptual analysis of the visual impact of the intervention in relation to the urban context

5.1 Accessibility-permeability: people-centered streets and low carbon mobility.

- Number of streetside bike parking spaces per resident.
- Km/miles of connected and segregated cycle lanes across the district.
- % of public space dedicated to pedestrian and cycling access only.

5.2 Completeness: a complete neighbourhoods following the 15 minutes city model.

- % of basic services accessible within a 15-minute walk from the project centre.
- % of the population that are located within 1/4 mile from the nearest fresh food store, healthcare facility, school, and green space etc.
- Numer of functions introduced in the area.

5.3 Activity - Liveability: numerous and varied activities on a flexible ground floor to make it active and dynamic.

- Number of different activities present on the ground floor of the project and/or accessible to citizens.
- % utilisation of the different areas of the facility with respect to different times of the day.
- Presence of amenities and urban furniture supporting different activities

6.1 Food productivity: the performance of the agri-food entity managing the production structure.

- Estimation of healthy meals/year produced from locally grown fresh food.
- Space for growing food: % of land used compared to traditional systems.
- Number of purposes met by the project e.g.: social, educational,...

6.2 Food distribution: inclusion in the territory's distribution network.

- % of the food that is sold, processed at 0 km.
- % of food distributed in urban-local distribution networks e.g. city food market, district market,...

6.3 Exchange interface: spaces for consumption and direct sale/exchange.

- Number of services for consumption in place of the food produced.

= HOW to evaluate

Urban Quality Compass

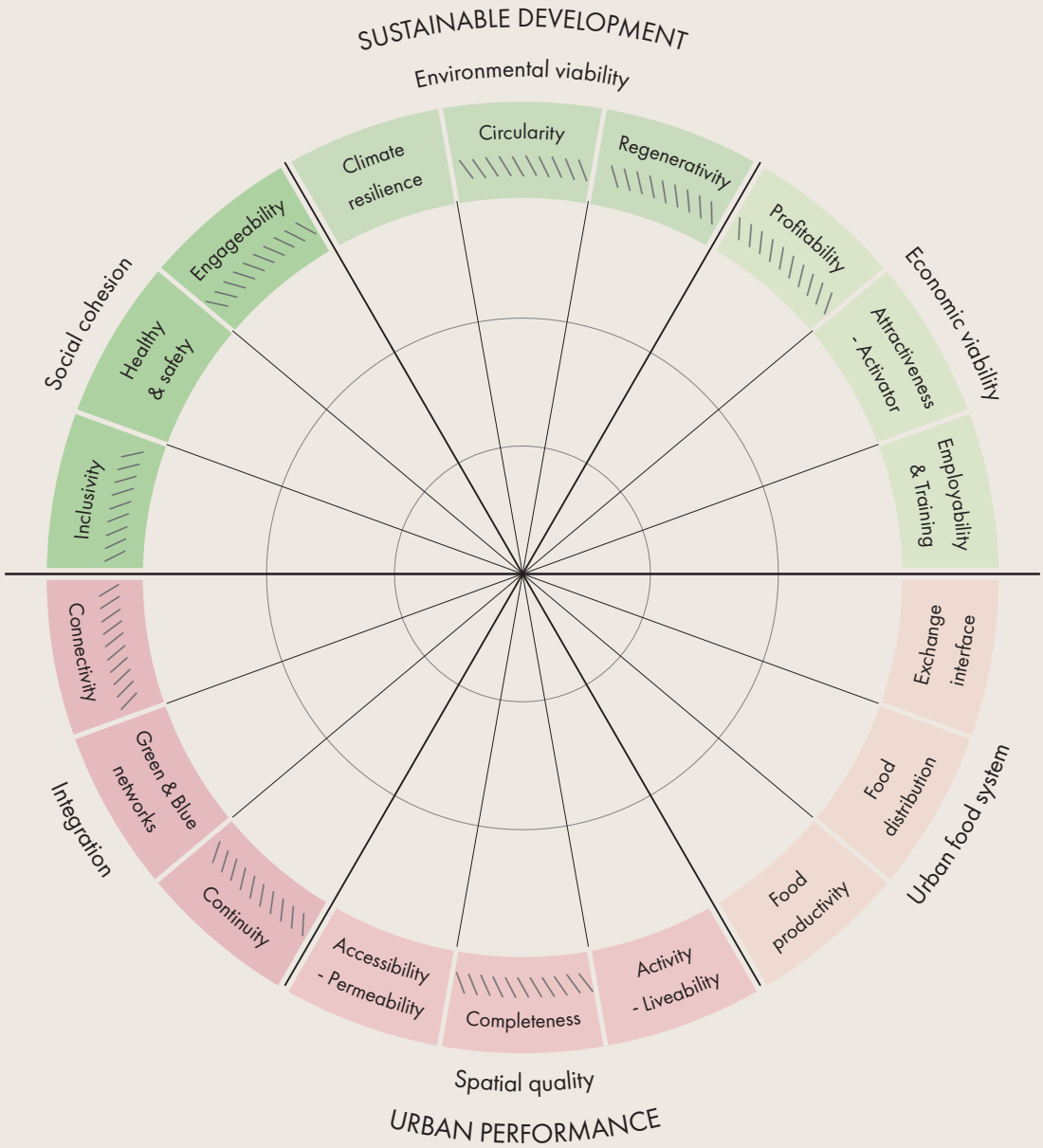


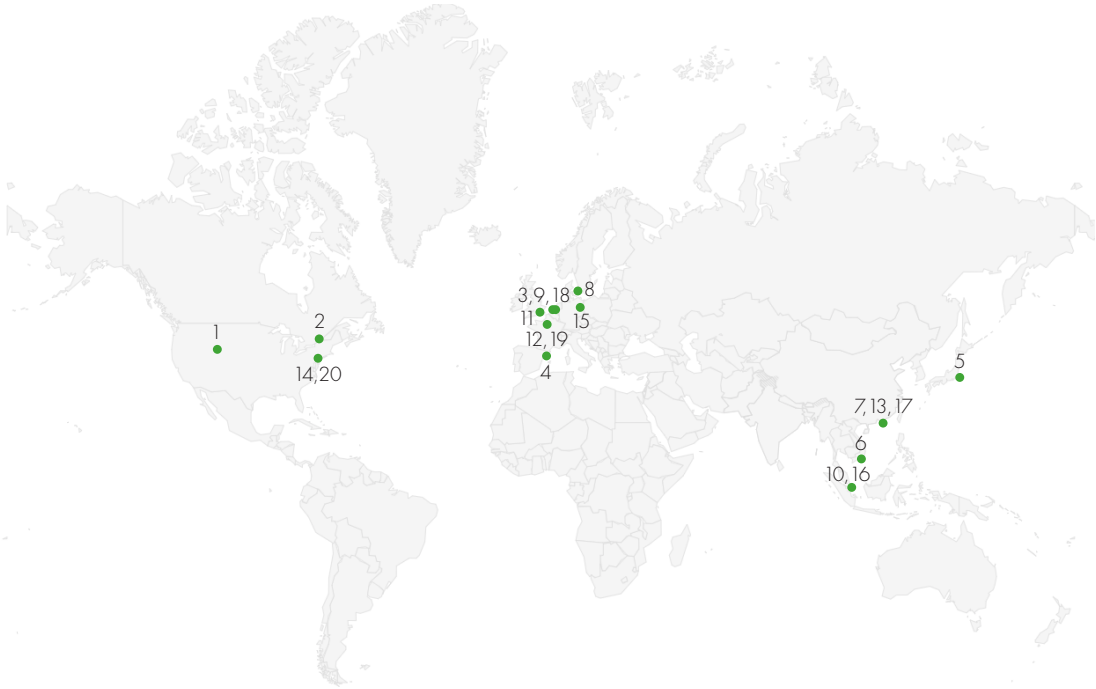
Figure 14: Urban Quality Compass.

3 - CASE STUDIES

3.1 - Overview of realized projects

This case study analysis will examine the concept of urban farming, specifically focusing on the internal **Strengths** and **Weaknesses** of farming practices in cities . It will explore the ways in which this type of farming can contribute to sustainable urban development and discuss the various factors that need to be considered for its successful implementation.
Twenty realised and active projects were therefore selected, allowing their impacts to be analysed using the **Urban Quality Compass** previously identified.

The case studies were selected to cover the widest possible range of different characteristics that define them: **site**, **people + scope**, **urban form**, **experience** and **growing system**. Similarly they differ in geographical location and consequently to local climate.



Jackson Hole farm by Vertical Harvest.

In Jackson, Wyoming - USA - 2016

The first hydroponic vertical greenhouse in North America.

https://verticalharvestfarms.com

Site

Development of underused space in the city. It exploits a vacant side space of a multi-story car park. Site area: 420 sq m. Building area: 1'250 sq m. Width: 45 m Depth: 9 m.

People + Scope

Vertical farming enterprise with a mix of public/ private partnership.
Its scope(s) is/are: Economic development, Environment and Social interactions.

Urban Form

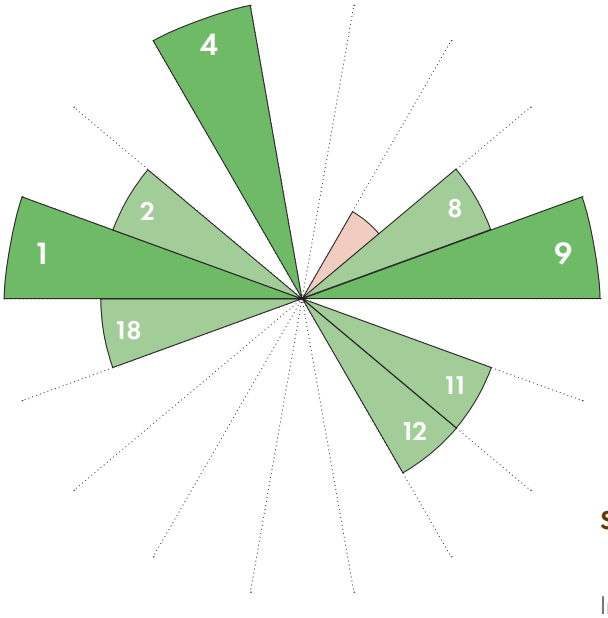
Building-integrated agriculture - Facade greenhouse: thick wall for production purposes on the west side of an existing building.

Experience

Education: Participation in training workshops;
Connection: Raising awareness through tourist visits;
Conversation: A permanent market allows direct purchase from the producer;
Immersion: Stimulation of car park users.

Growing system

Hydroponic CEA greenhouse.



Strengths

- **Inclusivity + Employability & training** Inclusive employment model currently focused on individuals with physical and/or intellectual disabilities. The Vertical Harvest project has created a large number of jobs in the Jackson Hole community.
- **Climate resilience** Energy savings: The vertical greenhouses used by the Vertical Harvest project consume less energy than conventional cultivation methods, as they use solar energy and require fewer resources for heating and cooling. Reduced environmental impact: The Vertical Harvest project uses less water (-85%) and pesticides than traditional farming methods, reducing the environmental impact of agriculture.
- **Food productivity + Healthy & safety** Production of fresh, high-quality food: The Vertical Harvest project uses hydroponic and greenhouse techniques to produce high-quality fruit and vegetables year-round. It replaces 100,000 pounds of products previously transported in the community.
- **Attractiveness - Activator** Their goal is to develop a network of farms that serve locally, support regionally and scale nationally to bring food production closer to home. A support for the local economy: The Vertical Harvest project sells its products to local restaurants and stores, supporting the community's economy.
- **Food distribution** Multi-channel sales: direct to consumer, wholesale, and food service. Supplies to over 80 grocery stores and restaurants across three states.

Weaknesses

- **Profitability** High initial costs: the Vertical Harvest project requires a significant initial investment for the construction of the vertical greenhouses and the purchase of the necessary equipment. It is also financially supported by its mix of public/private partnership.

Lufa Farm by Lufa organic farm.

In Montreal - Canada - 2009

The World's largest commercial rooftop greenhouse.

https://montreal.lufa.com

Site

Development of underused space in the city. It exploits the free space of the flat roof of the super-market. Area: 15'000 sq m.

People + Scope

Vertical farming enterprise. Its scope(s) is/are: Economic development and Environment.

Urban Form

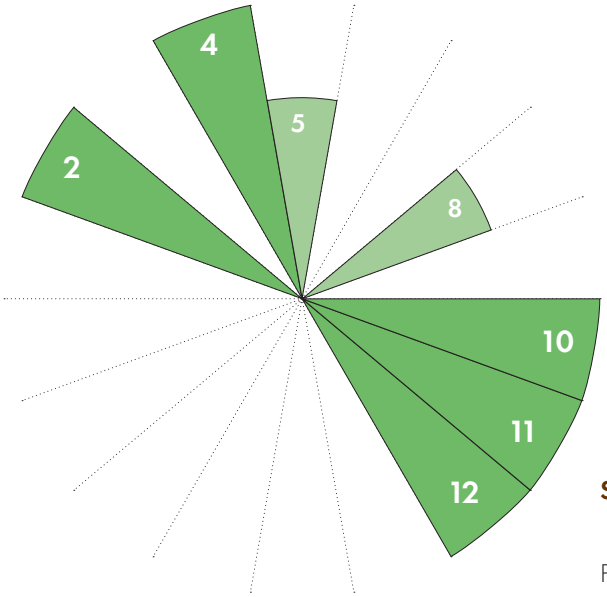
Building-integrated agriculture - Rooftop greenhouse.

Experience

Immersion: Stimulation of citizens who see the greenhouse in the city.

Growing system

Hydroponic containers in CEA greenhouse. Lined with coconut coir and fed liquid nutrients, including lettuce, cucumbers, zucchini, bok choy, celery and sprouts.



Strengths

- **Food productivity + Healthy & safety** Production of fresh, local produce year-round, regardless of weather conditions. The use of sustainable growing practices promote the health and well-being of both the plants and the consumers. The company currently delivers approximately 20'000 baskets each week.
- **Climate resilience** It reduces the carbon footprint of food production and distribution, as products do not have to be transported long distances. Lufa Farms also employs sustainable and environmentally friendly cultivation practices, such as the use of organic seeds and natural pest control methods, which can help protect the environment. In addition, the new greenhouse features a water system that gathers and recycles rainwater, achieving a reduction of up to 90%.
- **Food distribution + Exchange interface** They use a multi-channel sales model. The company's 'online marketplace' also sells goods produced by local partner farms. A massive distribution center on the first floor of the new greenhouse gathers nearly 2,000 food products to provide to "Lufavores," which includes restaurants.
- **Circularity** It makes use of underused urban spaces, such as rooftops, to grow food.
- **Attractiveness - Activator** Their goal is to develop a network of rooftop greenhouses that serve locally to contribute to the development of a more sustainable and equitable food system in Montreal and beyond. They currently own three rooftop greenhouses in Montreal and plan to expand their operations in the future.

Urban Farmers by Space&Matter.

In The Hague - Netherlands - 2016

Commercial rooftop greenhouse.

https://www.urbanfarmers.nl

Site

Development of underused space in the city. It exploits the free space of the flat roof of the abandoned multi-story office building.
Area: 1'200 sq m (greenhouse) + 900 sq m (fish cultivation on the floor below).

People + Scope

Vertical farming enterprise. Its scope(s) is/are: Economic development, Environment, Social interactions.

Urban Form

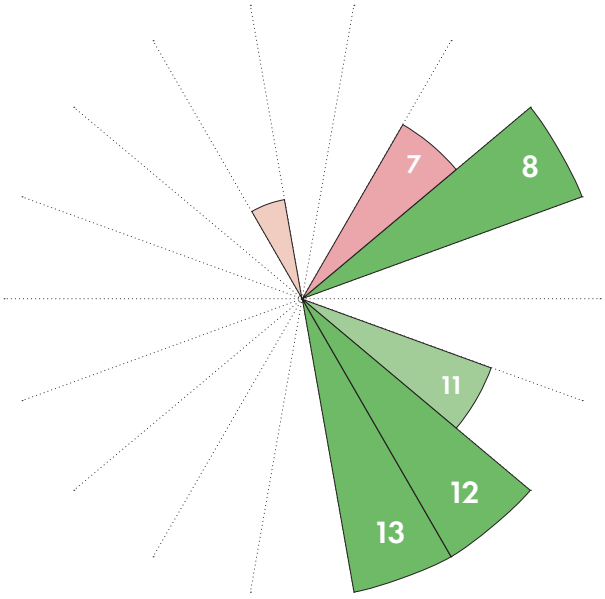
Building-integrated agriculture - Rooftop greenhouse.

Experience

Connection: Raising awareness through tourist visits;
Immersion: Stimulation of citizens who see the greenhouse in the city;
Inspiration: Inspiration of bar users inside the greenhouse.

Growing system

Aquaponics in CEA greenhouse.



Weaknesses

• **Profitability** High initial costs: the Vertical Harvest project requires a significant initial investment because of the unusual location. Numerous infrastructure and technical obstacles needed to be resolved. The total investment of the business unit is 2.7M €. In contrast to the food industry that seeks to produce food as cheaply as possible, UF seeks to grow the best possible food and sell it of superior quality. UF farms can deliver to investors an approximate 8 to 12 years ROI (return on investment).

• **Climate resilience**
The greenhouse uses additional artificial lighting (HPS) to ensure adequate production levels and a new dedicated heating system (gas burners), as waste heat sources cannot be used.

Strengths

• **Attractiveness - Activator** After the realisation of Urban Farmers, the unoccupied building below started to attract all sorts of innovative food start-ups, transforming the vacant space into a food innovation hub. At the same time, the company aims to expand with 24 projects under development. It has opened a branch office in Manhattan, New York City, to pursue development on the US East Coast.

• **Activity - liveability** Following the objectives of the municipality, the entire building is becoming a meeting place for education, research and innovation.

• **Food productivity**
Production reaches 19 tonnes of fish and 50 tonnes of vegetables per year.

• **Food distribution**
Distribution channels are B2B and include supermarkets, restaurants and canteens. The fish is processed on the farm and sold to the market as gutted fish or fillets.

ICTA-ICP UAB by HArquitectes + DATAAE.

In Barcelona - Spain - 2014

Building-Integrated Greenhouse. A rooftop greenhouse integrated with a research center.

Site

A new isolated building wrapped in a low-cost bioclimatic skin and covered by a solar greenhouse.

People + Scope

Research institute with a greenhouse for agricultu-re research activities. Its scope(s) is/are:
Education and Environment.

Urban Form

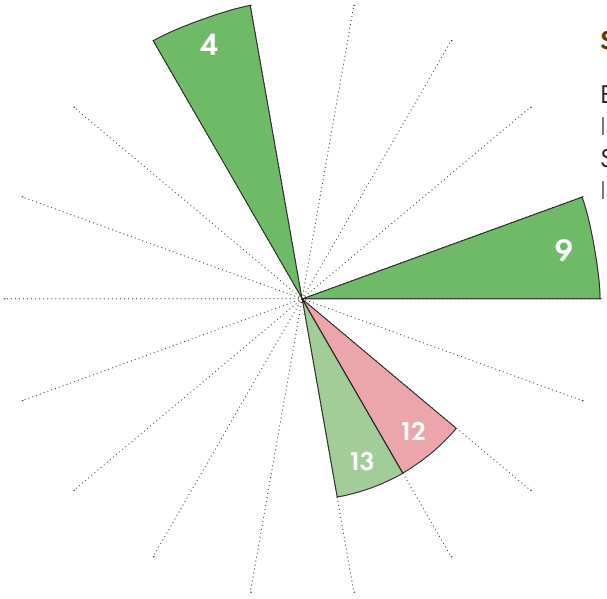
Building-integrated agriculture -
Building-integrated greenhouse: a greenhouse that completely envelops and acts as the outer skin of an office building.

Experience

Education: Participation in training workshops;
Connection: Raising awareness through tourist visits;
Immersion: Stimulation of citizens who see the greenhouse in the city;
Inspiration: Inspiration of the users of the resting spaces inside the greenhouse.

Growing system

CEA greenhouse.



Similar case studies:

Building with Integrated Rooftop Greenhouse.
In Oberhausen - Germany - 2019;
Sky Vegetables.
In The Bronx, New York - USA - 2013.

Strengths

• **Climate resilience** A building that provides an ambitious response to the challenges of sustainability. Thanks to a system of industrialized greenhouses that open and close automatically, solar gain and ventilation are regulated. The humidity gradient is regulated by cultivated courtyards and the use of natural light. The building optimizes the entire water cycle by reducing water demand and consumption through the reuse of rainwater, grey, yellow, and wastewater.

• **Employability & training** The building itself, in addition to the cultivation space, serves as a study environment whose data is monitored by researchers to identify new sustainable patterns. New skills are formed by studying the sustainability of the different strategies in situ.

• **Activity - liveability** It was conceived as an adaptable and flexible infrastructure capable of undergoing changes in use, developing several simultaneous strategies that function in a complementary manner.

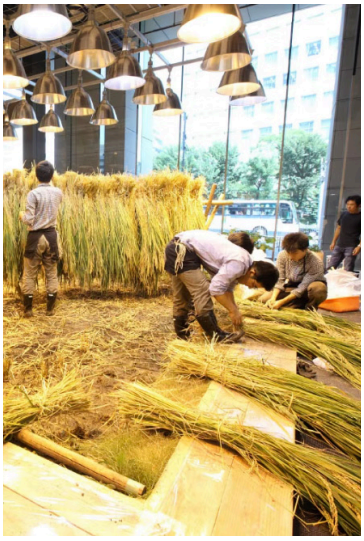
Weaknesses

• **Food productivity** Very low food production: The project uses hydroponics and greenhouse techniques for teaching and research purposes only.

Pasona Urban Farm by Kono Designs.

In Tokyo - Japan - 2022

The most significant and straightforward farm-to-table concept ever implemented within a Japanese office building.



Site

A multi-story workspace renovated so as to integrate food production within it.

People + Scope

HQ, corporate office building. Its scope(s) is/are: Leisure Activities, Health, Environment and Social interactions.

Urban Form

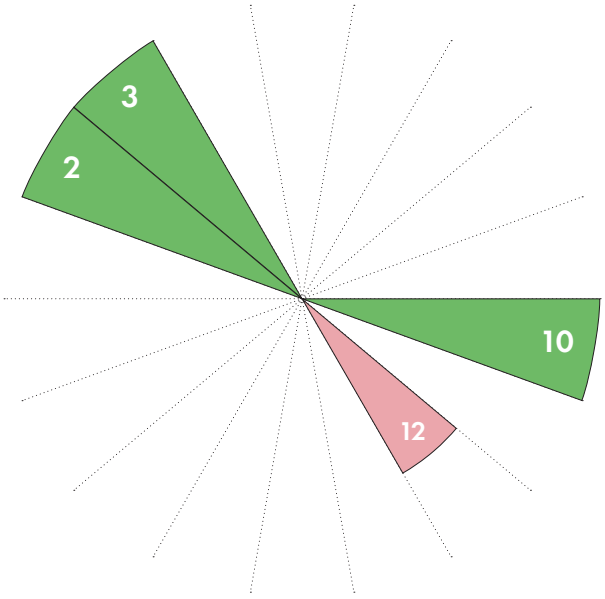
Building-integrated agriculture - Indoor farming + Edible walls: urban farming facilities integrated within the building.

Experience

Education: Participation in training workshops;
Connection: Raising awareness through client visits;
Immersion: Stimulation of citizens who see the green facade from the city.
Inspiration: Inspiration of employees, who eat the food produced in the company canteen.;
Embodiment: Employees actively participate in the growth of food and inspire others.

Growing system

Productive façades, walls and ceilings, containerised farming.



Weaknesses

• **Food productivity** Very low production of food: The project uses hydroponic and greenhouse techniques for educational and research purpose only.

Strengths

• **Healthy & safety + Exchange interface** The production involves 200 species including fruits, vegetables and rice that are harvested, prepared and served at the cafeterias within the building. All employees benefit from the food produced on site and from the presence of plants as a sense of well-being resulting from biophilia: the close connection with nature.

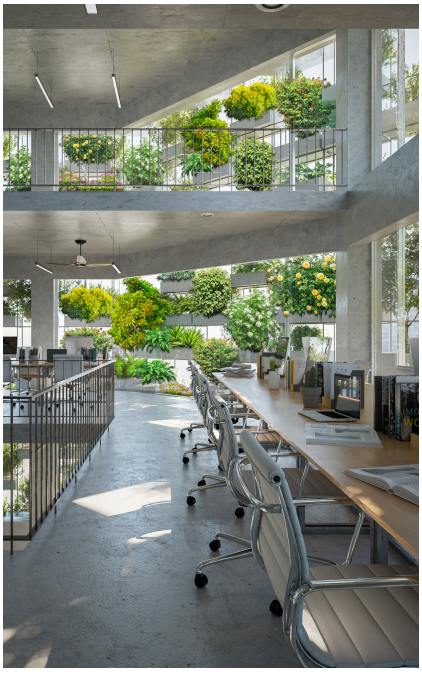
• **Engageability** The aim of the project is to engage the public and to provide better workspace for their employees. Employees are invited to cultivate and harvest the products, creating moments of collaboration.

Urban farming office by VTN Architects.

In Ho Chi Minh city - Vietnam - 2022

A façade that ensures a comfortable microclimate throughout the office building.

https://vtnarchitects.net



Site

A new HQ, corporate office building, designed in order to integrate a productive façade.

People + Scope

HQ, corporate office building. Its scope(s) is/ are: Leisure Activities, Health, Environment and Social interactions.

Urban Form

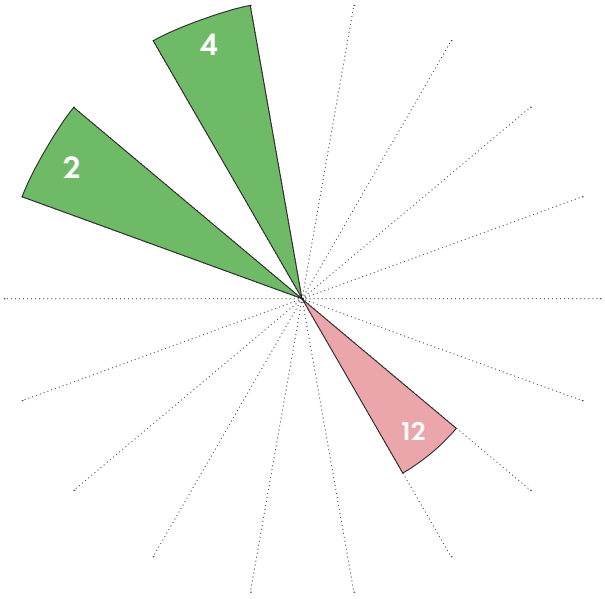
Building-integrated agriculture - Edible walls: Urban farming facilities integrated into the façade of the building.

Experience

Connection: Raising awareness through client visits;
Immersion: Stimulation of citizens who see the green facade from the city;
Embodiment: Employees actively participate in the growth of food and inspire others.

Growing system

Modular and flexible Productive façade.



Weaknesses

• **Food productivity** Productivity is limited. This is not one of the aims of the project. Five different vegetables are planted in a 200 sq m vertical garden, the main purpose of which is to boost the office's image and control the indoor micro-climate.

Strengths

• **Healthy & safety + Climate resilience**
The "vertical farm" establishes a pleasant microclimate throughout the structure, and in combination with glazing, the plants filter out direct sunlight and cleanse the air. It is irrigated with stored rainwater while evaporation cools the air. Various local edible plants, such as vegetable, herb, and fruit trees, are selected to contribute to the biodiversity of the region. The project stands in contrast to the lack of greenery, which causes various social problems, such as air pollution due to an overabundance of motorbikes, flooding, and the heat island effect. At the same time, fruit and vegetables are made available and eaten in the office.

Farming Kindergarten by VTN Architects.

In Biên Hòa - Vietnam - 2013

The building is designed as an uninterrupted green roof that offers an agricultural learning experience for children, as well as a vast playground in the sky.

Site

A new isolated kindergarten, next to a factory. The green roof houses a 200 sq m cultivated area.

People + Scope

A kindergarten for the children of the workers (the factory next door). Its scope(s) is/are:
Education, Leisure Activities, Health, Environment and Social interactions.

Urban Form

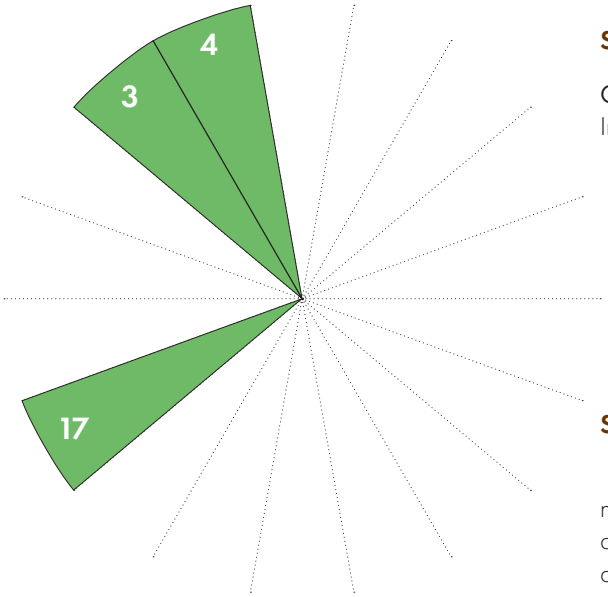
Building-integrated agriculture -
Open-air rooftop.

Experience

Education: Participation in training workshops;
Immersion: Stimulation of citizens who see the green roof from the city and and employees of the factory next door;
Embodiment: Children actively participate in the growth of food.

Growing system

Open-air intensive rooftop.



Similar case study:

Gary Comer Youth Center by Hoerr Schaudt.
In Chicago, IL - USA.

Strengths

- **Climate resilience** Architectural and mechanical energy-saving methods are comprehensively applied including but not limited to: green roof as insulation, green facade as shading and solar water heating. These devices are intentionally visible and play a vital role in the sustainable education of children. The factory's wastewater is recycled to water the plants and flush the toilets. According to post-occupancy records released ten months after its construction, the building conserves 25% of energy and 40% of fresh water compared to the standard building performance, resulting in a significant reduction of its environmental impact.
- **Engageability** Educational opportunities: The rooftop farm provides an opportunity for children at the kindergarten to learn about agriculture and the environment in a hands-on way. They can participate in planting, harvesting, and caring for the plants, which helps to teach them about the natural world and where their food comes from. Community engagement: The rooftop farm can provide a space for community members to come together to work on the farm and learn about agriculture. This can help to build a sense of community and foster a connection to the natural world.
- **Green & Blue networks** Aesthetically pleasing: The rooftop farm can add a green, natural element to the built environment, which can improve the overall appearance of the building and the surrounding area. The completely green roof mitigates the presence of the kindergarten and allows it to blend in with its natural surroundings while also providing nourishment for the local fauna.

ØsterGro.

In Copenhagen - Denmark - 2014

The first rooftop 'Farm to Table' in Denmark

https://www.oestergro.dk/

Site

Redevelopment of an underused roof in the heart of Copenhagen's Climate Resilience Quarter. The roof is located on top of an old car auction house.

People + Scope

ØsterGro operates as a community-supported agriculture (CSA) and collaborates with Stensbølgård farm to distribute its produce.
Its scope(s) is/are: Leisure activities, Health, Food Security, Environment and Social interactions.

Urban Form

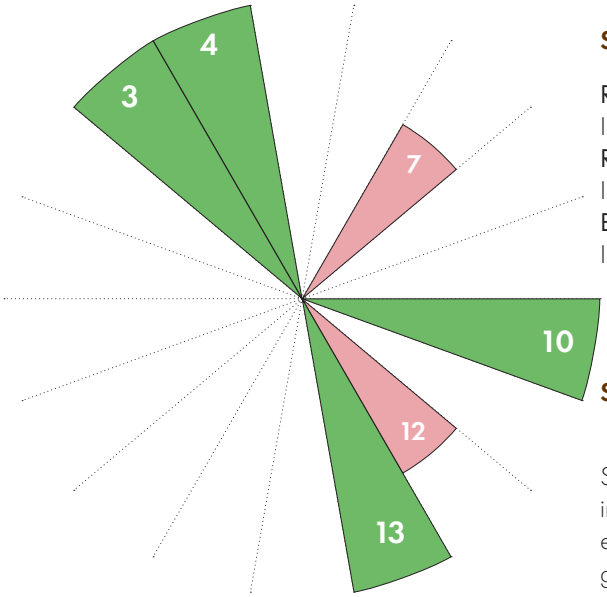
Building-integrated agriculture - Open-air rooftop. From farm to table.

Experience

Immersion: Stimulation of citizens who see the green roof from the city;
Inspiration: Inspiration of the users of the restaurant inside the greenhouse;
Embodiment: Citizens actively participate as volunteers in the growth of food and inspire others.

Growing system

Open-air intensive rooftop with organic raised beds.



Similar case studies:

Riverpark Farm by ORE Design + Technology.
In New York, NY - USA - 2011;
Rooftop Reds.
In Brooklyn, NY - USA - 2016;
Big Delicious Planet.
In Chicago, IL - USA - 2012.

Strengths

- **Exchange interface** With their restaurant Gro Spiseri they want to invite even more people up in their green surroundings creating unique dining experiences for their guests inside the rooftop greenhouse.
- **Engageability + Activity - Liveability** The vision of ØsterGro is to invite everyone to participate in the growing season from April to mid-December. There is a weekly volunteer day. The ØsterGro project can provide a space for community members to come together and enjoy the outdoors. This can help to build a sense of community and foster a connection to the natural world. Throughout the year, citizens can indulge in seasonal breakfasts, lunches, and dinners at the long table located in the greenhouse, in addition to participating in various workshops and events, such as the Christmas market.
- **Climate resilience** It is established in the heart of Copenhagen's Climate Resilience Neighbourhood thus reinforcing the environmental commitment of the area. Improved air quality: The plants on the green roofs in the ØsterGro project can help to absorb carbon dioxide and other pollutants from the air, improving the air quality in the surrounding area. Cooling effect: The plants on the green roofs can help to keep the buildings cooler by providing shade and releasing water vapor into the air. This can help to reduce the need for air conditioning and lower energy use. Habitat for wildlife: The green roofs in the ØsterGro project can provide habitat for a variety of wildlife, including birds, insects, and small mammals. Flood prevention: Green roofs can help to absorb stormwater, reducing the risk of flooding in the area.

Weaknesses

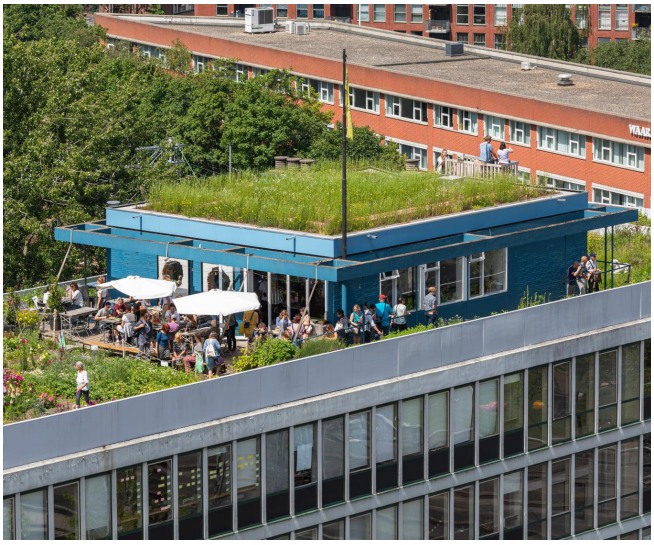
- **Food productivity + Profitability** It provide local and fresh vegetables, honey and eggs to people in the city. It's organized as a community-supported agriculture (CSA) and it sells its products to 40 members. Productivity is made possible through volunteering and it mainly covers the food demand of the restaurant.

DakAkker rooftop farm.

In Rotterdam - The Netherlands - 2012

The DakAkker is the most extensive open-air rooftop farm in the Netherlands and one of the largest in Europe.

https://dakakker.nl



Site

Development of underused space in the city. It exploits the free space of the flat roof of an office building in the center of Rotterdam.
Area: 1'000 sq m.

People + Scope

Run by research experts and a large number of enthusiastic volunteers. Its scope(s) is/are: Environment, Education, Health and Social interactions.

Urban Form

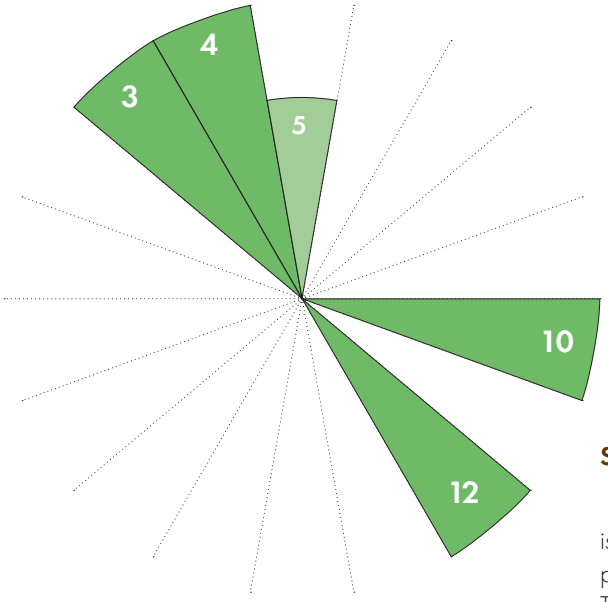
Building-integrated agriculture - Open-air rooftop. From farm to table.

Experience

Education: Participation in training workshops;
Immersion: Stimulation of citizens who see the green roof from the city;
Inspiration: Inspiration of bistro customers;
Embodiment: Citizens actively participate as volunteers in the growth of food and inspire others.

Growing system

Open-air intensive rooftop.



Strengths

- **Climate resilience** On the roof of the pavilion is the production area, a botanical garden with protected plants and the so-called 'smart roof'. This is a test site for intelligent water storage and management. For cultivation, the rooftop farm collects and uses rainwater. This smart roof system is equipped with sensors for a rain-proof Rotterdam. When heavy rain is forecast, the intelligent control reacts by providing additional water storage capacity 24 hours in advance. In anticipation of more irregular rainfall in the future, the DakAkker helps the city of Rotterdam adapt to climate change.
- **Engageability** There is an education program at the rooftop farm about urban agriculture, green roofs, climate and water, healthy food and bees for primary schools. A lot of enthusiastic volunteers takes part of this initiative.
- **Food distribution + Exchange interface** Bistro 'Op het Dak', located on the roof, uses the super fresh harvest of the DakAkker for its menu. The products are also delivered to other local restaurants, sold during festivals and in high season directly to visitors. The food is delivered within a short walking or cycling distance, ensuring the food chain is as short as possible.
- **Circularity** The 'worm hotels' produce compost that is used on the roof itself and sold as 'worm tea' (liquid compost) to shops and consumers. Food waste is limited to a maximum by maximising the use of resources and closing the loop whenever possible. The DakAkker contributes to the realisation of a zero-waste city.

Citiponics.

In Singapore - 2015

Cultivation innovators on the rooftops of Singapore.

https://www.citiponics.com

Site

Development of underused space in the city. It exploits the free space of the flat roof of a multi-story car park.

People + Scope

Vertical farming enterprise. Its scope(s) is/are: Economic development, Environment, Health and Food Security.

Urban Form

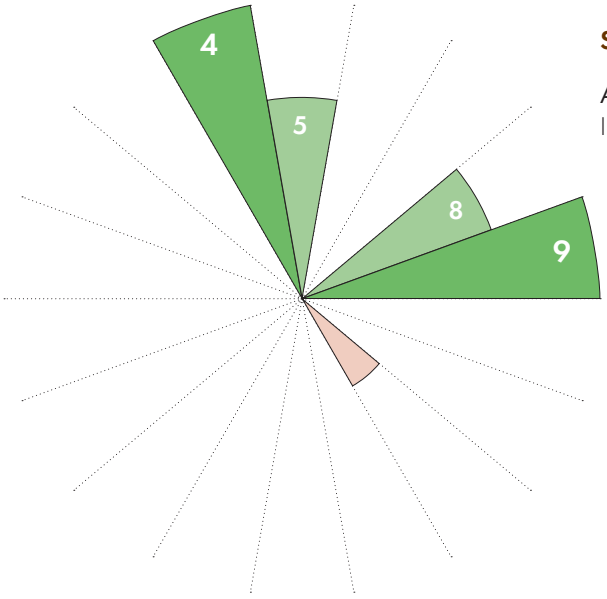
Building-integrated agriculture - Open-air rooftop.

Experience

Education: Participation in training workshops; Immersion: Stimulation of citizens who see the rooftop farm in the city.

Growing system

They patented and innovated Aqua Organic System (AOS) made with growing towers. Hydroponic open-air rooftop.



Similar case study:

Agripolis.
In Paris - France - 2019.

Strengths

- **Climate resilience** Sustainably farmed with zero waste and minimal carbon emission. Produce with -99% water & minimal electricity. Grown with 0 pesticides.
- **Employability & training** They offer a customised Agritech learning programme designed to provide learners with early exposure to experimentation with alternative agricultural methodologies. A programme designed to stimulate the next generation to embark on a personal journey towards discovering new forms of urban agriculture.
- **Circularity** Thanks to their AOS technology, every component of the cultivation system, including the farming medium, is recyclable and reusable, creating a sustainable cultivation process. Allowing them to cultivate more without creating additional waste or negative environmental impacts.
- **Accractiveness - Activator** Their Aqua Organic System (AOS) can now be seen in Singapore, Malaysia, and China.
- **Food productivity** Vertical nature of the system allows amount of harvest to be enhanced by +70% per sq-m, utilizing less space for more produce. Compared to conventional farming methods, it guarantees a yield that is 3.5 times higher with 30% less human labor required.

Weaknesses

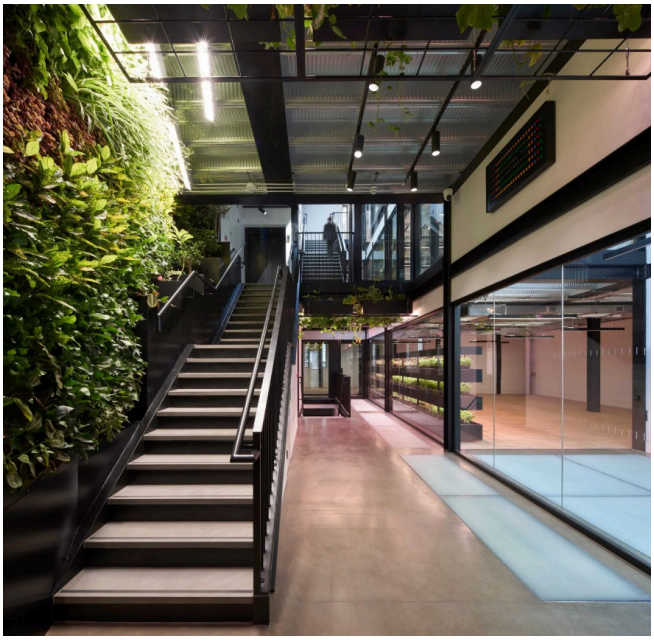
- **Food productivity** Although the water within the system is constantly moving, preventing the reproduction of mosquitoes, the choice of not using pesticides, preserving the natural nutrients of the vegetables and allowing the plants to develop their natural immunity, and not using controlled environments exposes the entire system to external agents. Foreign diseases can affect the plants, the weather can ruins the crop and GHG fine dust settles on them.

Plantworks by Marek Wojciechowski Architects.

In London - United Kingdom - 2021

Plantworks is a pioneering workspace with integrated urban planting.

https://plantworks.space



Site

A multi-story abadoned building renovated so as to integrate food production and working spaces within it.

People + Scope

A working space designed to nurture the wel-lbeing and success of everyone who encounters it. Its scope(s) is/are: Leisure Activities, Health, Environment and Social interactions.

Urban Form

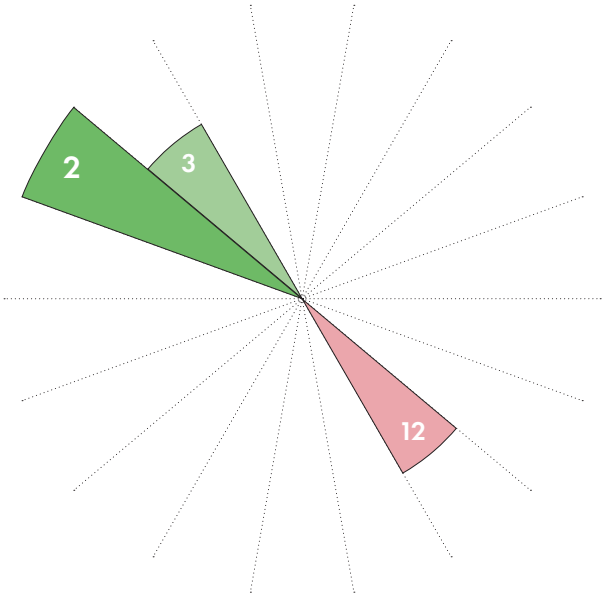
Building-integrated agriculture - Indoor farming.

Experience

Connection: Raising awareness through client visits;
Inspiration: Inspiration of employees, who eat the food produced in the office canteen;
Embodiment: Employees actively participate in the growth of food and inspire others.

Growing system

Productive walls and ceilings, containerised farming.



Weaknesses

- **Food productivity** The productivity, limited, is not among the aims of the project. There are 82 sq m of green infrastructure.

Strengths

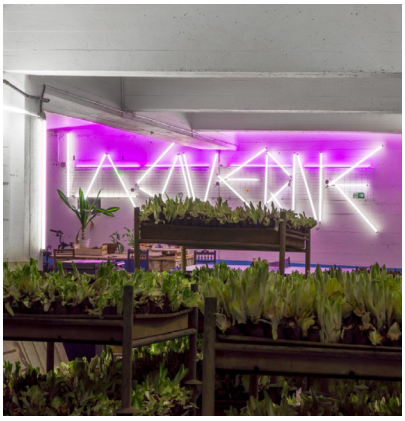
- **Health & Safety** Biophilic design – bringing the outside in – is proven to make people happier, more creative and harder working. Green office environment +15% productivity; Improvement in strategy +31%; Improvement in focus +38%; Applied activity +44%; Crisis management +37%.
- **Engageability** Those who work in Plantworks can experience first-hand cultivation, harvesting and consumption on site. This increases education in food culture.

La Caverne.

In Paris - France - 2018

An organic, underground farm in Paris.

https://lacaverne.co



Site

Development of underused space in the city center. It exploits a vacant underground space that was once used as a car park. Area: 3'500 sq m.

People + Scope

Vertical farming enterprise. Its scope(s) is/are: Economic development and Environment.

Urban Form

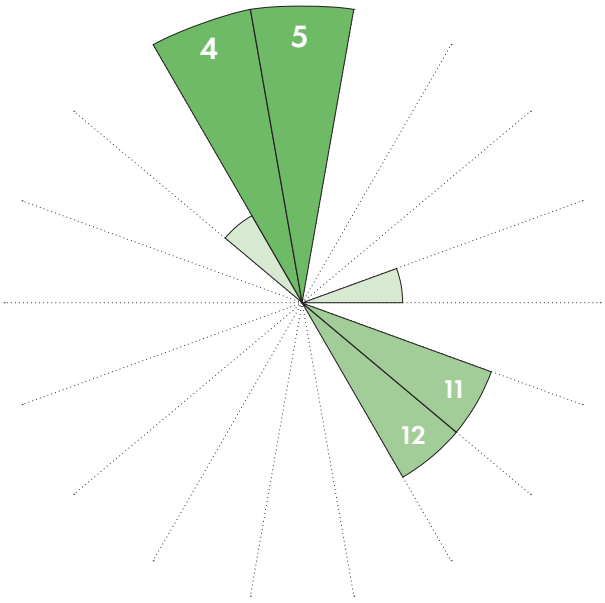
Building-integrated agriculture - Indoor farming.

Experience

Connection: Raising awareness through client visit-tasting tours.

Growing system

Permaculture. Productive walls, containerized farming.



Strengths

- **Climate resilience** The CO2 generated by the mushrooms is used for plant growth, the organic matter is composted to fertilise the crops. These techniques are largely inspired by permaculture.
- **Circularity** This project makes use of a disused space in the city's basement. 3,500 sq m of space once used as a car park converted into a zero-emission food growing area.
- **Food productivity** The underground farm produces 150 tonnes of chicory and 40 tonnes of mushrooms annually in organic agriculture.
- **Food distribution** The production will be commercialized in the neighborhood by the young company 'Cycloponics', especially at the market.
- **Employability & Training** Thanks to this project, 10 full-time positions have been created, 80% of which are occupied by the inhabitants of the neighbourhood.
- **Engageability** They promote visit-tasting tours.

Value Farm by Thomas Chung.

In Shenzhen - Cina - 2013

Value Farm is the world's first large-scale urban farm built to regenerate al obsolete factory, designer as a hybrid of plots, fabricated urban ruins and public garden.

Site

Redevelopment of an obsolete industrial site. A post-industrial regeneration project on the site of an old glass factory. Site area: 2'100 sq m.

People + Scope

Created for a Biennale, it aims to create a green oasis above the urban chaos. Its scope(s) is/are: Leisure Activities, Health, Environment, Social interactions, Education and Urban Planning.

Urban Form

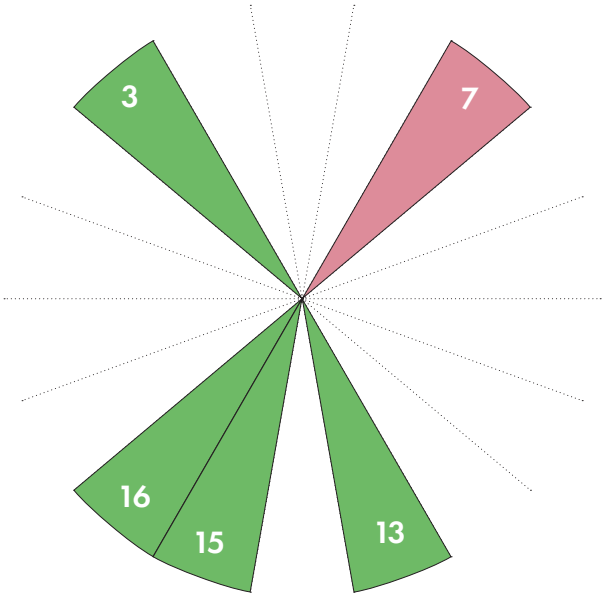
On ground agriculture - Community garden: a permanent regenerative landscape infrastructure. A hybrid combination of farm, manufactured urban ruins and public garden.

Experience

Education: Participation in training workshops;
Connection: Raising awareness through tourist visits and visit-tasting tours;
Immersion: Stimulation of citizens who see the green park-garden from the city.
Embodiment: Citizens actively participate as volunteers in the growth of food and inspire others.

Growing system

On-ground farm.



Strengths

• **Continuity** The design recalls the rooftop farms of the dense city of Hong Kong and the emerging trend of urban agriculture. Secondly, the site aims to create continuity with the vibrant urban vernacular of Hong Kong's Central District, particularly the 170-year-old market area and its fabric of low-rise buildings that embodied its fine-grained metamorphosis. Value Farm envisions retroactively transforming the rooftops of an entire demolished wet market block into farmland. Utilizing rooftop spaces for sustainable agriculture is viewed as a promising avenue towards creating a sustainable post-urban future.

• **Accessibility - permeability** The design of Value Farm is multi-layered. The composition of farm plots, platforms and pavilions creates an undulating, hard and soft edible landscape whose different depths are matched to the corresponding crop types. The landscape is made accessible and fully permeable to the citizenry who can use it as a space for gathering.

• **Engageability + Activity - Liveability** Value Farm not only oversees the operations of the farm but also coordinates the immensely popular planting, tasting, and market festivals with the involvement of global curators, architects, and design experts. These events have gained tremendous backing and eagerness from the local population, media outlets, and community organizations.

Weaknesses

• **Profitability** Created for a Biennale, it aims to create a green oasis above the urban chaos. The completed project occupies a large space permanently in order to regenerate value in the post-industrial area. The project does not generate earnings but positive spin-offs in the area.

Empress Green by Zaro Bates.

In New York - USA - 2016

One of New York city's largest urban farms.

https://www.empressgreen.com

Site

Development in a green area in-between two Urby buildings, in a complex of 571 flats. Site area: 5,000 sq m.

People + Scope

A family business set up and run by Zaro Bates and Asher Landes, who live on Staten Island. Its scope(s) is/are: Economic development, Environment and Urban planning.

Urban Form

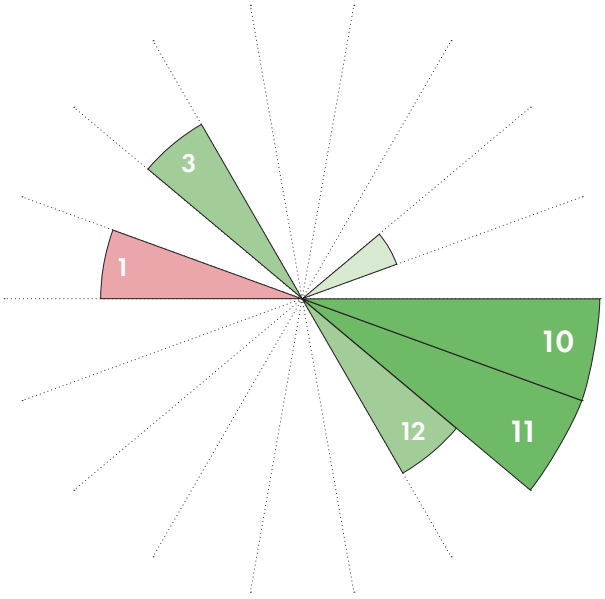
On ground agriculture - Urban farm:
a space between buildings for residents and the general public.

Experience

Education: Participation in training workshops;
Conversation: It is possible to purchase directly with the producer;
Immersion: Stimulation of citizens who see the garden from the city;
Reflection: The space promotes moments of collective reflection on food issues.

Growing system

On-ground farm.



Weaknesses

• **Inclusivity** Limited affordability: These urban green development projects are mainly oriented towards high-end buyers or tenants, which may make it difficult for low- and moderate-income residents to find affordable housing nearby. Risk associated with green washing practices oriented only to enhance the identity and notoriety of the housing complex.

Strengths

• **Food distribution + Exchange interface** Weekly sale of agricultural products on the premises of the complex and donations to food banks. In addition to this, products are supplied to the communal kitchen of the housing complex with a subscription-based meal delivery service.

• **Food productivity** Around 50 types of produce are grown: vegetables, summer vegetables, flowers, herbs and roots.

• **Engageability** In addition to the promotion of the products and the use of the garden as a meeting and recreation space for the public, they also host a workshop and a book club.

• **Attractiveness - Activator** The space, which serves as an attractor for citizens and residents, is enabling the planning of other spaces within the same complex, designed for future expansion of the business.

InFarm.

In Berlin - Germany - 2013

A global network of climate-resilient farms located within supermarkets for direct sale.

https://www.infarm.com

Site

The units are located inside supermarket aisles and restaurants.

People + Scope

Vertical indoor farming company. Its scope(s) is/are: Economic development, Environment and Food security.

Urban Form

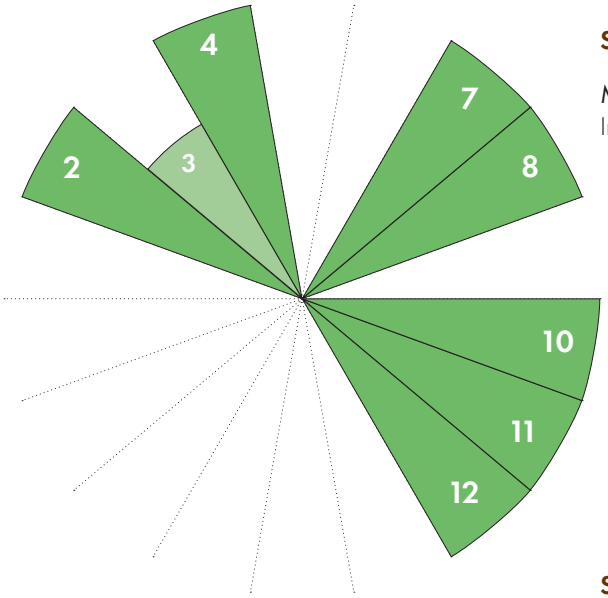
Building-integrated agriculture - Indoor farming: modular farming units inside supermarket aisles and restaurants.

Experience

Immersion: Stimulation of supermarket customers; Engagement: Customers get engaged by picking fresh vegetables directly at the supermarket.

Growing system

Modular hydroponic, indoor CEA farm units.



Similar case study:

Metro Farm by Seoul Metro + Farm8.
In Seoul - South Korea - 2019.

Strengths

- **Attractiveness - Activator + Profitability**

The start-up has an easily scalable success model.

- **Food distribution + Exchange interface**

The modules can be found on the aisles of supermarkets across the world, from Marks & Spencer in the United Kingdom to Kroger in the United States, or Metro and Aldi in continental Europe.

- **Food productivity + Healthy & safety**

Infarm's vertical vegetable garden produces almost four tonnes of herbs per year, which are sold on site at the METRO shop in Nanterre, France. These new farms will save labour, land, water, energy and food miles, contributing to a more sustainable food system and making fresh, pure, tasty and nutritious produce available and accessible to all in urban areas.

- **Climate resilience** Growing vertically, they save land: more than 205,000 sqm of land so far (-95%). Their closed-loop irrigation systems use -95% less water and recapture the water that evaporates from the plants, so not a single drop is wasted. Infarm has become the first company to pledge its commitment towards a Net Zero Science-Based Target.

- **Engageability** Present directly in supermarkets, they propose an innovative model based on offering the plants to retailers, so that customers can buy the live products. While Infarm provides the technology and the farm, the supermarkets grow the plants and harvest them.

Sky Greens.

In Singapore - 2012

World's first low-carbon, hydraulic driven vertical farm.

https://www.skygreens.com

Site

New development in a peri-urban industrial-agricultural context where other agricultural enterprises are also present.

People + Scope

Vertical indoor farming company. Its scope(s) is/are: Economic development and Environment.

Urban Form

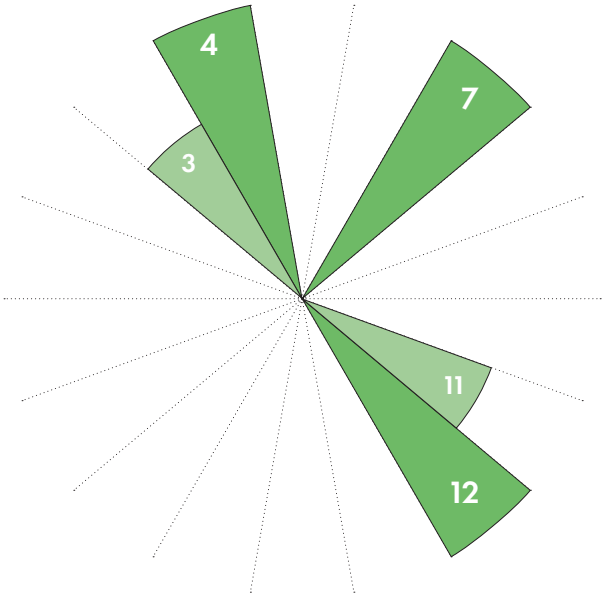
Vertical farming (Sky farming): series of side-by-side greenhouses that make up a single production building.

Experience

Connection: Raising awareness through client visits;
Immersion: Stimulation of citizens who see the greenhouse from the city.

Growing system

Hydroponic CEA greenhouse with Sky Greens' patented system inside: it uses a hydraulic vertical conveyor belt system.



Strengths

- **Climate resilience** Organic, carbon-neutral vertical farm. The hydraulic rotation of the cultivation beds makes the use of artificial light for cultivation unnecessary. The use of water is also reduced. It is stored in underground tanks and is recycled and reused.
- **Profitability + Food productivity** Compared to single-layer cultivation, the technology introduced by Sky Greens has a 10 times higher yield per unit area. At the same time, the customizable and modular structures allow excellent scalability of the system.
- **Engageability** Visits are organized to study food processes and improve awareness of what we eat.
- **Food distribution** Vegetables are harvested and delivered to the market every day in addition to the numerous retailers.

K-Farm by Avoid Obvious Architects.

In Hong Kong - 2021

A smart urban farm. K-farm challenges urban farming under extreme conditions and makes farming into a STEM education for all people.

Site

Redevelopment of underused space in a coastal area. It exploits an impermeable space, formerly an industrial site. Surface area: 2'000 sq m.

People + Scope

K-Farm is the proposed recreational farm developed by an NGO, ROUGH, which was awarded the lease starting in May 2019 for three years.
Its scope(s) is/are: Leisure Activities, Health, Environment, Social interactions, Education and Urban Planning.

Urban Form

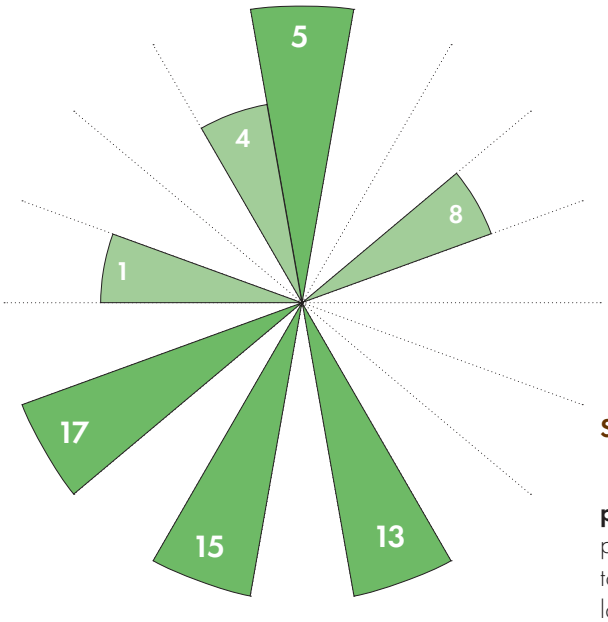
Vertical farming (Sky farming) +
On ground agriculture - Urban farm.

Experience

Education: Participation in training workshops;
Connection: Raising awareness through tourist visits;
Immersion: Stimulation of citizens who see the green park from the city;
Embodiment: Citizens actively participate as volunteers in the growth of food and inspire others.

Growing system

Hydroponic, aquaponic and organic CEA greenhouses, productive green wall, vertical farming racks and farming tables.



Strengths

- **Activity - liveability + Accessibility - permeability** The project serves to involve the public. The agricultural facilities are connected to the Belcher Bay Area and the reflecting pool, lawns, three rain shelters and event space are open 24/7. The project is designed to engage and entertain even non-agricultural enthusiasts. The farm will also offer activities that benefit the community: lectures, organic food and drink from the green kitchen, a farmers' market and all kinds of community events.
- **Circularity + Green & blue networks** Rehabilitation of an industrial site completely devoid of green space to transform it into a park, connected to the various parks in the vicinity and flanked by the waterfront. In addition, the modular design allows for the complete relocation of structures.
- **Climate resilience** Rainwater is collected in tanks and reused. Solar panels have been installed to cover the facility's energy needs. The use of organic farming also helps the ecosystem of the entire area: the lack of pesticides is attracting and increasing biodiversity on the waterfront.
- **Inclusivity** In the site there is also an organic cultivation system with various heights and species to serve as inclusive agriculture and maintain the community's ecosystem. The design of the cultivation elements allows people with special needs to access agriculture without having to bend over.
- **Attractiveness - Activator** The data collected on how to farm in extreme weather conditions will be shared with the community. This project will serve as a model for other urban farms to be disseminated in Hong Kong and Asia.

The Green House by Cepezed.

In Utrecht - The Netherlands - 2018

The Green House accommodates a 'circular' restaurant concept plus meeting facilities.

Site

It exploits a vacant space between administrative buildings, as a temporary solution.
The new 680 sq m volume houses an 80 sq m greenhouse.

People + Scope

Used as catering and meeting space. Its scope(s) is/are: Leisure activities, Economic development and Environment.

Urban Form

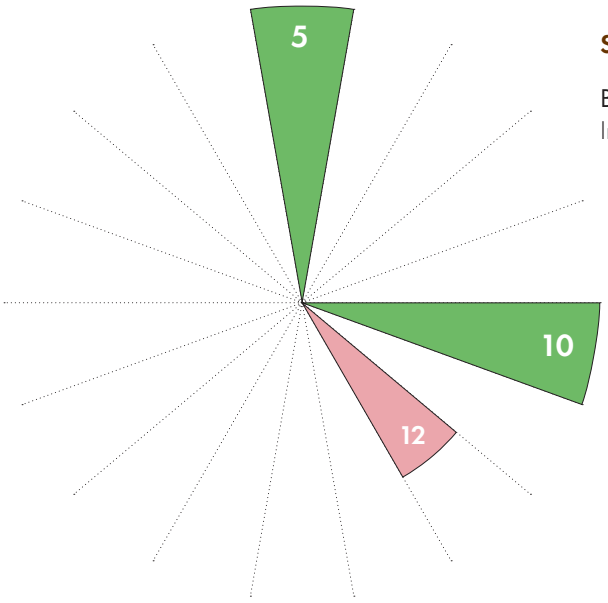
Building-integrated agriculture - Rooftop greenhouse.

Experience

Immersion: Stimulation of citizens who see the greenhouse in the city.
Inspiration: Inspiration of the users of the resting, restaurant and meeting spaces inside the greenhouse.

Growing system

Hydroponic CEA greenhouse.



Similar case study:

Brasserie 2050 by Overtreders W.
In Biddinghuizen - The Netherlands - 2018.

Strengths

- **Circularity** A project in which both function and architecture are completely 'circular' for a temporary and lively environment. A 'circular' restaurant concept with meeting facilities that can be completely dismantled to be rebuilt elsewhere, including its foundations in precast concrete blocks. The pavilion's second skin and greenhouse were constructed by repurposing the smoked glass façade panels of the former Knoop barracks.
- **Exchange interface** Vegetables and herbs serve the restaurant's kitchen. Thanks to a void in the pavilion, the greenhouse can be clearly seen freely accessible from the restaurant below. The presence of a sizable green wall is a major contributing factor to the overall ambiance.

Weaknesses

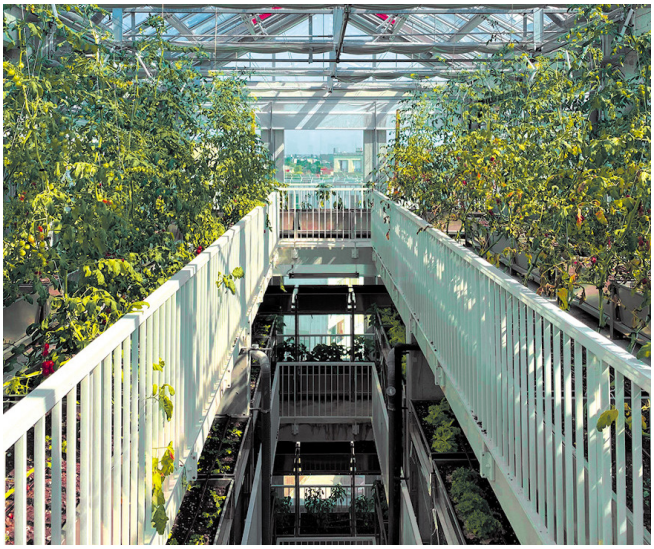
- **Food productivity** Of the restaurant's 680 sq m, 80 are used for production. Production does not entirely cover the restaurant's food needs, of which it is above all a source of identity and positive public image.

Cité maraîchère by Secousses architectes.

In Romainville - France - 2021

A multi-faceted place for producing vegetable gardens, raising awareness of more environmentally friendly lifestyles and a new place to live in the neighbourhood.

https://www.lacitemaraichere.com



Site

An isolated new building in the heart of a recently renovated neighbourhood benefiting from the proximity of a school and a community centre.

People + Scope

Cité maraîchère is a municipal structure at the service of residents and social and solidarity economy actors. Its scope(s) is/are: Leisure Activities, Health, Environment, Social interactions, Education and Urban Planning.

Urban Form

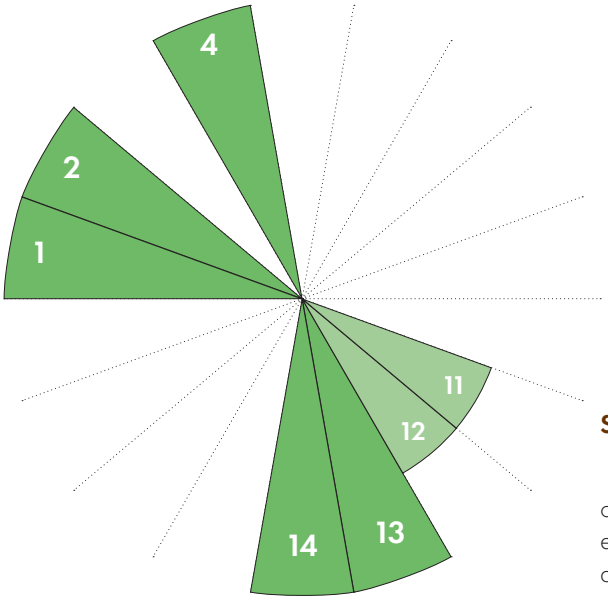
Vertical farming (Sky farming): A hybrid of a horticultural greenhouse and an industrial building, the project is divided into rational and flexible volumes.

Experience

Education: Participation in training workshops;
Immersion: Stimulation of citizens who see the vertical farm from the city;
Inspiration: Inspiration of bar-bistro users inside the vertical farm;
Engagement: Citizen volunteers participate in co-design and co-construction activities.

Growing system

Hydroponic CEA greenhouse.



Strengths

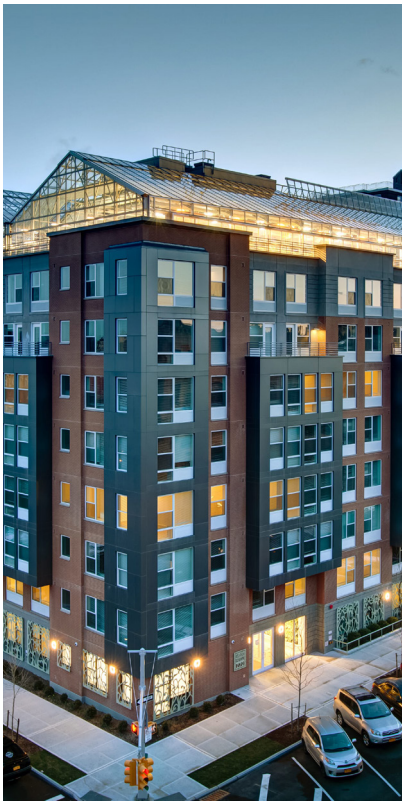
- **Climate resilience** Plants benefit from optimized natural sunlight due to the favorable exposure of the building's facades. Designed as a controlled bioclimatic environment, the building combines heat production, ventilation, and lighting systems within high-performance thermal envelopes adapted to plants.
- **Activity - Liveability + Completeness** The building is also an open facility for neighborhood residents and visitors to develop knowledge and practice of culture in the city. It hosts and offers numerous outreach and educational activities for all audiences on the topics of nature in the city, eco-citizenship and sustainable food. Educational, cultural, culinary and scientific events are organized in collaboration with city departments and committed local actors. In addition, the cafeteria-cellar offers a complementary and diverse range of organic, local and seasonal products.
- **Healthy & safety + Inclusivity** La Cité Maraîchère encourages reflection and proposes alternatives in the face of the social challenges of sustainable and quality food and aims to reduce inequalities in access to it.
- **Food productivity** Different species of fruits, vegetables and herbs are produced, depending on the season. Some high value-added products, such as oyster mushrooms, edible flowers and microfoods, are also cultivated.
- **Food distribution** La Cité Maraîchère encourages the consumption of products from the surrounding rural areas and sold through markets, associations for the maintenance of peasant agriculture (Amap) and grocery stores.

Sky Vegatables.

In The Bronx, New York - USA - 2013

A building-integrated rooftop greenhouse.

http://www.skyvegetables.com



Site

A new development of a social housing complex in the Bronx that incorporates a 720 sq m rooftop greenhouse.

People + Scope

Vertical indoor farming company. Its scope(s) is/are: Economic development and Environment.

Urban Form

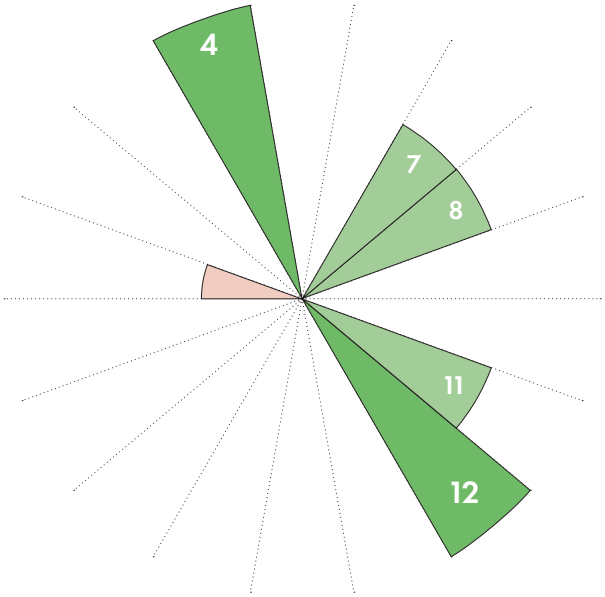
Building-integrated agriculture - Rooftop greenhouse.

Experience

Immersion: Stimulation of citizens who see the rooftop greenhouse in the city.

Growing system

NTF (Nutrient Film Technique) hydroponic CEA greenhouse.



Strengths

- **Climate resilience** The building's design, with the integrated greenhouse, makes it one of the first examples of BIA, enabled it to achieve LEED Platinum certification. The building's drainage water is collected in the basement and recirculated in the greenhouse.
- **Food productivity** During peak seasons, Sky Vegetables, which uses only natural light, is able to produce 200 to 250 boxes of fresh leafy vegetables for 49 weeks a year. They currently grow Genoese basil, Upland cress, wild rocket and sometimes Baby Bibb lettuce, dill and coriander.
- **Food distribution** The fresh produce is sold to 20 supermarkets, including Whole Foods. As part of their business model, Sky vegetables is also trying to reach end consumers.
- **Profitability** A maintenance fee for the common area is paid instead of a rent. It is also realised thanks to tax credits received by the owner of the building, who is partly responsible for financing the greenhouse.
- **Attractiveness - Activator** Sky Vegetables' experimentation has allowed them to validate data for larger models. They are planning to build and operate a 4'500 sq m greenhouse. Current expansion plans include the construction of greenhouses in NYC, Boston, Maryland and potentially Chicago.

Weaknesses

- **Inclusivity** The concept involved not only supplying leafy greens to restaurants and supermarkets but also directly providing food to the local community through a community supported agriculture (CSA) initiative. The aim was to address the issue of food deserts in the area. Unfortunately, the CSA part of the plan did not last long. The logistics of manpower needed to manage the people arriving in the space and the management of food security meant that the CSA was unsuccessful and was terminated.

3.2 - Considerations

Analysing the case studies, the problem of the **high initial investment cost** emerges first. Some successful case studies solved this issue in different ways:
- **Jackson Hole farm** with a model for social inclusion is a mixed public-private company.
- **Lufa Farm** by using the roof of an existing building without any particular technical impediments managed to install the production facility at a low cost of €800 per square metre.
- **Sky Vegetables** on the other hand sees the owners of the residential complex as co-investors in the greenhouse. They do not pay rent but only part of the maintenance costs of the common areas. This is thanks to local laws that have made it possible to finance the facility through tax credits for energy improvements in the building.

Other problems are related to **low food production**. Associated with this are phenomena of both Green Washing and Green Waste:
- **ICTA-ICP UAB** integrates smart solutions for thermal gain and natural ventilation. However, the space for food production is underutilised. The waste of an opportunity for Nature-base solution such as food production and biophilic design into the workspace form an example of **Green Waste**.
- **The Green House**, on the other hand, although an interesting example of a structure that follows circular design principles, has little food production on site. In-house production does not cover the needs of the bar-restaurant, which instead uses this feature as its key identity. For this reason, we treat it as a case of **Green Washing**, also considering the benefits that the actual expansion of food production would bring to the new office district in which it is located.

The last major issue to be addressed is the extension of **Gentrification** phenomena in urban-residential areas. In the case of **Empress Green**, the growing space is given to the growers free of charge in addition to a flat and the payment of a salary. This is because the owners of the housing complex mainly use the urban farm as a public attractor and to improve the image of the complex, consequently the value of its flats, rather than to produce fresh and healthy food locally.

The individual components, the site in which it is located, the people who run the farms, the urban form, the experiential enablers and the growing systems will be analysed including external opportunities and threats. This will be useful to identify sustainable urban practices that reinforce the strengths and also resolve possible weaknesses found in the case study analysis.

4 - AGRITECTURE STRATEGIES: COMPONENTS

4.1 - Overview

This section aims to introduce the individual components that define an urban agricultural system.
The chapter first analyzes possible cultivation **sites** and their **urban forms**, examining possible new relationships established at both the building scale and with the surrounding urban fabric. Following this, the chapter introduces various individuals and **communities** of **growers**, along with **engagement strategies** to promote healthy and sustainable food, as well as raising citizens' knowledge and awareness of sustainable food production, processing, and consumption.
The chapter then delves into different **growing systems** and the employed **cultivation system modules (CSMs)** used.
Each individual component is analyzed for its strengths and weaknesses, as well as specific indicators of both environmental and urban impact.
Overall, this research provides a comprehensive overview of the key components that define an agritecture project, offering insights into the potential benefits and challenges associated with using different strategies.

WHERE
+
how?

4.2

Urban sites
+
Urban forms

WHO
+
how?

4.3

Communities - growers
+
Engagement strategies

WHAT
+
how?

4.4

Growing systems
+
Cultivation system modules (CSM)

Assessment range

very low
low
medium
high
very high

4.2 - Urban sites + Urban forms

- Urban sites

The chapter aims to provide an analysis of several sites suitable for urban farming practices, both ground-based and soil-less solutions. The potential use of these sites is analyzed in terms of access to necessary natural resources such as water and light, visibility to the public as well as the complexity of transforming them into urban growing spaces.

- **1** Ground-based sites

Cultivable spaces at ground level.

- **1.1** Private backyards - gardens
- **1.2** Public parks - gardens
- **1.3** Public roads - streets
- **1.4** Vacant lots
- **1.5** Industrial & infrastructure wasteland
- **1.6** Institutional spaces

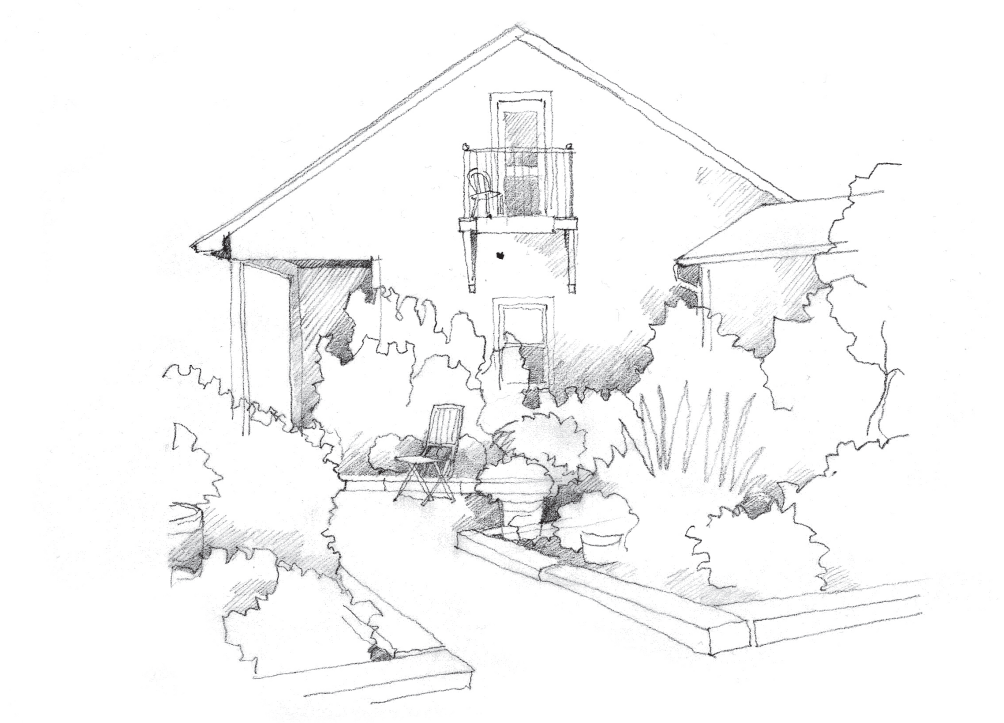
- **2** Soil-less sites

Spaces suitable for zero-acreage farming (z-farming) operations. For both horizontal and vertical farming systems.

- **2.1** Façades & Balconies
- **2.2** Rooftops
- **2.3** Interior spaces
- **2.4** Underground spaces

Ground-based sites: Private backyards - gardens.

These spaces are privately owned and offer a convenient location for small-scale urban agriculture. They can be easily maintained and provide a good source of fresh produce for individuals and families.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

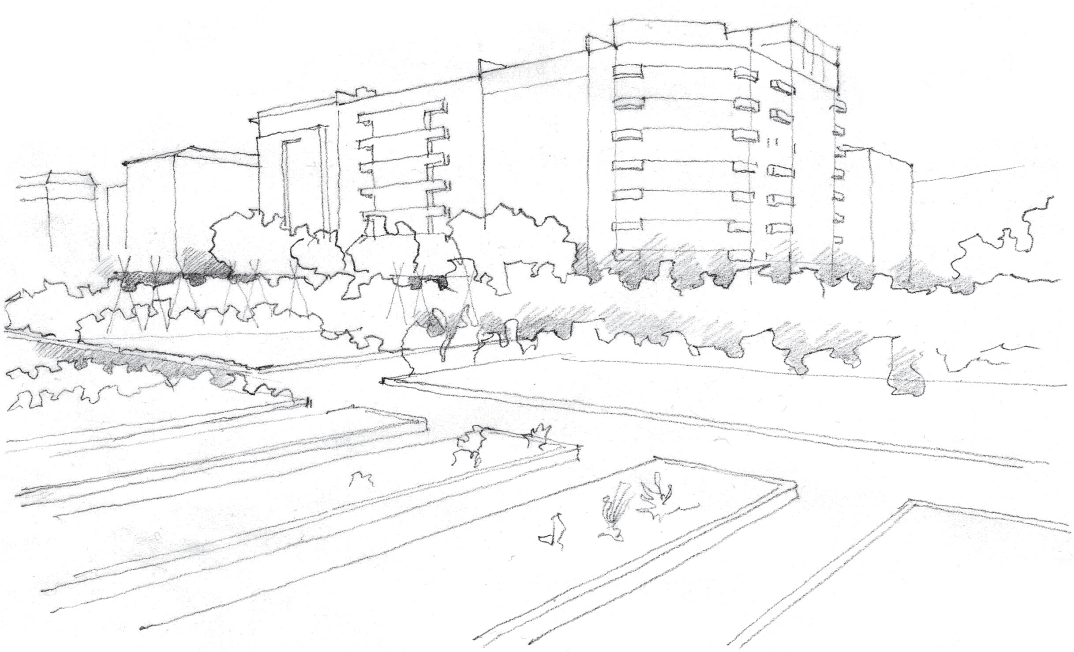
- Accessible
- Easily maintained-controllable
- Motivated owners
- Often already equipped

Weaknesses

- Limited space
- Limited access to water
- Risk of contaminated soil
- May not be visible to the wider community

Ground-based sites: Public parks - gardens.

Public parks and gardens offer a shared space for the community to engage in urban agriculture. They provide an opportunity for social interaction and education, as well as the production of fresh produce.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

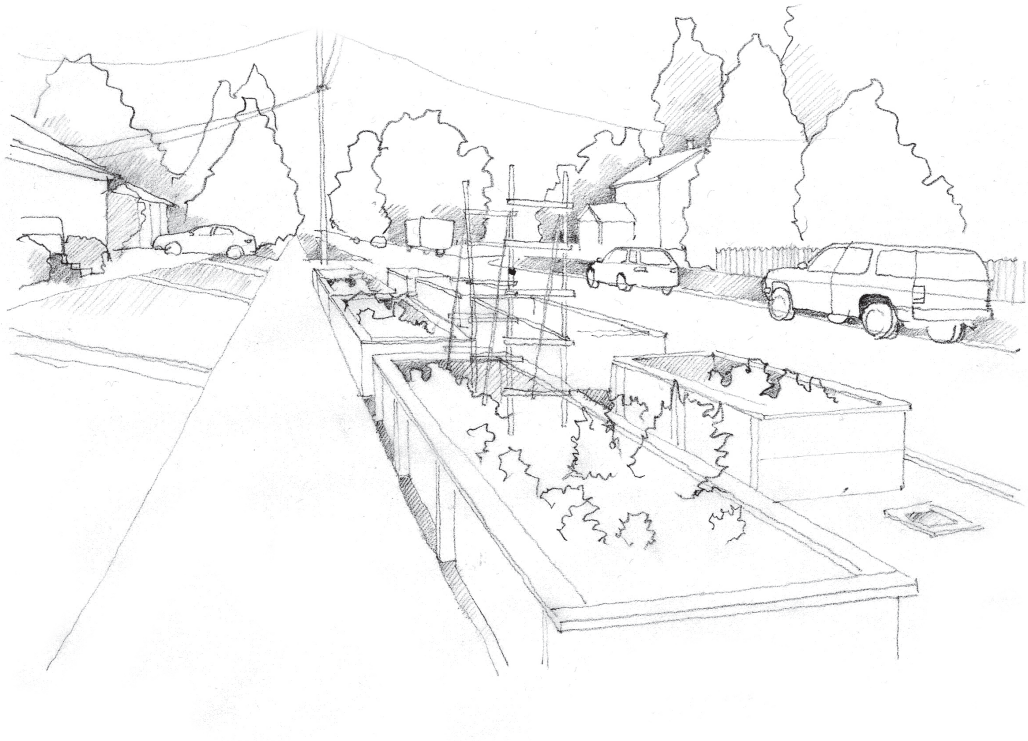
- Accessible
- Large space well exposed to sun
- Opportunity for social interaction and education
- Existing infrastructure

Weaknesses

- Municipal regulations: limited management
- Competition with other park uses
- Risk of contaminated land
- Potential for vandalism or theft

Ground-based sites: Public roads - streets.

Urban agriculture on public roads and streets involves the use of curbsides and other public spaces for growing food. This approach can help to beautify neighborhoods, promote healthy eating, and reduce the urban heat island effect.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

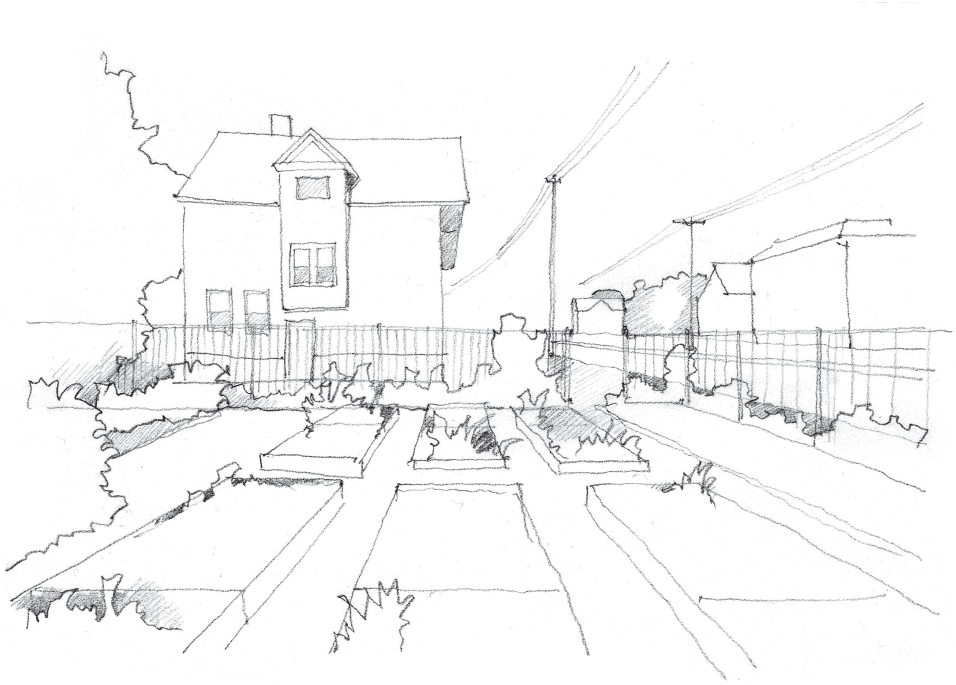
- Extensive sun exposure
- Existing space often underutilized
- Low access and maintenance costs
- Potential to reduce urban heat island effect

Weaknesses

- Air and noise pollution
- Risk of soil contamination from vehicle exhaust
- Limited water access
- Need for permits

Ground-based sites: Vacant lots.

Vacant lots are often considered blights on urban landscapes, but they can be transformed into productive spaces for urban agriculture. They offer a large, open space for growing food and can help to revitalize urban neighborhoods.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

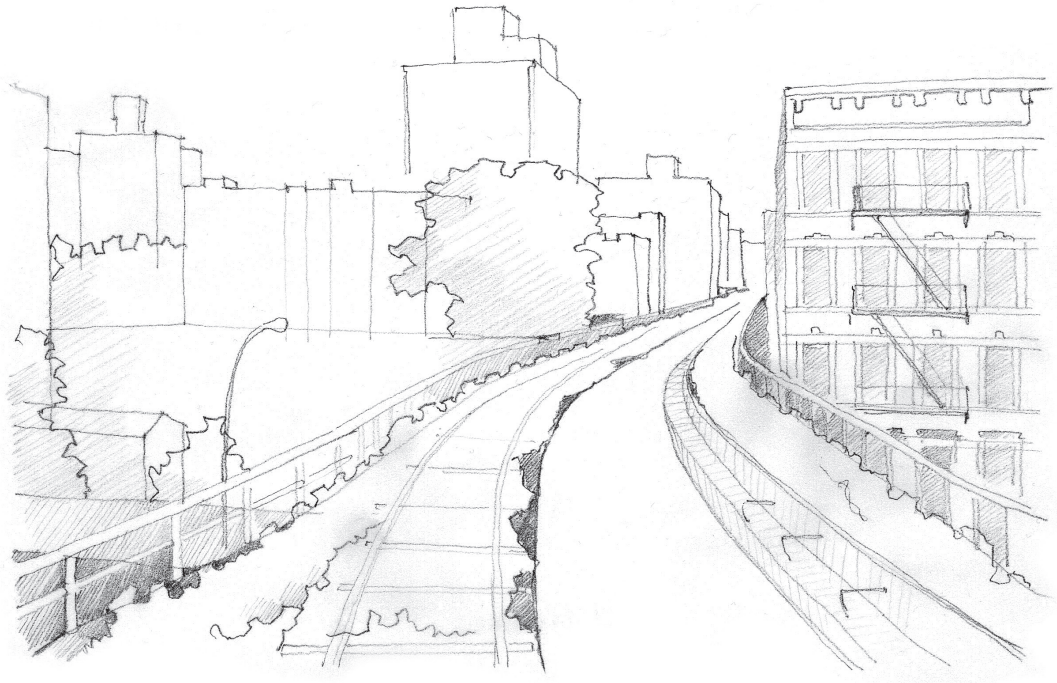
- Large, open space
- Potential to revitalize urban neighborhoods
- Low access and maintenance costs
- Often private land available for rent

Weaknesses

- Potential for illegal dumping
- There may be unsafe soil contamination
- Lack of infrastructure
- Need for permits

Ground-based sites: Industrial & infrastructure wasteland.

These spaces, such as former industrial sites and railway yards, offer large areas for urban agriculture. However, they may require significant remediation efforts to ensure that the soil is safe for food production.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

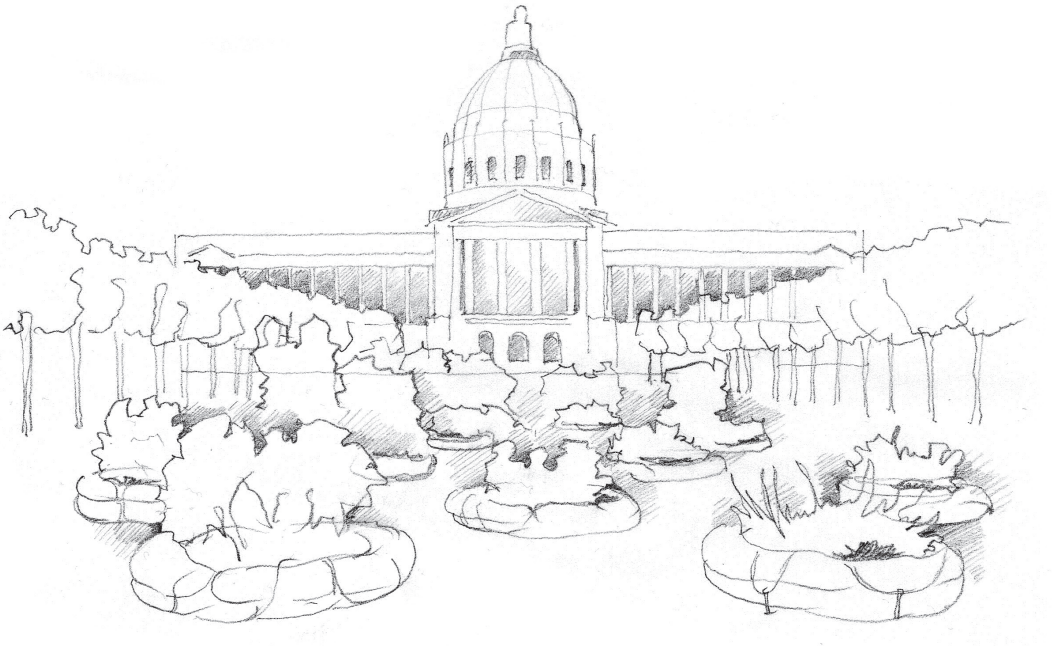
- Large space
- Great sun exposure
- Potential to repurpose underutilized spaces
- Often private land available for lease

Weaknesses

- Need for permits
- Risk of illicit activities
- Risk of contamination from industrial pollutants
- Significant investment in soil remediation

Ground-based sites: Institutional spaces.

Institutional spaces such as schools, hospitals, and government buildings can offer opportunities for urban agriculture. They can provide fresh produce for the institutions themselves, as well as educational opportunities for students and employees.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

- Accessible
- Infrastructure often already exists
- Potential for community involvement
- Potential for educational opportunities

Weaknesses

- Limited space
- Institutional regulations
- Competition with other uses
- Limited management control

Soil-less sites: Façades & balconies.

Façades and balconies offer limited space for urban agriculture, but can still be used for small-scale production. They provide an opportunity to grow food in areas where traditional gardening is not possible.

Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

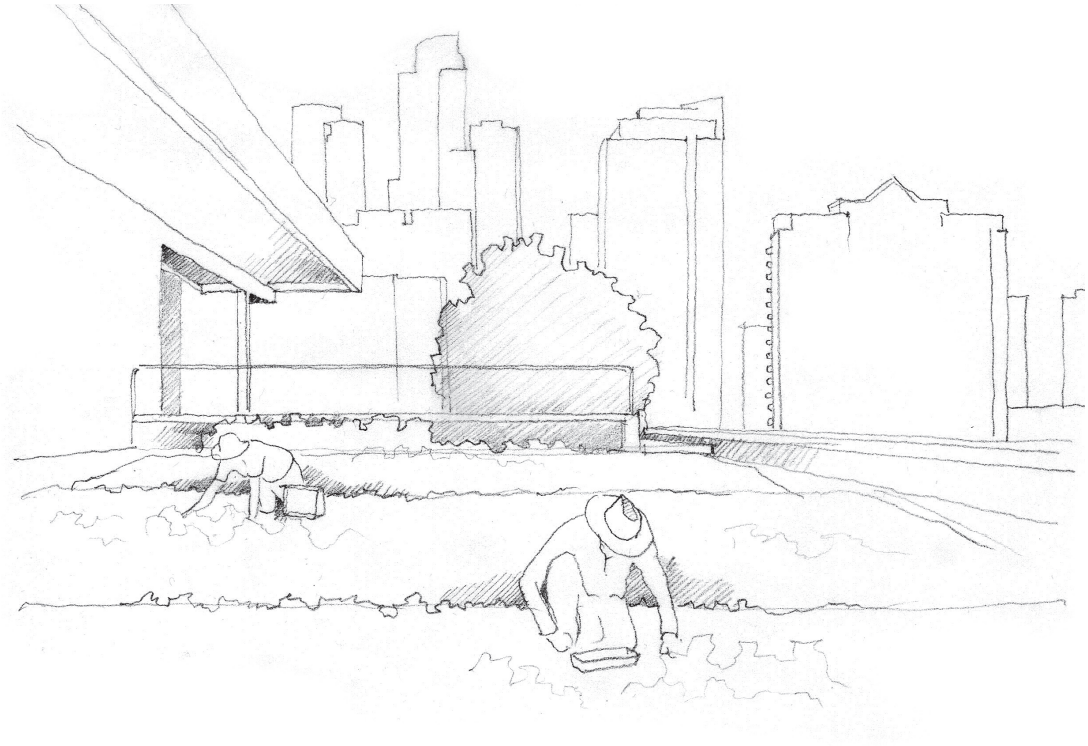
- Thermal benefit to the building
- Great sun exposure
- Low cost of access
- High public visibility

Weaknesses

- Limited space
- Limited soil depth
- Potential for damage to building exteriors
- Need for constant maintenance

Soil-less sites: Rooftops.

Rooftops can offer a large, open space for urban agriculture in densely populated urban areas. They can help to reduce the urban heat island effect, provide a source of fresh produce, and promote sustainable building practices.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

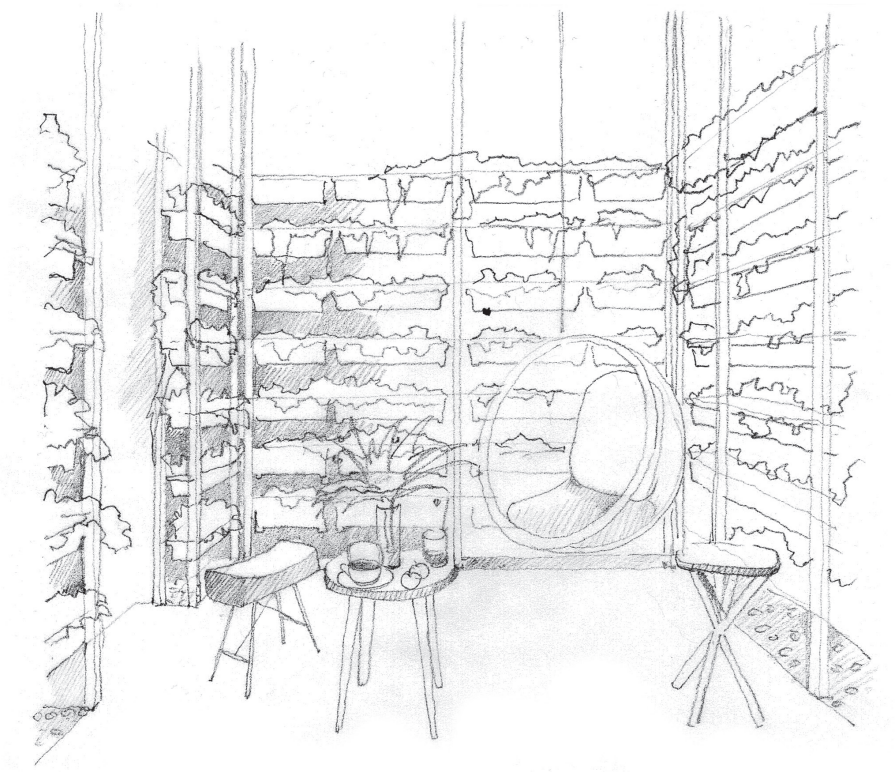
- Open space
- Excellent sun exposure
- Promotes sustainable building practices
- Potential for creating community gardens

Weaknesses

- It may have a difficult access
- Need for permits
- Need for security infrastructure
- Potential for structural limitations

Soil-less sites: Interior spaces.

Interior spaces such as warehouses and other industrial buildings can be repurposed for urban agriculture. However, they may require significant investment in lighting and ventilation systems to support plant growth.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

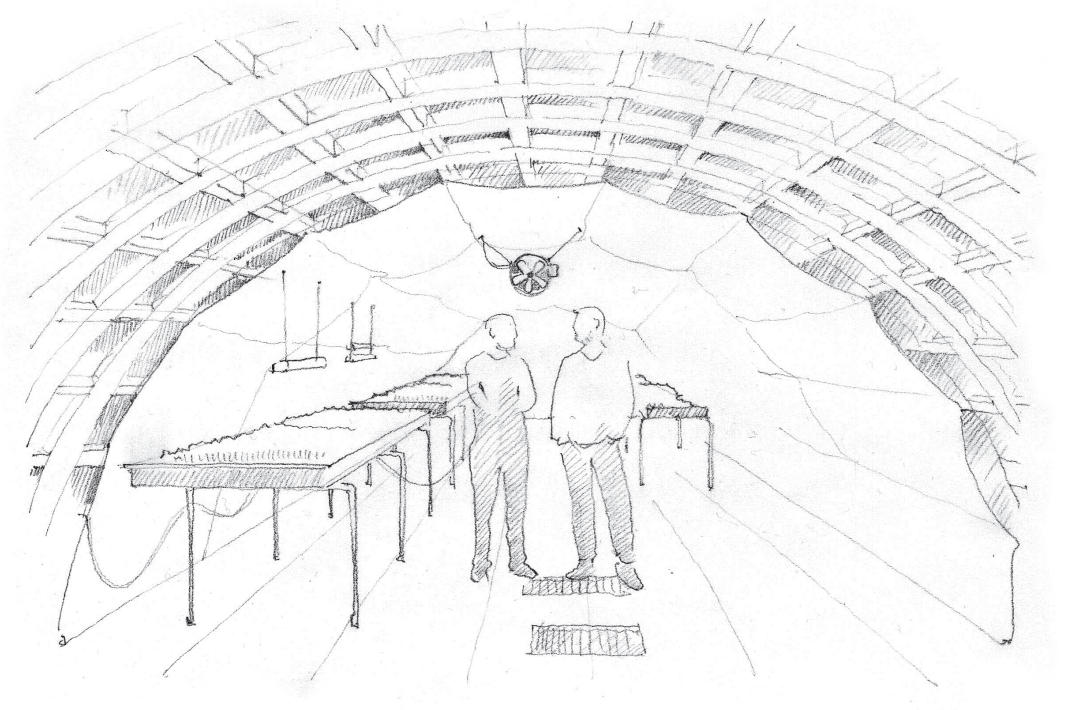
- Easy access to infrastructure and resources
- Controllable sun exposure
- No soil contamination issues
- Potential for biophilic interior design

Weaknesses

- Limited natural light
- Limited space
- Need for artificial ventilation and lighting
- High maintenance cost

Soil-less sites: Underground spaces.

Underground spaces such as basements and tunnels offer protection from the elements and can provide a unique location for urban agriculture. However, they may require significant investment in lighting and ventilation systems and face challenges related to access to water and soil contamination.



Scale

Sun exposure

Accessibility - visibility

Cultivation complexity

Strengths

- Weather protection
- Controllable sun exposure
- No soil contamination issues
- Potential use of underutilized space

Weaknesses

- Limited access to water and resources
- Need for artificial lighting and ventilation
- Maintenance difficulties
- Risk of soil and groundwater contamination

= Urban forms

Urban agriculture spaces can create new relationships both at the building level and with the urban fabric by changing their connections, permeability, and accessibility to the area. Similarly, the location influences various aspects such as natural lighting and public visibility.

- **1** Relation with a building
  - **1.1** Conversion - Retrofit
  - **1.2** Fill-in
  - **1.3** Top-up
  - **1.4** Rebase
  - **1.5** Extend
  - **1.6** Parasite
  - **1.7** Wraps-up
- **2** Relation with the urban fabric
  - **2.1** Add-on
  - **2.2** Divide - Barrier
  - **2.3** Core - Porous
  - **2.4** Node
  - **2.5** Observe - Tower
  - **2.6** Connect - Planimetric hinge
  - **2.7** Connect - Corridor

The different forms-new volumes for urban agriculture practices can be classified according to their capacity to use natural resources, technological complexity, seasonal or year-round production capabilities, and production density.

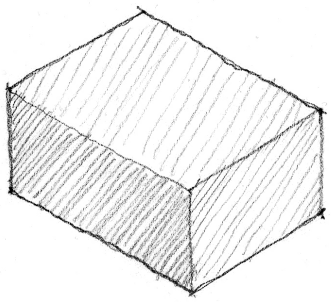
- **3** New volumes
  - **3.1** Hoop houses
  - **3.2** Greenhouses
  - **3.3** Plant factory with artificial lighting (PFAL)

Relation with a building

Spatial-architectural relationship of a building with a growing module.

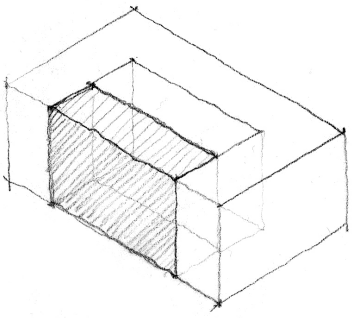
1.1 Conversion - Retrofit

- Conversion of an entire building
- Retrofitting of volumes



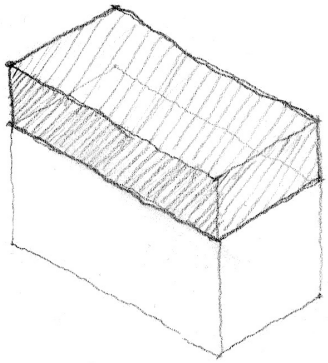
1.2 Fill-in

- Completion of the building massing
- New urban front



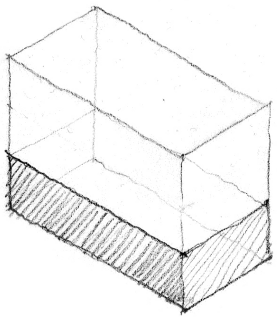
1.3 Top-up

- Vertical extension of the building
- Thermal benefit to the building



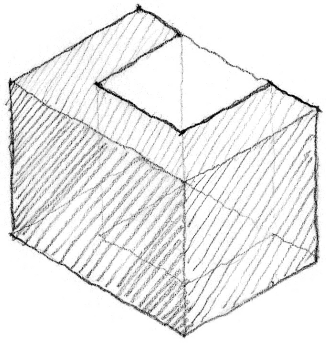
1.4 Rebase

- Reconfiguration of the building base
- New urban relationship at the pedestrian level



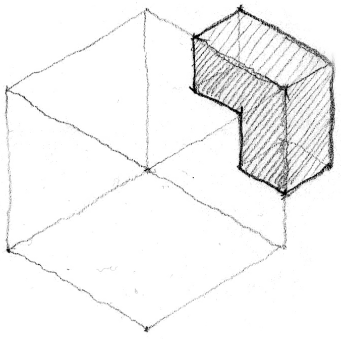
1.5 Extend

- Volume extension
- Thermal benefit to the building



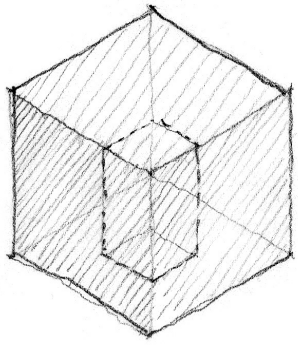
1.6 Parasite

- Addition of a smaller volume
- Element with a different aesthetic



1.7 Wraps-up

- Expansion of the building volume
- The building becomes an internal module

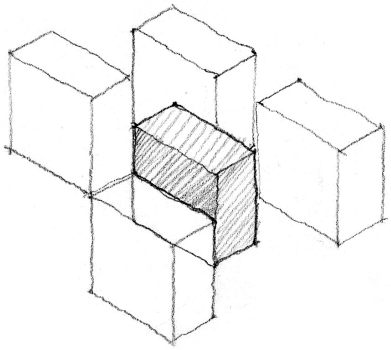


Relation with the urban fabric

Spatial-urban relationship of the context with a growing module.

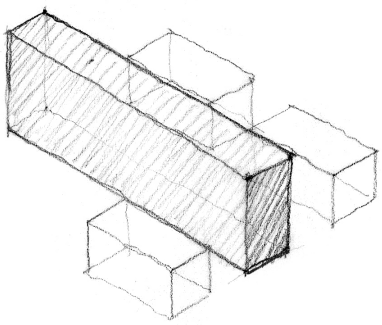
2.1 Add-on

- Extent of urban fabric
- The module blends into the context



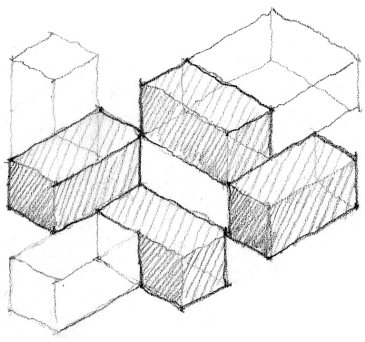
2.2 Divide- Barrier

- Linear volume
- Protection from industrial areas,...



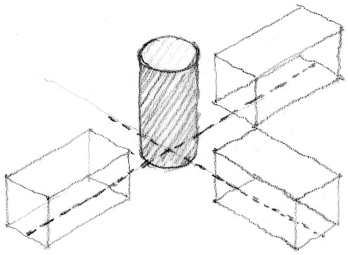
2.3 Core - Porous

- Permeable volume
- Element that drives traffic



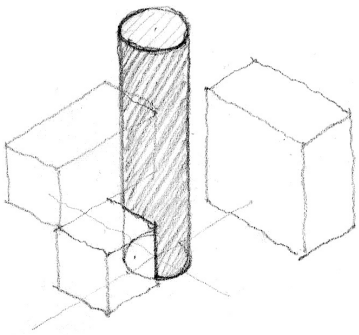
2.4 Node

- Central, intersection location
- Possible urban landmark



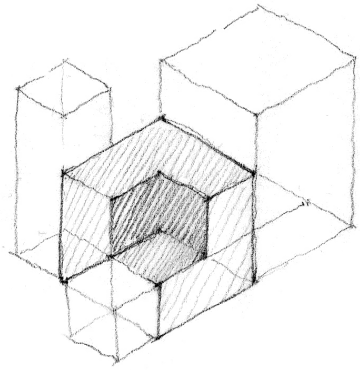
2.5 Observe - Tower

- Highest element of the context
- Slender volume



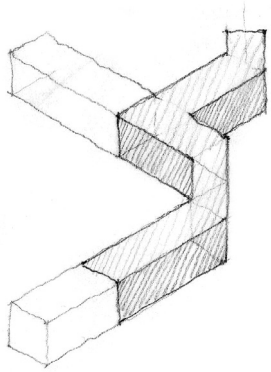
2.6 Connect - Planimetric hinge

- Wolkable - stepped volume
- Element adjacent to other buildings



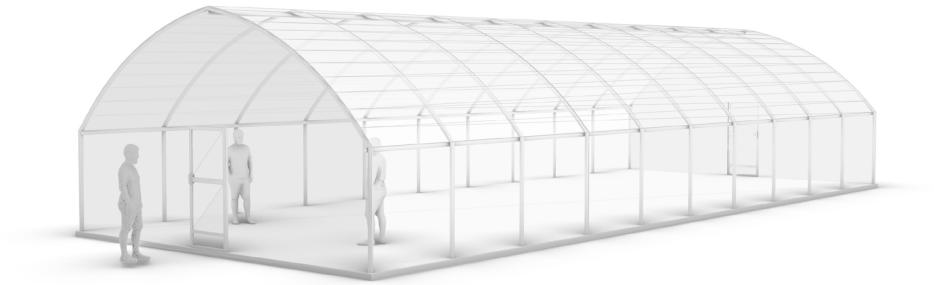
2.7 Connect - Corridor

- Urban corridor: green corridor,...
- Linear body connecting different urban areas



New volumes: Hoop houses.

These are low-cost, simple structures that use curved metal pipes and plastic sheeting to create a semi-permanent growing space. They are well-suited for seasonal production and can extend the growing season by several months, making them popular among urban farmers.



Sun exposure

Visibility

Cultivation period

Cultivation density

Technical complexity

Strengths

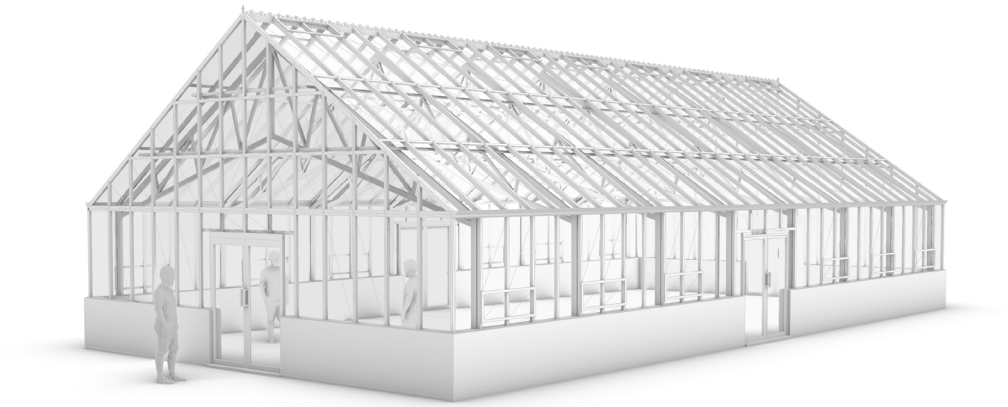
- Low cost
- Eeasy to construct
- Ability to extend growing season

Weaknesses

- Limited temperature control
- Seasonal production
- Can be visually unappealing

New volumes: Greenhouses.

These are more sophisticated structures that offer greater control over temperature, humidity, and light. They are designed for year-round production and can support a wider range of crops, making them a popular choice for commercial urban agriculture operations.



Sun exposure

Visibility

Cultivation period

Cultivation density

Technical complexity

Strengths

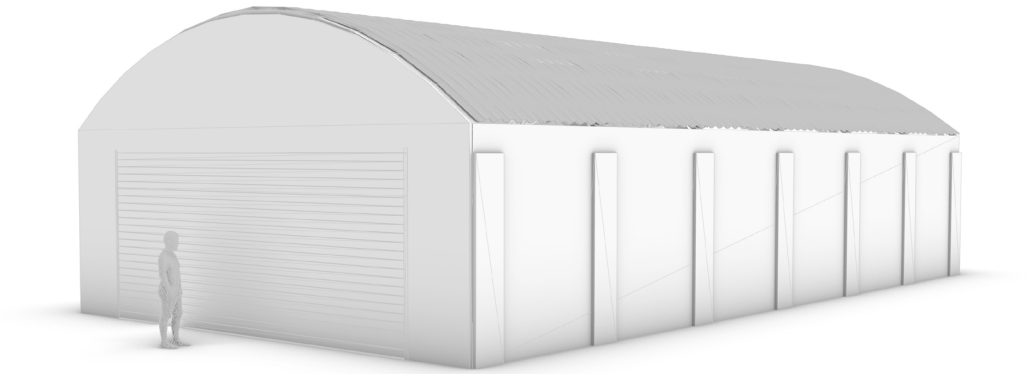
- Year-round production
- Greater temperature and humidity control
- Ability to grow a wider variety of crops

Weaknesses

- Higher capital investment
- Technical expertise required
- Can be visually obtrusive

New volumes: Plant factory with artificial lighting (PFAL).

These highly-technical facilities use artificial lighting, hydroponic systems, and environmental controls to create optimal growing conditions for plants. They offer the greatest control over the production environment and can produce high yields year-round, but require significant capital investment and technical expertise to operate.



Sun exposure

Visibility

Cultivation period

Cultivation density

Technical complexity

Strengths

- High yields year-round
- Precise control over growing conditions
- Ability to grow in non-traditional environments

Weaknesses

- Most expensive option
- Technically complex option
- Requires significant energy inputs

4.3 - Communities - growers + Engagement strategies

= Communities - growers

Urban farming is a diverse and complex practice that involves a wide range of individuals and organizations. These actors can be differentiated based on their scopes, level of experience, and the scale of their production.

Personal production:

- **1** Home-based gardening

Family members growing plants for personal use in home gardens.

- **1.1** Household growers

- **2** Community-based gardening

Groups of community members who collaborate to cultivate shared spaces, such as community gardens or vacant lots, in urban areas.

- **2.1** Co-operative
- **2.2** Neighbors volunteers
- **2.3** Several families

Large scale production:

- **3** Commercial production

Enterprises with professional farmers who cultivate plants on a large scale for profit, often selling to restaurants or consumers directly.

- **3.1** Farming enterprise
- **3.2** Community-supported farming enterprise (CSFE)
- **3.3** Restaurant

- **4** Institutional food growing

Institutions, such as hospitals, schools, and prisons, with a mixed group of farmers growing plants for their own consumption or for sale.

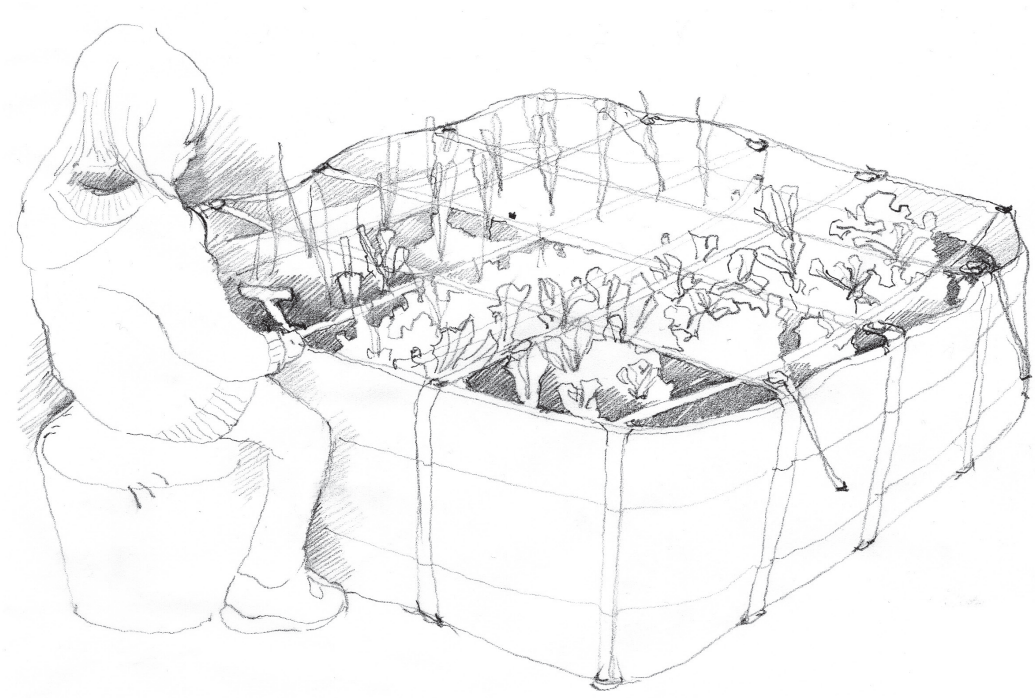
- **4.1** Prison
- **4.2** Hospital & Medical center
- **4.3** RSA - Elderly people
- **4.4** School - People in training + Teacher & trainers
- **4.5** PPP Company - Social entrepreneurs

Scopes

- Leisure Activities: Relaxation, Contact with Nature
- Health: Physical activities, Food quality, Mental Health
- Food Security: Food accessibility, Food quality
- Environment: Heat Island, Composting, Water recycling, Biodiversity
- Social interactions: Multiple interindividual interactions, Social participation, Social integration
- Education: Awareness, Empowerment
- Urban Planning: Contaminated soil, Appropriation of space, Green space/parks
- Economic development: Economic integration, Fight against poverty

Home-based gardening: Household growers.

These are individuals or families who grow crops for their own consumption on a small scale, often in their own backyards or balconies. This activity can help them reduce their grocery bills, provide fresh and healthy food for their families, and promote a sense of connection with nature.



Scope

- Leisure activities
- Health

Experience

Scale

Strengths

- Promotes self-sufficiency
- Reduces food costs
- Provides access to fresh and healthy produce

Weaknesses

- Limited space for production
- Lack of expertise in gardening
- Dependence on weather and season

Community-based gardening: Co-operative.

This sub-category includes groups of people who pool their resources and knowledge to cultivate crops collectively, often on a shared plot of land. By working together, they can produce a larger variety of crops, share the workload, and build a sense of community.

Scope

- Leisure activities
- Health
- Food security

Experience

Scale

Strengths

- Shared resources and knowledge
- Increased production and efficiency
- Builds a sense of community

Weaknesses

- May require time commitment
- Challenges in decision making
- Potential conflicts among members

Community-based gardening: Neighbors volunteers.

Neighborhood volunteers are urban residents who work together to cultivate shared spaces, such as community gardens or vacant lots. They collaborate with environmental activists to promote social cohesion and environmental stewardship, but their efforts may be limited by resource constraints and land tenure insecurity.

Scope

- Health
- Environment
- Urban planning

Experience

Scale

Strengths

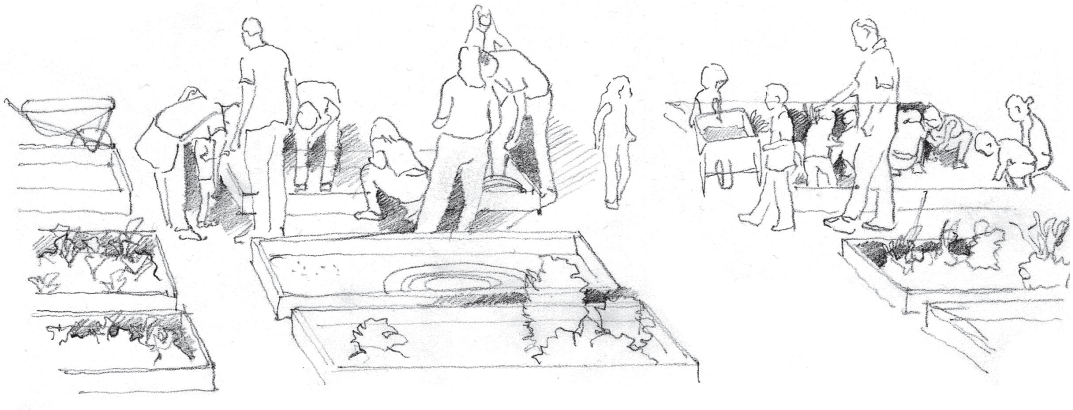
- Builds social connections
- Beautifies the neighborhood
- Increases access to fresh produce

Weaknesses

- Limited production capacity
- Dependence on volunteers
- Quality control may be an issue

Community-based gardening: Several families.

It is composed of multiple households that join forces to create and maintain a shared garden. Each family contributes time, resources, and expertise to the project, sharing the responsibilities of planning, planting, and harvesting.



Scope

- Leisure activities
- Health
- Social interactions

Experience

Scale

Strengths

- Shared workload and resources
- Promotes self-sufficiency
- Provides access to fresh and healthy produce

Weaknesses

- Limited production capacity
- Challenges in decision making
- Potential conflicts among families

Commercial production: Farming enterprise.

It involves the commercial production of food in an urban setting. These are businesses that engage in farming activities for profit. Urban farming enterprises often utilize innovative techniques to optimize the use of available space and resources.

Scope

- Health
- Environment
- Economic development

Experience

Scale

Strengths

- Generates income
- Supports local economy
- Provides access to fresh produce

Weaknesses

- May require significant investment
- High competition in the market
- Vulnerable to weather and market fluctuations

Commercial production: Community-supported farming enterprise (CSFE).

It refers to businesses that receive support from the community, such as through subscriptions or memberships, to sustain their commercial urban farming activities. These enterprises usually offer fresh and locally grown produce to their supporters.

Scope

- Health
- Social interactions
- Economic development

Experience

Scale

Strengths

- Builds a sense of community
- Provides access to fresh and healthy produce
- Supports local economy

Weaknesses

- May require significant investment
- Challenges in decision making
- Potential conflicts among members

Commercial production: Restaurant.

Some restaurants grow their own produce for use in their kitchens. Urban farming allows restaurants to offer locally grown, fresh, and unique ingredients in their dishes while also reducing the carbon footprint of their ingredients.

Scope

- Health
- Environment
- Economic development

Experience

Scale

Strengths

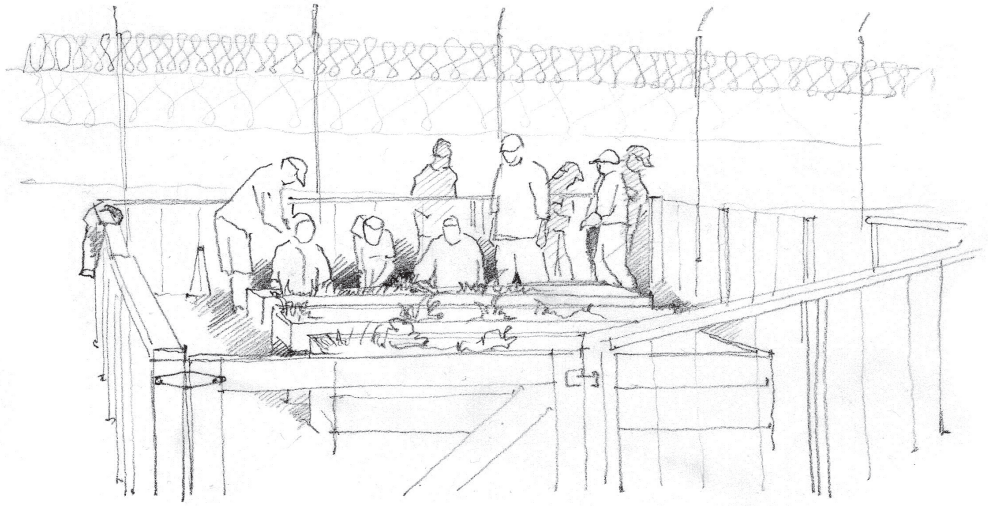
- Provides fresh and local ingredients
- Builds relationships with local farmers
- Can differentiate the restaurant

Weaknesses

- Requires coordination with farmers
- Challenges in ensuring consistent supply
- May not be cost-effective

Institutional food growing: Prison.

It refers to institutional food growing, where prison inmates engage in urban farming activities. Urban farming can offer inmates a sense of purpose and accomplishment, as well as provide fresh produce for consumption within the prison or for donation to external charitable organizations.



Scope

- Leisure activities
- Social interactions
- Education

Experience

Scale

Strengths

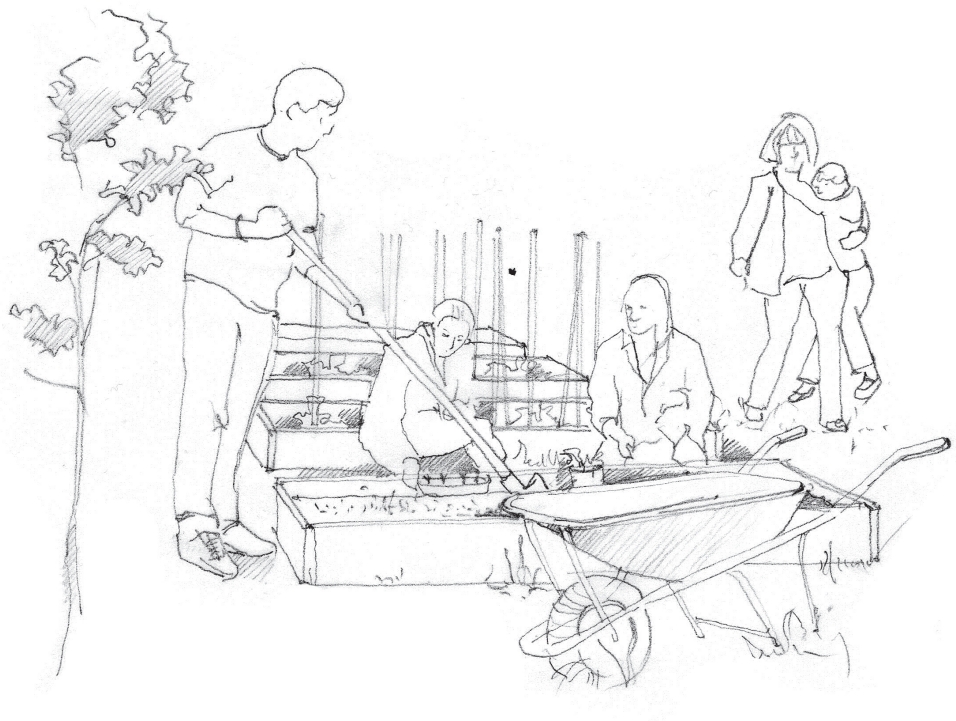
- Provides vocational training
- Reduces food costs
- Improves health and wellbeing of inmates

Weaknesses

- Limited space for production
- Dependence on security protocols
- Limited access to resources and expertise

Institutional food growing: Hospital & Medical center.

It involves the production of fresh and healthy produce for use in hospitals and medical centers. Urban farming can help promote healthier food choices for patients and staff while also creating a therapeutic and calming environment.



Scope

- Leisure activities
- Health
- Social interactions

Experience

Scale

Strengths

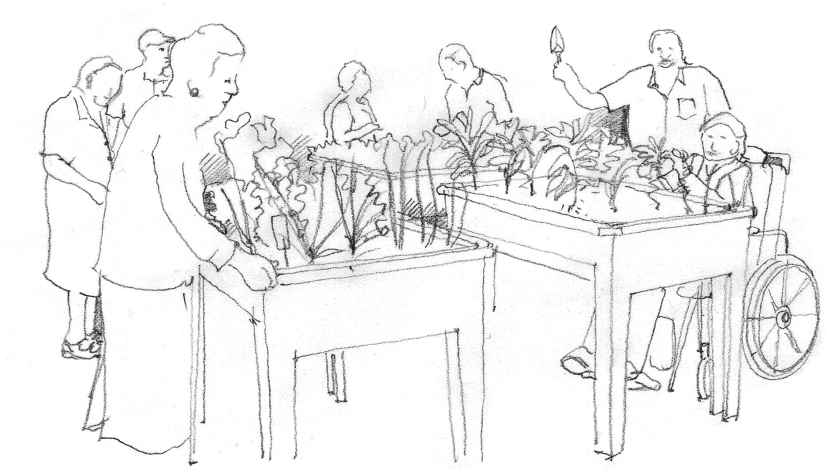
- Provides fresh and healthy produce for patients
- Improves health outcomes
- Can reduce food costs

Weaknesses

- Limited space for production
- Requires specialized expertise in food safety
- Challenges in ensuring consistent supply

Institutional food growing: RSA - Elderly people.

It refers to the use of urban farming as a therapeutic activity for elderly people living in residential care facilities. Urban farming can provide a sense of purpose, community, and physical activity for elderly residents.



Scope

- Leisure activities
- Health
- Social interactions

Experience

Scale

Strengths

- Provides access to fresh produce
- Promotes physical activity and social interaction
- Improves health and wellbeing of elderly

Weaknesses

- Limited space for production
- Dependence on volunteers or staff
- Challenges in ensuring consistent supply

Institutional food growing: School - People in training + Teacher & trainers.

It involves the use of urban farming as an educational tool for schools and training centers. Urban farming can teach students and trainees about sustainable agriculture, healthy eating, and entrepreneurship while also promoting physical activity and community building.

Scope

- Leisure activities
- Health
- Education

Experience

Scale

Strengths

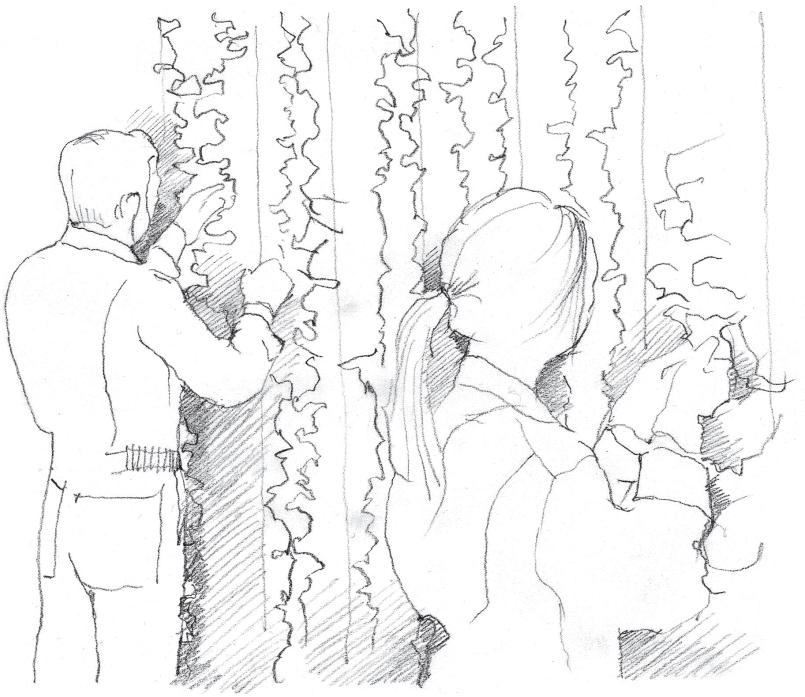
- Provides educational opportunities
- Promotes healthy eating habits
- Builds students-teachers-trainers relationships

Weaknesses

- Limited space for production
- Requires specialized expertise in food safety
- Challenges in ensuring consistent supply

Institutional food growing: PPP Company - Social entrepreneurs.

This category encompasses private-public partnerships (PPPs) and social entrepreneurs who engage in urban farming activities for various social, environmental, and economic purposes. They may aim to provide fresh and healthy food to underserved communities, create job opportunities, promote green infrastructure, or generate revenue for their business while contributing to the local community.



Scope

- Environment
- Social interactions
- Economic development

Experience

Scale

Strengths

- Addresses social and environmental issues
- Can generate profits
- Builds relationships with local communities

Weaknesses

- May require moderate investment
- Challenges in ensuring consistent supply
- There may be problems with the distribution

▫ Engagement strategies

One important aspect of urban agriculture is engaging consumers and citizens to promote a culture of healthy eating and inform them about the production, preparation, and sale of food. To achieve this, there are various strategies that can be employed to involve people in urban agriculture practices.
It's important to outline the different points of contact for engagement and highlight how they can be used to effectively convey messages that impact us in different ways.
The ABC model of attitudes can be used to identify how engagement can have an impact on us: affective, a experience that emotionally impacts us, behavioral, an experience that influences our actions, and cognitive, which influences our beliefs and mindset.

• **1** Affective	• **1.1** Immersion • **1.2** Communication • **1.3** Conversation
• **2** Behavioural	• **2.1** Connection • **2.2** Education • **2.3** Engagement
• **3** Cognitive	• **3.1** Inspiration • **3.2** Reflection • **3.3** Embodiment

Urban agriculture can engage consumers and citizens in promoting healthy and sustainable food through various strategies like community gardens, cooking classes, and farmer's markets. These strategies can have an impact on different points of contact in the ABC model: affective, behavioral, and cognitive. Engaging people in urban agriculture is crucial for promoting a culture of healthy, fresh, and sustainable food.

Affective: Immersion.

Experiencing urban farming through sensory stimulation and direct interaction with the environment. Often used to raise awareness about the potential of urban farming.

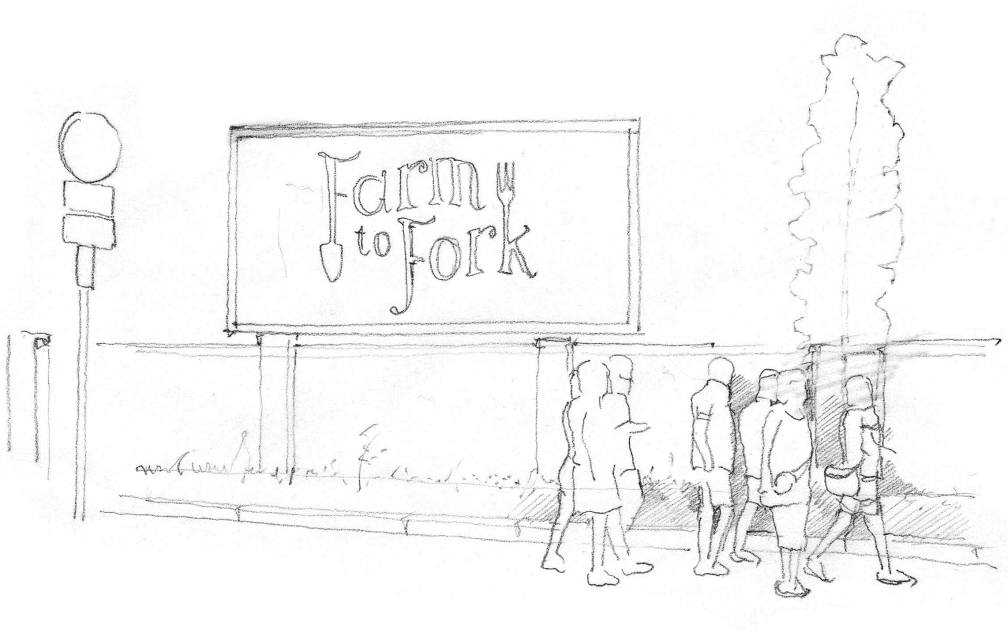
Engagement

Activities

- Slow mobility spaces around the urban farm
- Agricultural spaces near interchange facilities
- Field trips to urban farms

Affective: Communication.

Sharing information and knowledge about urban farming through different channels such as social media, events, or word of mouth. Usually used to disseminate information and to create a sense of community.



Activities

- Social media campaigns
- Newsletters
- Public lectures and seminars

Engagement

Affective: Conversation.

Engaging in dialogues and exchanges with different actors involved in urban farming, such as farmers, policymakers, and citizens. This is often used to foster collaboration and to generate new ideas and solutions.

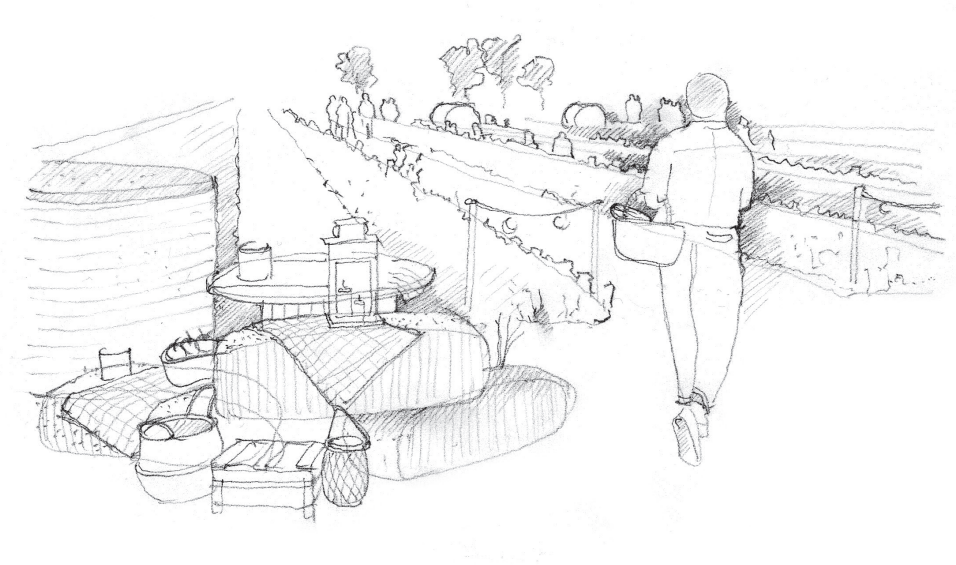
Engagement

Activities

- Panel discussions
- Stakeholder meetings
- Participatory design workshops
- Citizens in direct contact with growers

Behavioural: Connection.

Building relationships and networks between different actors involved in urban farming, such as farmers, consumers, and local businesses. This is typically used to create a sense of belonging and to leverage the power of collective action.



Activities

- Community gardens
- Farmers' markets with tasting tours
- Food co-ops
- Community-supported agriculture
- City farm sightseeing tours

Engagement

Behavioural: Education.

Providing formal or informal training and education on urban farming practices, techniques, and related topics. Often used to enhance skills and knowledge and to empower individuals and communities.

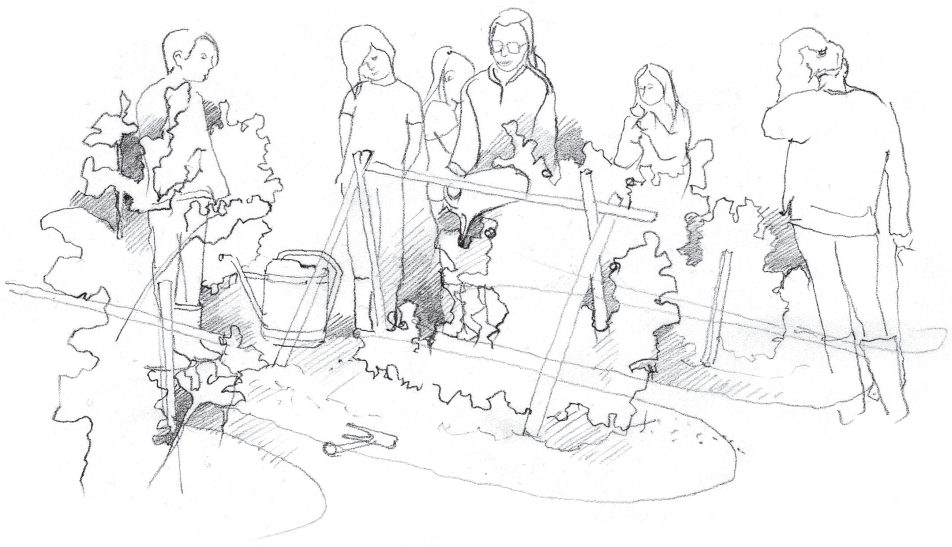
Engagement

Activities

- Gardening and cooking classes
- Workshops on composting
- Educational on sustainable food systems

Behavioural: Engagement.

Encouraging active participation and involvement of individuals or groups in urban farming activities, such as volunteering, co-designing, or co-creating. Usually used to generate a sense of ownership and to foster a culture of participation.



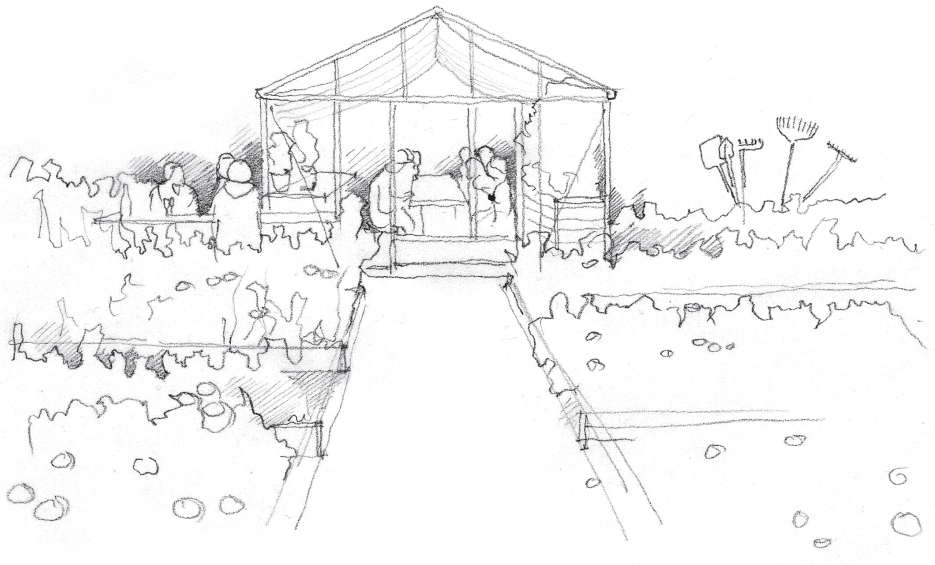
Activities

- Community-based food production
- Shared kitchens
- Urban food hubs
- Co-design & co-construction activities

Engagement

Cognitive: Inspiration.

Stimulating imagination and creativity by showcasing innovative and inspirational examples of urban farming projects and practices. This is often used to promote urban farming as a desirable and viable option.



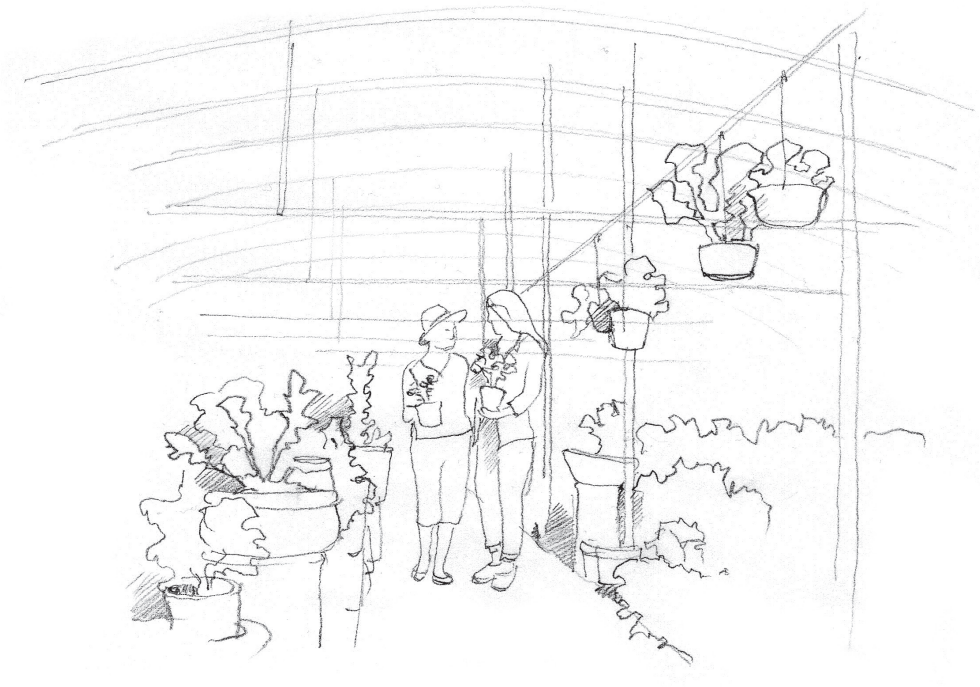
Activities

- Art-green installations
- Farm-to-table restaurants
- Green-resting spaces inside the farm
- Community events
- Public markets

Engagement

Cognitive: Reflection.

Encouraging critical reflection and analysis of urban farming practices, including their social, economic, and environmental implications. This is typically used to foster a deeper understanding of the complexity of urban farming and to generate informed action.



Engagement

Activities

- Contemplative gardens
- Urban wilderness areas
- Mindfulness and meditation practices

Cognitive: Embodiment.

Promoting the embodiment of urban farming practices and values in everyday life through the adoption of new habits, behaviors, and attitudes. This is often used to create a sense of continuity and to support long-term changes.

Engagement

Activities

- Rooftop gardens
- Outdoor exercise programs
- Walking and biking trails
- Community-supported agriculture programs

4.4 - Growing Systems + Cultivation System Modules (CSM)

= Growing Systems

The chapter aims to provide an analysis of various growing systems, both with and without soil. The sustainability of these systems is compared in terms of resources needed and strengths and weaknesses.

Ground-based systems:

- **1** Ground planting

Traditional soil-based cultivation involves growing plants directly in soil, either in outdoor fields or indoor containers. Plants receive nutrients from the soil and watered as needed, with soil providing physical support for plant roots.

- **1.1** Traditional ground-based farming
- **1.2** Permaculture

Soil-less systems:

- **2** Hydroponics

Hydroponic is a method of growing plants without soil, where they are grown in a nutrient-rich solution or substrate instead. This cultivation system offers a sustainable alternative to soil-based agri-culture, allowing year-round cultivation of crops.

- **2.1** NFT - Nutrient film technique
- **2.2** DWC - Deep water culture
- **2.3** Wick hydroponics
- **2.4** Edd & flow / Flood & drain
- **2.5** Drip Hydroponics
- **2.6** Kratky method of hydroponics

- **3** Aeroponics

Aeroponic cultivation is a method of growing plants without soil, where they are grown in a nutrient-rich solution or substrate instead, offering the advantage of using significantly less water than traditional soil-based agriculture.

- **3.1** Aeroponics

- **4** Aquaponics

Aquaponics is a method of cultivation that combines aquaculture (raising aquatic animals) with hydroponics. The waste produced by the aquatic animals is used to fertilize the plants, while the plants filter the water for the animals.

- **4.1** Aquaponics

Crop-food classification:

1 Leafy greens
2 Herbs
3 Brassicas
4 Vining Crops
5 Root Crops
6 Strawberries
7 Fruits
8 Fish

Ground planting: Traditional ground-based farming.

The plants obtain their resources, such as light, water, and nutrients, from the soil, and face challenges from pests and diseases that also inhabit the soil. The success of this method depends on soil quality, climate, and management practices.

Water consumption

Electricity consumption

Technical complexity

Product density

Crops

Varies

Strengths

Well-suited for a wide variety of crops, low start-up cost.

Weaknesses

Soil depletion, inefficient water and nutrient use. Exposed to pests and air pollution.

Ground planting: Permaculture.

Permaculture is a design approach that emphasizes sustainable, self-sufficient ecosystems. It involves designing gardens, farms, and other systems to mimic the patterns and relationships found in nature, while also meeting human needs. Permaculture practices include composting, natural pest control, and the use of renewable energy sources.

Water consumption

Electricity consumption

Technical complexity

Product density

Crops Varies

Strengths

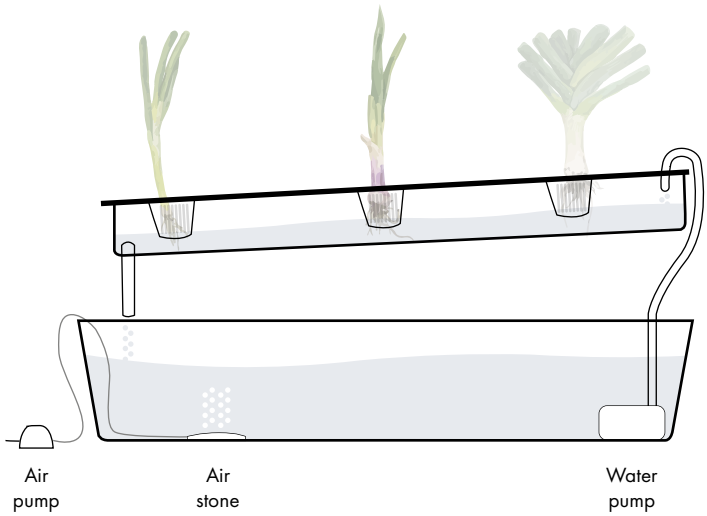
Sustainable, regenerative, low-cost, improves soil health.

Weaknesses

Takes time to establish, requires knowledge and experience.

Hydroponics: NFT - Nutrient film technique.

NFT is a hydroponic cultivation system that utilizes a thin film of nutrient-rich water flowing over plant roots to provide them with the necessary nutrients. This system offers high productivity density and reduced use of pesticides, making it a popular choice for cultivating herbs, salads, and leafy vegetables.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,3

Strengths

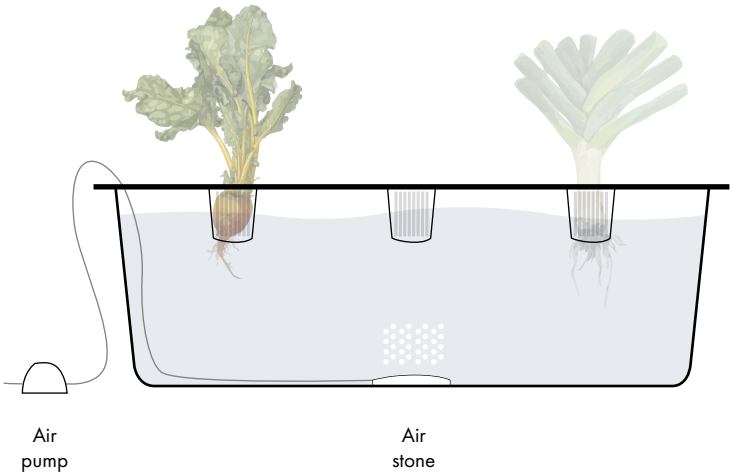
Easy cultivation, reduced use of pesticides.

Weaknesses

Risk of nutrient flow interruption, vulnerability to diseases.

Hydroponics: DWC - Deep water culture.

DWC is a hydroponic system where plants are grown in a nutrient-rich solution with their roots submerged in water. This system is easy to assemble and modify and offers high productivity density, making it suitable for growing herbs, salads, leafy vegetables, berries, and tomatoes.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,3,4,6

Strengths

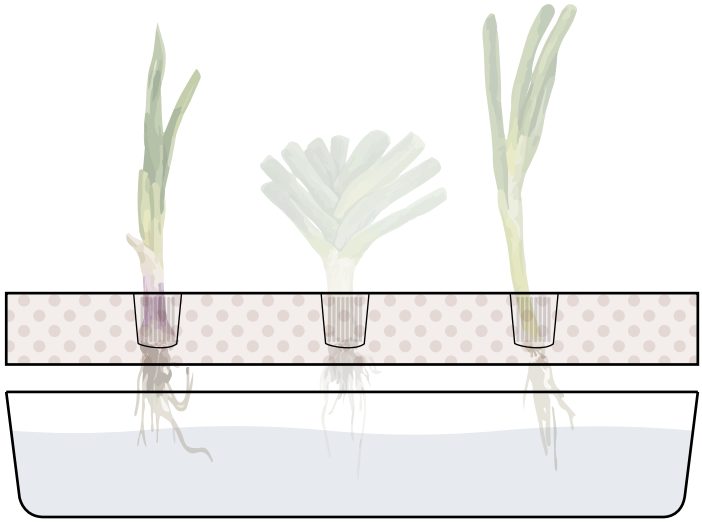
Easy cultivation, easy to assemble and modify.

Weaknesses

Risk of nutrient flow interruption, vulnerability to diseases.

Hydroponics: Wick hydroponics.

Wick Hydroponics is a low-cost hydroponic system that uses a wick to transfer nutrients to plant roots from a nutrient solution reservoir. While offering low productivity density, it is easy to grow and provides sustainable, reduced water and pesticide use, making it suitable for growing herbs, salads and leafy greens.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,3

Strengths

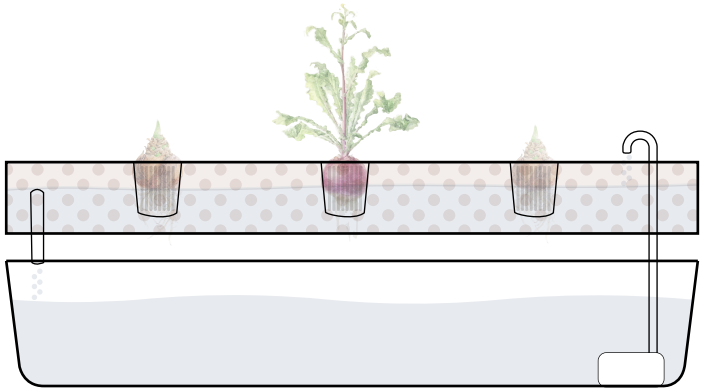
Easy cultivation, low cost.

Weaknesses

Difficulty managing nutrient flow, vulnerability to diseases,

Hydroponics: Ebb & flow / Flood & drain.

Ebb & Flow/Flood & Drain system is a hydroponic cultivation system that floods the plants' roots with nutrient-rich water intermittently. This system offers high productivity density and is suitable for growing leafy vegetables, berries, tomatoes, and cucumbers. However, it also has a high technical complexity-cost and requires careful management of nutrient flow.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,4,6,7

Strengths

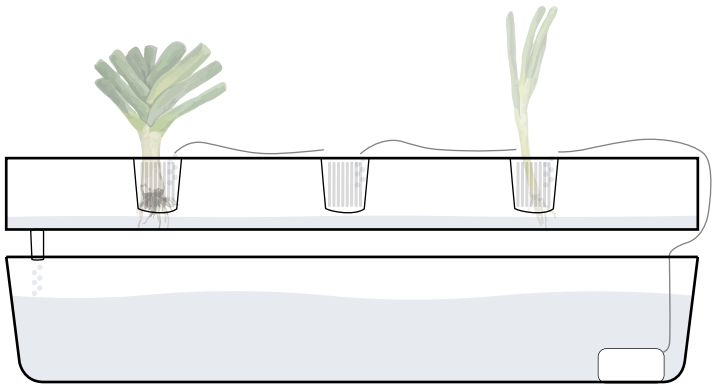
Easy cultivation, suitable for growing large plants.

Weaknesses

Difficulty managing nutrient flow, vulnerability to diseases.

Hydroponics: Drip hydroponics.

Drip Hydroponics delivers nutrients to plant roots through a drip irrigation system, making it suitable for growing large plants such as berries, tomatoes, and cucumbers. While it offers high productivity density, it also has a medium to high technical complexity-cost and requires careful management of nutrient flow.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,3,4,6,7

Strengths

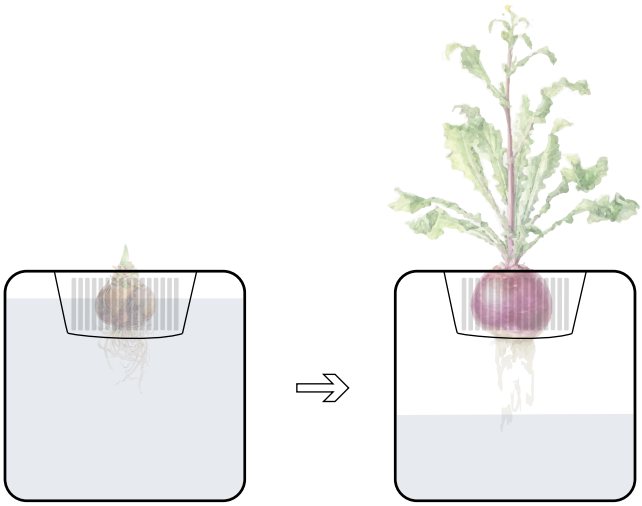
Easy cultivation, suitable for growing large plants.

Weaknesses

Difficulty managing nutrient flow, vulnerability to diseases.

Hydroponics: Kratky method of hydroponics.

Kratky Method of Hydroponics involves suspending plants in a nutrient solution, allowing them to draw nutrients as they grow. It offers low productivity density and is not suitable for commercial cultivation or growing large plants. However, it is easy to cultivate and provides sustainable, reduced water, and pesticide use, making it suitable for growing herbs, salads, and leafy vegetables.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,3

Strengths

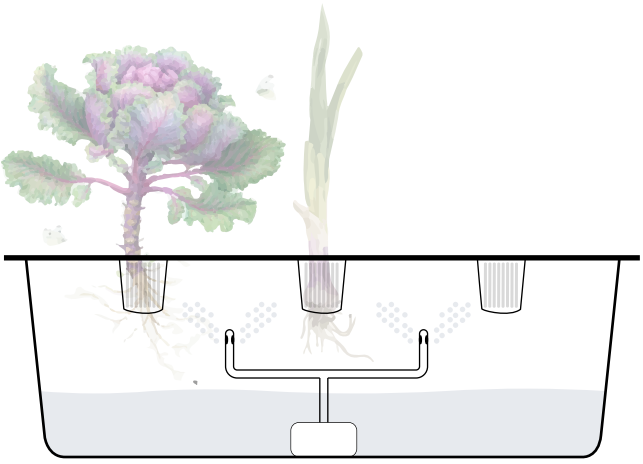
Easy cultivation, low cost.

Weaknesses

Not suitable for growing large plants, not suitable for commercial cultivation.

Aeroponics.

Aeroponic cultivation is a unique form of hydroponic cultivation that uses a mist or fine spray to deliver nutrients and water to plant roots, allowing them to grow in a highly oxygenated environment. This method provides an excellent opportunity for increased productivity density, as well as reduced water and pesticide use. While the aeroponic system has a high technical complexity-cost, it is capable of growing a wide range of crops, including leafy greens, berries, tomatoes, and potatoes. With the use of advanced technology, the aeroponic system is becoming more popular in commercial and urban farming settings due to its sustainable, efficient, and space-saving capabilities.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,4,5,6

Strengths

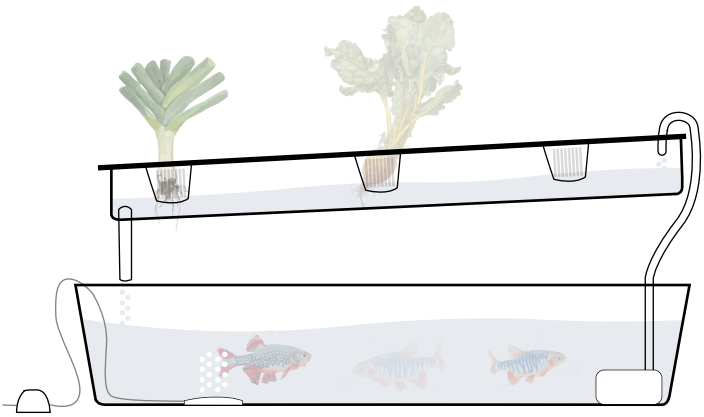
High productivity density, reduced water and pesticide use, space-saving capabilities.

Weaknesses

High technical complexity-cost, risk of system failure due to clogged sprayers.

Aquaponics.

The aquaponic system is a sustainable method of cultivation that combines aquaculture and hydroponics in a closed-loop system. This system uses fish waste as a natural fertilizer for plants, while the plants filter the water for the fish. The aquaponic system requires less water, energy and nutrients compared to traditional farming methods. It is a highly efficient method of cultivation that produces high yields of fresh and healthy crops. The aquaponic system can be used to grow a wide range of crops, including vegetables, herbs, fruits, and ornamental plants. It is also an ideal method for producing fish, such as tilapia, catfish, and trout.



Water consumption

Electricity consumption

Technical complexity

Product density

Crops 1,2,8

Strengths

Efficient use of water and nutrients, sustainable, produces fish.

Weaknesses

Requires expertise in aquaculture and hydroponics, high start-up cost.

= Cultivation System Modules (CSM)

In recent years, there has been increasing interest in developing innovative and sustainable farming practices to meet growing demands for food, while minimizing environmental impact. One such approach involves implementing different cultivation modules in agriculture, which can improve efficiency, reduce waste, and increase yields. In this context, understanding the advantages and challenges associated with different production modules is essential for sustainable agriculture.

• **1** Ground-based systems	• **1.1** Open space farming • **1.2** Raised beds • **1.3** Cold frames • **1.4** Floating row covers
• **2** Soil-less systems	• **2.1** Vertical grow rack • **2.2** Benches • **2.3** Tower gardens • **2.4** NGS - Hydroponic recirculation • **2.5** NFT Pipes • **2.6** GHE Aeroflo • **2.7** Rotating tiers unit. A-Go-Gro towers

Microclimate

While 'Open space farming' and 'Raised beds' adapt to local microclimate, 'Cold frames' and 'Floating row covers' extend growing season in local microclimate. All the other CSMs have their own controlled microclimate that can be created within the growing system, such as maintaining a certain temperature and humidity level, as well as providing appropriate lighting conditions. Those system may not necessarily adapt to different microclimates, but rather create its own controlled microclimate.

CSM - 1.1

Ground-based system: Open space farming.

The traditional method of farming in an open space involves the cultivation of crops on open fields, which can be inefficient in terms of water usage and yield.

Land use

Energy usage

Water usage

Crop yields

Workforce-Automation

Growing systems 1

Crops Varies

Strengths

Large scale production; low setup costs; natural light and rain.

Weaknesses

Vulnerable to pests and disease; soil erosion; limited control over microclimate.

Ground-based system: Raised beds.

Raised bed farming involves growing crops in soil-filled beds that are elevated above the ground. This method provides better drainage, aeration, and weed control compared to traditional farming.

Land use

Energy usage

Water usage

Crop yields

Workforce-Automation

Growing systems 1

Crops Varies

Strengths

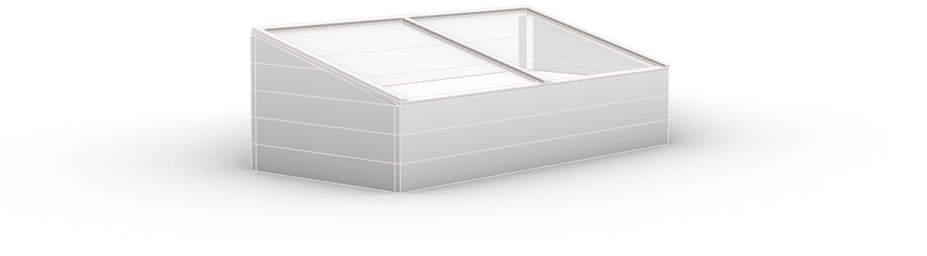
Improved drainage and aeration; higher yields; less soil compaction.

Weaknesses

Higher setup costs; limited growing space per unit area.

Ground-based system: Cold frames.

Cold frames are simple structures with transparent roofs that capture solar energy and provide a controlled environment for plant growth. This method allows for an extended growing season and protects plants from harsh weather conditions.



Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	1
Crops	Varies

Strengths

Protection from extreme weather; extended growing season; low maintenance.

Weaknesses

Limited growing space; requires manual watering and ventilation.

Ground-based system: Floating row covers.

Floating row covers are lightweight fabric covers that float above the plants and provide protection from pests, extreme weather, and temperature fluctuations. This method increases crop yield and reduces the need for pesticides.

Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	1
Crops	Varies

Strengths

Protection from pests and extreme weather; increased yields; low maintenance.

Weaknesses

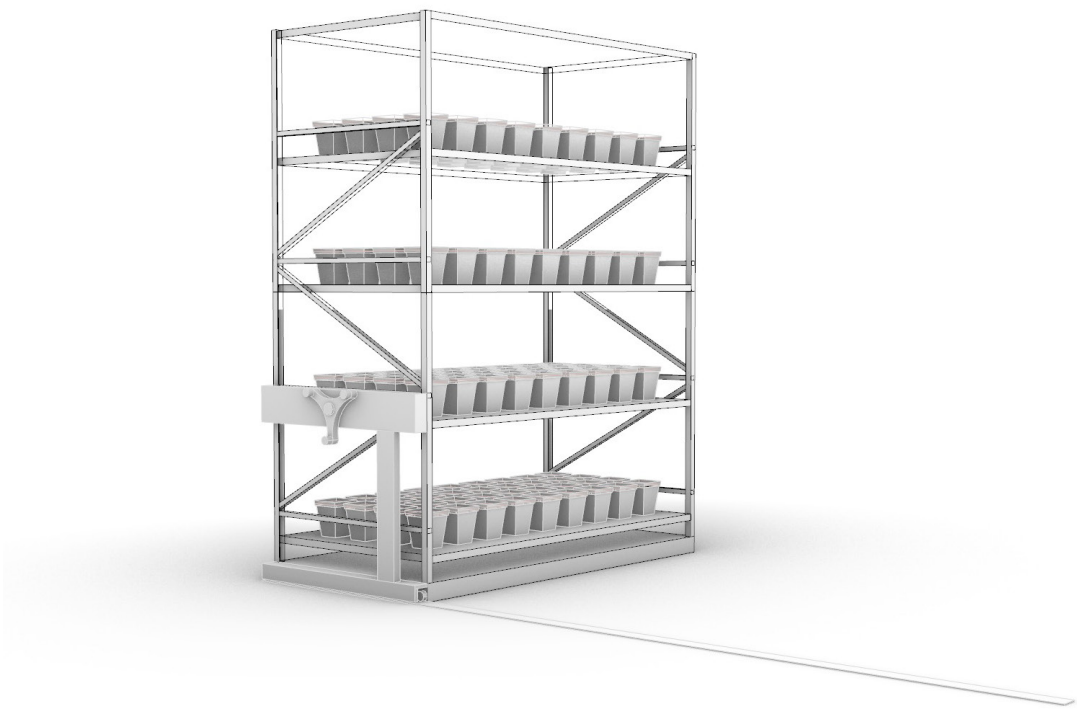
Limited access for weeding and watering; reduced airflow and light penetration.

CSM - 2.1

Soil-less system: Vertical grow rack.

Vertical grow racks utilize vertical space to maximize crop yield per square foot. This method allows for year-round production and efficient use of water and nutrients.

https://www.montel.com/en/applications/ag-tech-vertical-cultivation



Land use	● ○ ○ ○ ○
Energy usage	○ ○ ● ○ ○
Water usage	○ ○ ● ○ ○
Crop yields	○ ○ ○ ○ ●
Workforce-Automation	● ● ○ ○ ○
Growing systems	2,3,4
Crops	Varies

Strengths

Vertical farming using shelves allows for maximum use of space, increases crop yields, reduces water usage, and allows for year-round crop production.

Weaknesses

The initial investment cost can be high, and the energy needed for lighting and climate control can be significant. Additionally, the maintenance and operation of vertical farming systems can be complex and require specialized knowledge.

Soil-less system: Benches.

Benches are used in indoor farming to raise crops off the ground for better control of temperature, humidity, and irrigation. This method allows for high-density planting and easy access to plants for maintenance and harvesting.

https://www.montel.com/en/applications/single-tier-and-double-tier-mobile-benches

Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	2,4
Crops	Varies

Strengths

It provides excellent control over growing conditions, reduces water usage, and increases crop yields. It also eliminates the need for pesticides and other chemicals, resulting in cleaner and healthier produce.

Weaknesses

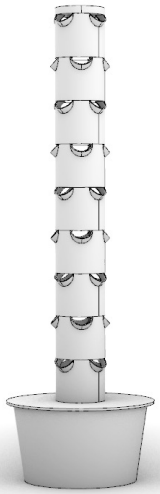
Indoor farming using raised beds or benches requires a significant amount of space, making it difficult to scale for large commercial operations. The initial investment cost can be high, and the ongoing energy costs for lighting and climate control can also be significant.

CSM - 2.3

Soil-less system: Tower gardens.

Tower gardens are vertical aeroponic systems that allow for high-density planting, water and nutrient conservation, and year-round production. This method is ideal for small spaces and can be used for both commercial and home farming.

https://agrotonomy.com/aeroponic-towers/



Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	3
Crops	1,2,3,6,7

Strengths

It allows for high-density planting, maximizing yield per unit area and reducing the amount of space required for cultivation.

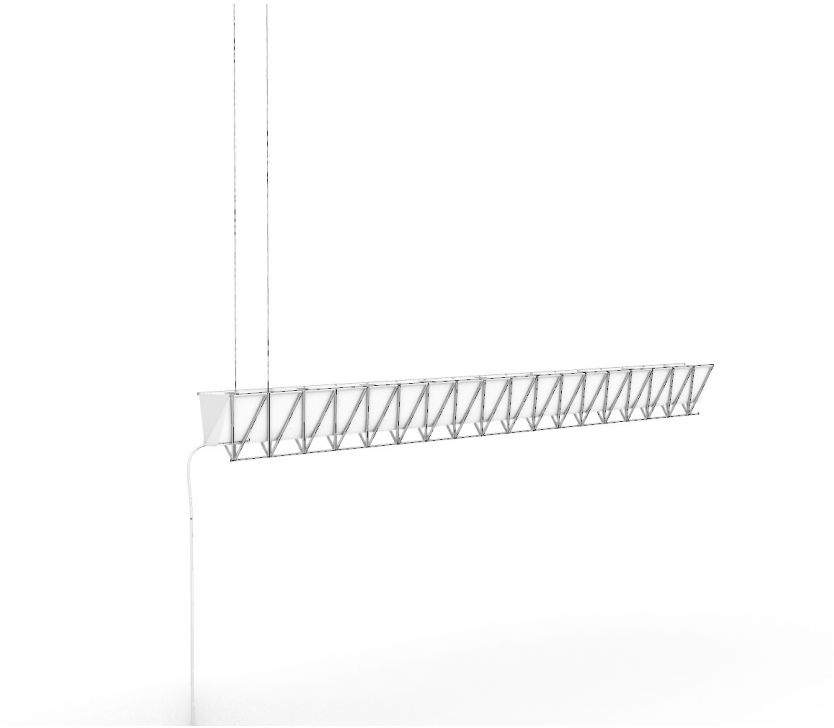
Weaknesses

The initial cost of setting up a tower garden system can be expensive, and there is a risk of power outages or equipment failures that could disrupt the entire system.

Soil-less system: NGS - Hydroponic recirculating.

NGS is a hydroponic system that recirculates water and nutrients, reducing water waste and providing optimal growing conditions for crops. This method allows for high-density planting and efficient use of space and resources.

https://ngsystem.com/ngs-system/



Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	2.1
Crops	1,2,5,6

Strengths

It allows for efficient use of water and nutrients, reducing water consumption and waste and increasing crop yields.

Weaknesses

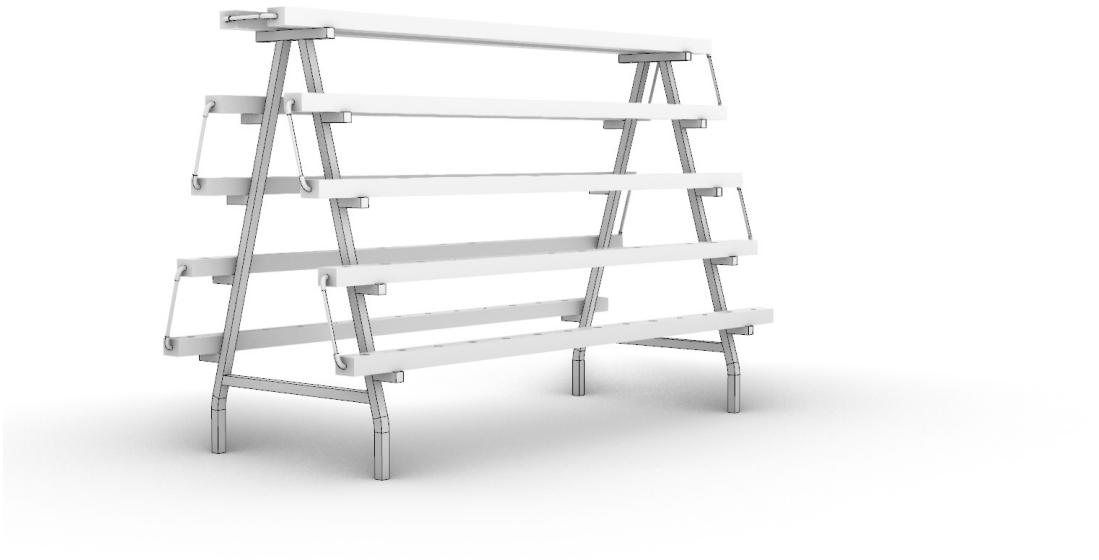
These systems can be expensive to set up and require technical expertise to maintain and optimize, which can be a barrier to entry for some growers. Additionally, there is a risk of equipment failures that could affect the entire system.

CSM - 2.5

Soil-less system: NFT Pipes.

NFT pipes grow system is a hydroponic system that uses a thin film of water to grow plants in PVC pipes. This method allows for efficient use of water and nutrients and high-density planting.

https://www.shinygrow.com/products/hydroponic-system.html



Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	2.1
Crops	1,2,7

Strengths

It allows for a high-density planting, leading to higher productivity and yields in smaller spaces. The system also saves water and reduces the need for pesticides and herbicides.

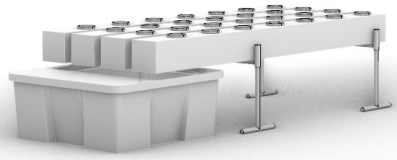
Weaknesses

The NFT pipes grow system requires constant monitoring to prevent clogging and ensure proper nutrient delivery. It is also susceptible to power outages, which could lead to plant damage or loss.

Soil-less system: GHE Aeroflo.

GHE Aeroflo is a soil-less system that uses a continuous flow of nutrient-rich water to grow plants in a highly oxygenated environment. This method provides rapid growth and high yields, but requires careful maintenance and monitoring.

https://www.terraaquatica.com/hydroponics-system/growstream-html/



Land use	
Energy usage	
Water usage	
Crop yields	
Workforce-Automation	
Growing systems	2,3,4
Crops	Varies

Strengths

It provides efficient nutrient delivery and oxygenation to plant roots, resulting in faster growth and higher yields in a vertical farm setting.

Weaknesses

This system can be expensive and requires a certain level of technical expertise for proper installation and maintenance. Additionally, if not properly monitored, the misting system can lead to the spread of plant diseases.

CSM - 2.7

Soil-less system: Rotating tiers unit. A-Go-Gro towers.

A-Go-Gro Towers utilize a rotating tier system that uses water energy to rotate the grow beds, reducing the need for electricity. This method allows for high-density planting, low-carbon emissions, and efficient use of water and space.

https://www.skygreens.com/technology/
https://skygreenscanada.com/blog/f/growing-up-utilizing-sky-greens-canada-vertical-farming-system

Land use	● ○ ○ ○ ○
Energy usage	○ ● ○ ○ ○
Water usage	○ ● ○ ○ ○
Crop yields	○ ○ ○ ○ ●
Workforce-Automation	○ ○ ○ ○ ●
Growing systems	2,3,4
Crops	Varies

Strengths

A-GO-GRO towers have a high crop yield due to the efficient use of water and energy, resulting in reduced carbon emissions. They also provide equal lighting to all plants and have a high planting density.

Weaknesses

The initial investment cost for A-GO-GRO towers can be high, and they require a reliable and consistent source of water to operate efficiently.

5 - AGRITECTURE STRATEGIES: TYPOLOGIES

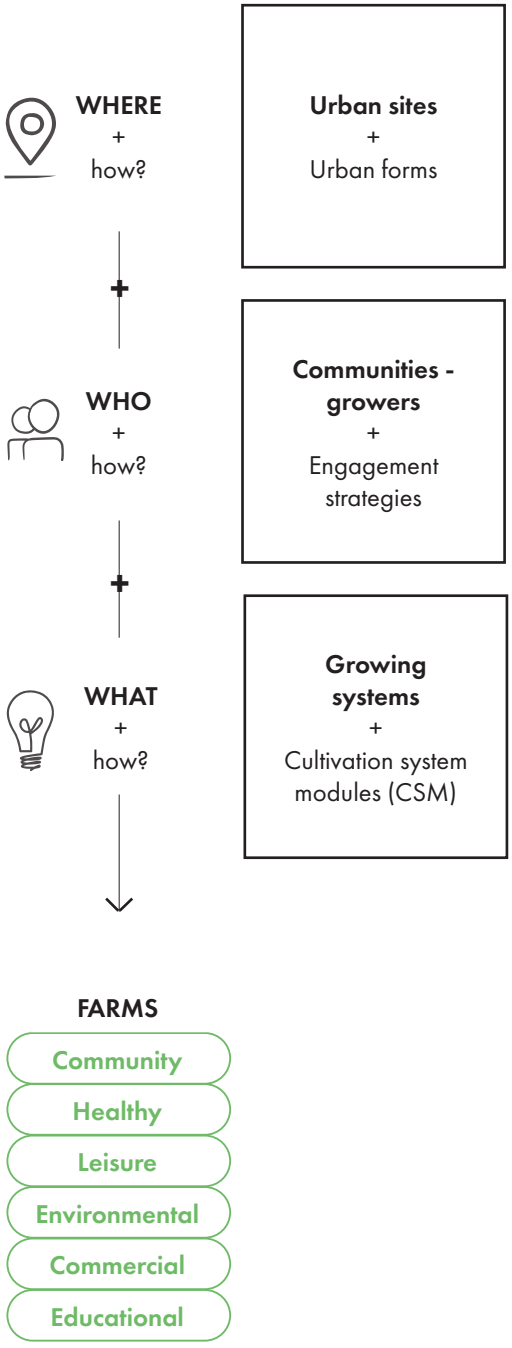
5.1 - Overview

The purpose of this chapter is to present potential **typologies** of agritecture projects that respond to different primary goals of the project. A design process is proposed at the end of the chapter to help identify these purposes and provide a practical approach to defining sustainable development for the project. This approach focuses on meeting the primary goals of the urban impact to be generated and addressing the actual design needs.

The components previously introduced are combined to form possible typologies. Each typology serves as a "filter" for the components based on their sustainability factors: social, environmental, and economic. For each types, several possible urban opportunities and associated threats are presented, and relevant case studies that are compatible with the typologies are presented to understand possible issues that have arisen in real-world situations.

This chapter presents six different typologies of agritecture projects: community farm, healthy farm, leisure farm, environmental farm, commercial farm, and educational farm. These typologies cater to different primary goals of the project and provide a wide range of possibilities for creating sustainable and impactful agritecture projects. (European Parliament, 2017, Duchemin, Wegmuller & Legault, 2008)

The **design methodology** presented in the chapter includes a step-by-step approach that encompasses all the points discussed in the research: site introduction, identification of primary objectives through urban quality analysis using the **Urban Quality Compass**, typologies selection, components selection, guidance on project development, and assessment of urban impacts.



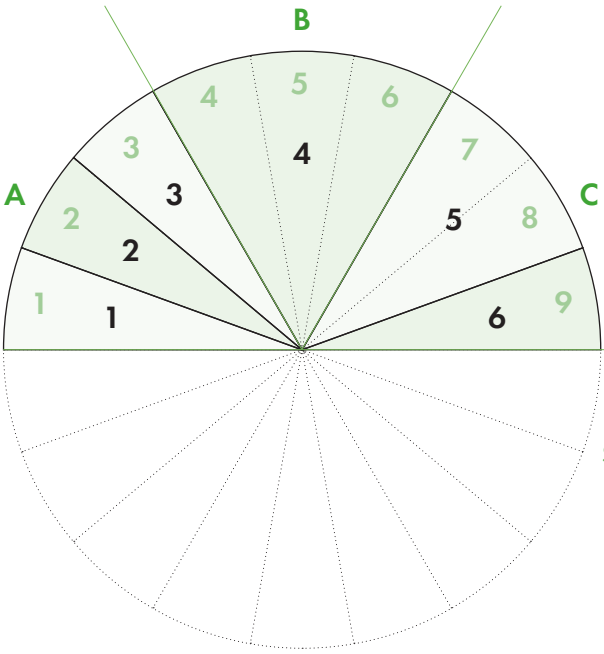
5.2 - Farm typologies

= Design guides

Various types of urban farms differ based on their primary purpose, which aligns with one or more indicators of urban sustainability, including social, environmental, or economic aspects. Each typology has distinct characteristics, urban opportunities to explore, and threats to consider during the design process in addition to specific urban performance metrics to be analyzed.

- **1** Farm typologies

- **1** Community farm
- **2** Healthy farm
- **3** Leisure farm
- **4** Environmental farm
- **5** Commercial farm
- **6** Educational farm



Sustainable development

- **A** Social cohesion
- **B** Environmental viability
- **C** Economic viability

- 1 Inclusivity
- 2 Healthy & safety
- 3 Engageability
- 4 Climate resilience
- 5 Circularity
- 6 Regeneravitity
- 7 Profitability
- 8 Attractiveness - Activator
- 9 Employment & Training

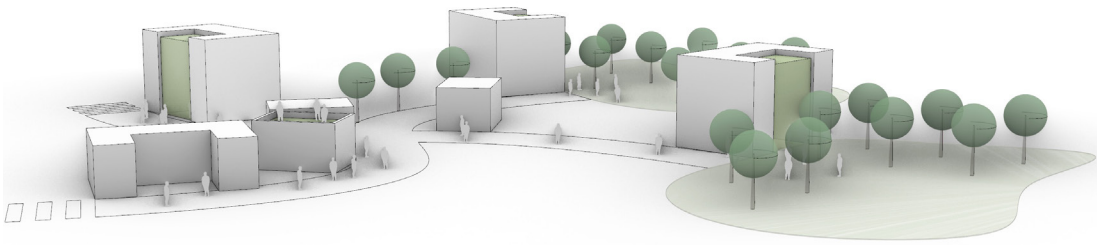
Assessment range

very low · low · medium · high · very high

Farm typologies: Community farm.

Community farms are agricultural spaces that focus on social integration and provide opportunities for individuals with physical, mental, or social challenges to engage in farming activities. These farms promote social inclusion, mental well-being, and personal development through sustainable farming practices. Participants are involved in all aspects of farming and are supported by trained professionals.

Ideals: Inclusive and accessible for all members of the community, Strengthening the sense of community and cooperation, Intergenerational and multicultural exchange opportunities, Food justice promotion.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

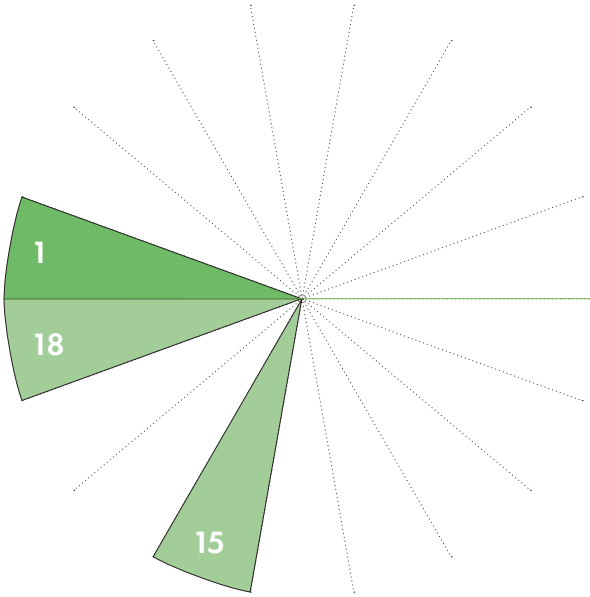
Crop density

Opportunities

- Provides opportunities for social inclusion and personal development for individuals with physical, mental, or social challenges.
- Creates new urban relationships among diverse social groups, fostering community building: integrate social programming with spatial enhancement and productive plantings.
- Enhance the availability of publicly owned production areas and locate new projects in close proximity to existing social infrastructure.

Threats

- May require additional costs for training professionals and making necessary adaptations for people with disabilities.
- Can face challenges in securing funding for the program's operations.
- Could potentially face social stigmatization or opposition from those who do not understand the importance of social integration.



Sustainable development:

1 Inclusivity

Analyzed case studies:

01 Jackson Hole farm by Vertical Harvest.
In Jackson, Wyoming - USA - 2016
13 Value Farm by Thomas Chung.
In Shenzhen - Cina - 2013
17 K-Farm by Avoid Obvious Architects.
In Hong Kong - 2021
19 Cité maraîchère by Secousses architectes.
In Romainville - France - 2021

Components

- **Urban sites**

1.2 Public parks - gardens
1.6 Institutional spaces
2.2 Rooftops

- **Urban forms**

1.4 Rebase
1.3 Top-up
2.3 Core - Porous
2.4 Node
3.2 Hoop houses

- **Communities - growers**

2.1 Co-operative
2.2 Neighbors volunteers
2.3 Several families
4.2 Hospital & Medical center
4.5 PPP Company - Social entrepreneurs

- **Engagement strategies**

1.3 Conversation
2.3 Engagement
3.1 Inspiration

- **Growing systems**

1 Ground planting

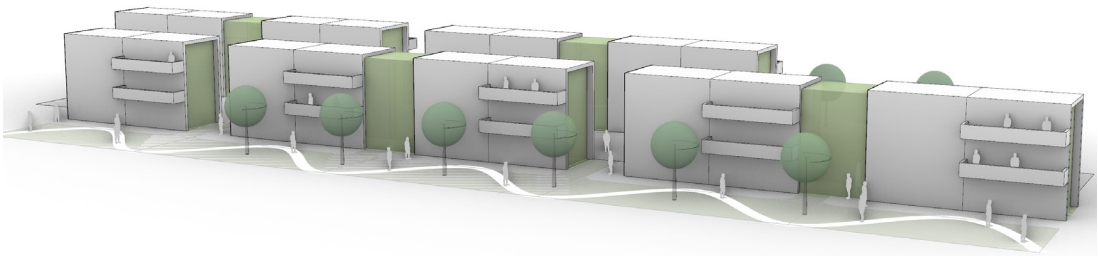
- **Cultivation system modules (CSM)**

1 Ground-based systems

Farm typologies: Healthy farm.

Healthy farms promote healthy living through sustainable food production practices. These farms focus on producing fresh, organic, and locally grown food that is free from harmful chemicals and pesticides. Participants are involved in all aspects of farming, from planting to harvesting, and have access to fresh produce that promotes healthy eating habits.

Ideals: Food quality, Healthy lunch breaks, Mental health, Public relaxation spaces, Contact with nature, Physical activities, Encouragement toward healthy eating habits and lifestyle choices.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

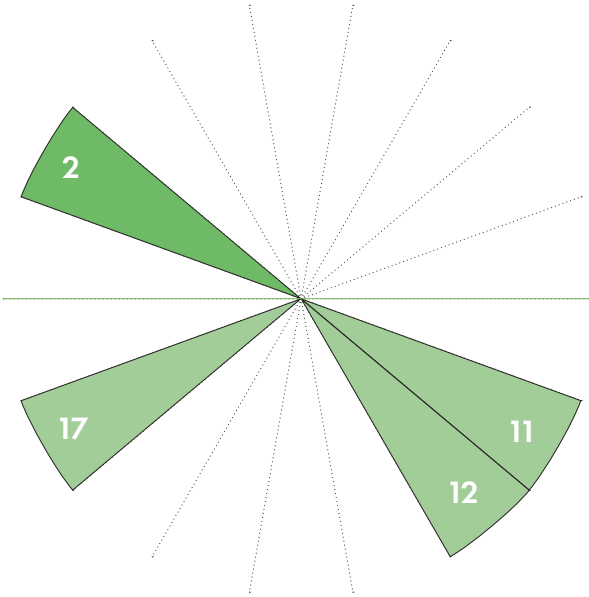
Crop density

Opportunities

- Promotes healthy, sustainable eating habits and enhance food security through the production of local, organic food.
- Provide for the creation of gardens near high-stress areas such as schools, health centers, RSAs, prisons and office districts.
- Enhance availability of planting spaces in all urban communities: disseminate information about community gardens.

Threats

- May face challenges in finding suitable land and water resources for agriculture.
- Can be impacted by changing weather patterns and natural disasters.
- May require significant investments in agricultural infrastructure and marketing.



Sustainable development:

2 Healthy & Safety

Analyzed case studies:

05 Pasona Urban Farm by Kono Designs.
In Tokyo - Japan - 2022
07 Farming Kindergarten by VTN Architects.
In Biên Hòa - Vietnam - 2013
08 ØsterGro.
In Copenhagen - Denmark - 2014
11 Plantworks by Marek Wojciechowski Architects.
In London - United Kingdom - 2021

Components

• **Urban sites**
1.1 Private backyards - gardens
1.4 Vacant lots
1.5 Industrial & infrastructure wasteland
1.6 Institutional spaces
2.1 Façades & Balconies
2.2 Rooftops
2.3 Interior spaces
2.4 Underground spaces

• **Urban forms**
1.1 Conversion - Retrofit
1.2 Fill-in
1.3 Top-up
1.5 Extend
1.7 Wraps-up
2.2 Divide - Barrier
3.1 Hoop houses
3.2 Greenhouses
3.3 Plant factory with artificial lighting (PFAL)

• **Communities - growers**
1.1 Household growers
2.1 Co-operative
2.2 Neighbors volunteers
3.3 Restaurant
4.2 Hospital & Medical center
4.3 RSA - Elderly people
4.5 PPP Company - Social entrepreneurs

• **Engagement strategies**
1.1 Immersion
2.1 Connection
3.3 Embodiment

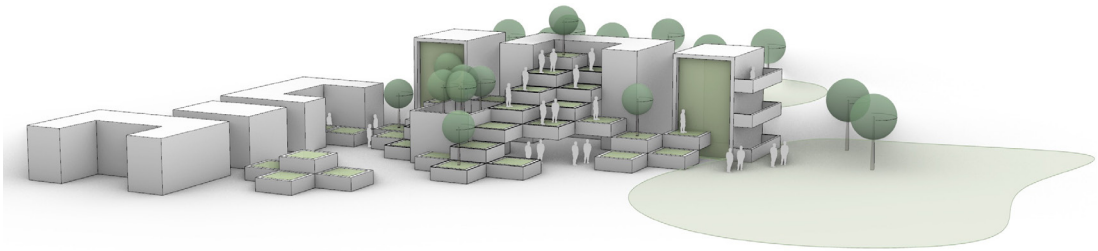
• **Growing systems**
1 Ground planting
2 Hydroponics
3 Aeroponics
4 Aquaponics

• **Cultivation system modules (CSM)**
1 Ground-based systems
2 Soil-less systems

Farm typologies: Leisure farm.

Leisure farms are designed for recreational and entertainment purposes. These farms offer a range of leisure activities, such as corn mazes, and hayrides, alongside farming activities. Participants are involved in various aspects of the farm and have access to a range of leisure activities that promote outdoor recreation and family bonding.

Ideals: Peaceful and relaxing environment, Recreational and social activities, Cultural and artistic elements into the farm design and programming, Biophilic design.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

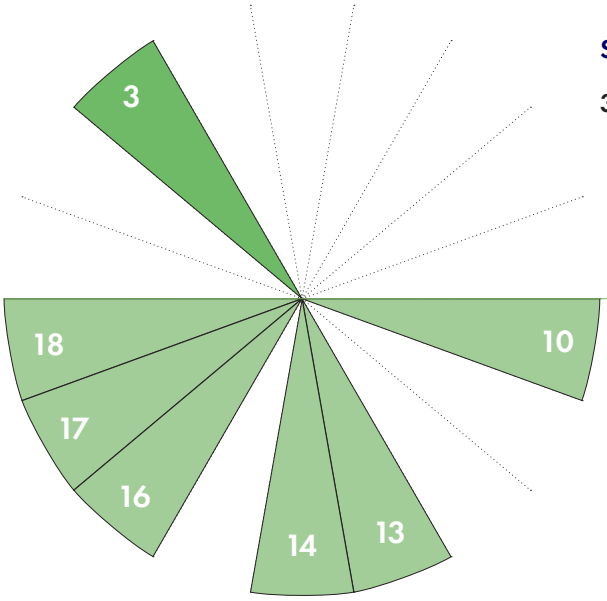
Crop density

Opportunities

- Provides recreational opportunities and outdoor activities for families and tourists.
- Can enhance tourism and economic growth in the region.
- Establish dynamic hubs of activity and interaction in developing neighborhoods, utilizing food production as a temporary measure for landscape improvement that responds to the specific site and enhances its distinctiveness.

Threats

- May require significant investments in leisure equipment and infrastructure.
- Can be impacted by changing weather patterns and natural disasters.
- Can face competition with other tourist activities in the region.



Sustainable development:

3 Engageability

Analyzed case studies:

05 Pasona Urban Farm by Kono Designs.
In Tokyo - Japan - 2022
06 Urban farming office by VTN Architects.
In Ho Chi Minh city - Vietnam - 2022
11 Plantworks by Marek Wojciechowski Architects.
In London - United Kingdom - 2021
17 K-Farm by Avoid Obvious Architects.
In Hong Kong - 2021

Components

- **Urban sites**

1.1 Private backyards - gardens
1.2 Public parks - gardens
1.6 Institutional spaces
2.1 Façades & Balconies
2.2 Rooftops
2.3 Interior spaces

- **Urban forms**

1.1 Conversion - Retrofit
1.3 Top-up
1.6 Parasite
2.5 Observe - Tower
2.6 Connect - Planimetric hinge
3.2 Greenhouses

- **Communities - growers**

1.1 Household growers
3.3 Restaurant
4.3 RSA - Elderly people

- **Engagement strategies**

1.1 Immersion
2.3 Engagement
3.3 Embodiment

- **Growing systems**

1 Ground planting
2 Hydroponics
3 Aeroponics
4 Aquaponics

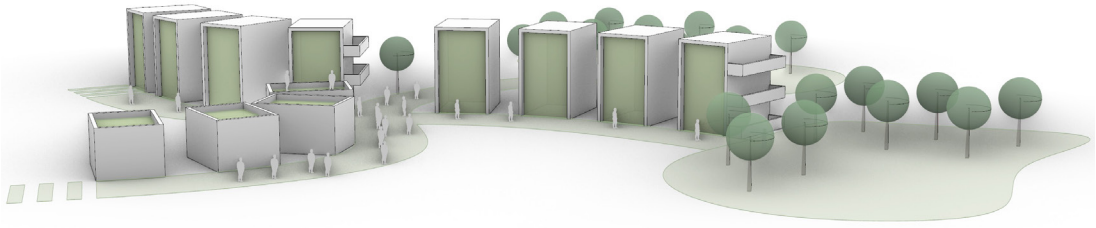
- **Cultivation system modules (CSM)**

1 Ground-based systems
2 Soil-less systems

Farm typologies: Environmental farm.

Environmental farms focus on environmental sustainability and conservation through sustainable farming practices. These farms aim to reduce environmental impact by utilizing renewable energy sources, practicing crop rotation, and employing eco-friendly pest control methods. Participants are involved in farming activities that prioritize the preservation of the local ecosystem and natural resources.

Ideals: Heat island reduction, Composting, Water collection and recycling, Net-zero energy, Part of a green network, Climate resilience: year round cultivation, Regenerative and agroecological practices.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

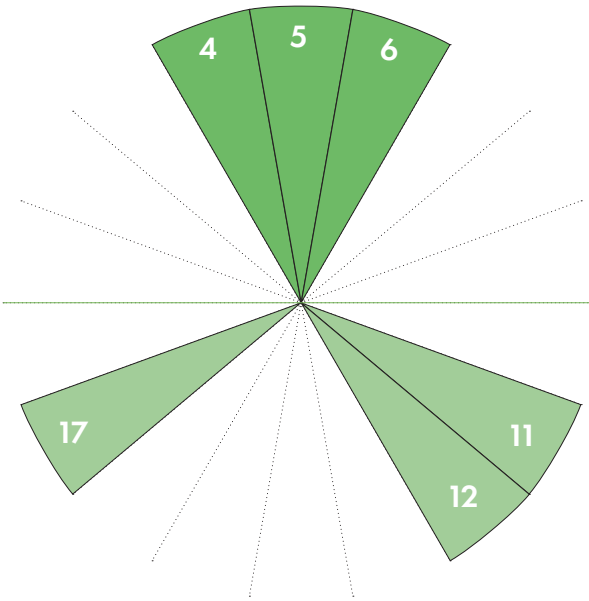
Crop density

Opportunities

- Promotes environmental sustainability through eco-friendly agricultural practices.
- Can reduce carbon footprint by implementing renewable energy sources and composting techniques.
- Reinforce urban green-blue infrastructure: combine ecological corridrs, develop them in parallel to major infrastructure entities and intricate urban topographies, identify and reinforce green islands.

Threats

- Can be subject to weather and climate-related challenges that can impact agricultural production.
- Can face difficulties in finding a market for environmentally-friendly-products.
- May require significant initial investment in eco-friendly technology and infrastructure.



Sustainable development:

4 Climate resilience
5 Circularity
6 Regenerativity

Analyzed case studies:

04 ICTA-ICP UAB by HArquitectes + DATAAE.
In Barcelona - Spain - 2014
10 Citiponics.
In Singapore - 2015
12 La Caverne.
In Paris - France - 2018
16 Sky Greens.
In Singapore - 2012
20 Sky Vegatables.
In The Bronx, New York - USA - 2013

Components

- **Urban sites**

1.3 Public roads - streets
1.4 Vacant lots
1.5 Industrial & infrastructure wasteland
2.1 Façades & Balconies
2.2 Rooftops

- **Urban forms**

1.1 Conversion - Retrofit
1.3 Top-up
1.5 Extend
1.7 Wraps-up
2.7 Connect - Corridor
3.2 Greenhouses

- **Communities - growers**

2.1 Co-operative
2.2 Neighbors volunteers
3.2 Community-supported farming enterprise (CSFE)
4.5 PPP Company - Social entrepreneurs

- **Engagement strategies**

1.1 Immersion
2.1 Connection
3.3 Embodiment

- **Growing systems**

3 Aeroponics

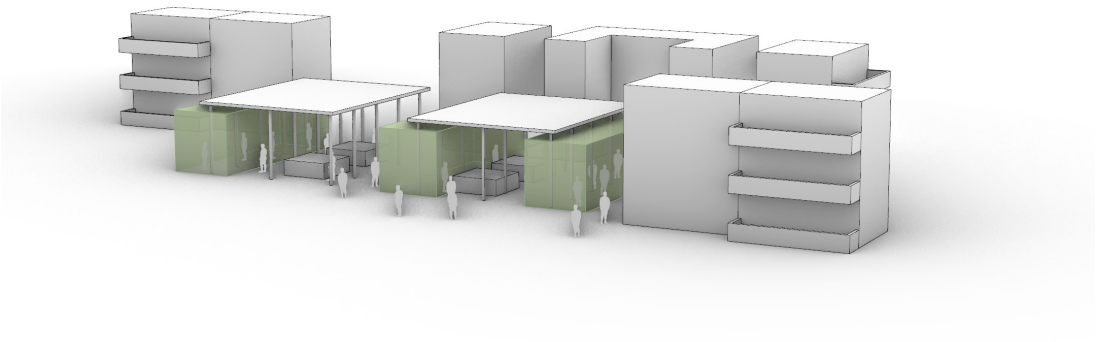
- **Cultivation system modules (CSM)**

2.1 Vertical grow rack
2.3 Tower gardens
2.7 Rotating tiers unit. A-Go-Gro towers

Farm typologies: Commercial farm.

Commercial farms are designed for profit-oriented food production. These farms use large-scale farming practices to produce crops for sale to retailers or distributors. Participants are involved in various aspects of the farming process, such as planting, harvesting, and marketing, and are trained to operate the farm as a business.

Ideals: Viable business operation, High-quality and marketable produce, Efficient and cost-effective production methods, Sound business and financial management practices, Contribution to the local economy.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

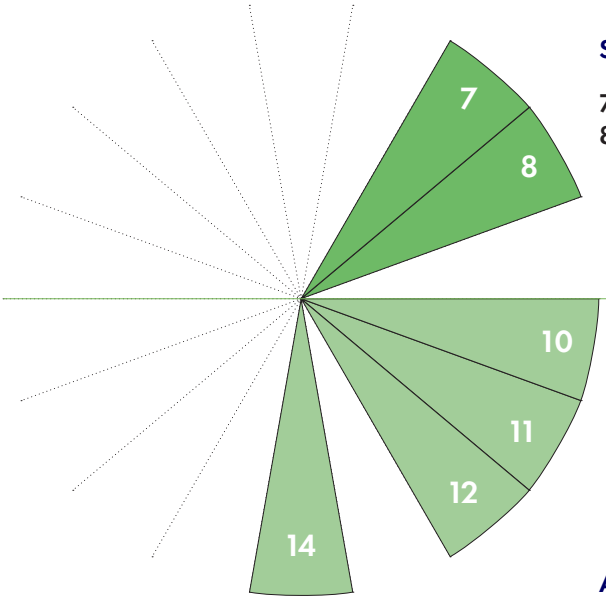
Crop density

Opportunities

- Provides opportunities for profit through large-scale food production.
- Can create jobs and stimulate economic growth in the region.
- Maximize constructed surfaces: promote the revitalization of rooftops and utilization of residual or underutilized spaces for production purposes.

Threats

- May require significant initial investments in equipment, land, and labor.
- Can be impacted by market fluctuations and changing consumer demands.
- Can face environmental criticism due to the ecological impact of industrial agriculture.



Sustainable development:

7 Profitability
8 Attractiveness - Activator

Analyzed case studies:

02 Lufa Farm by Lufa organic farm.
In Montreal - Canada - 2009
12 La Caverne.
In Paris - France - 2018
15 InFarm.
In Berlin - Germany - 2013
16 Sky Greens.
In Singapore - 2012
20 Sky Vegatables.
In The Bronx, New York - USA - 2013

Components

- **Urban sites**

1.4 Vacant lots
1.5 Industrial & infrastructure wasteland
2.2 Rooftops
2.4 Underground spaces

- **Urban forms**

1.1 Conversion - Retrofit
1.2 Fill-in
1.3 Top-up
2.1 Add-on
2.2 Divide - Barrier
3.2 Greenhouses
3.3 Plant factory with artificial lighting (PFAL)

- **Communities - growers**

3.1 Farming enterprise
3.2 Community-supported farming enterprise (CSFE)
4.5 PPP Company - Social entrepreneurs

- **Engagement strategies**

1.2 Communication
2.1 Connection
3.1 Inspiration

- **Growing systems**

2 Hydroponics
3 Aeroponics
4 Aquaponics

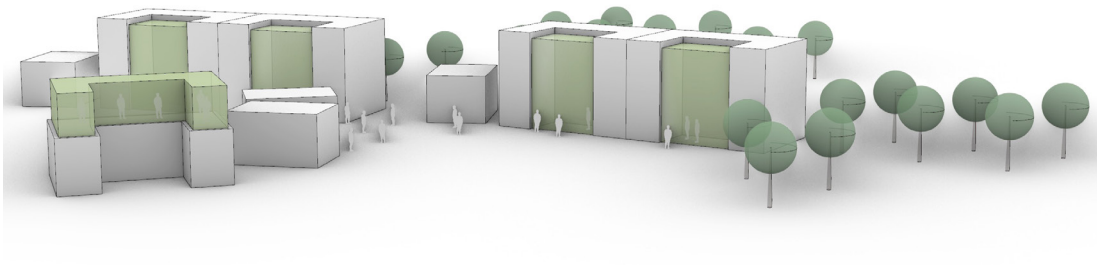
- **Cultivation system modules (CSM)**

2 Soil-less systems

Farm typologies: Educational farm.

Educational farms are designed to provide hands-on learning opportunities for students of all ages. These farms offer educational programs on sustainable agriculture and environmental conservation. Participants learn about farming practices, food production, and natural resource management through practical activities such as planting and harvesting crops.

Ideals: Integration and connection with schools, Training activities, Awarness and empowerment of citizens, High-qualified works, Research and experimental activities, Open for public visits: hands-on learning.



Cropland use

Water use

N application

P application

GHG emissions

Crop yield

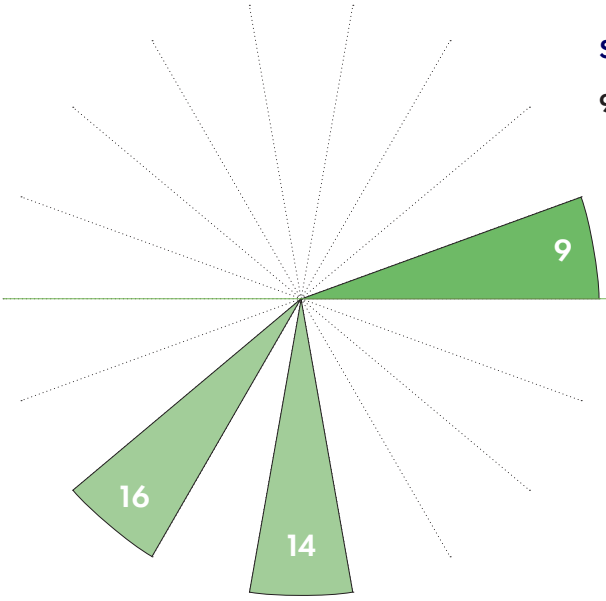
Crop density

Opportunities

- Facilitates hands-on learning experiences on sustainable agriculture and environmental conservation, promoting collaboration with prominent institutions like healthcare centers, hospitals, correctional facilities, and schools.
- Can enhance knowledge and awareness of food production, natural resources management, and ecological preservation.
- Repurpose current urban spatial infrastructure for gatherings, education, and skill-building activities.

Threats

- May require initial investments in educational equipment and staff training.
- Can face challenges in securing funding for educational programs and attracting participants.
- Could potentially face opposition from those who do not see the value of environmental education.



Sustainable development:

9 Employability & Training

Analyzed case studies:

04 ICTA-ICP UAB by HArquitectes + DATAAE.
In Barcelona - Spain - 2014
07 Farming Kindergarten by VTN Architects.
In Biên Hòa - Vietnam - 2013
09 DakAkker rooftop farm.
In Rotterdam - The Netherlands - 2012
19 Cité maraîchère by Secousses architectes.
In Romainville - France - 2021

Components

- **Urban sites**
1.6 Institutional spaces

- **Urban forms**
2.1 Add-on
3.2 Greenhouses
3.3 Plant factory with artificial lighting (PFAL)

- **Communities - growers**
4.1 Prison
4.2 Hospital & Medical center
4.4 School - People in training + Teacher & trainers

- **Engagement strategies**
1.2 Communication
2.2 Education
3.2 Reflection

- **Growing systems**
1 Ground planting
2 Hydroponics
3 Aeroponics
4 Aquaponics

- **Cultivation system modules (CSM)**
1 Ground-based systems
2 Soil-less systems

5.3 - Design metodology

- Design process

The design process promoted follows the previously presented research. The designer is guided from the use of the Urban Quality Compass, to the definition of the typologies and subsequently the components of the project in order to design it and evaluate the impacts.

1. Site

1.1 Site introduction
Quick identification of Key Opportunities and Constraints.

2. Project aim & Agritecture typologies

2.1 Qualitative site analysis
Apply the Urban Quality Compass as an evaluative tool to consider what indicators-aspects of the site to focus on. +
Choice of specific KPIs to be used in the design project.

2.2 Agritecture typologies and ideals
Based on the indicators to work on, choice of agritecture typologies.

3. Agritecture components

3.1 Urban analysis
Analysis of selected indicators. +
Climate analysis: light, temperatures and air quality. +
Growing goals: crops, temperatures and climate zones.

3.2 Agritecture components
Based on the chosen agritecture typologies, choice of agritecture components.

- Sites + Urban forms
- Communities - growers + Engagement strategies
- Growing systems + Cultivation system modules (CSM)

4. Design

4.1 Program & Layout
Based on the chosen agritecture typologies, the similar analyzed case studies, values, SW-OT analysis, spatial-definition of a program.

4.2 Design development
Based on the components, development of the design and identity of the project.

5. Impact

5.1 Input - Output analysis
Evaluation of the entire flow of resources used in cultivation processes and their impact.

5.2 Project evaluation
Evaluation of the project based on the chosen KPIs defined by the indicators in the Urban Quality Compass.

- Considerations

The chapter concludes by presenting possible typologies of sustainable urban farming and a design method that identifies the primary goals and practical steps for sustainable development. While the six typologies may seem limiting, they offer site-specific solutions to address the strengths and weaknesses of each component, and can intersect with the diverse needs of various categories to create new urban models.

The case studies presented for each typology demonstrate how different approaches can achieve primary goals in diverse ways, creating new urban relationships, permeability, and connections with external elements. This toolkit aims to provide a practical system for designing elements that effectively respond to sustainable goals for the territory. However, the definition of local spaces rich in meaning and value depends primarily on the concrete analysis of the territory and its potential.

The ultimate goal of this design guide is to provide tools that can effectively help address primary urban issues and resolve them without resorting to possible unrealistic or Greenwashing projects or urban gentrification practices. Overall, the integration of social, environmental, and economic sustainability in urban farming projects can create meaningful and diverse experiences that educate and connect communities to sustainable food and agriculture practices.

6 - DESIGN PROJECT

6.1 - Site

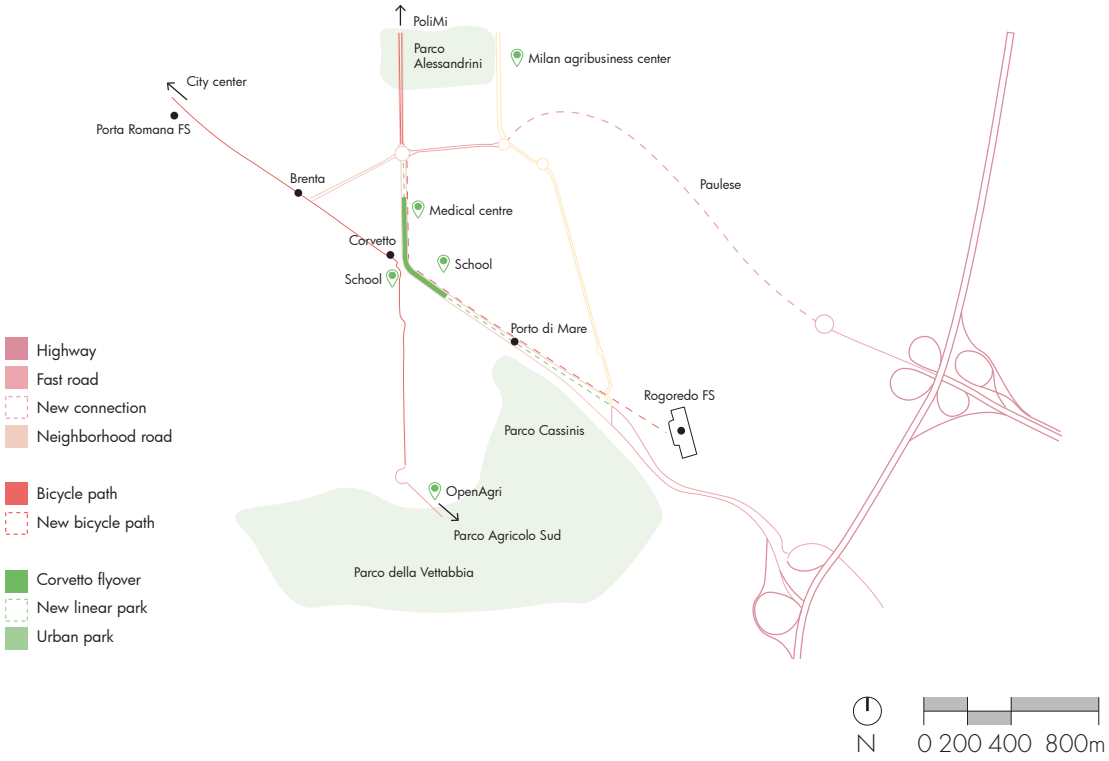
- Site introduction

Located in the southern area of Milan, Corvetto is a neighborhood that has undergone significant transformations over the past decades. However, one element of its urban fabric still stands as a remnant of a past era: the flyover that crosses through Piazzale Corvetto. This infrastructure, once a symbol of a city based on speed and mobility, is now seen as an obstacle to the development of a more sustainable and livable urban environment. As part of a new project aimed at rethinking the area, the overpass is being reimagined as a space for the community, reconnecting the two sides of the neighborhood and promoting more sustainable modes of transportation. This project represents a step towards a more human-centered city, where the needs of people and the environment come first.

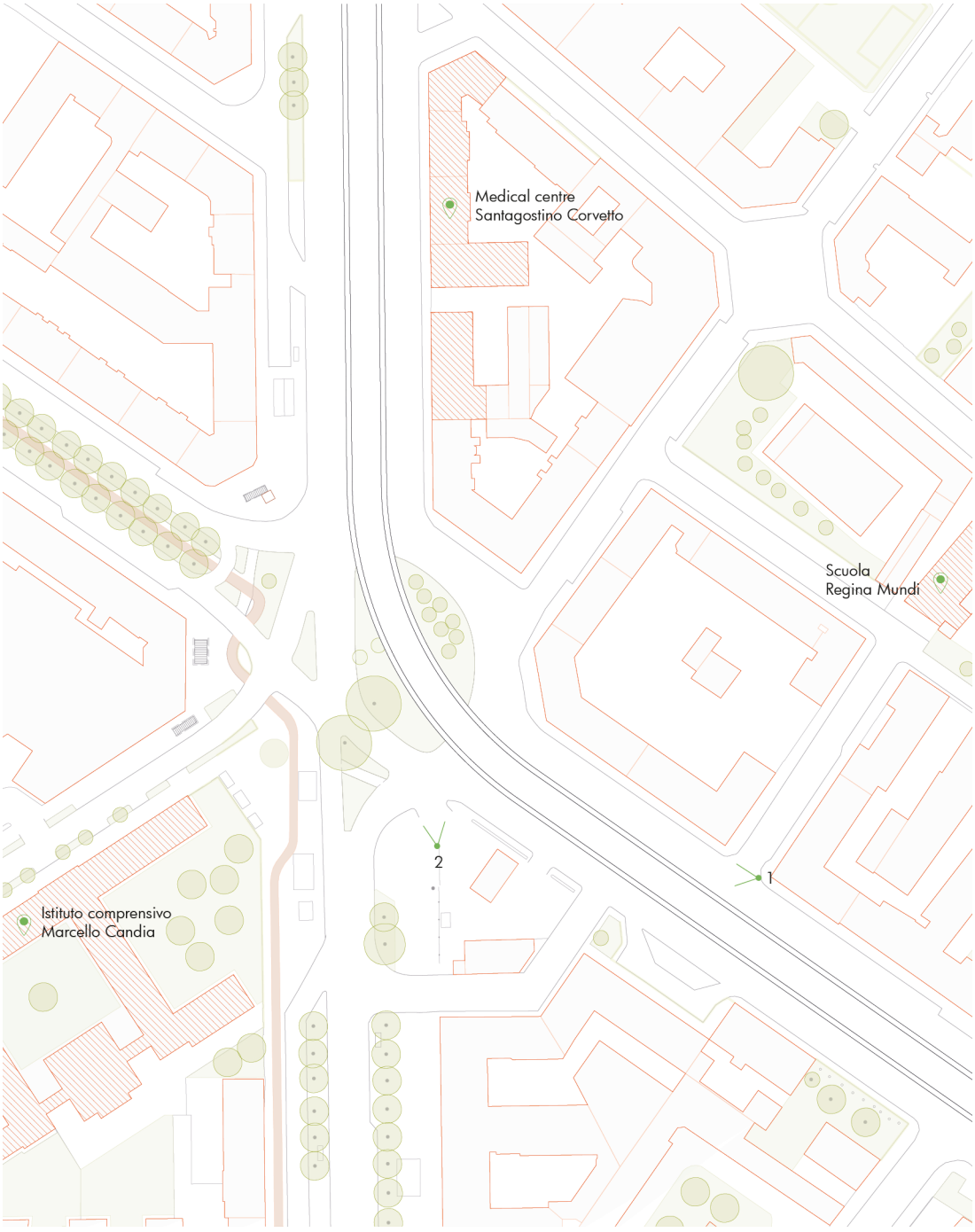
Piazzale Corvetto in 1970

Road infrastructure and connections

The Corvetto flyover is a product of the past paradigm of a city in motion. Today, however, the overpass that connects the highway to the urban center creates an insurmountable barrier, generating noise and air pollution. Therefore, a complete rethinking of the overpass and the road on which it is located is required to transform it into a linear park with new functions that will reactivate the area, making it active, safe, and connected.
The surrounding roads, as already planned, will become neighborhood streets, predominantly for pedestrians.
A new cycle path will be introduced that connects Rogoredo station with the area to the North along the axis leading to Città Studi. The current traffic, which is already decreasing, will be completely reorganized and redirected to Paulese: a pre-existing connection between a highway exit and the city center will decongest the area.
The location of the overpass is strategic as a point of connection between various urban parks and for the food theme, connecting the agro-food center of Milan with the vast southern agricultural park, which also houses new projects such as OpenAgri, a hub of excellence that hosts start-ups in the agro-food sector.
Similarly, there are several public services nearby including schools, municipal offices, and medical centers that support the activation of a possible new gathering space for the neighborhood.



Site area



The flyover site has 2,800 m2 of GFA.
The roadway is 8.3 m wide and 330 m long

N

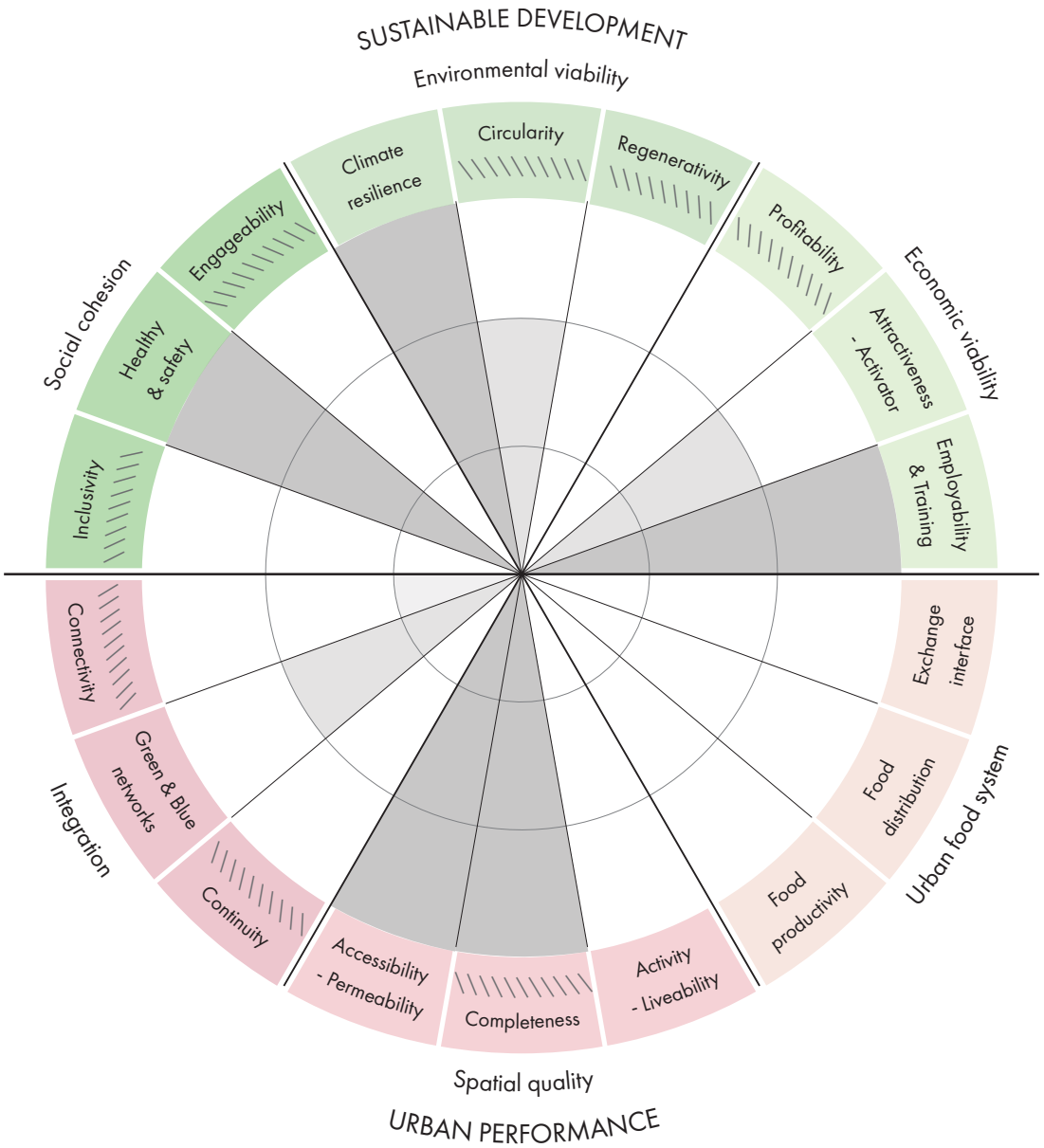
0 10 20 40m

↑ Spot 1: View from via Carlo Marochetti
↓ Spot 2: View from viale Enrico Martini

6.2 - Project aim & Agritecture typologies

- Qualitative site analysis

Urban Quality Compass



The aspects that want to be improved in the project area concern both the social-community, environmental, and economic spheres and the configuration of urban space.

Urban quality indicators

- **Healthy & Safety** Promoting quality of life and fostering connectivity and social cohesion as well as healthy and sustainable lifestyles.
- **Climate resilience,**
- **Employability & Training**

Implement new green economy projects that foster resilience. Capable of creating profit and new jobs as well as enabling cities to recover quickly and bounce back efficiently when shocks and climate-related stresses occur.

- **Circularity** Implementing the Reduce-reuse-recycle principle.
- **Completeness,**
- **Accessibility - Permeability ,**
- **Attractiveness - Activator**

The overpass needs to be rethought through innovative actions and a functional mix aimed at transforming this space, and thereby the surrounding environment, into an attractive capable of strengthening the green economy in line with the 15-minutes city concept.

- **Green & Blue networks** Creating a green corridor that connects the main existing and future urban parks, including Parco Alessandrini and Parco Cassinis, through the implementation of new ecological, social, productive and recreational infrastructure. This will transform the flyover from a barrier to a connecting element promoting sustainable urban development.
- **Connectivity** Improving urban connectivity by promoting sustainable mobility, modulating vehicular traffic, enhancing cycling and pedestrian mobility, and implementing and strengthening the cycling network of adjacent neighborhoods.

Project KPIs

- **Healthy meals/d provided in the area**

Estimation of healthy meals/year produced from locally grown fresh food. Number of children and youth benefitting from school feeding programmes with supplies from the urban agriculture project.

- **Carbon footprint tCO2**

Emissions in annual tCO_2 and or tCO_2/m^2 directly related to food production.

- **Land use**

Space for growing food: % of land used compared to traditional systems.

- **Water use**

Estimation of the volume of rainwater and wastewater that can be collected and/or purified and reused.

- **Nutrient cycle**

% of nutrients for food production recovered without polluting the urban water system and land.

- **Learning opportunity**

Number of opportunities for food system-related learning and skill development in i) food and nutrition literacy, ii) employment training and iii) leadership.

- Agritecture typologies and ideals

A

ENVIRONMENTAL FARM

This typology of farm focuses on sustainable and eco-friendly agricultural practices that aim to reduce the negative environmental impacts of farming while providing fresh produce to local communities.

Ideals:

- Heat island reduction
- Composting
- Water collection and recycling
- Net-zero energy
- Part of a green network
- Climate resilience: year round cultivation

B

HEALTHY FARM

It provides local communities with easy access to fresh, nutritious food. In addition, by promoting the benefits of a healthy diet, these farms encourage positive lifestyle choices and contribute to improved health and overall well-being.

Ideals:

- Food quality
- Healthy lunch breaks
- Mental health
- Public relaxation spaces
- Contact with nature
- Physical activities

C

EDUCATIONAL FARM

It prioritizes education and training for individuals entering the farming industry. Aims to address the changing landscape of agriculture by connecting with new markets and adapting to the decreasing presence of traditional agricultural actors.

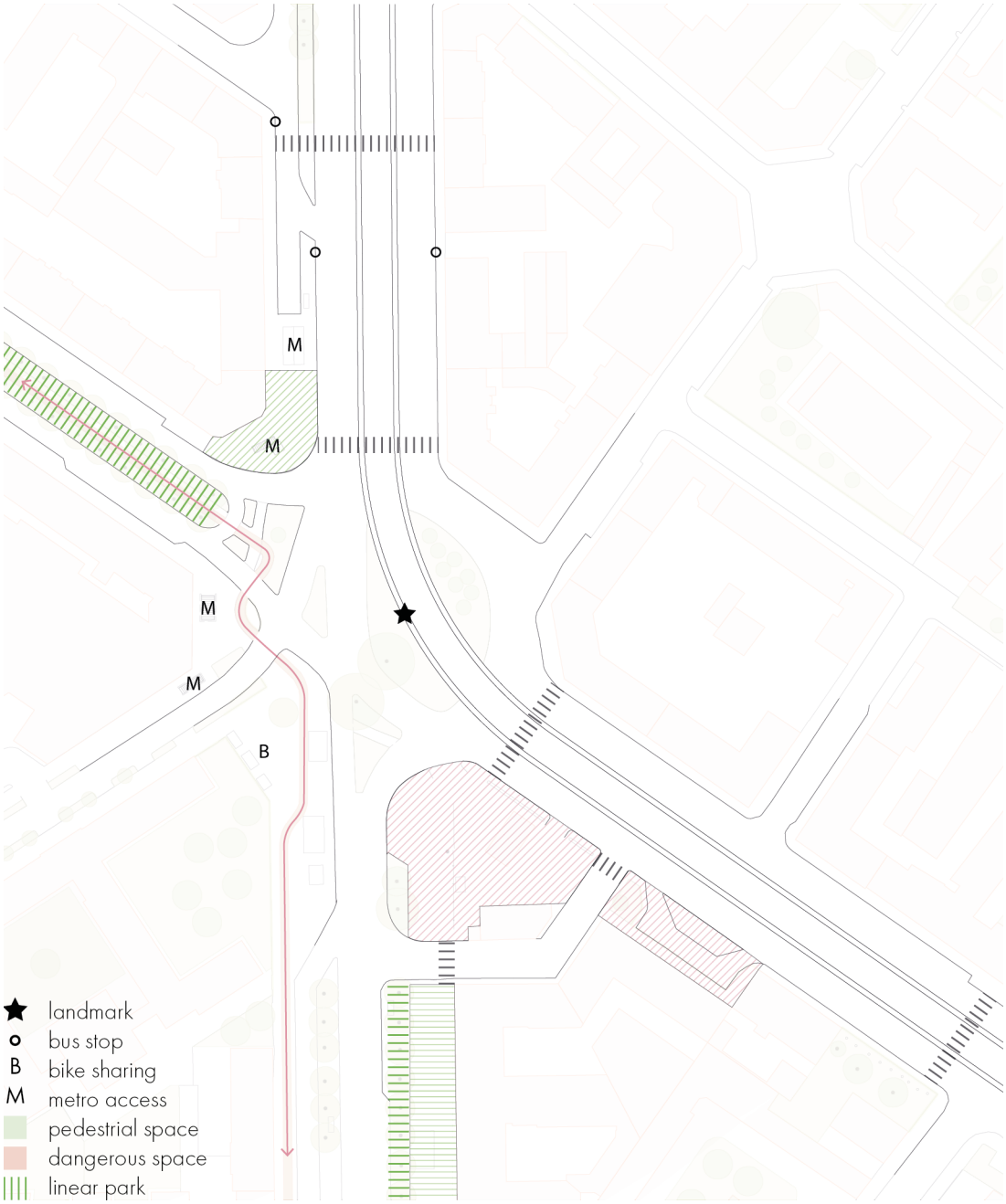
Ideals:

- Integration and connection with schools
- Training activities
- Awarness and empowerment of citizens
- High-qualified works
- Research and experimental activities
- Open for public visits

6.3 - Agritecture components

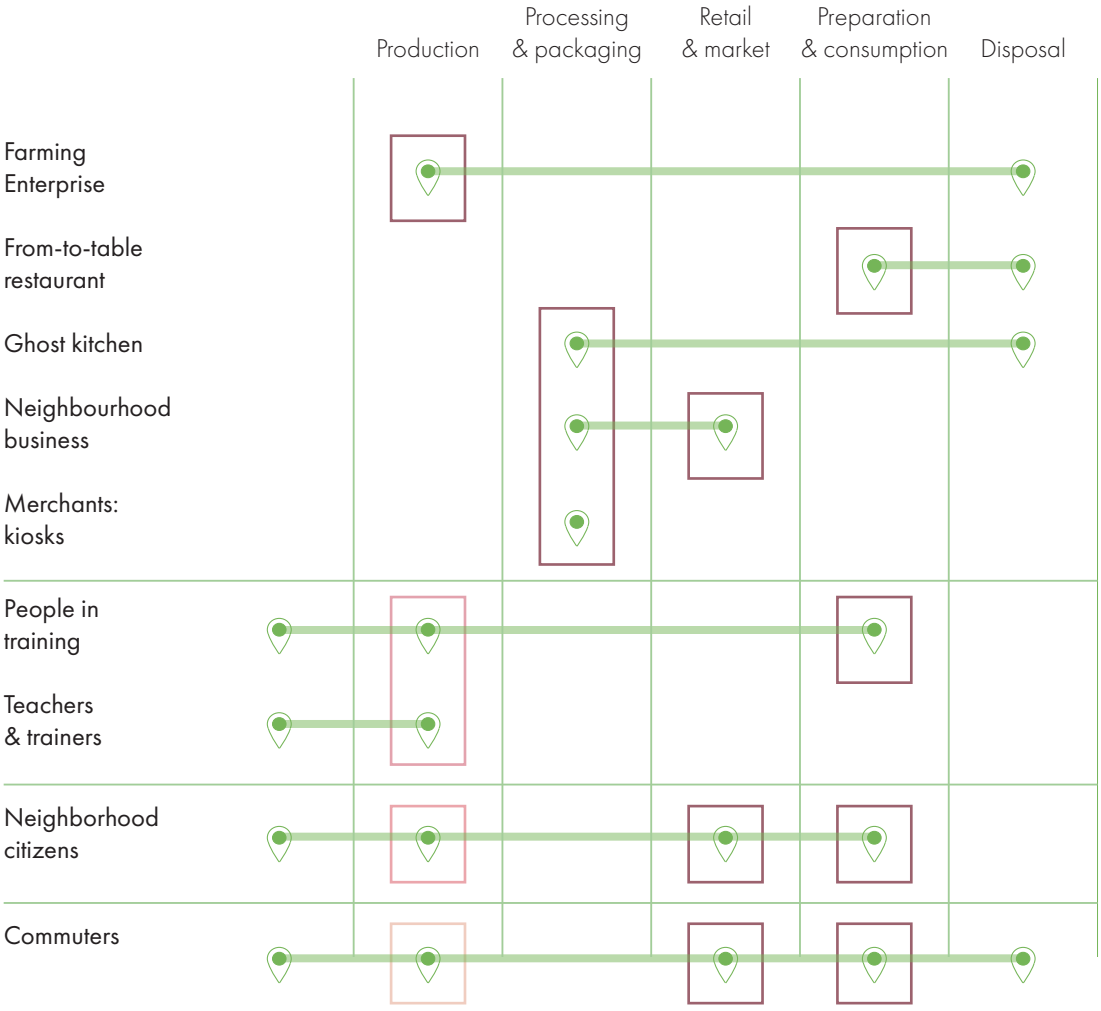
- Urban analysis

Urban perception analysis



This mapping includes consideration of perceptual analysis of the area particularly on slow mobility and the presence of action-elements that counter climate change.

Local user journeys - touchpoints & experiences

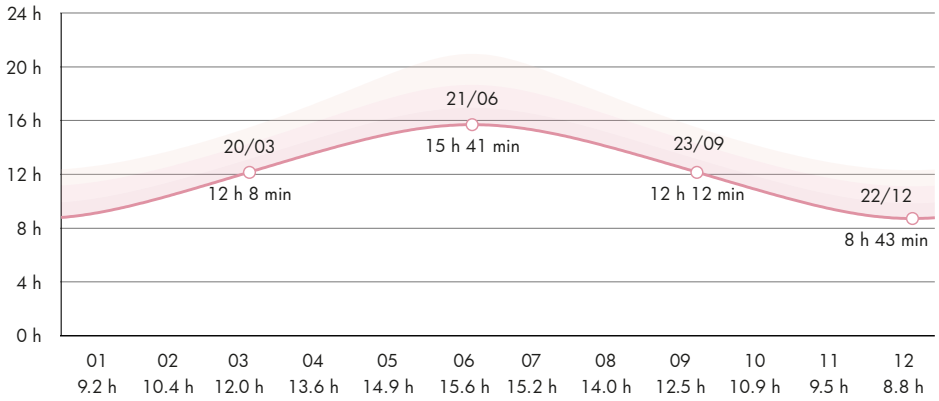


conversation, reflection
education, embodiment
connection, immersion
inspiration, engagement

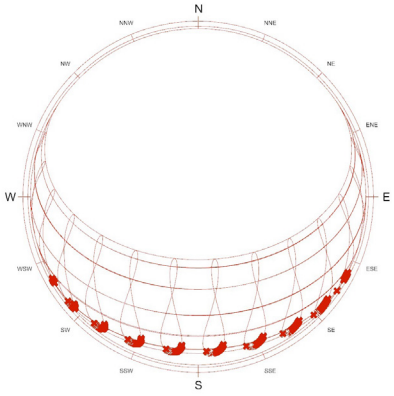
These pre-project insights were done in response to the identification of the key indicators of the project proposal, following the guidelines in the 'HOW we should act' sections.

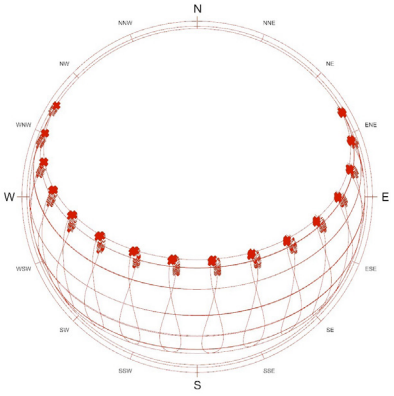
Climate analysis

Light - light hours
The length of the day in Milan changes significantly throughout the year (Weatherspark, n.d.)



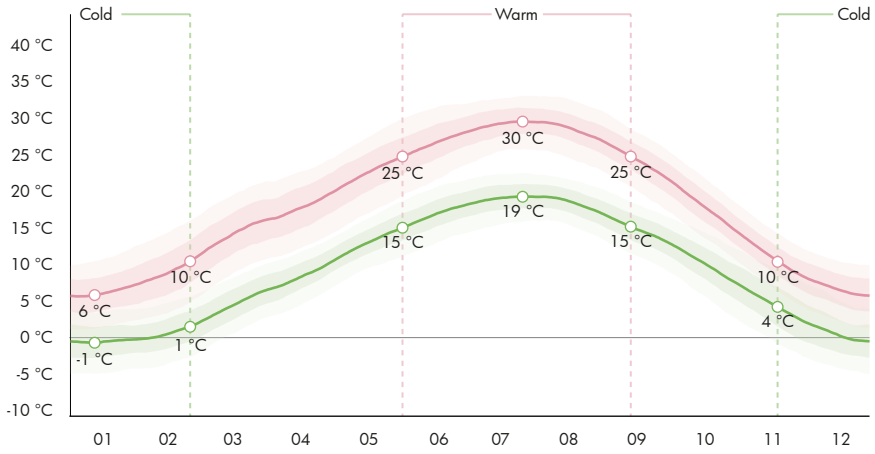
Light - sun path
Highest altitude angle: 22° in December
Lowest altitude angle: 45° in June





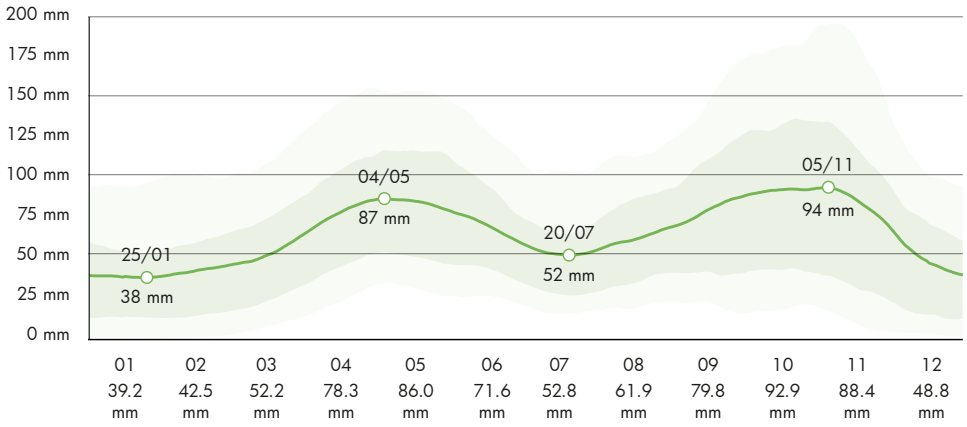
Temperatures - climate zones

USDA: 9B (-4/-1 °C)
Minimum temperature: -1°C



Water - rainwater

Potential rainwater collection & storage: 814.4 L/m^2/year
Potential rainwater collection & storage from the flyover (2'800 m^2): 2'280'320 L/year



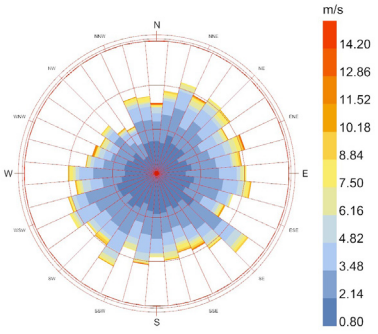
Air quality - pollution

Although the air quality in Milan is improving, it still remains highly polluted due to various factors such as traffic, heating, and agriculture (Legambiente, 2021. Plume Labs, n.d.).

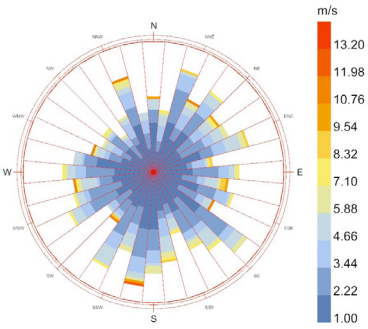
	PM 10	PM 2.5	NO2
Annual concentrations	32 µg/m^3	21 µg/m^3	39 µg/m^3
WHO limit for health	15 µg/m^3	5 µg/m^3	10 µg/m^3
Reduction needed	-52%	-76%	-74%

Wind - wind rose

The calmest time of year begins in June. The calmest day of the year in Milan is August, with an average hourly wind speed of 6.2 kilometers per hour. There is no strongly predominant wind direction



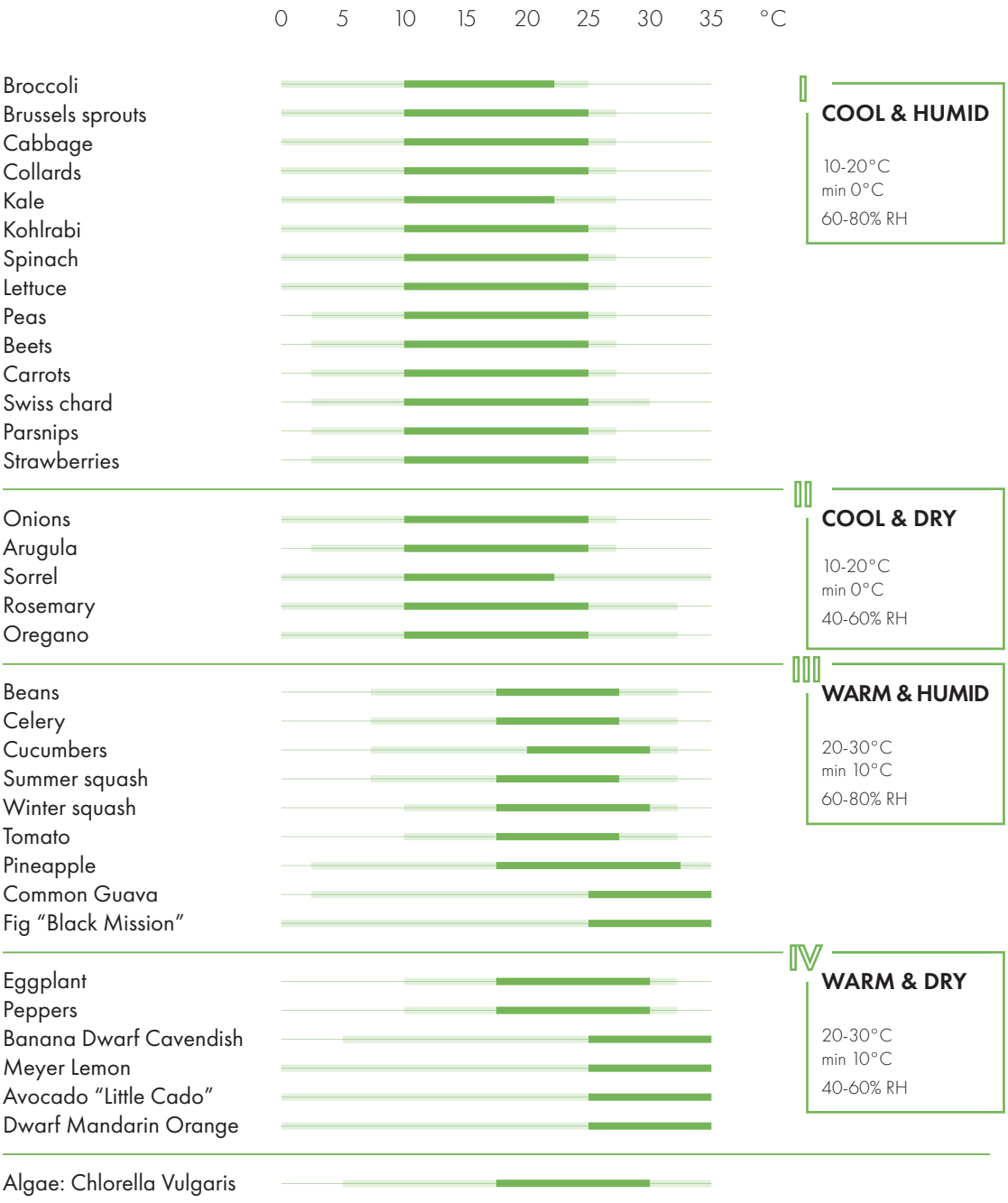
Wind Speed (m/s)
city: Milano-Linate
country: ITA
source: IGDG
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 61.24% of the time = 5365 hours.
Each closed polyline shows frequency of 1.5% = 50 hours.



Wind Speed (m/s)
city: Milano-Linate
country: ITA
source: IGDG
period: 6/1 to 9/30 between 0 and 23 @1
Calm for 61.68% of the time = 1806 hours.
Each closed polyline shows frequency of 4.5% = 50 hours.

Growing goals

Crops - temperatures - climate zones
The selection includes vegetables divided into four different micro-climates.



- Agritecture components

Selection based on Agritecture strategies

URBAN SITES + URBAN FORMS

1

SOLAR GREENHOUSE

Solar greenhouses provide increased productivity and year-round growing capabilities while minimizing energy consumption and reducing environmental impact.

INDUSTRIAL & INFRASTRUCTURE WASTELAND

+

TOP UP, REBASE.

Selection based on:

- Connectivity: 15-minutes city model
- Product density: Land use reduction
- Ideals: Net-zero energy
- Ideals: Year-round cultivation

COMMUNITIES - GROWERS + ENGAGEMENT STRATEGIES

2

PPP COMPANY: PUBLIC-PRIVATE PARTNERSHIP

These partnerships can involve fiscal advantages or the transfer of assets to the private sector, while delivering a range of public services and infrastructure projects that benefit the wider community.

FARMING ENTERPRISE, RESTAURANTS, NEIGHBORHOOD BUSINESS, MERCHANTS

+

CONVERSATION, REFLECTION

PEOPLE IN TRAINING, TEACHERS & TRAINERS

+

EDUCATION, EMBODIMENT

COMMUTERS

+

CONNECTION, IMMERSION

NEIGHBORHOOD CITIZENS

+

INSPIRATION, ENGAGEMENT

Selection based on:

- Employability & Training:training of new experts
- Healthy & Safety: education, awareness and training of the inhabitants or passers-by
- Ideals: Prevent Gentrification & Green washing

GROWING SYSTEMS + CULTIVATION SYSTEM MODULES (CSM)

3

AEROPONIC FARM

Aeroponics, a soilless method of growing plants that delivers essential nutrients and oxygen directly to plant roots using a nutrient-rich mist, offers the significant advantage of reduced water usage.

AEROPONICS

+

VERTICAL GROW RACKS; TOWER GARDENS; ROTATING TIERS UNITS

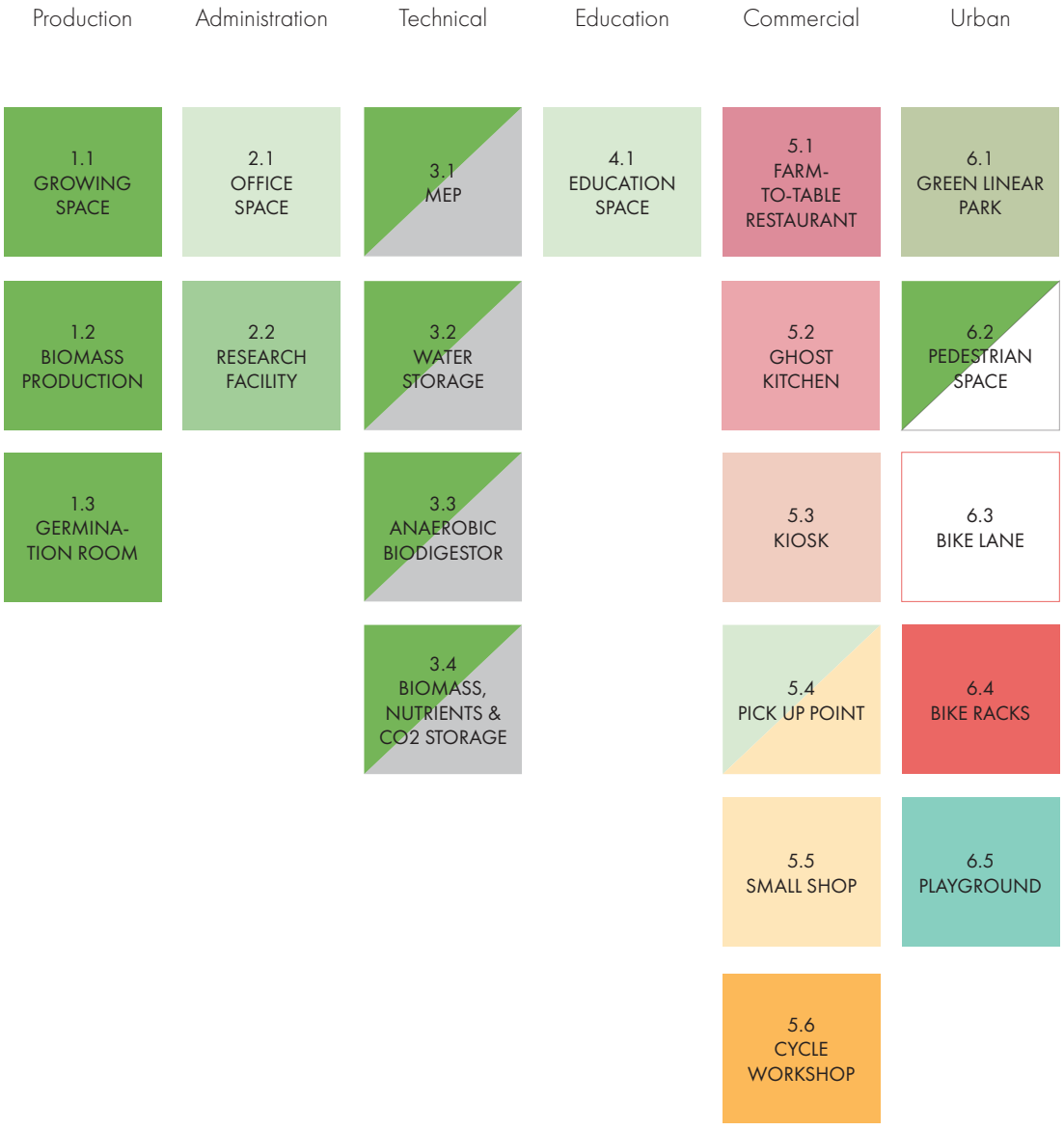
Selection based on:

- Water consumption: Rainfall shortage
- Product density: Land use reduction
- Ideals: Sustainable nutrient cycle
- Circularity: Reduce-Reuse-Recycle

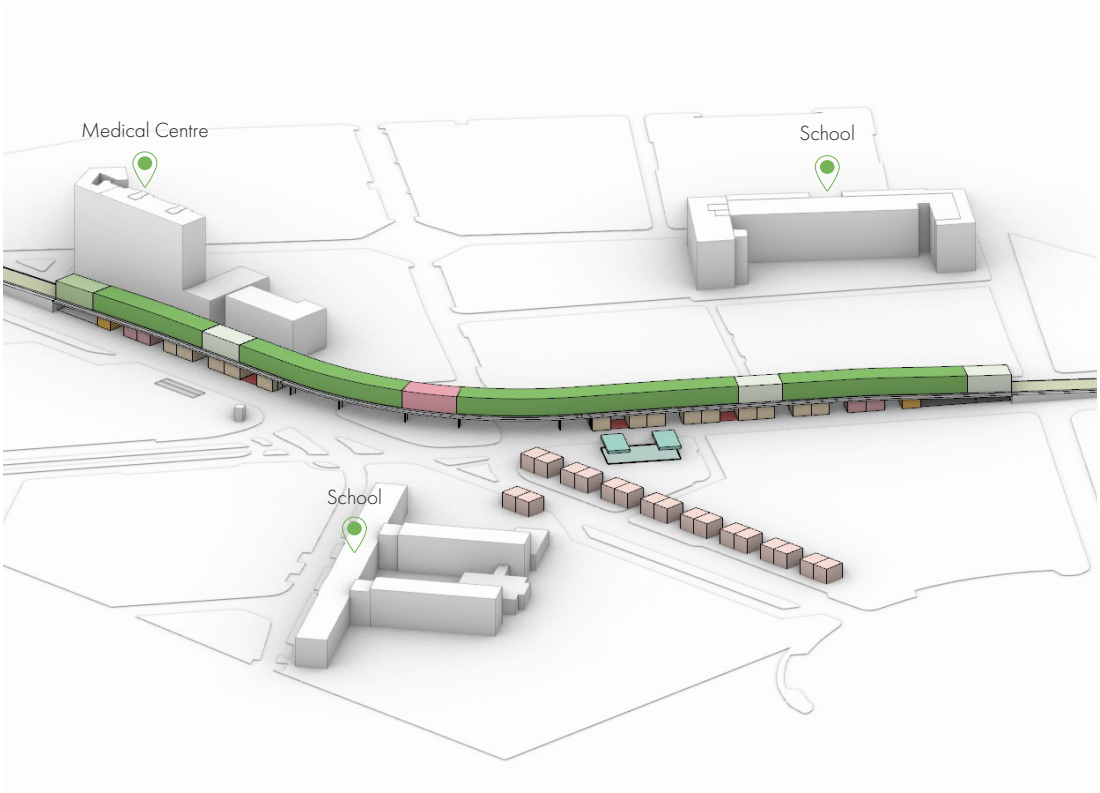
6.4 - Design

= Program & Layout

Spaces & functions - social & growing spaces

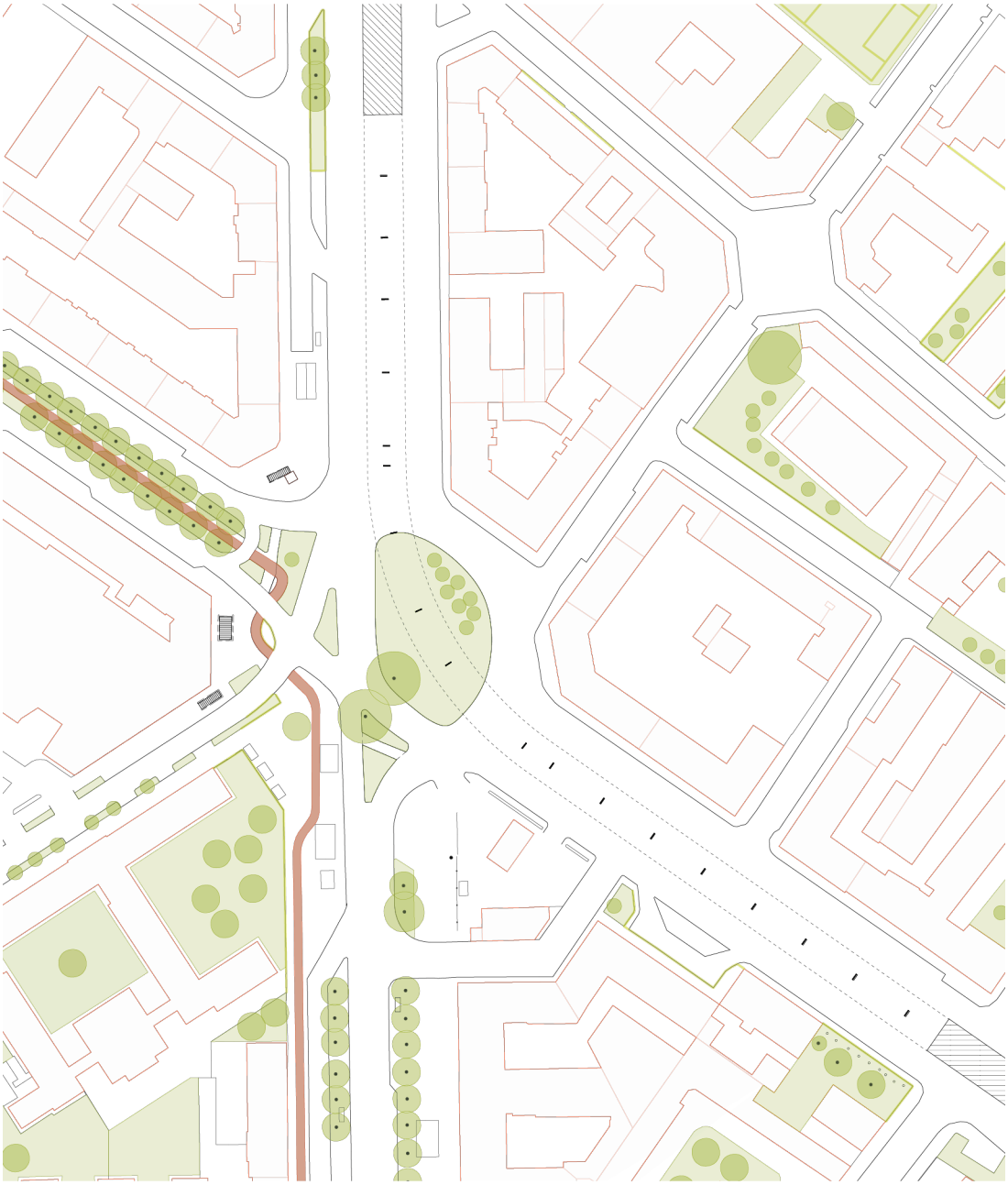


Program layout - distribution



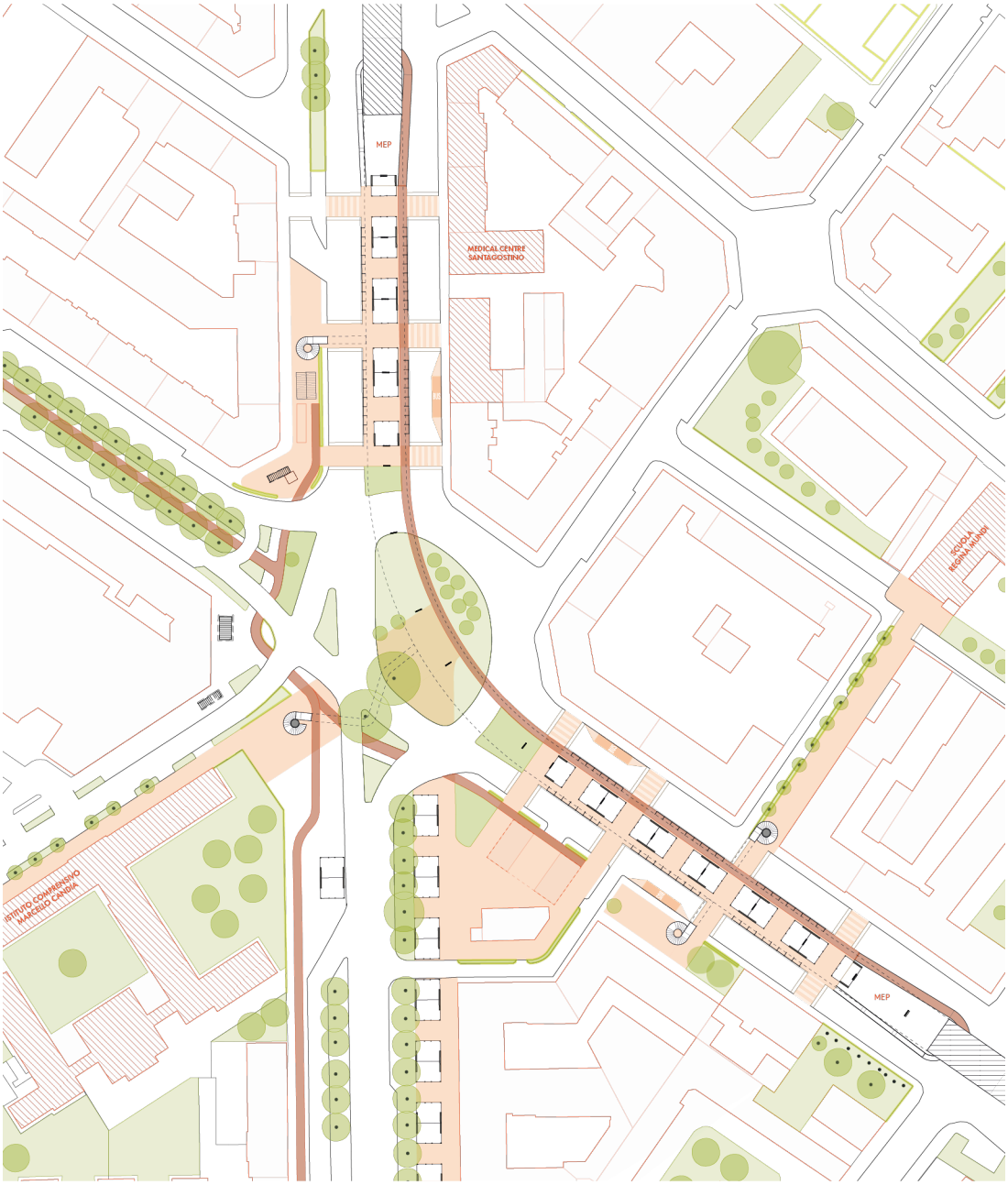
Ground floor

Original configuration



The area mainly has problems of lack of space for slow mobility, both pedestrian and bicycle. Green spaces are fragmented and there are green corridors that terminate at the site. The different urban areas are disconnected.

Proposal



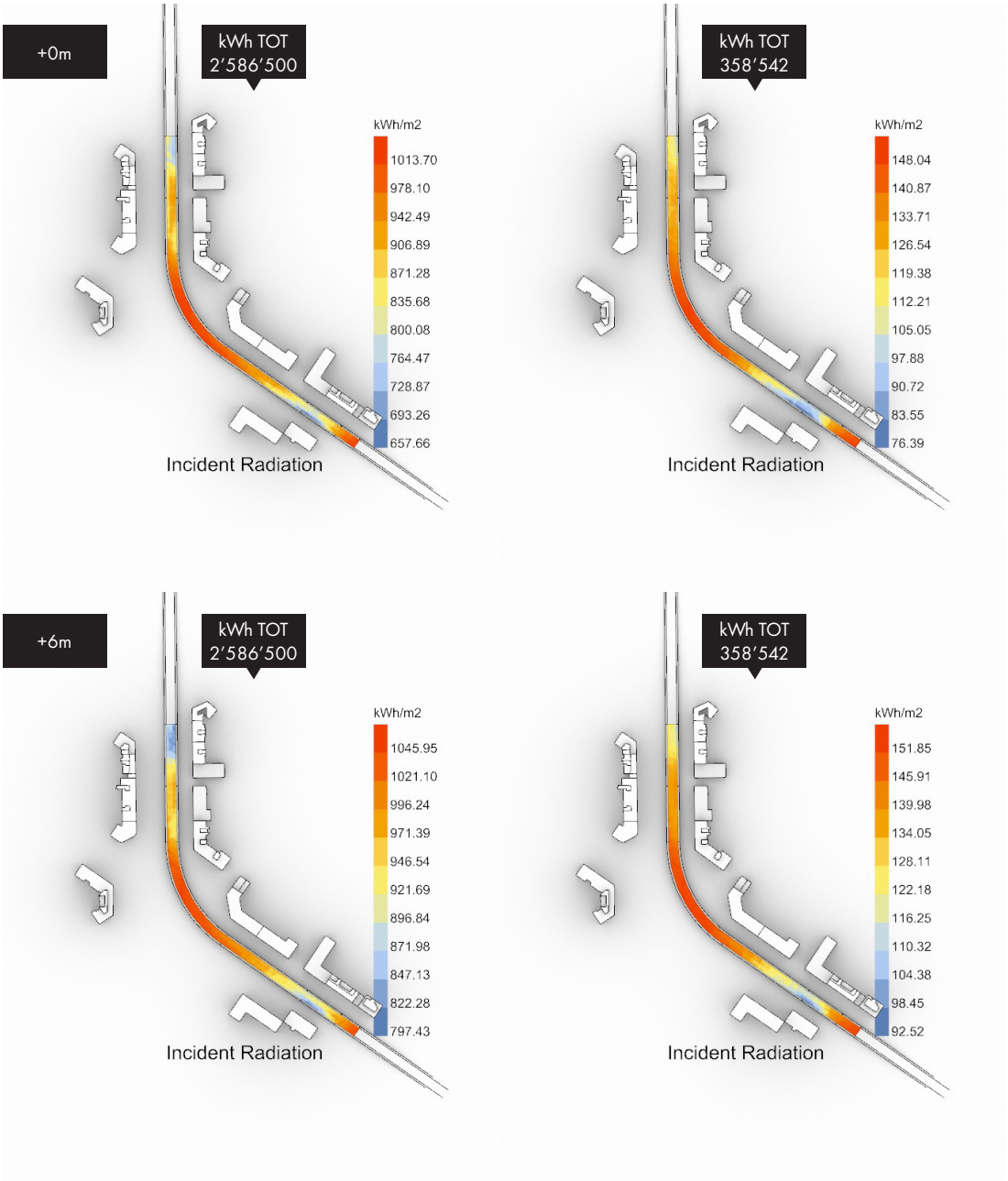
Pedestrial space
Bike path
Grass
Vegetation

N

0 10 20 40m

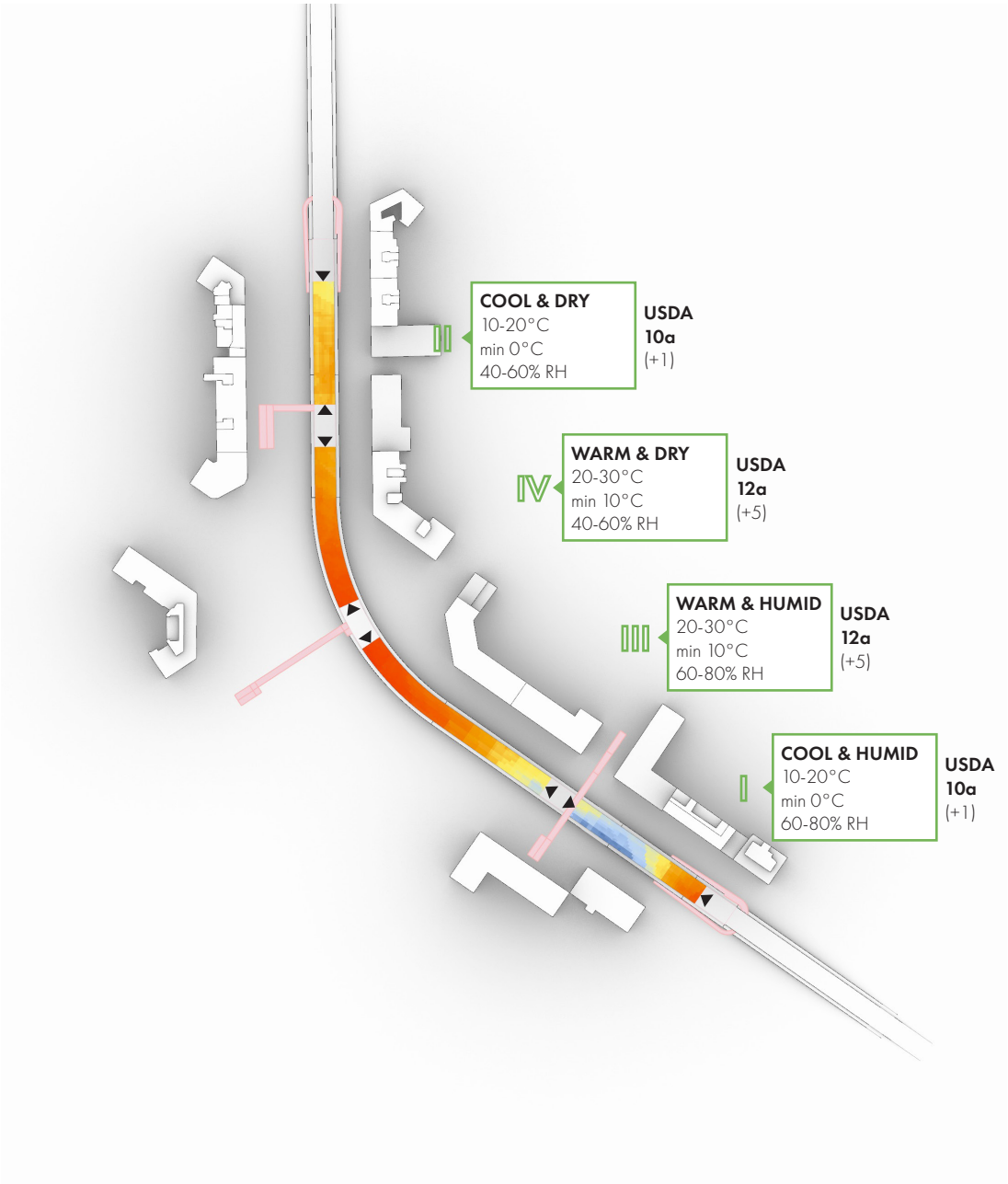
Greenhouse envelope design: solar radiation analysis

At +0 and +6m from the base - Year and Winter period



Climate zones

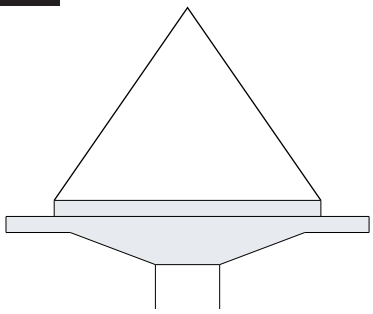
Micro-climates



Volumetric studies

Solar radiation analysis of climate zones - Studies of different solar greenhouse sections during Winter

1 A-Frame



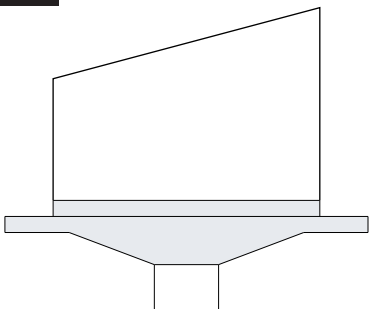
- **Strengths**

Cost-effective build

- **Weaknesses**

Much wasted space due to low heights at the sides. Can generate a too high central space

2 Shed



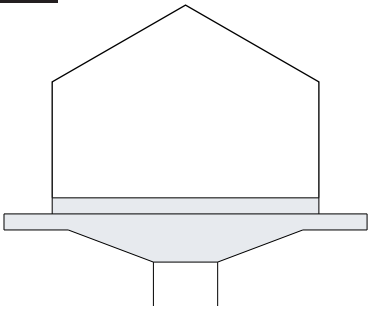
- **Strengths**

Simple and cheap design with two glazing areas: the roof and south wall

- **Weaknesses**

The glass/opaque surfaces ratio can be too high

3 Cable



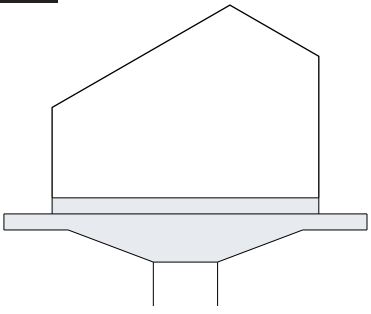
- **Strengths**

Simple design with moderate cost. It can be easely divided in two spaces and accomodate another use in the north side

- **Weaknesses**

With half of the roof glazed part of the space can be shaded

4 Salt Box 1



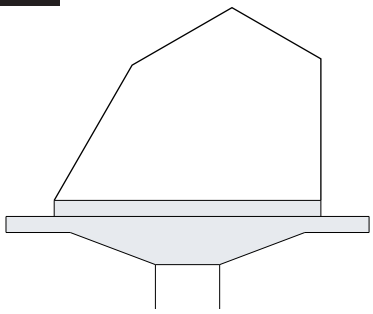
- **Strengths**

Great glass/opaque surfaces ratio. It can be easely divided in two spaces and accomodate another use in the north side

- **Weaknesses**

Moderately complex structure

5 Salt Box 2



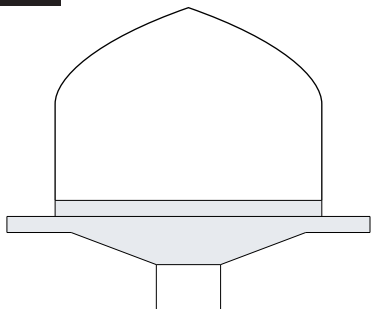
- **Strengths**

The angle of the southern facade increases light penetration during winter

- **Weaknesses**

Complex structure, too many angles to be supported

6 Gothic



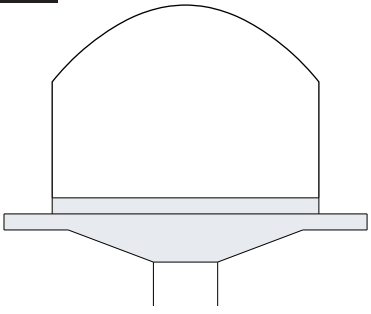
- **Strengths**

Moderate cost structure. Easy to install roof openings for natural ventilation

- **Weaknesses**

Glazed surface is too high. Particular shape to be related to the local urban fabric

7 Arched 1



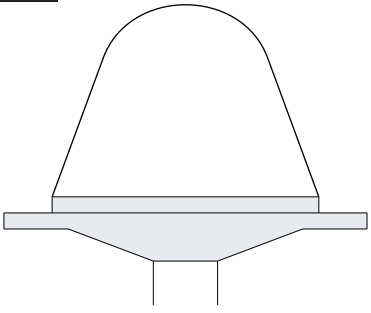
- **Strengths**

Low cost structure

- **Weaknesses**

Glazed surface is too high. It doesn't allow to divide the internal space for other functions

8 Arched 2

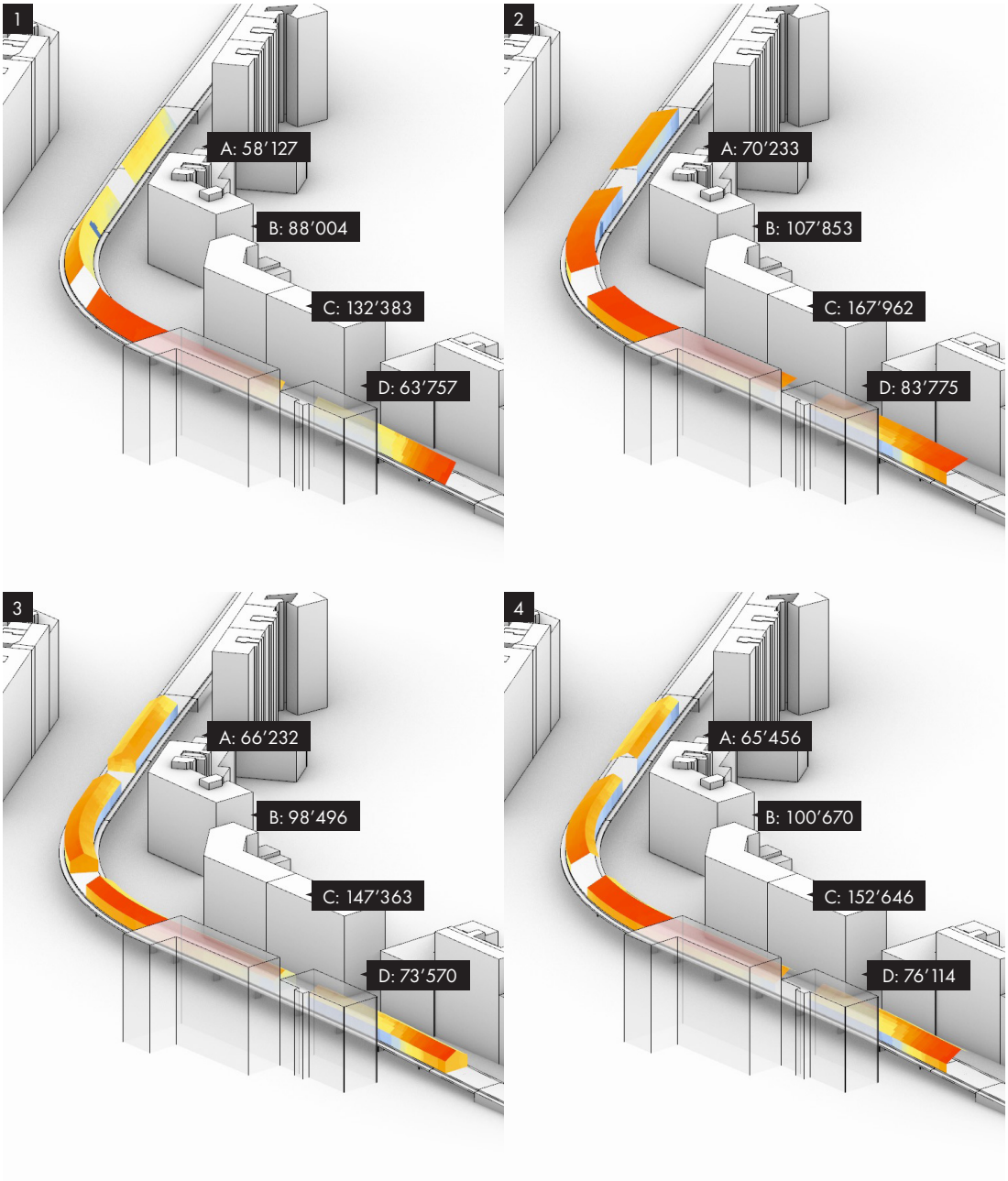


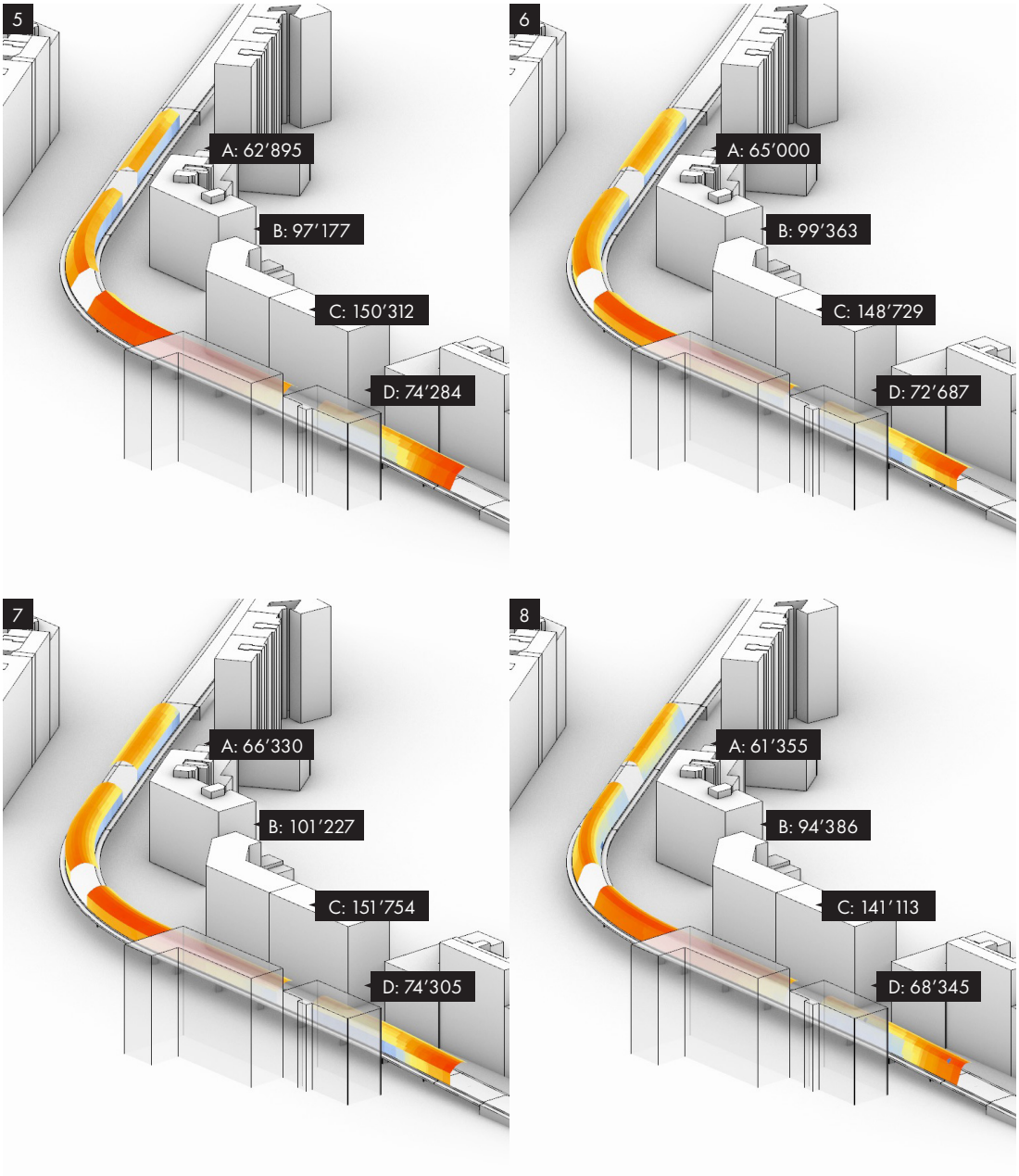
- **Strengths**

Shape that promotes drainage by rainwater collection at the base of the facade

- **Weaknesses**

Glazed surface is too high. Sloping walls may require too complex a structure


1
A: 58’127
B: 88’004
C: 132’383
D: 63’757
2
A: 70’233
B: 107’853
C: 167’962
D: 83’775
3
A: 66’232
B: 98’496
C: 147’363
D: 73’570
4
A: 65’456
B: 100’670
C: 152’646
D: 76’114



Although Section 2 - Shed has higher values from direct irradiation it also presents the section with the most surface area at low irradiation, which should be insulated to limit its dispersion. Also evaluating the design aspects, Section 4 - Salt Box 1 presents an interesting option to be explored further.

Design choice

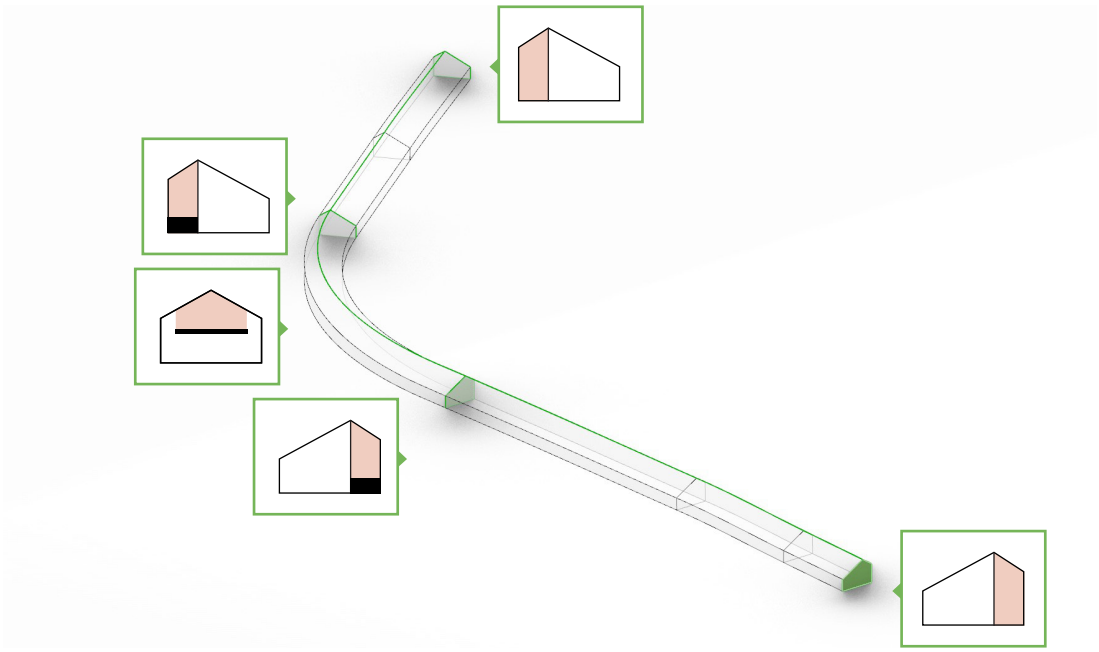
Validation of a design strategy

VOLUMETRIC STUDIES

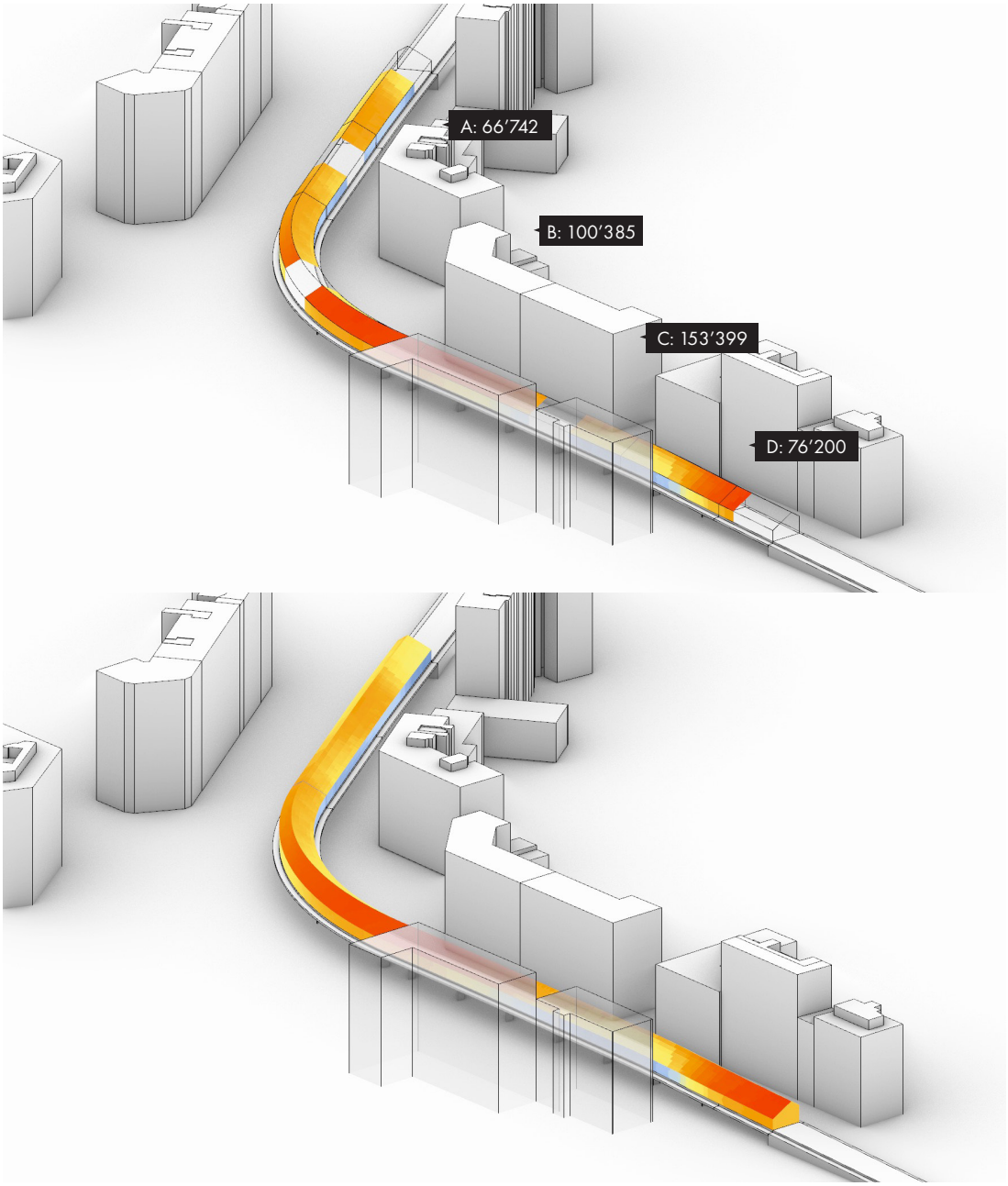
4

SALT BOX 1

Although the shed section has better performance, the salt box 1 section was chosen because of the design possibilities. The side band allows the distinction-presence of the linear public pathway to be created and made evident.
Further testing was done on this section, assuming mirroring it along the North Wing.
Thermal performance improves as does the presence of the greenhouse, which takes on a more dynamic design.



public space



The reflection of the north wing section further improves the thermal performance of the solar greenhouse. Likewise, the thermal gain is more evenly distributed along the greenhouse.

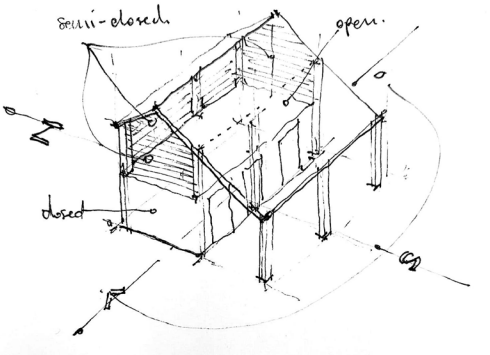
Design identity

Cascina 2.0: reinterpreting the rural architecture of Lombardy

CASCINA 2.0

4

In the 'Parco agricolo sud', in the immediate vicinity, there are several historic farmhouses, known as "cascine", that have been reinterpreted to meet the needs of a new paradigm of agricultural production and public conviviality: multi-functional spaces that combine vertical production activities, educational programs and cultural events. The typology and morphology of these farmhouses have been reimagined to create a more sustainable and inclusive model of agricultural production, one that integrates with the urban fabric and promotes a stronger connection between people and nature.

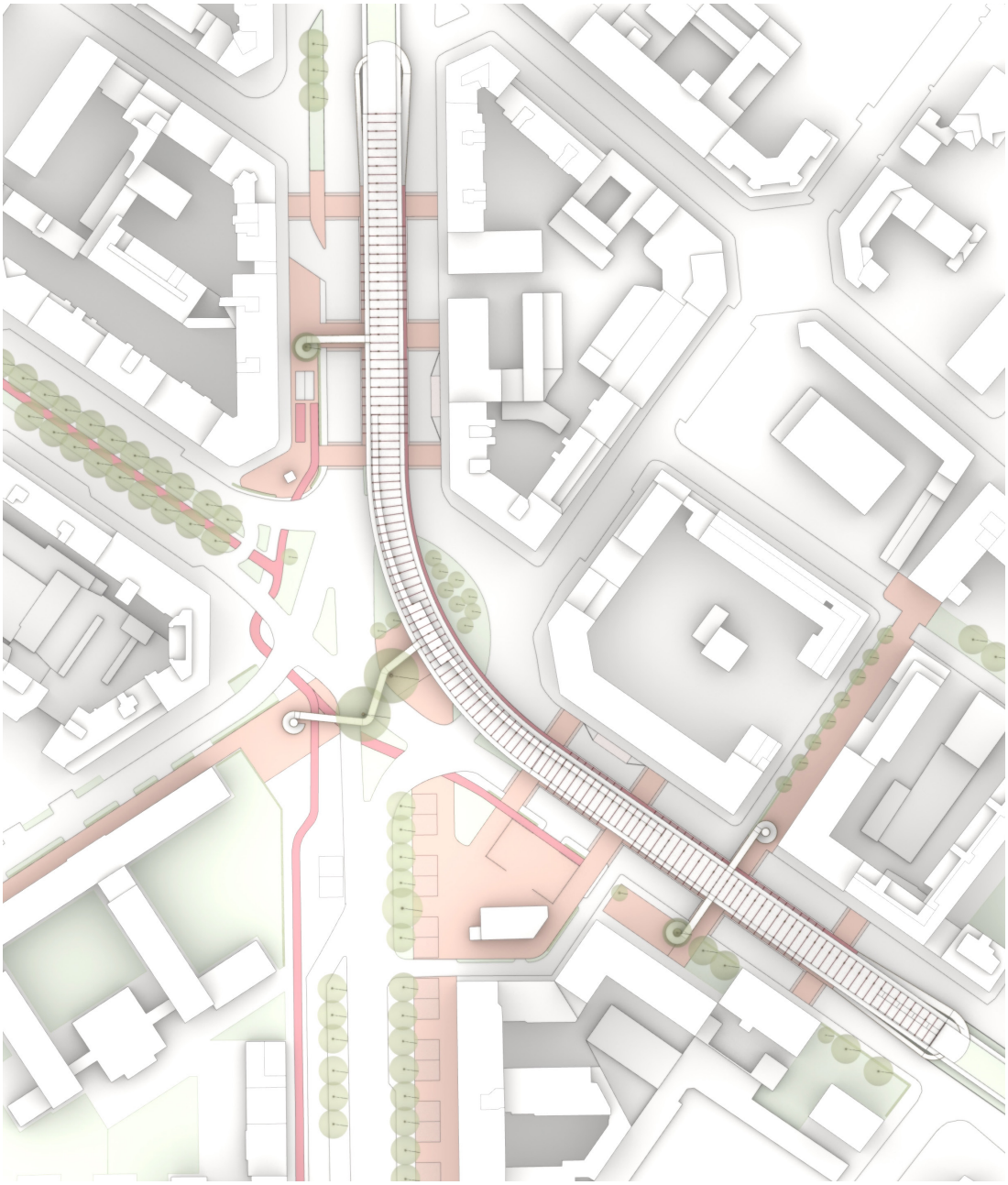


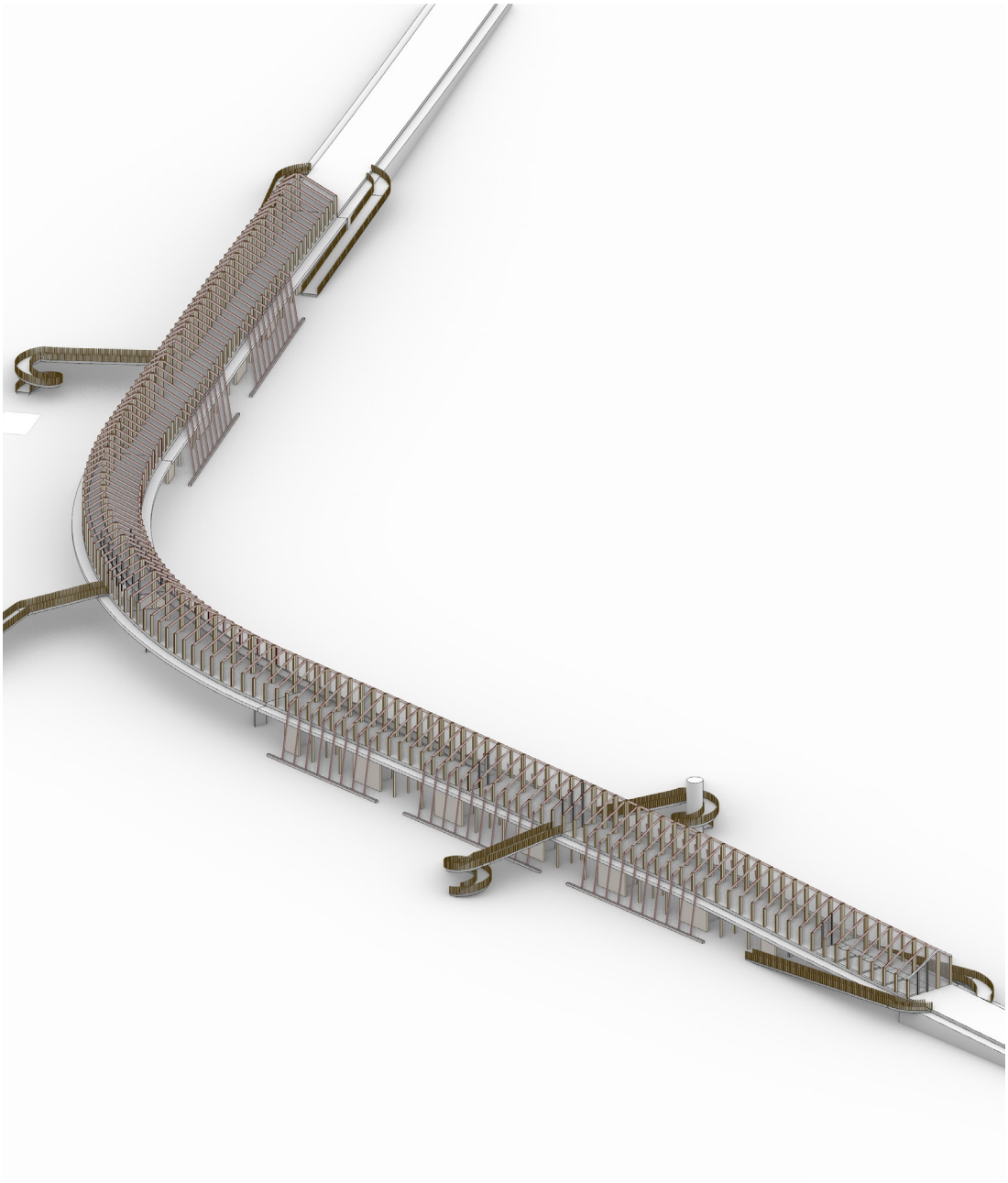
← Reconstruction of the view of the current 'Corso Lodi' in 1900 (Arsuffi, 2021).
→ Current state

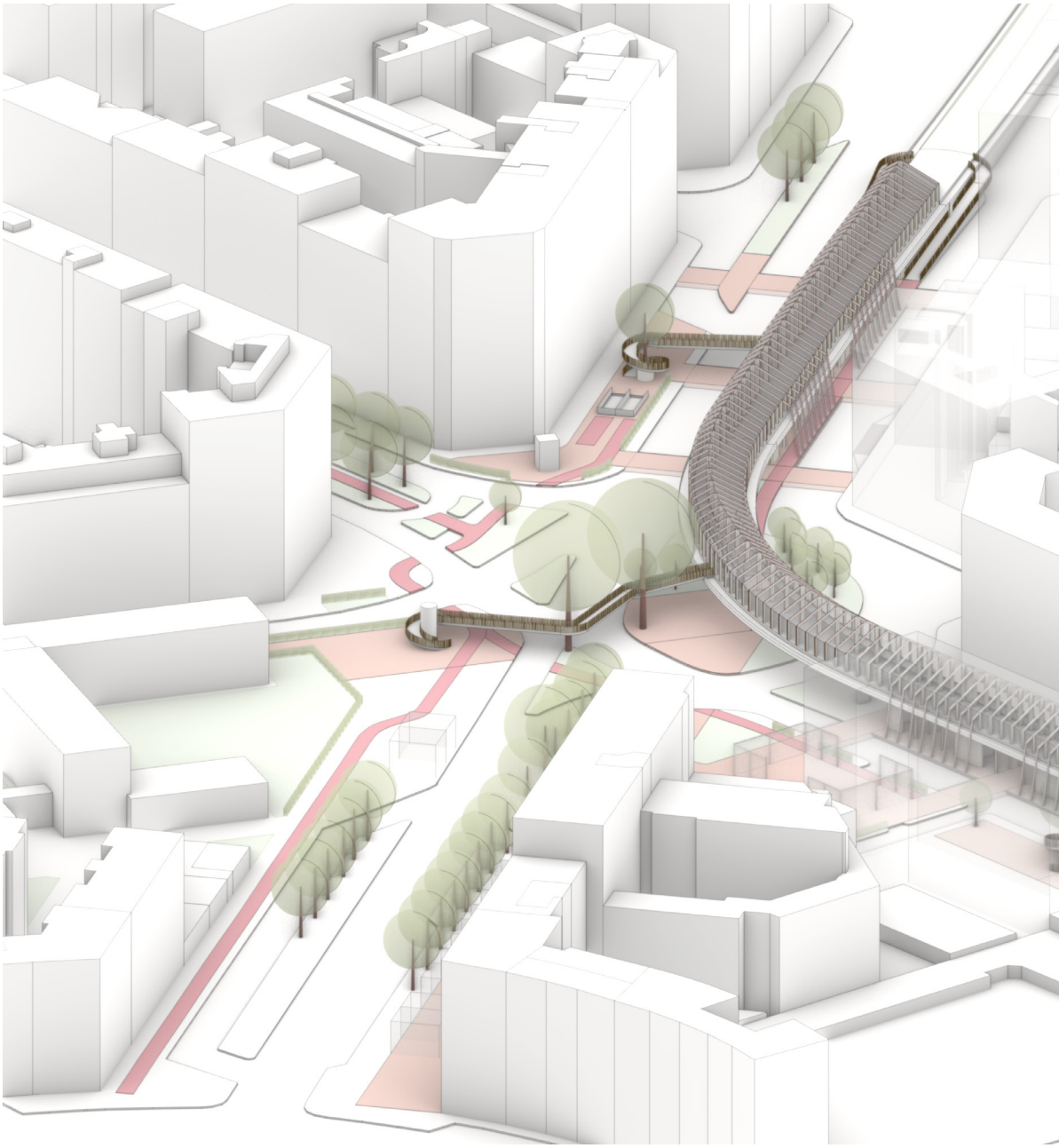
↑ Cascina Nosedo. Home to the 'Openagri', a hub of excellence hosting start-ups in the agribusiness sector
↓ The 'aja' of the Gambaloita or Gamboloita farmstead in about 1890

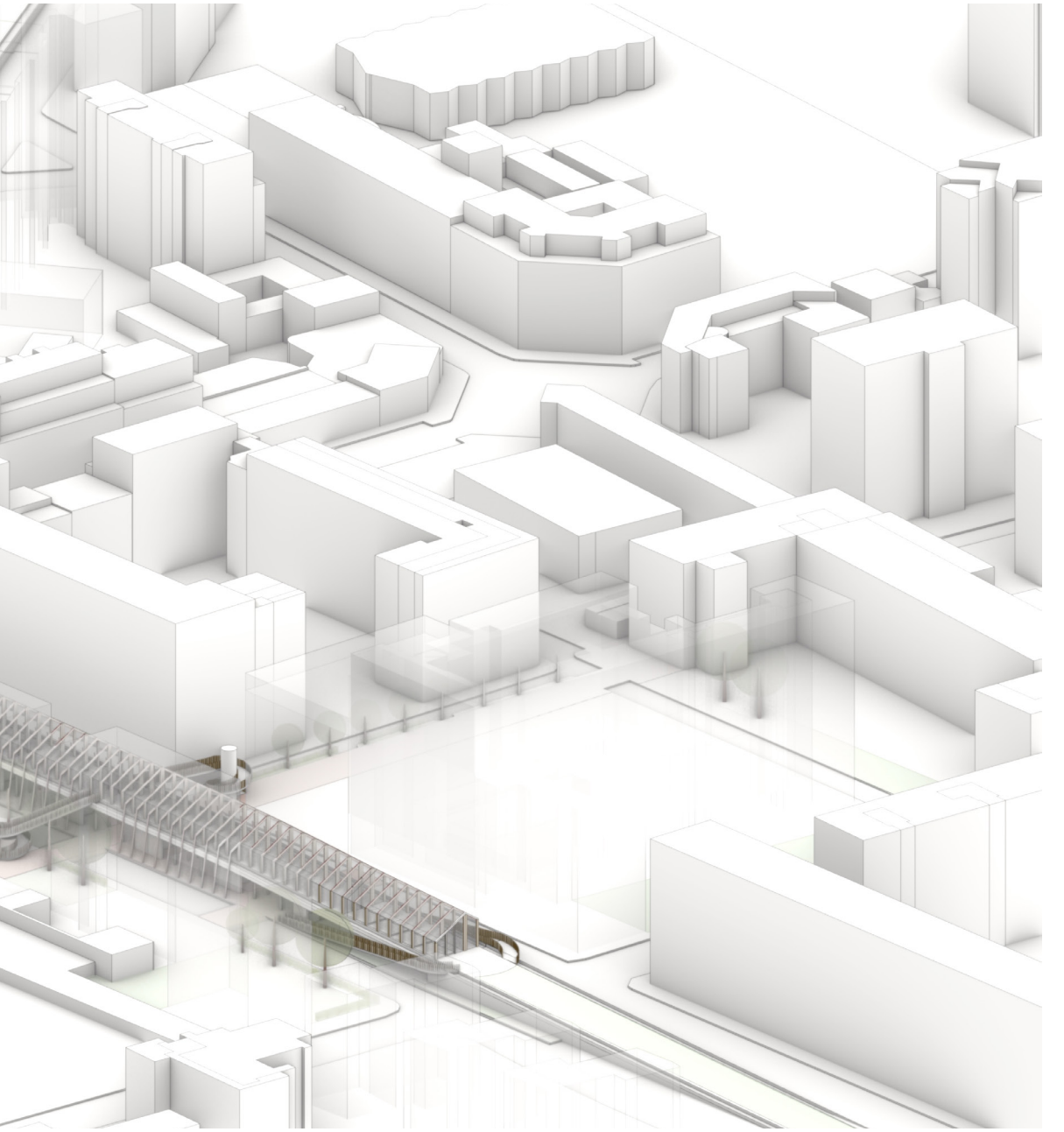
Structure

3D model









Exterior spaces

View of viale Lucania from the central pedestrian bridge

View of viale Lucania

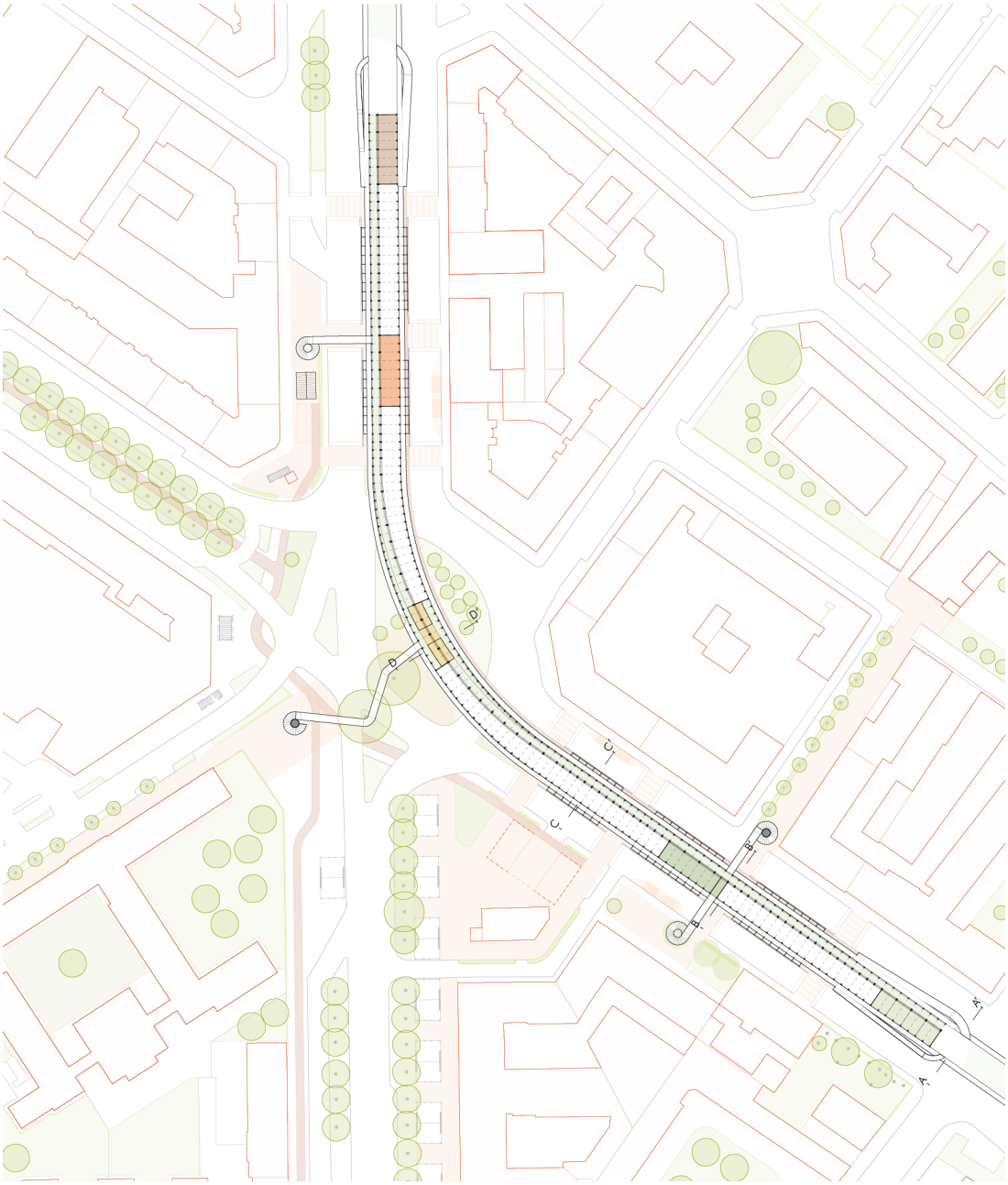
View of via Carlo Marochetti


SCHOOL BUS

View of via Carlo Marochetti from the central pedestrian bridge

Floor plan

Proposal



Section A-A′

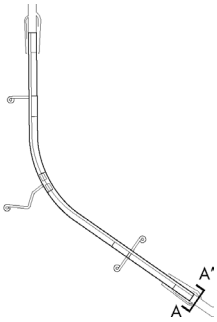
Section B-B′

Section C-C′

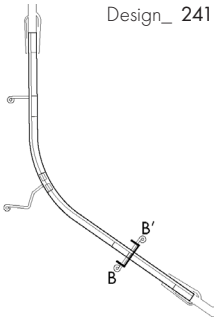
Section D-D′

Interior spaces

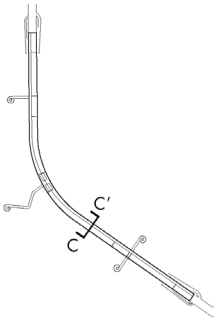
A journay in the farm - Section A-A′: Access from linear park



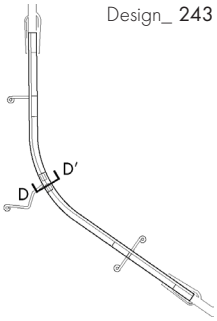
A journay in the farm - Section B-B′: Education space



A journay in the farm - Section C-C′: Growing space



A journay in the farm - Section D-D′: Farm-to-table



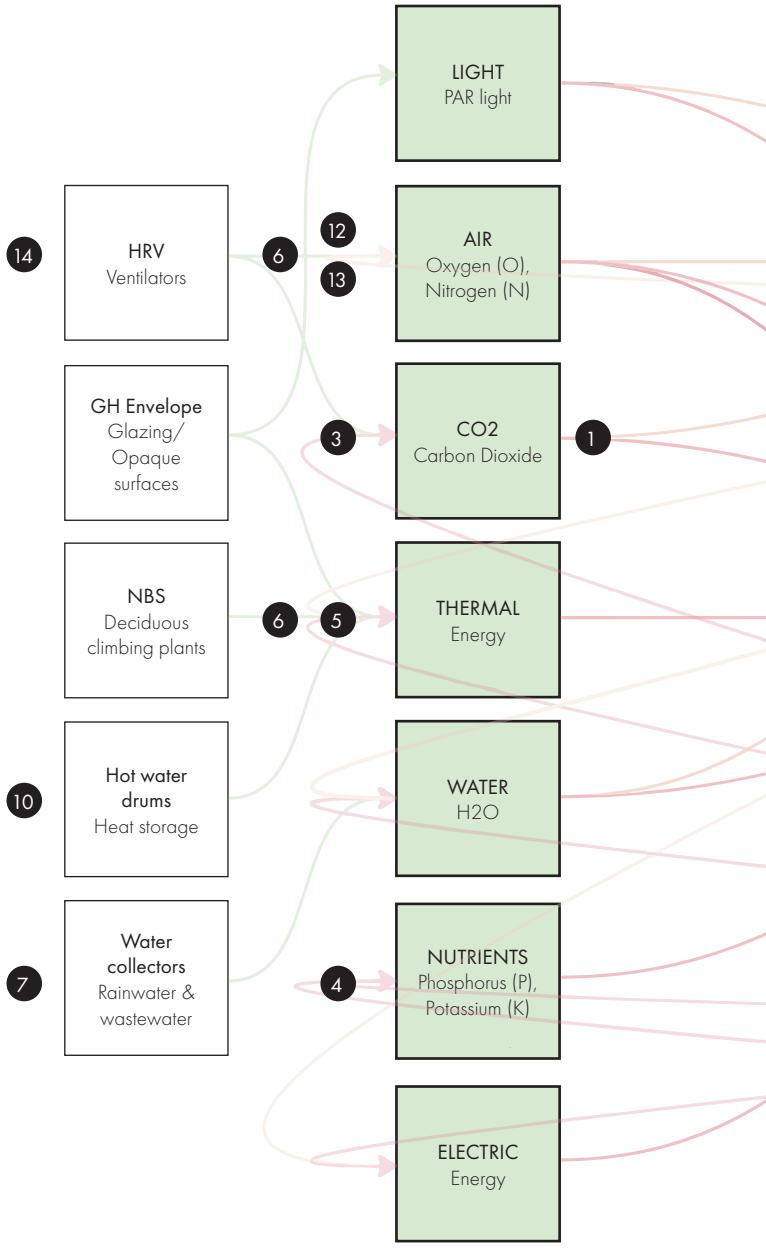
6.5 - Impact

- Input - Output analysis

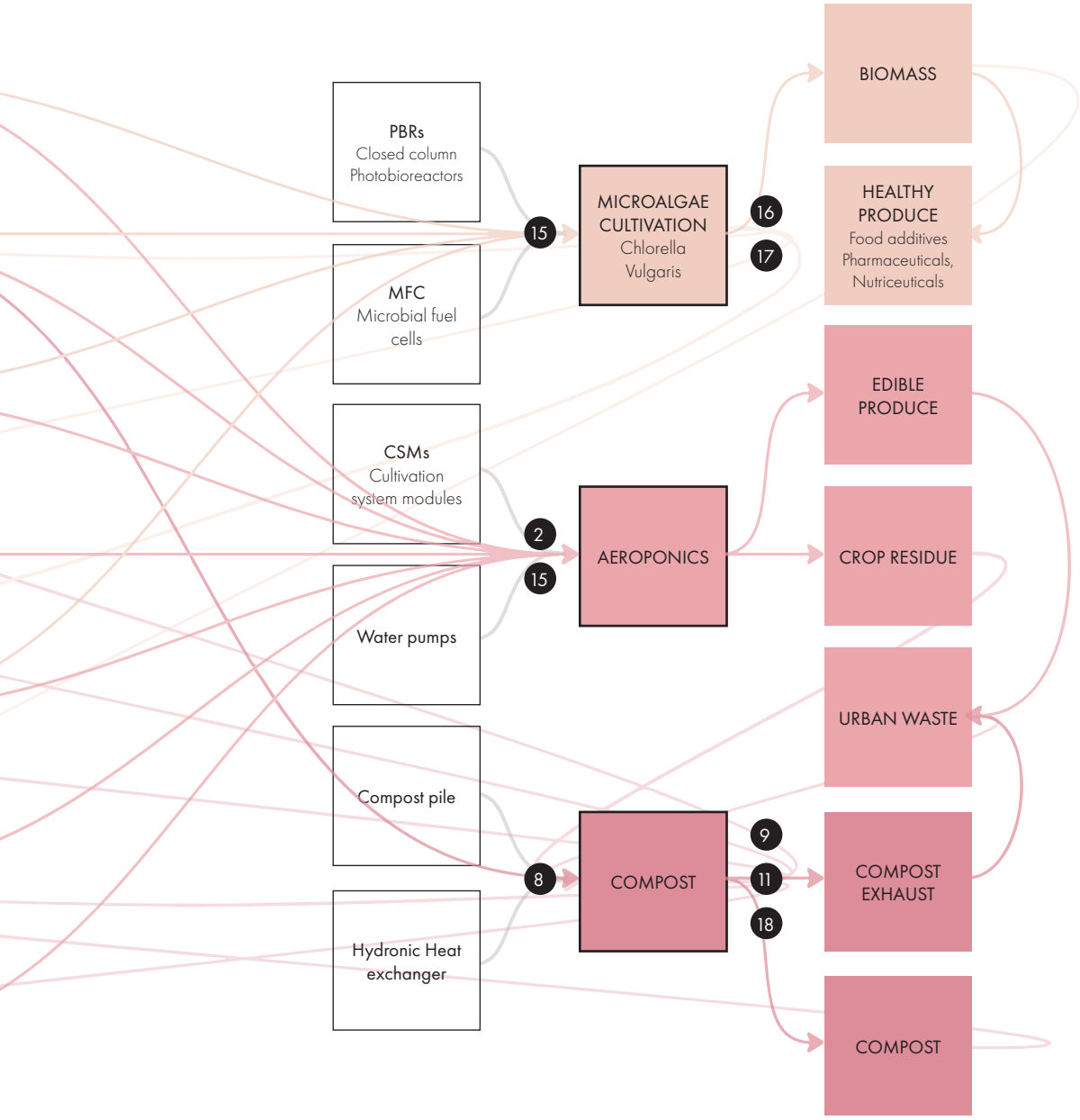
Requirements, components, production systems and related processes

- **Processes**

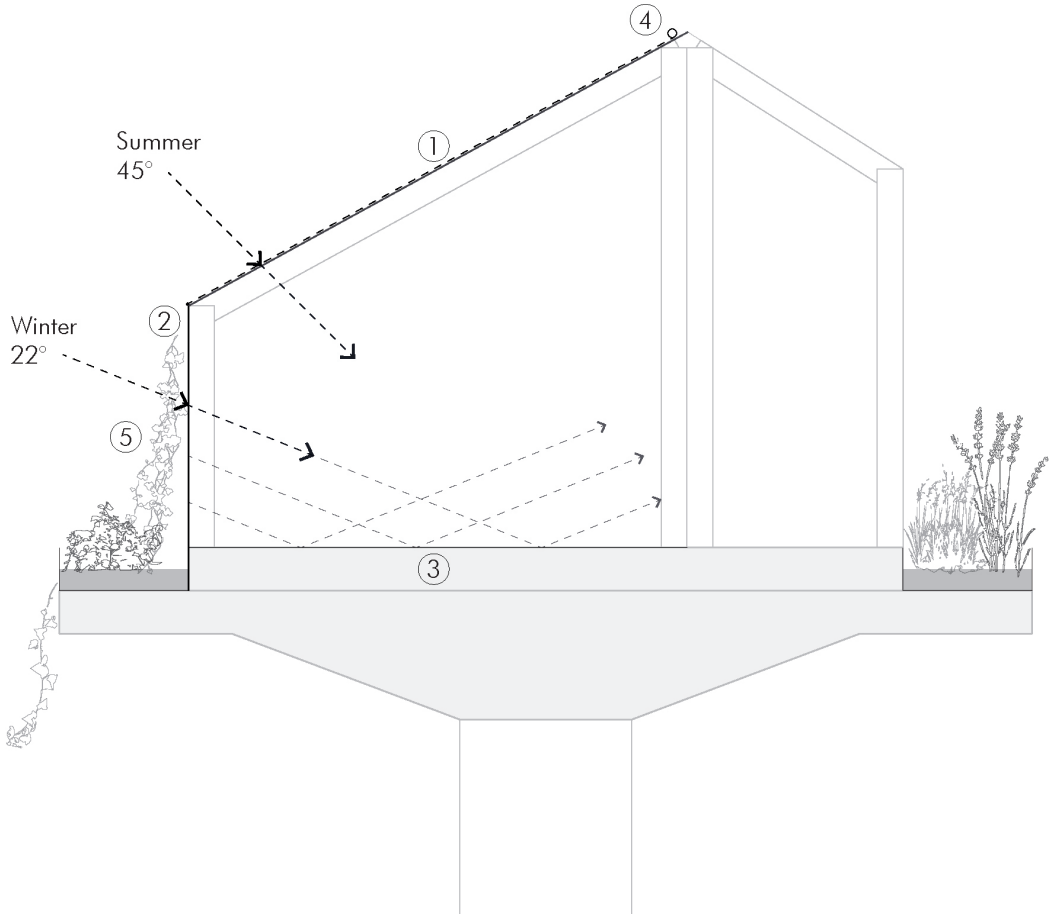
1. Carbon Dioxide (CO2) enrichment;
2. Vertical farming;
3. Exhaust treatment;
4. Nutrient extraction & extract treatment;
5. Heating;
6. Cooling;
7. Water collection & storage;
8. Composting;
9. Thermal energy extraction;
10. Thermal energy storage;
11. Resource recovery;
12. Air filtration;
13. Humidity reduction;
14. Carbon Dioxide (CO2) sequestration;
15. Carbon Dioxide (CO2) fixation;
16. Waste water treatment & purification;
17. Oxigen generation;
18. Bioenergy production.



Input-output flow system realized according to scientific references (1, 2,3)


PBRs
Closed column
Photobioreactors
MFC
Microbial fuel
cells
CSMs
Cultivation
system modules
Water pumps
Compost pile
Hydronic Heat
exchanger
15
MICROALGAE
CULTIVATION
Chlorella
Vulgaris
16
17
2
15
AEROPONICS
8
COMPOST
9
11
18
BIOMASS
HEALTHY
PRODUCE
Food additives
Pharmaceuticals,
Nutriceuticals
EDIBLE
PRODUCE
CROP RESIDUE
URBAN WASTE
COMPOST
EXHAUST
COMPOST

Glazing



- **GH Envelope**

1. Glazing surface: Double-layer diffuse ETFE
2. Glazing surface: Double-layer clear ETFE
3. Opaque surface: White paint lo reflect light
4. Opaque surface: 25% Shade cloth in woven polyethylene

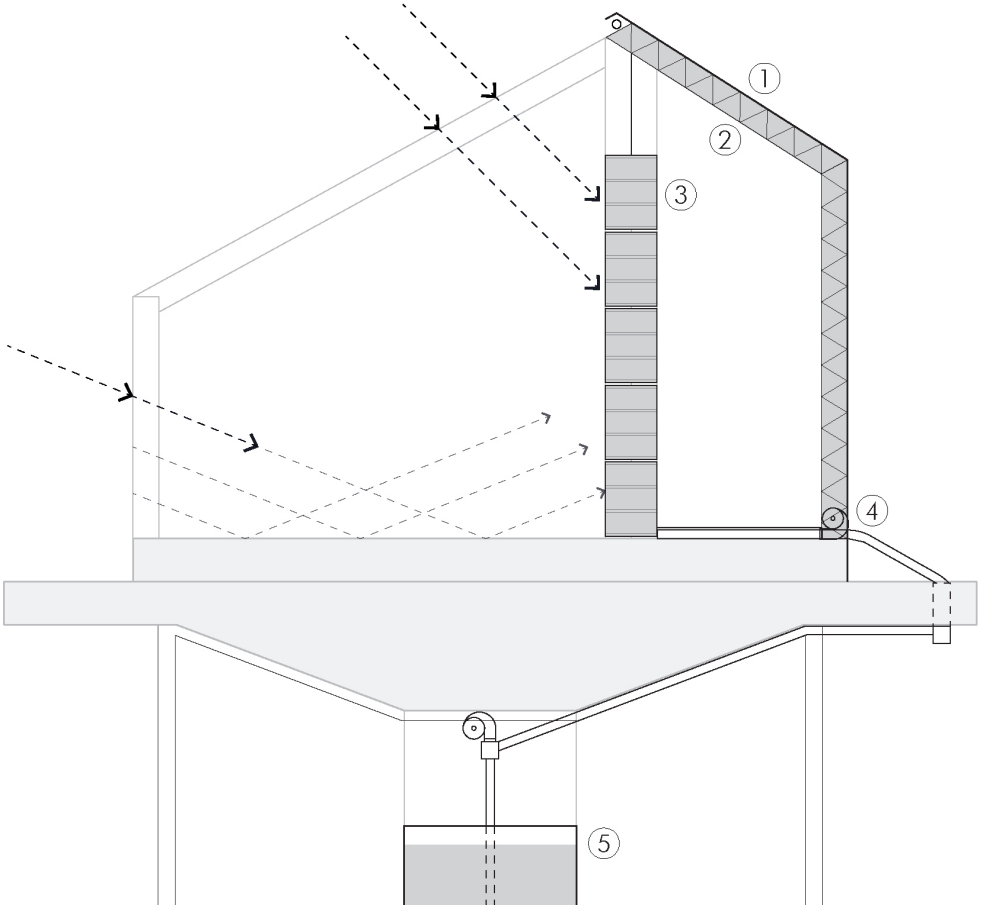
- **NBS**

5. Deciduous climbing plant

ETFE:
Transmittance: 89%
Insulation: R 1.85, U 0.55
Over time: No modification
UV transmission
Self-cleaning
Light-weight

High light transmittance material on the vertical wall to absorb more light during winter. One with increased light diffusion on the roof to ensure even brightness for plants. A shade cloth to reduce heat gain during summer.

Insulation



- **GH Envelope** Glazing/Opaque surfaces

1. Opaque surface: Waterproof cladding
2. Opaque surface: Rigid foam board - Polyiso

- **Hot water drums**

3. Heat storage: 200L water drum.

- **Compost pile + Hydronic Heat exchanger**

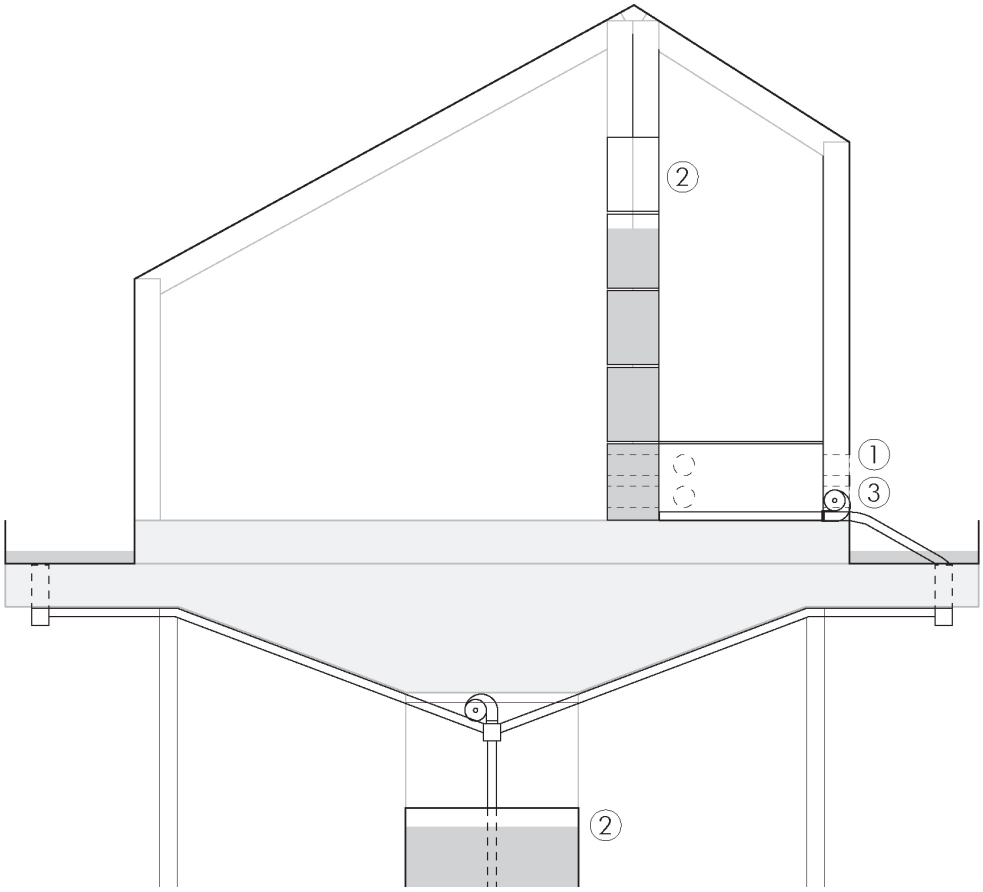
4. Water pump + Insulated PEX tubing
5. Compost pile + Hydronic heat exchanger

Polyiso:
Insulation: R 12, U 0.08
High moisture resistance
Excellent insulation-price ratio
White reflective foil backing
Water resistant

Water drum:
62 Btu/ft³/F
Ø 0.6 m. H 0.9 m

High insulation in surfaces not exposed to direct light in addition to heat storage and release systems to make the building passive and to counteract the high indoor airflow that cools the growing rooms.

MEP



- **HRV**

1. Heat recovery ventilator

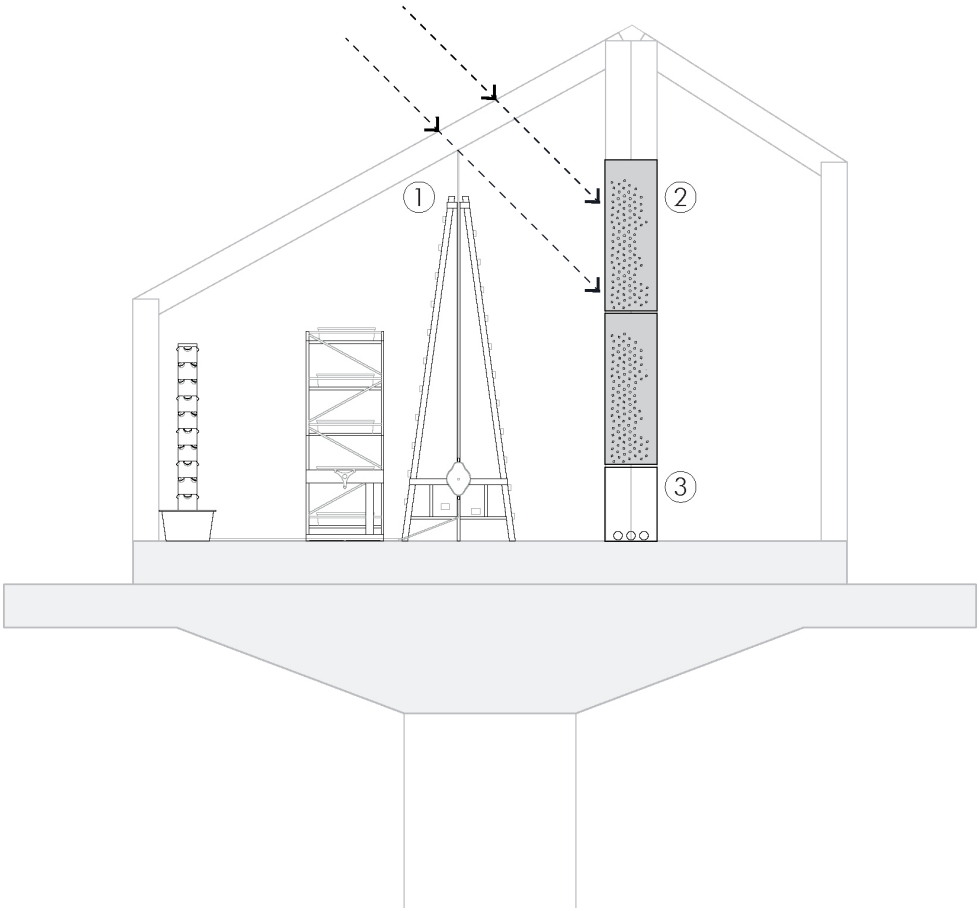
- **Water collectors**

2. Rainwater & wastewater collector
3. Rainwater & wastewater pumps

HRV:
Airflow: 1vol/min = 93m^3/min/span
Consumption: 23,5 kWh/day/span
Heat recovery: 75 %
Cooling: 0 m^3/min/span
Air filtration + CO2 enrichment + Humidity reduction

To ensure optimal ventilation, as well as carbon injection, of the growing environment of 1 vol/min there are HRVs that recover part of the internal heat and filter out particulate matter and other pollutants from outside.

Growing space



- **CSMs**

1. Cultivation system module

- **PBRs**

2. Closed column Photobioreactor

- **MFC**

3. Microbial fuel cell

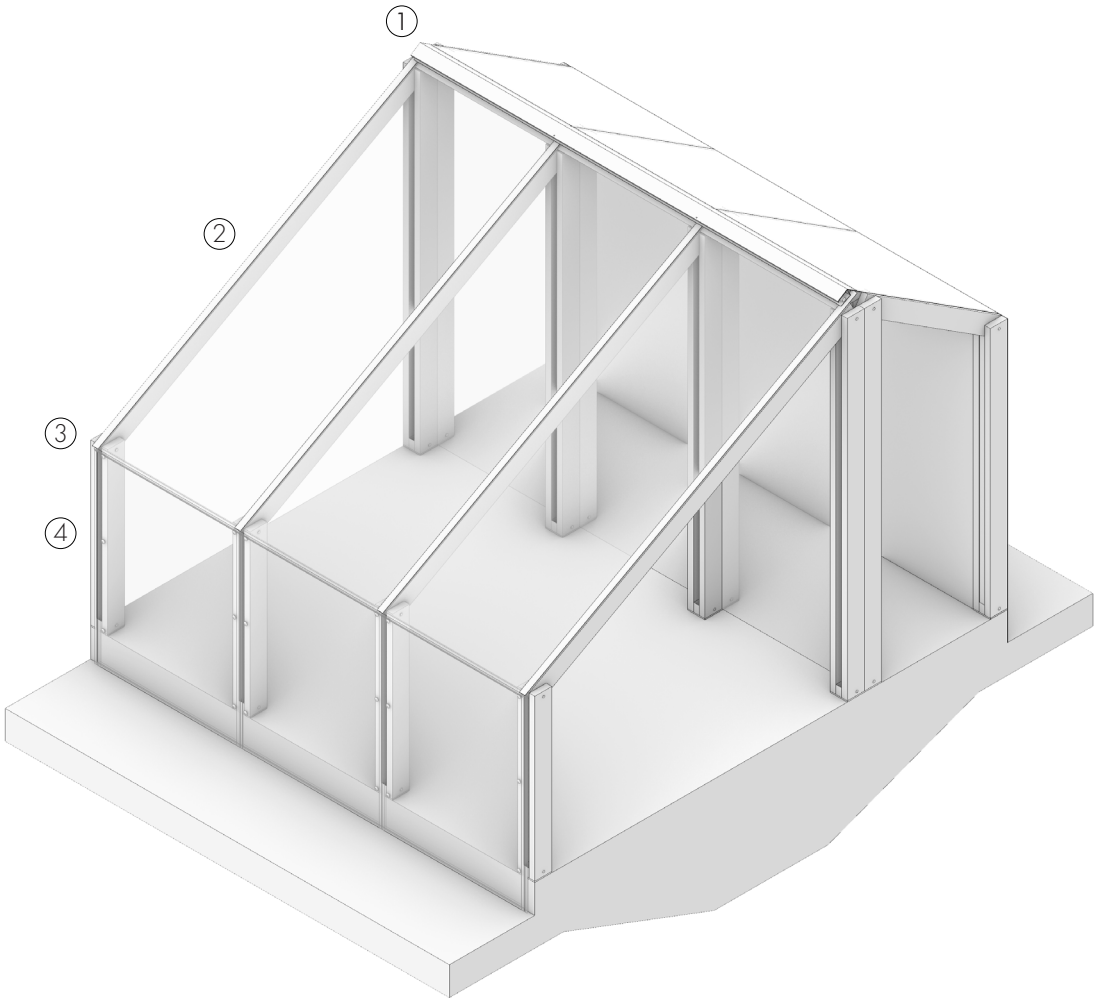
CSMs:
Plants: 500/span
Yield: 4,76 Kg/day/span
Water: 50 L/day/span
Energy: 4,32 kWh/day/span

MFC
0,15 kW/h/m^2
36 kWh/day/span

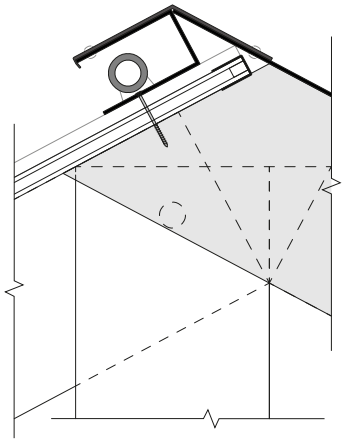
Rain and waste water is collected and treated through the PBRs for use in the CSMs. At the same time, the biomass of photobioreactors reacts in the microbial fuel cells generating the energy needed by the greenhouse.

Details

Glazing-structure connections

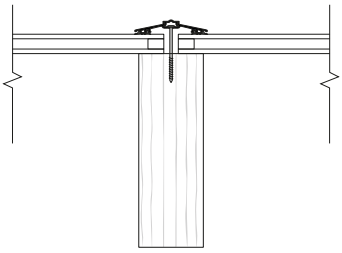


1 Ridge



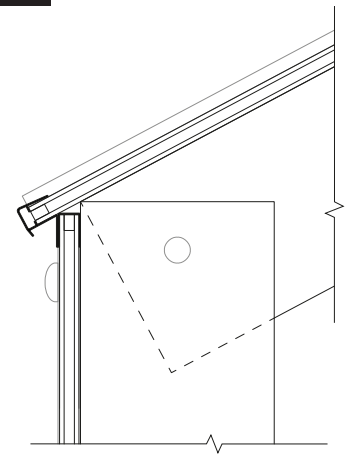
Aluminum flashing profile +
U-channel polycarbonate profile.

2 Rafters



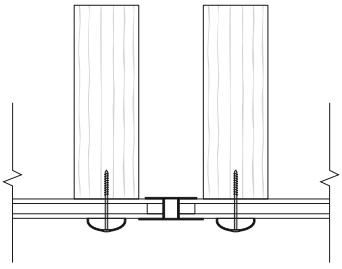
Concealed fix roofing bars.
Aluminium profile. L100, H20 mm

3 Eave line



Drip edging polycarbonate profile +
U-channel polycarbonate profile.

4 Columns



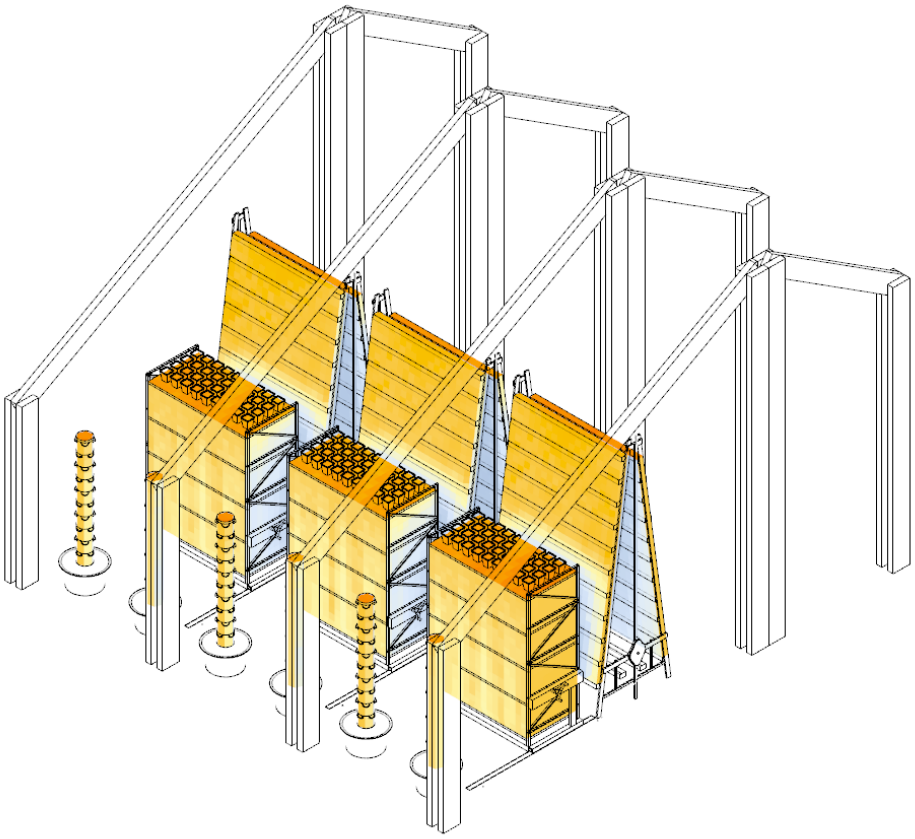
Plastic roofing fasteners-screws +
H-channel polycarbonate profile.

0 5 10 20cm

Crop distribution

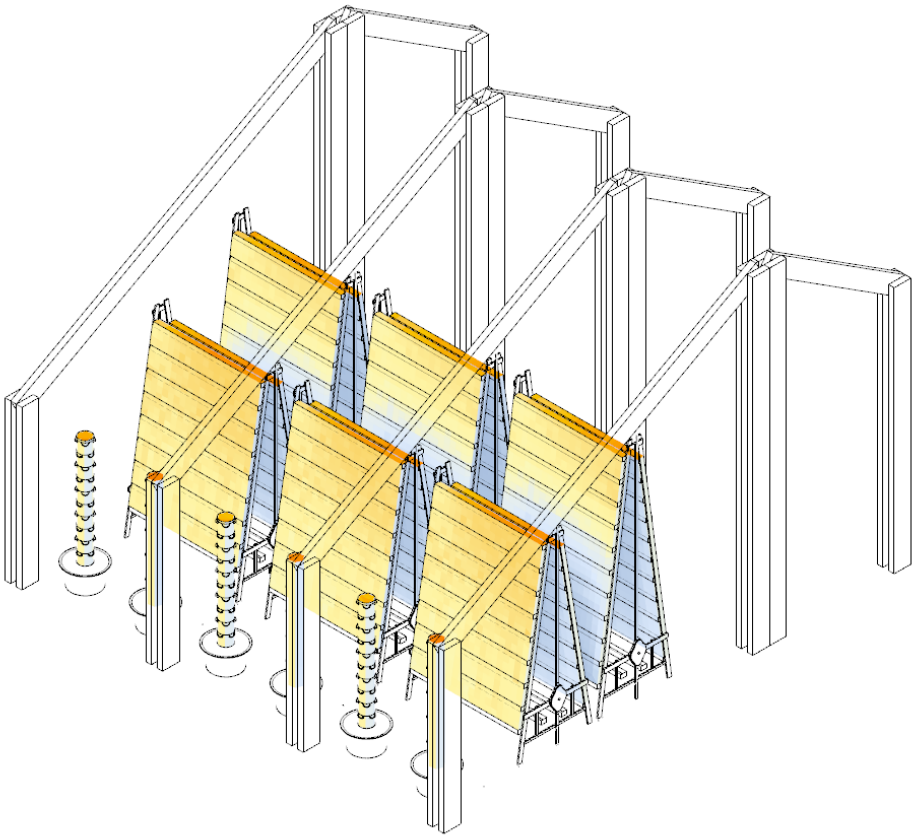
Cultivation system modules

South section



For both sections, the presence of Day Light Integral (DLI) >= 15-20 mol/day/m^2 was checked. To do this, an annual daylight simulation was done with Honeybee, a plugin in the Grasshopper/Rhino environment for detailed daylighting and thermodynamic modeling, to study PAR light. This simulation has the limitation of not filtering the results to obtain only the red and blue channel values, which are the ones of greatest interest to plants.

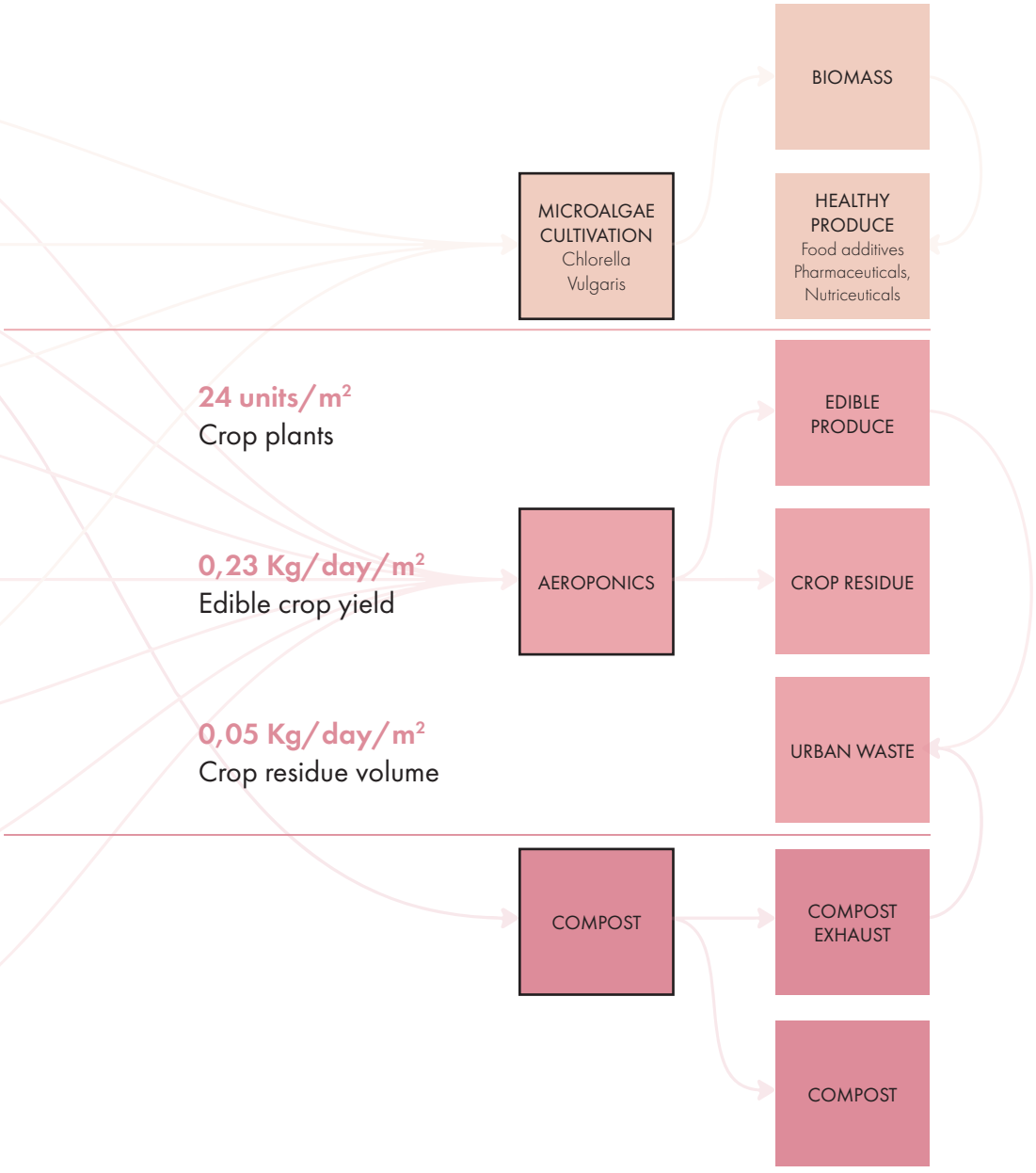
North section



Similarly, an energy simulation model of the building was also created, dwelling in particular on model sections of the four different indoor microclimates. Dial+, a software for dynamic thermal simulations, was used. Through it, the energy demand was evaluated by considering HRV appliances as well. The energy contribution of the heat storage and release elements was simulated separately.

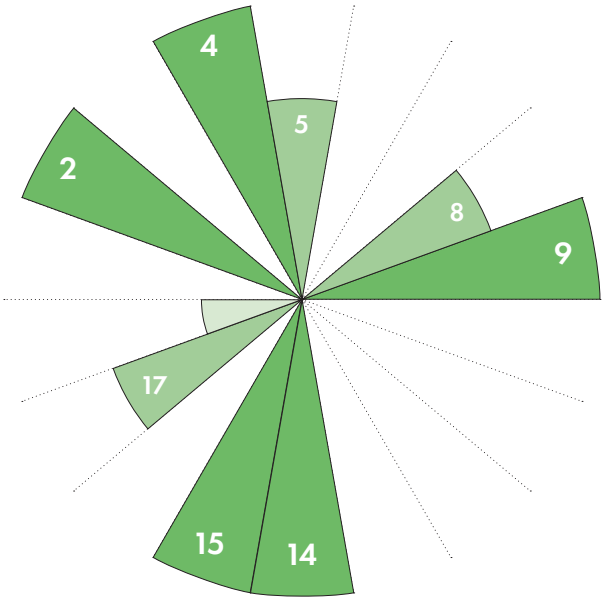
Input - Output evaluation

Natural light in DLI: >= 15-20 DLI (mol/day/m²) Artificial light in DLI: 0 DLI (mol/m²/day)	**15-20 mol/day/m²** DLI (Day light integral)	LIGHT PAR light
Airflow: 93m³/min/span	**+ 1vol/min** Volume	AIR Oxygen (O), Nitrogen (N)
CO2 from airflow: + 53,568 Kg/day/span CO2 injection: + 80,35 Kg/day/span	**- 6,45 Kg/day/m²** Volume	CO2 Carbon Dioxide
Heating demand: 0 kWh/m² Cooling demand: 137,5 kWh/m²	**- 137,5 kWh/m²** Energy demand	THERMAL Energy
Water demand: 50 L/day/span Water collected in m³/day: 63 L/day/span	**+ 0,63 L/day/m²** Volume	WATER H2O
Nutrients recovered in the process: 100%	**100 %** Percentage	NUTRIENTS Phosphorus (P), Potassium (K)
Energy demand: 27,82 kWh/day/span Energy produced: 36 kWh/day/span	**+ 0,34 kWh/d/m²** Energy demand	ELECTRIC Energy


BIOMASS
MICROALGAE CULTIVATION
Chlorella Vulgaris
HEALTHY PRODUCE
Food additives
Pharmaceuticals,
Nutriceuticals
24 units/m²
Crop plants
EDIBLE PRODUCE
0,23 Kg/day/m²
Edible crop yield
AEROPONICS
CROP RESIDUE
0,05 Kg/day/m²
Crop residue volume
URBAN WASTE
COMPOST
COMPOST EXHAUST
COMPOST

= Project evaluation

Evaluation of the impact generated, with the Project KPIs based on the Urban Quality Compass



- **Healthy & Safety** Promoting quality of life and fostering connectivity and social cohesion as well as healthy and sustainable lifestyles.
- **Climate resilience,**
- **Employability & Training**

Implement new green economy projects that foster resilience. Capable of creating profit and new jobs as well as enabling cities to recover quickly and bounce back efficiently when shocks and climate-related stresses occur.

- **Circularity** Implementing the Reduce-reuse-recycle principle.
- **Completeness,**
- **Accessibility - Permeability ,**
- **Attractiveness - Activator**

The overpass needs to be rethought through innovative actions and a functional mix aimed at transforming this space, and thereby the surrounding environment, into an attractive capable of strengthening the green economy in line with the 15-minutes city concept.

- **Green & Blue networks** Creating a green corridor that connects the main existing and future urban parks, including Parco Alessandrini and Parco Cassinis, through the implementation of new ecological, social, productive and recreational infrastructure. This will transform the flyover from a barrier to a connecting element promoting sustainable urban development.
- **Connectivity** Improving urban connectivity by promoting sustainable mobility, modulating vehicular traffic, enhancing cycling and pedestrian mobility, and implementing and strengthening the cycling network of adjacent neighborhoods.

A

Healthy meals/d provided in the area

Estimation of healthy meals/year produced from locally grown fresh food.

+2'100 meals/d

B

Carbon footprint tCO_2/y

Emissions in annual tCO_2 and or tCO_2/m^2 directly related to food production.

-6'592 tCO_2/y

C

Land use

Space for growing food: % of land used compared to traditional systems.

-33,3 %

D

Water use

Estimation of the volume of rainwater and wastewater that can be collected and/or purified and reused.

-101,37 %

E

Nutrient cycle

% of nutrients for food production recovered without polluting the urban water system and land.

100 %

F

Learning opportunity

Number of opportunities for food system-related learning and skill development.

+50 student seats

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Dalla ricerca emergono delle possibili strategie urbane per l'integrazione di spazi di coltivazione. A seconda delle minacce ed opportunità del territorio gli indicatori guidano nella scelta tra sei possibili tipologie di progetto. Questi includono la selezione delle componenti, analizzate in base ai loro punti di forza e punti di debolezza.
Le tipologie individuate sono: community farm, healthy farm, leisure farm, environmental farm, commercial farm ed infine educational farm.
Per ogniuna sono state selezionate le possibili componenti da incorporare nel progetto e forniti dei casi studio per comprendere concretamente come enfatizzare al meglio le opportunità connesse e limitare le possibili minacce esterne.
Le componenti che sono state individuate rispondono al dove viene realizzato il progetto di Agritecture, al chi vi partecipa attivamente e come avviene la coltivazione.
Rispondono dunque in ordine ai siti urbani e le relative forme urbane che possono assumere, alle communità-coltivatori e connesse strategie di coinvolgimento ed infine i sistemi di coltivazione e relativi Cultivation system modules (CSM).

Come evidenziato anche in un secondo momento nel progetto di esempio, il toolkit definito ha permesso di creare delle linee guida senza limitare il progettista per quanto concerne la progettazione degli spazi architettonici e quindi delle relazioni urbane. La guida aiuta in un primo momento nella definizione degli obiettivi di progetto, grazie alla valutazione fatta con gli indicatori sulla sostenibilità e urbani individuati. Conseguentemente vengono selezionate le tipologie di urban farm attinenti e fornite le informazioni necessarie su una selezione di componenti progettuali, esempi di casi reali, opportunità e minacce. Sarà grazie allo studio approfondito del sito specifico, in particolare effettuando le analisi connesse a ogni singolo indicatore chiave di progetto, che si avrà la conoscenza adatta per scegliere definitivamente le componenti da adottare in modo da creare un programma funzionale adatto al territorio e alla tipologia di intervento, oltre allo sviluppo del flusso di risorse del progetto inteso come input e output della produzione e delle diverse tecnologie impiegate.
Quest'ultime in particolare guideranno verso lo studio dei dati utili ad un confronto quantitativo oltre che qualitativo degli impatti generati, misurati attraverso gli indicatori specifici selezionati in origine.

Il progetto di riqualificazione del cavalcavia del Corvetto a Milano, seguendo questa strategia progettuale, ha portato allo sviluppo di una serra solare aeroponica gestita da un'attività mista pubblico-privato incentrata sull'aspetto ambientale, della salute ed educativo. Dal progetto emerge dunque un esempio di come una struttura per la coltivazione chiusa possa diventare un corridoio verde che connette diversi parchi ed embiti della città, fornendo al tempo stesso la possibilità ai cittadini di percorrerlo internamente per osservare la coltivazione di ortaggi e fornendo diversi spunti di riflessione ed attività che guidano all'adozione di una dieta più sana. Allo stesso modo è stato creato un luogo per l'apprendimento in connessione con le scuole locali.
I risultati del progetto riflettono come sia effettivamente possibile progettare in modo sostenibile degli spazi agricoli urbani e questo è stato possibile grazie alla definizione di un metodo che guidasse alle scelte progettuali, evitando soluzioni impraticabili o non in linea con gli obiettivi primari.

Il progetto è solo una delle possibili soluzioni emerse dall'uso delle guide alla progettazione. Essendo Agritecture un ambito di natura interdisciplinare sarebbe utile promuovere l'adozione delle guide applicate allo stesso sito per osservare le diverse risposte alle problematiche ed opportunità locali che creerebbe un team di persone con background differenti, coinvolgendo attivamente anche i diversi gruppi di utenti del territorio coinvolti.
Allo stesso modo il lavoro di ricerca potrebbe essere inizialmente espanso approfondendo l'aspetto finanziario delle diverse operazioni promosse.

CONCLUSIONS

Possible urban strategies for integrating cultivation spaces emerge from the research. Depending on the threats and opportunities of the area, the indicators guide the choice among six possible project types. These include the selection of components, analyzed according to their strengths and weaknesses.The typologies identified are: community farm, healthy farm, leisure farm, environmental farm, commercial farm and finally educational farm. For each one, possible components were selected for incorporation into the project and case studies were provided to gain a concrete understanding of how to best emphasize the related opportunities and limit possible external threats. The components that were identified respond to where the Agritecture project is implemented, who actively participates in it, and how cultivation takes place. They thus respond in order to urban sites and the related urban forms they may take, communities-growers and related engagement strategies, and finally growing systems and related Cultivation system modules (CSM).

As also highlighted later in the example project, the defined toolkit allowed for the creation of guidelines without limiting the designer in terms of the design of architectural spaces and thus urban relationships. The guide helps at first in defining the project objectives, thanks to the assessment made with the sustainability and urban indicators identified. Consequently, relevant types of urban farms are selected and the necessary information is provided on a selection of design components, real case examples, opportunities and threats. It will be through the in-depth study of the specific site, in particular by carrying out the analyses related to each of the key project indicators, that one will have the suitable knowledge to definitively choose the components to be adopted in order to create a functional program suited to the area and the type of intervention, as well as for the development of the resource flow of the project, understood as inputs and outputs of production and the different technologies employed. The latter in particular will guide toward the study of data useful for a quantitative as well as qualitative comparison of the impacts generated, measured through the specific indicators originally selected.

The Corvetto flyover redevelopment project in Milan, following this design strategy, led to the development of an aeroponic solar greenhouse managed with public-private partnership focused on environmental, health and educational aspects. Thus, an example emerges from the project of how an enclosed growing facility can become a green corridor that connects different parks and embites in the city, while providing the opportunity for citizens to walk through it to observe the cultivation of vegetables and providing different insights and activities that guide the adoption of a healthier diet. Likewise, a place for learning was created in connection with local schools.
The results of the project reflect how it is indeed possible to design urban agricultural spaces in a sustainable way, and this was made possible by establishing a method to guide design choices, avoiding solutions that are impractical or not in line with the primary objectives.

The project is just one of the possible solutions that emerged from the use of the design guides. Since Agritecture is a field of interdisciplinary nature, it would be useful to promote the adoption of the guides applied to the same site in order to observe the different responses to local problems and opportunities that would create a team of people with different backgrounds, while also actively involving the different groups of land users involved. Similarly, the research work could be initially expanded by delving into the financial aspect of the different operations promoted.