

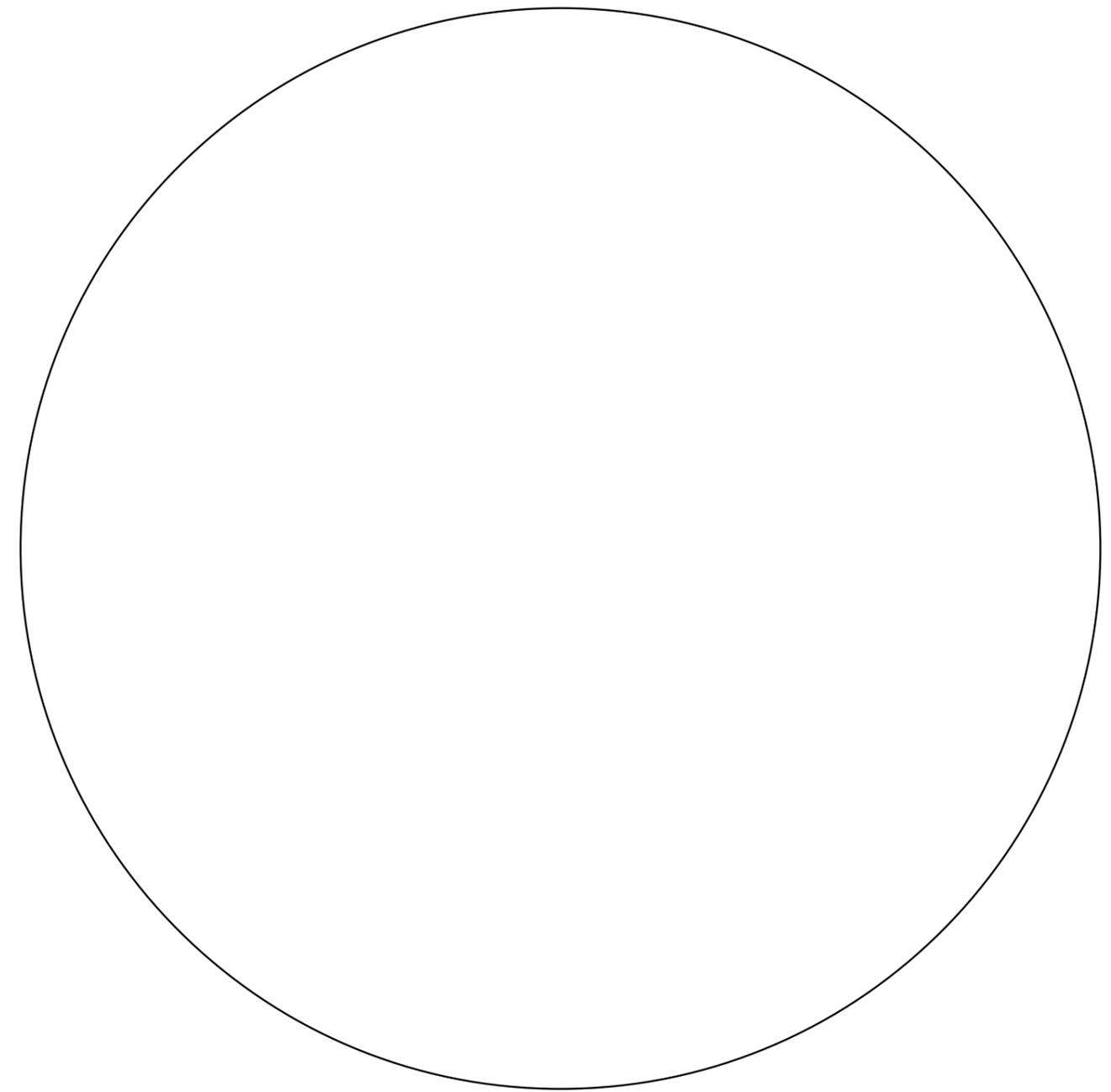


Photo: SPARK Architects

Urban Greenhouses and the Future of Food



WAGENINGEN
UNIVERSITY & RESEARCH



Urban Greenhouses and the Future of Food

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We thank our partners and sponsors for their generous contributions. Their support has been invaluable in making the Student Challenge "Design the Ultimate Urban Greenhouse" an unforgettable and inspirational event, educate the game changers of the future and contribute to innovations for a sustainable future.



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A word from the Rector

Cities all over the world have to meet complex challenges such as rapid urbanisation, population growth, the decreasing area of arable land and climate change. It will not be easy to provide for the booming urban populations in a sustainable, healthy and equitable way. Research into urban greenhouses, indoor and vertical farms can help cities counter these issues. I am very proud of the results of the green challenge where future generations come up with fresh, out of the box and optimistic ideas. It's also important to keep two primary concepts in mind: to look for a circular resolution to these issues, and secondly, to remember the human scale of the challenge.

Opportunities

There are many possible opportunities to move towards more circular solutions, such as technology supporting year-round crop production, reducing the last food-mile, making sustainable use of unused city properties, and the new opportunities for employment resulting from these forms of agriculture. Circularity concepts arose, fairly alternatively, in the 70s, so they're not really new, but now we are able to integrate them in professional chains and integrate the concepts into the ways we design and build ag-food solutions.

Scalability is key

The second concept is about scalability. From our European view, we sometimes forget the scale of the problem. In the rapidly growing urban areas in China, Africa and Mexico, a city is considered 'small' when it is home to only 5 million people. The flood of new residents needs feeding and it must be done in a sustainable, affordable and healthy way. It is not enough to focus on the size of the cities in question because there are many different food cultures that can make or break a solution.

Extending the scope

We are thinking of extending the scope of the challenge to non-European countries. We are already talking to major partners, both academic and business, to look at new business models where we can blend our scientific insights with their expertise and to move in new directions. I am looking forward to these new initiatives as well.

We also have to increase the cooperation with other Dutch technical universities. We need to incorporate sensor science and data science and come up with crossover solutions. This of course means that we have to improve the communication with the language of the 'other' disciplines. It is good to see this already happening in all the groups participating in this challenge.

New generation of changemakers

As the leading university in the field of agriculture, we consider it our core-business to contribute to the required transition and innovation, and to educate a new generation of change makers that can drive this transition. The launch of this recurring Student Challenge "Design the Ultimate Urban Greenhouse" is exemplary for this: 40 international teams from 10 different countries applied, 24 teams were admitted at the start of 2018, of which 14 made it to the finals half a year later. Even if your team wasn't selected for the final challenge presentation, your contributions will also be heard and felt!

Common effort

I want to thank all the partners that have supported this first edition of the Challenge: the students that have invested their knowledge, creativity, brainpower and months of their time, the professors, lecturers and companies that supported the teams, as well as the experts involved in the Grand Finale of the Challenge, and who are quoted in this book. I would like, especially, to thank our main partners: Rabobank, AMS Institute, Klasmann-Deilmann, and Bajes Kwartier Ontwikkeling C.V. Thank you very much for your support!

I hope the concepts, innovations and scenarios presented in this book provide inspiration to everyone involved in the sustainable production of healthy food in cities, from professionals in the public and private sectors, to academics and students. I invite you to keep an eye out for the next Urban Greenhouse Challenge in 2020!

Arthur Mol

Rector Magnificus/Vice President Executive Board
Wageningen University & Research



About this book

The book before you is meant to inspire. It illustrates the results of Student Challenge “Design the Ultimate Urban Greenhouse” and shares the visions of experts involved. It is made in recognition of the effort and creativity that students have put into this competition, and provides food for thought to readers that are interested in the field of urban greenhouses and the future of food.

It comprises a compilation of the concepts, innovations and designs that have been submitted by the 14 finalists, and interviews with jury-members and speakers at the Grand Finale on August 28th 2018.

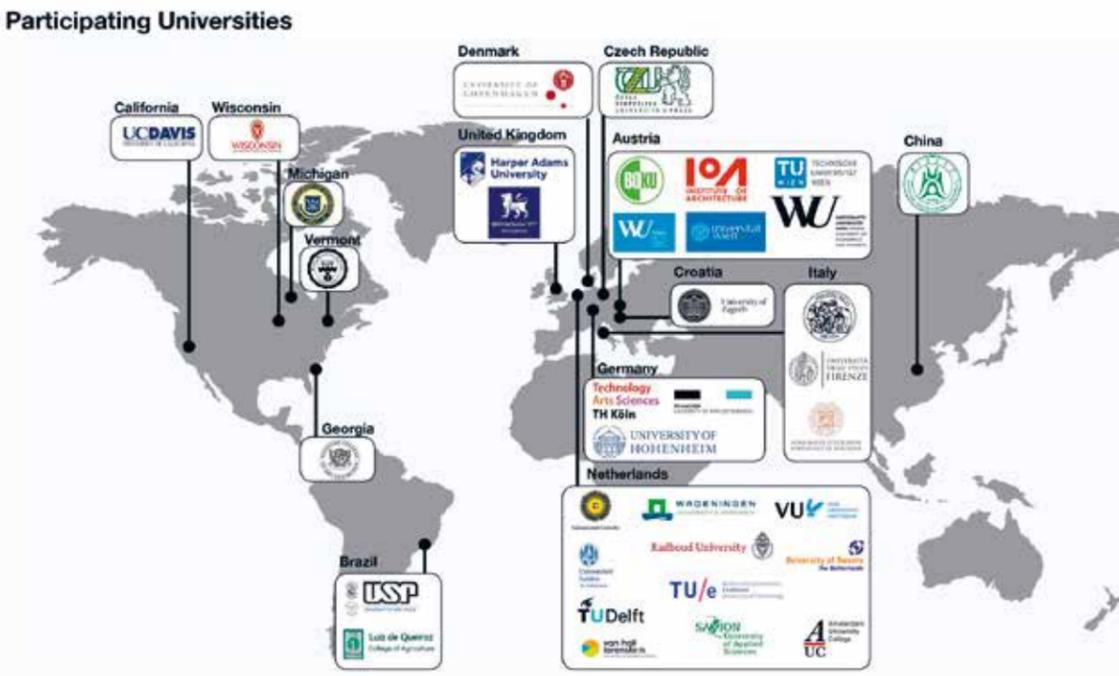
The Challenge

Multidisciplinary student teams were challenged to bring professional food production (back) into an urban neighbourhood, connecting it with local resource flows and e.g. local (smart) energy systems. Their designs had to be based on an existing location in Amsterdam: the former Bijlmer prison. It had to encourage citizens to actively engage with the sustainable production and consumption of healthy food. Their business plans had to show which values are created and prove that their design is worth investing in. The Challenge integrated social, economic, environmental and technical aspects.

The Challenge was open to student teams from all around the world. Forty teams pre-registered, 24 teams from 10 countries were admitted and fourteen teams made it to the Grand Finale.

Student Challenge “Design the Ultimate Urban Greenhouse will be organised every two years, each edition based on a different location in the world. You can find more information about the Student Challenge on www.wur.eu/studentchallenges. For questions you can turn to the Challenge coordinator Rio Pals and project officer Marta Eggers at studentchallenges@wur.nl.

We wish you pleasant reading!



Bijlmerbajes

Photos were taken by photographer Sven Menschel and students during meeting in Amsterdam (6-7th April 2018).



Bright Sunshine | Out of Control

As you enter this urban living room, you'll discover a wide variety of activities like Sunday concerts, gatherings, salons, gaming and places to read. Turn left, and you'll be amazed by the waterfall cascading down the first three floors. The waterfall together with the constantly changing LED lighting add vitality to this space. As you walk up the stairs, you can feel the full strength of the waterfall. Keep on walking along the corridor around the reservoir, and experience it from both near and far.

Water fantasy

As you wander around, you'll suddenly come across the supermarket located on the second and third floors. The supermarket's interior design is based on natural elements: water, trees and flowers. You walk on through an indoor garden, one of the four gardens themed on the four seasons. The winding steps then lead you to a quiet space which feels like a valley; a plant-covered setting which emulates a continuous, undulating, layered mountain. If you take a closer look, the plants' automatic sensors tell you about them and you can record your voice or your desires. As you move on into the waterscape, you'll see the water flowing down the plant curtain walls, with simulated birdsong.

Standing on the glass steps, with the sounds of water and birds intertwined, you can feel comforted by this natural art form; you can imagine yourself in a mountain forest. As you continue, you find yourself in a confined valley 2.5 metres wide by 6 metres high, surrounded by a water curtain running down the rock faces. As you walk down the undulating steps, you can touch the water, experiencing its effect on you: complete relaxation!

USP: Healthy eating

Childhood obesity is on the increase, so we have designed a vegetarian restaurant to promote healthy eating. Community residents and visitors can design their own menu, personalized to their health status. The restaurant can also be accessed through an app, which also allows guests and residents to log in to their account to check their health status and update their recipes. Restaurant guests are also welcome to enter the kitchen and learn to make vegetarian dishes, nutritious meals and prepare medicated diets. We expect that regular demonstrations will be given by experienced chefs, who will share their knowledge and recipes.

For the non-vegetarians, we have added special meat-tasting vegetarian dishes, using products available from specialized companies with which we collaborate, like 'Vivera'. The restaurant's main target groups families with dietary or obesity issues. As the restaurant's principles are 'green and healthy', we will introduce a series of activi-



ties such as private menu customization, gourmet experience, short-term cooking training, and healthy recipe salon. The vegetarian restaurant is the main place where we process and sell organic food in this building. We have designed it as a reassuring location where families troubled by health and/or obesity problems can take positive actions to help them back on the road back to better health.

Sustainability

In the plant production area, we've included a production flow line from seedlings to packaging and sales of the vegetables, designed to ensure the highest food safety standards. The whole system includes a plant factory in containers, semi-closed sunlight seedling systems, and modular three-dimensional cultivation. The containers are made from plant litter and can be used as fertilizer when degraded. In addition, the building has a completely sustainable recycling systems. These include intelligent IoT management of light, temperature, humidity and CO2, integrated management of water-fertilizer, a rainwater circulation system combining landscape with rainwater purification and utilization, a waste utilization system with the reuse of construction waste, integrated application of plant leaves and straw), and energy supply systems using solar and wind energy.

Jialong Ren
Xiaoli Su
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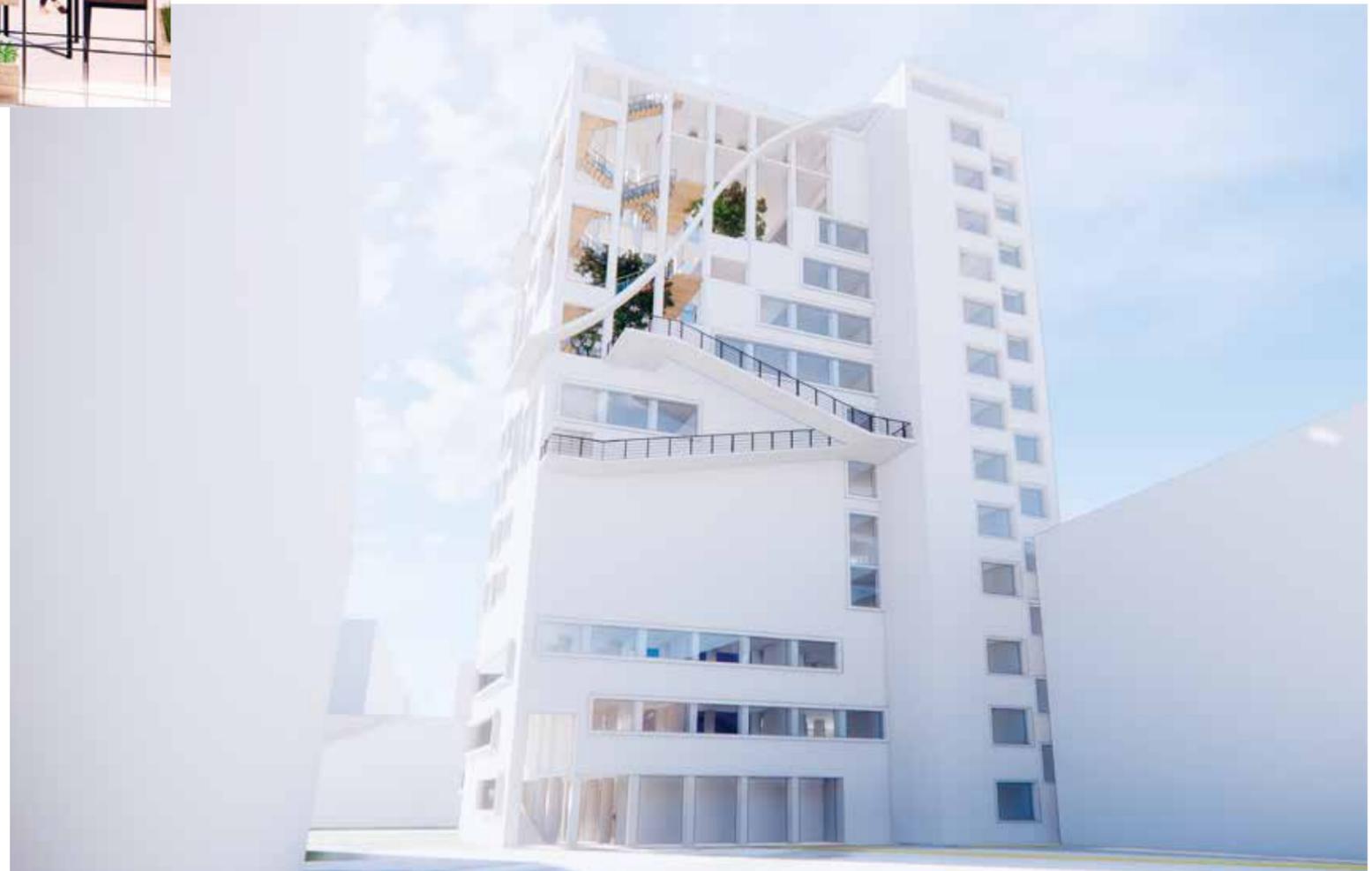


Lessons learned

The first lesson we learned was the importance of patience. We also discovered that it is a whole new experience to collaborate with people from other disciplines, and that communication plays a vital role.

We've learned so much during the challenge. Not only do we have a deeper understanding of other disciplines and urban farming, but we have also made friends with people we otherwise might never have met. The challenge has also shown us how important communication and

collaboration is. For us, understanding the information was initially an obstacle which took considerable effort and time to overcome, making it even more exciting as we approached the project's end. We've gone a long way, and we've learned to be patient and to deal with our anxiety and unease. The design itself is our biggest prize. And indeed we learned this as well: always run before your deadlines! Thanks for the challenge hosted by Wageningen UR and the support provided by Huazhong Agricultural University, it's been a really wonderful and meaningful journey.



Thanks Work | Millennial Growth

The transparent double facade will catch people's eye, no matter from whether they're in the train or walking around the area. Hunter, who lives in new Bijlmer Bajes neighbourhood, walks past the Green Tower every day. He's first attracted by the natural look of the building and the landscaped green surroundings which run all the way to the riverbank. Looking more closely, he can see the dynamic activities located on the ground floor; this makes him want to enter the building.

Once inside, he sees open space, a cafeteria, a market, and much more. People in groups are walking around and talking about growing the plants they bought from the greenhouse. He sees that many visitors have picked up an interesting box from the market; a ready-to-eat box for working people. And a group of young people are talking about the new recipes being served at the greenhouse, so he enters the restaurant and orders the new dishes.

He's curious about the supply systems in the greenhouse, so he decides to further explore the building. He walks through the market and tastes some of the local fresh produce. Moving on, he tours the mini-gallery to see the history of the greenhouse; the transformation from prison to greenhouse, and how it works and serve the surrounding neighbourhood.

From the gallery, he takes the sightseeing elevator to view the complete food production system: from germination, seedling growth, to packaging and process mature plants, and finally to box production. On the way he learns a little about urban agriculture. Finally, he arrives at the research centre and walks around the lab. He downloads the Joy Farm app to his smartphone and signs up for a workshop to learn more about urban agriculture, and how he himself can be an urban farmer.

USP: Healthy eating

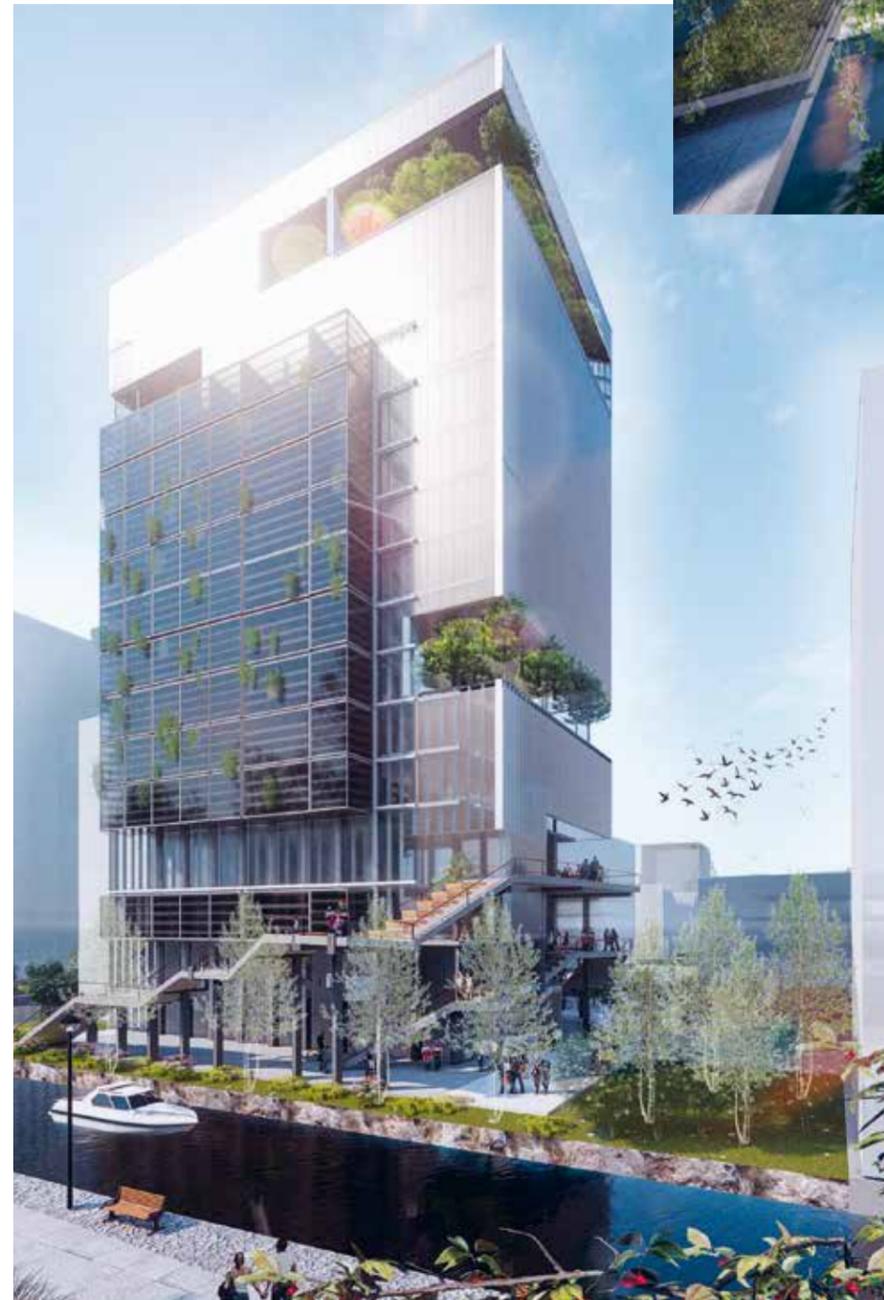
The transparent architecture makes the building's internal elements visible and provides visual access to the riverbank landscape. In addition, the transparency also links those working inside the Green Tower to the neighbourhood. We have created three platforms:

1. Food bank

The greenhouse food bank encourages investments in local businesses, promoting system management and embedding this in the neighbourhood. The greenhouse is the central system which controls and manages the production programmes for:

- people who want to buy food;
- a food union management association system with other greenhouses;

- people to discover the advanced technology being used;
- a connection with local schools;



Xuwei Chen
Chao Deng

Tiantong Gu
Mingyang Xia

University of Michigan



Sustainability

Based on the Triple Bottom Line theory (social responsibility, environmental stewardship and economic prosperity), we consider sustainability for Bijlmer Bajes neighbourhood from socio-environmental, socioeconomic, and eco-efficiency perspectives. The greenhouse is supported by advanced technical companies to ensure efficient and environmentally friendly operation.

We bring the idea of intelligent sustainability through the platform we created: food bank, greenhouse box, and joy farm app. By leveraging these new technologies, we promote a healthy enjoyable lifestyle for residents.

We have applied the "cradle to cradle" closed system to the neighbourhood. By leveraging the box concept, we designed a closed system embedding in neighbourhood: the greenhouse is responsible for assembly, distribution, waste collection and recycling.

- acting as a city food bank, minimizing the travel distance of food;
- establishing new ways to grow, manage and sell food in urban centre.

2. Box

To blend urban agriculture into people's daily lives, the team have created a portable ready-to eat greenhouse, utilizing the flexibility of a box. Five box concepts have been designed for different target groups:

- Vending Machines: inside schools, offices targeted at students, residents and workers;
- Living Box: functions as an urban agriculture education showcase for the growing process. Designed for use in schools, restaurants and offices; targeted at students, residents and workers;
- Structured Street Market: a unique temporary canteen designed for special events. Farmers rent booths to sell their products;
- Home Greenhouse: a medium-sized green box equipped with LEDs, growing medium, temperature adjust system, and air control. Residents buy seedlings from our market and grow them at home;
- Ready-to-Eat Box: customers purchase ready to eat products fresh from our market or from the vending machines.

3. Joy farm (app)

- Version 1 promotes urban agriculture public education through fun games;
- Version 2 connects new residents to the greenhouse and encourages people to become urban farmers; they can grow, sell, or pick crops.

Lessons learned

1. Business model: Based on the triple bottom line approach, we considered the business models from people, plant, and profit perspectives. By leveraging different business models, the project will generate revenues through diverse channels. By working with different partners, the project will create different stakeholder relationships and strengthen social interaction.
2. The learning process of how to build a vertical farm. The techniques have enabled us to make innovations and make design ideas like greenhouse boxes and the app feasible.
3. Urban farming strategies. Through the presentations and case studies, we reviewed many urban farming and design strategies. We looked at urban farming alternatives from ground to rooftop, from indoor to outdoor. We found that we needed to balance their advantages and disadvantages in order to provide an optimal solution for the Bijlmer Bajes, where by embedding urban farming in the neighbourhood and including cultural facilities, our cradle to cradle concept is both viable and vital.

Nothing new under the sun!

So, where will we be in 2050 with urban farming? Well actually, what we're talking about – urban farming practices – is really not all that new. These days we're able to apply advances in technology, breeding, construction etc. to what is actually a traditional idea: grow the things that you need nearby.

Let's take a step back and look at one of the earliest agro-economists, Johann van Thünen. In the 19th century, he developed his 'isolated state' model of concentric rings around the city, with land use in each ring being determined by economic value. For example, horticulture should be in the first circle, as fresh vegetables should be directly available to the local population. He based his model on a number of assumptions, for example 'soil quality and climate are consistent', which of course is exactly what we are now able to perfect in our quest for urban agriculture.

After the war, we moved away from his model because we were able to, based on limitless low-cost transport and 'growing things where they grow best' regardless of distance, with cheap labour, and with technology helping to keep things fresh. So we eat strawberries now grown in Spain, when we're perfectly able to grow strawberries around Rotterdam or Stockholm! But economies of scale and farming subsidies dictate that our strawberries still are grown in Spain!

At the moment, it doesn't make much sense to have farms within the city boundaries, as they still need a large area –

rents are high, other (service) industries compete, so we won't be seeing large farms in the city in the short term. As van Thünen planned, these will be located near the city.

In the city itself we'll see small scale production of high quality produce.

If a restaurant can integrate produce into their business model, then this will make certain aspects of urban farming feasible. But we see all types of small-scale urban farming initiatives taking place in many cities in western Europe; they're happening now. Crops can now be produced all year round, new varieties have been developed, robots can replace costly labour, sustainable energy sources are available, and many cities have spaces and locations where these 'new' greenhouses can be located, for example unused industrial areas, office space, roof-tops etc. The whole production and planning system can be controlled by technology – so we have, I suppose you could call it 'produce to go'.

We as consumers will be drivers of this; we'll be able to place our orders: what products we want, how much, when, and we'll be able to pick them up locally at the urban farm, greenhouse or vertical farm. Also, we are becoming more demanding; we don't want to find a frog in a pack of greens, we don't want pesticides to be used, we don't want the food to be flown in from far-away places etc. we also want there to be no food-safety risks – every-

thing has to be under control: these are all factors driving urban greening. However, we're still talking about natural products, but production will be much more controllable. That's why cities can become good locations.

Scalability of course then becomes important. If you look at the Netherlands, our vegetables are already produced close to the cities – Rotterdam, Utrecht, Amsterdam and the Hague are in fact a single urban area – and in Westland – food is produced 50 kms max from the consumer; it's only a few hours away from London! So in one context – we're already there.

However if you look outside Europe, in China, Africa and the US distances are much greater. There are interesting developments there; California and Mexico are now the gardens of the US – and they are a long way away from, for example, the east coast, so produce transport is expensive, produce is not fresh etc. This is also true in countries like Egypt and Nigeria, for example Cairo or Lagos, where it would make more sense to have urban farms nearby the city. Urban farming enables a better control of things like climate, so currently the food is grown where possible, given the soil, climate etc. and the farmers face ruination if these elements fail.

Urban farming practices secure the food chain as well as making it locally available.

Cindy van Rijswick: Senior Industry Analyst Fresh Produce, Rabobank, the Netherlands

Cindy is Senior Research Analyst in the 80-strong global Rabobank Research Food & Agribusiness team. She has published numerous reports on topics covering the complete supply chain, from grower to consumer, including vertical farming and the European greenhouse industry. She has given keynote speeches at several international fresh produce events such as the Fruit Logistica and the Global Berry Congress. Her research and analyses are key deliverables for Rabobank customers and prospects, both in the corporate and rural domains. Before joining Rabobank in 2001, Cindy worked for Wageningen Economic Research and the European Parliament as a research analyst in the food and agribusiness sector. She earned a Master's degree in Economics from Tilburg University in 1997.

In many countries, people are also migrating to urban areas, leaving the farmlands empty and unattended. However these new urban citizens do have the necessary farming skills.

I'll give you an example of a pitfall, a place where this is difficult, even unachievable! I was recently asked to look at an urban farming project in Singapore, There was support from the government, the supermarkets were on board, however the rents there are so excessive, it would never be feasible to find the economies of scale needed for a farm to be able to produce basic foodstuffs and be profitable. Another current pitfall is related to planning, certainly in western Europe. Government or city planners can block these initiatives: it's simply not permitted to 'build' a farm on an allotted industrial site. So first of all, we need to make (local) governments aware of the opportunities, and they are often difficult to convince.

To be honest, for my favourite project, I have to say that many of the projects I liked – have gone bankrupt! However when a company like the Staa Food Group in Dronten starts looking at this seriously, this may change things. They supply supermarkets with fresh, pre-packed salad products, including the dressing and other ingredients. They are starting a vertical lettuce farm in Dronten, as they can then really plan the sourcing; they are no longer reliant on the variable climatic conditions in Spain, and the lettuce is clean (no snails and frogs!) and, in this case, it's feasible because the lettuce

is only a small part of the overall price.

So for young professionals in this field, there are huge opportunities; it's not just Wageningen students who'll be needed. We need entrepreneurs, economists, business analysts, marketeers to work together and look for the opportunities that are there for them.

Luckily urban farmers are considered to be 'hip' at the moment.

Urban farming is here to stay – although it will take on many different forms in the future.



Flor-Green | The living Tower

By designing a Greenhouse, we took the productional part of the building as a point of origin for all the other considerations and components of this multifunctional building. It's the combination of the visible production area occupying 1/3 of the building and the participation of the community in these in production processes that makes it work best: direct consumption of freshly-prepared, zero-kilometre food!

Therefore, we created a building which facilitates scientific progress and stimulates projects that communicate the significance of urban farming in this continuously spatially consolidated world. In order to achieve this, we designed something more than a beautiful, pleasant building; we designed a landmark: an iconic building that in all its parts, communicates the fact that food production can now be achieved in cities. It's a building that is much more than just wood, steel and concrete; a building that itself is the Land!

We then created a truly living bio-skin: we decided to keep the old structure and replace the existing facade with a new transparent one made in ETFE, integrating a system of algae production within the cushions. As ivy grows on old abandoned buildings without affecting their structure, our new facade symbolically gets "eaten up" by nature, like green plants growing on ruins. The new envelope represents the importance and role of green in built-up areas, while breaking down the old traditions and rules. Our building wants to communicate its productional value while providing new opportunities and strategies for the integration of architecture and agriculture.

Key-elements

The key innovatory aspects of our project lie in the design of a structure that integrates food production, promotes collective collaboration, and aims to reduce CO2 emissions. In our tower, we will grow 20 different types of crops using 7 different cultivation systems. The tower is home to many social activities including training courses, children's playgrounds, creativity workshops, the Greenhouse itself, together with a VR Experience room, exhibition hall and much more.

Sustainability

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first universal and legally binding global climate agreement. The agreement defines a global action plan, with the aim of putting the world back on track to avoid dangerous climate change by limiting global warming to below 2°C. To support this, we have implemented an ETFE wall in the tower, within which the cultivation and production of algae takes place. Thanks to



photosynthesis by the algae, a large amount of CO2 is fixed in organic structures and, at the same time, oxygen is produced. This idea is already in use elsewhere, and is an exciting concept as it allows us to meet some of the global objectives of environmental sustainability. In addition, we have introduced other strategies in the tower to reduce CO2 emissions, including the sale of food inside the tower and the neighbourhood with zero-kilometre transport, and by limiting home delivery to a radius of 15 Kilometres

Our multifunctional facade produces energy thanks to the PV-panels integrated in the ETFE cushions, and creates closed loop-systems as algae produce energy to warm water. The panels provide the energy for the pumps that distribute the water all over the building as well as for other energy needs. We use passive strategies to reduce the building's global energy consumption: the ETFE facade is constructed as a 4-layered air cushion with an additional insulatory effect thanks to the air inside it.

Where the metallic structure replaces the ETFE, an inner facade with triple glazing covered by a layer of translucent polycarbonate made from recycled plastic sheets ensures that our envelope is thermally insulated in all parts. Inside, the automatic system allows optimal control of irrigation of the plants cultivated in the greenhouse as well as control

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of the greenhouse microclimate by managing the existing environmental conditioning systems. This includes opening / closing doors, the fan heating and ventilation systems, the misting system, shading sheets and lighting.

The wireless technology allows improved monitoring and management of the main environmental and crop parameters of the greenhouse, while at the same time reducing problems related to the presence of connection cables, and solving issues related to the representativeness of the measurement points.

Lessons learned

The first lesson we learnt by participating in the Challenge was the ability to work together with students and professionals with different visions, knowledge and skills. It was extremely interesting to discover how people view and think about the current situation in the world. Secondly, we experienced a different culture from our own Italian one, namely the Dutch: to understand what to cultivate and how to design our idea for the tower, we had to learn about the habits, traditions and dynamics of Dutch society. The third lesson was about discovering the willpower needed and our ability to get involved in an international challenge on a very innovative and interesting theme. Many of our group had never participated in a competition on a global scale before, so the challenge has helped us to grow individually, increase our confidence, and create connections that will be valuable in the future.

Other

The Flor-Green Team was born out of a collaboration between the universities of Bologna and Florence. While Bologna provided the main input related to agronomic skills, Florence provided the project's architectural capabilities. This challenge has allowed us to bring together two realities that often seem to be disconnected. Prior to the green revolution, our two worlds were separate: the agricultural world was positioned in the countryside while architecture focused on the construction of cities. The global need for sustainability has therefore brought these two systems together (urban and agricultural-environmental): our team has really focused on the benefits that can be achieved by the union of agro-environmental and architectural skills.



A Tale of Two Cities

I research and teach about urban food policy at the CUNY School of Public Health. CUNY is very much part of the city, with 274,000 students reflecting New York City's diversity and facing many of the same challenges of the wider population, including food insecurity among an estimated 15% of our students.

Towards social justice

I research policies to make the urban food system more just and more healthy. With a background in urban planning.

I'm particularly interested in how the tools of planning can be used to increase access to healthy food, especially to the most economically vulnerable.

Much of my work has focused on the role of urban agriculture in promoting health, sustainability, and social justice.

I co-authored a comprehensive look at urban agriculture in NYC, called Five Borough Farm, which identified policies to support, expand and justify investments in urban agriculture in NY. This was followed by a book, 'Beyond the Kale: Urban agriculture and social justice activism in NYC,' co-authored with Kristin Reynolds, that showed how urban agriculture is about much more than growing leafy greens.

The book profiles farmers and gardeners, including many women and people of colour, who are using their farms and the

It has been practiced in communities of colour for many generations but often is portrayed as something new and innovative, "discovered" by young, affluent, often white, tech-based urban farmers.

practice of growing food to advance deep social justice issues like race, class and gender equality.

Access to land and funding are barriers to expanding urban agriculture in densely populated, wealthy cities.

Ensuring Success

A key to urban agriculture's success is ensuring equitable access to resources for both conventional, soil-based farms and gardens as well as for advanced technologies aimed at commercial production. And community based non-profit urban agriculture projects can provide young people with skills to move into commercial ventures.

One example is a farmer named Paul Philpott. He learned how to farm while working with a non-profit called Green City Force, which built and runs six large (0.5 hectare) farms on the grounds of high rise social housing developments. After leaving Green City Force, Philpott set up his own hydroponic farm ('Gateway Greens')

at an urban 'farm' called 'Square Roots' that is composed of a cluster of shipping containers fitted out to grow produce.

Re-thinking Food deserts

In the US, attention has focused on the need to increase access to healthy food in low income communities that suffer from high rates of malnourishment and diet-related diseases. Urban agriculture can play a role, but policymakers have framed access as the lack of nearby supermarkets, justifying policies subsidizing supermarkets as the solution to food access.

A recent article, 'Let them eat kale' (I like kale!) shows that when new supermarkets are built in so-called food deserts, they do not significantly change shopping patterns, diets, or health.

I call for food policies to move "upstream," addressing the social determinants of poor nutrition – low wage jobs, insufficient affordable housing, inadequate social welfare.

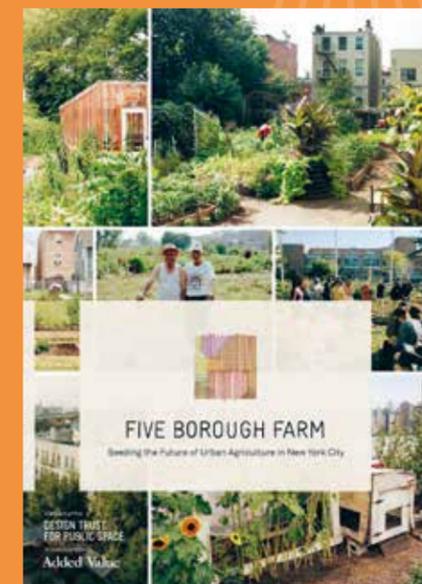
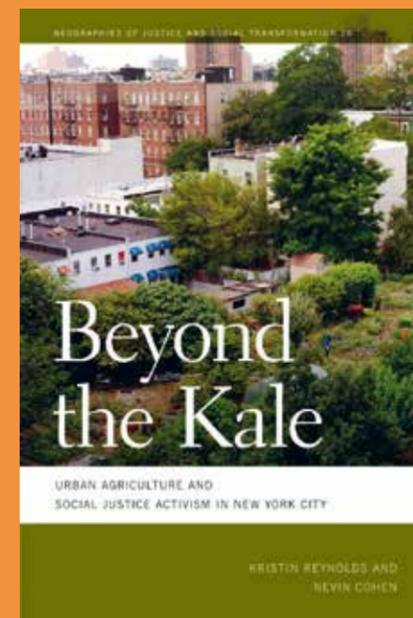
Rather than on "downstream" interventions like new grocery stores. In the current political climate in the US, cities are often on the leading edge of these efforts. For example, NY has increased the minimum wage, committed to building affordable housing, and adopted protections for low-wage workers.

Nevin Cohen: Associate Professor of Health/Food Policy at City University of New York School

In January 2015, Nevin joined the faculty of the CUNY School of Public Health as Associate Professor of Health/Food Policy. His teaching and research focuses on the roles that cities play in making food systems healthier, more socially just, and ecologically sustainable. He is involved in food policy development in New York City, and has co-authored the Five Borough Farm: seeding the future of urban agriculture in New York City study to support and strengthen New York City's urban agriculture system. He has a PhD in Urban Planning and Policy Development from Rutgers University, a Masters in City and Regional Planning from Berkeley, and a BA from Cornell.

Upstream students

What I'm looking for in the next generation of public health graduates is greater attention to upstream issues and who view the food system as a means to advance social justice in addition to a means to ensure nutritional health.



Panta Rhei | Green Tower

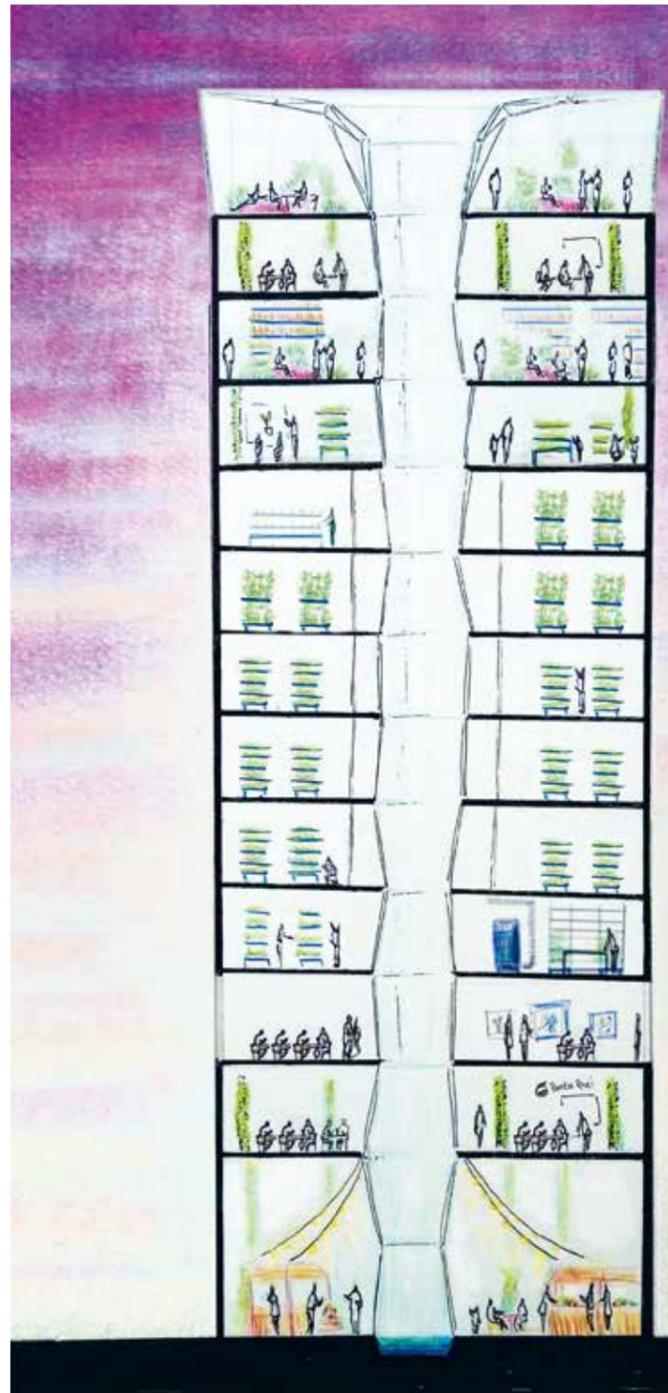
Before entering the building, you are reminded of its past, with hints of the sustainability of the present. Passers-by will see that the building's exterior has barely been modified, except for the addition of a glass façade on the existing fourth floor. We have included a rooftop greenhouse structure; solar panels cover two of the external walls, and we have constructed wetlands replacing the canal that now surrounds the building.

As you step into the Green Tower, you are greeted by the warm, natural aesthetics and values of our modern era. Juxtaposed to the historical, boxed facade, you enter an open, two-story ground floor; your attention is drawn to the large pool of water captured in an asymmetrical glass tunnel that shoots up the centre of the space, creating an internal transparency for the activities on all thirteen floors, specifically those related to plant production, while maintaining the original support system, and not comprising space for production and business. As you move on from the Bijlmer Bazaar on the ground floors to the Tea Room on the Roof, you pass through our production spaces on the middle 6 floors. Throughout the building, your sensual curiosity will be satisfied as you visit the vibrant, welcoming spaces including the Bijlmer Bazaar, the Tea Room, the Green Library, and green entrepreneurial offices.

USP's

Panta Rhei believes that bringing agriculture to cities is an adaptive process. For it to succeed, it must strive for the full integration of crop production in this urban environment, alongside proven yet innovative production systems. Our Green Tower celebrates the community's past, understands the desires of the present, and envisions the future. With the stability of guaranteed production as the foundation of the urban farm, our production strategy is to incorporate the latest innovations and developments in sustainable systems to ensure the project's continuity. Highlights are our use of technologies like biostimulants, augmented-reality, our density-adjustable growing system, and economic model predictive control.

While producing nutritious and high-quality crops is very important to us, we also believe that education is the key to acceptance by the community and to securing the future of urban agriculture. This is embodied in our Education Plots, cooking classes, and the Green Library. For example, our use of augmented-reality technology in the production room can be used to teach the unemployed without prior farming knowledge, or even to overcome language barriers.



Julia Winkeler
Michele Butturini
Maurizio Junior Chiurazzi
Naomi Chouinard
Elena Geroldi
Katherine Isaf
Guy Low
Gloryia Marinova

Robert McAllister
Martin Osowski
Elizabeth Richardson
Eri Gunawan Suriana
Merab Apkhazava
Lisheng Jiang

**Wageningen University & Research, TU Delft,
 University of Wisconsin**



We aim to be grounded in all that we do, including our business plan. Our internal activities have been selected for their ability to allow local residents and businesses to invest and engage in local food production and consumption. We have created spaces that are inclusive and transparent, offering visitors exciting ways to be involved with the building and with one another; and to give users resources to grow, learn, and innovate. We understand that in order to best serve and give back to the community, we have to provide an inclusive environment that relates to the community's needs.

At Panta Rhei, we believe that everything is a process; that Everything Flows. This framework can guide construction in any country: understand the traditions of the location and food production; understand the community's needs and values; and challenge the present technologies to keep moving forward.

Sustainability

Sustainability in Panta Rhei's Green Tower comes in many forms. We try to be sustainable with regard to the continuity of our business, as well as in our use of natural resources. A major sustainability aspect is our decision to reuse the structure and exterior of the building to reduce the energy spent on demolition and construction, as well as

the potential waste of materials. We collect rainwater for use in our aeroponic growing systems which require much less water than traditional, or even hydroponic systems, and we filter grey water through our wetlands.

While sustainable water use is important, our main goal is to reduce our energy demands by smart and efficient use throughout the building, especially in our production areas. We have optimised the growing density of the plants throughout their growth cycle to make effective use of artificial light and by incorporating natural light and sensors in the vining crops section. We have incorporated photovoltaic solar cells, a ground source heat pump, recirculation of humidity and other schemes to lower our energy consumption. We have introduced an economic model predictive control system to properly execute all of these heat transfer schemes, and to integrate the operation of these technologies throughout the building.

Lessons learned

The individual team members have all learned different things related to their personal journeys and goals. Collectively, we have learned that:

- Both Urban Agriculture and team-work are ever evolving concepts. The Panta Rhei team has grown both as team and as individuals. We learned to adapt our system of working to the schedules and needs of the team over time, based on feedback and necessity.
- Sometimes, having too much freedom can be just as debilitating as having none. Choosing an initial idea and adapting that idea is much more important than trying to have the best idea at the beginning.
- Communication is absolutely key, especially early on. With fourteen team members of many nationalities with some located at different universities, it's crucial to make sure everyone is on the same page. Sometimes long meetings are needed to discuss issues and gain feedback on whether people truly understand each other, on even small parts of the project, as this can cause much confusion later on.

This is all, of course, in addition to the numerous ideas and multidisciplinary knowledge we all took away.

Benefits of urban agriculture

Nothing is for 'free'

In my PhD thesis, I focused on what the first advocates of free trade, John Locke and Hugo Grotius, meant by the word 'free'. At that time the Catholic church regulated international trade; the English, Dutch, Spanish and Portuguese fought wars about international trade routes. Locke stated that free doesn't mean 'free' of competition, but it refers to being 'free of unilateral domination'. This also means that basic needs like water and soil are to be protected from international exchanges, as it cannot be conceptualised that people will give up these without being forced to. Today we have again redefined 'free trade'; to grow roses we go to Africa and use the local population's water- so free trade has nowadays become completely unlimited.

New balance/ Making sense

Getting back to food production, I'm talking about basic necessities.

So this is a model where a city or family are self-serving in terms of basic needs, and this is the model which is developing in urban agriculture; it's about being resilient for basic needs, finding a new balance between grow your own and international trade.

Economists need to rethink what free trade means and what its benefits are.

Free trade is for the realm of the extras – bananas, coffee etc., while the basic necessities should be locally provided.

So if it makes sense for a city to grow salad products instead of importing them, then that's OK: it's resilient, and it has a better quality.

Urban agriculture is about what's feasible – what makes sense – not about what's possible.

Gardener or farmer?

I've been working on urban agriculture for the last 10 years. In Rotterdam when we started, we looked at the allotments and how they are managed. Over half of these are worked by people with an ethnic background other than Dutch, and 100% of them use the gardens to grow food. For the municipality, these allotments are zoned as recreational however in these allotments the use is 100% farming; they grow the local herbs and vegetables they cannot buy in the Dutch supermarkets. So, when are you a farmer? The basic 'thought' is: if it doesn't provide your basic income, you're a gardener. But if I look at Europe from an economist's view, many of the farmers in many countries would then be also 'gardeners'. Without subsidies they would not be earning a living wage.

Social inclusion

At Wageningen, we are socially inclusive about urban agriculture – even herbs on a balcony are included; anything that contributes to food security and food resilience. In the situation where many farmers have no successors, urban small-holdings can be perceived as breeding grounds: locals learn how to grow food in their garden, move to the Westland greenhouses and learn the trade, and then move on to become farmers themselves. In Malmö in Sweden, their policy is to welcome refugees and select those with an agricultural background and offer them training to be employed in the sector.

Tastier strawberries

When vertical farming came along people said, 'what we have is already good, why do we need these?' Dutch farmers are a little conservative... so that is a pitfall. But now, people become more aware of changes in fertiliser availability, energy dynamics etc...

They see urban food growing as a source of human capital.

Another point is that the quality is better: fruits like strawberries in vertical urban farms can be kept on the plant longer before harvesting so they are tastier! We have to pick the right high-value products.

Circular streams!

People in the US predict that from the 15% currently grown indoors, within 5 years this will be 80% - mainly horizontal.

Jan Willem van der Schans: Senior Researcher at Wageningen Economic Research

Jan Willem is a specialist in short and ultra-short fresh food supply chains (urban and periurban agriculture), business model innovation. He focusses on the role city-region food systems can play in achieving a more sustainable food system. He is an active board member / co-founder of several urban agriculture start-ups such as the GROWx vertical farm in Amsterdam, Edible Rotterdam, a citizen-led initiative promoting urban agriculture in and around Rotterdam, and the Rotterdam Food Council, a network organisation to promote urban food policies for the Rotterdam city region. He has a PhD in Business Administration from Erasmus University Rotterdam, and is member of the European Rural Networks Assembly, its steering group and its subgroup on innovation.

By making agriculture more circular, we create places which not only produce, but also that sequester the carbon in the ground and are space efficient.

This is driven by climate change. They also predict that ultra-short supply chains will develop: wholesalers will no longer collect produce at the farm; they grow it in their own vertical farm. I'm an economist – so this is about economic dynamics. Urban agriculture should become more circular and use waste streams, water and sewage from the city to grow food. In Rotterdam there's a great example where special mushrooms grow on coffee waste.

Urban agriculture will become part of our urban metabolism; with a circular flow of waste streams.

Multidisciplinary futures

I can see that this Challenge is attracting a wider range of student skills than traditional production experts. We see students in artificial intelligence or finance modellers, involved; I really welcome these new skills. Often the traditional Wageningen students are too much production oriented, too much about low value commodities. New ideas, new blood can help direct these production skills.



Tardigrade Consultants | (Re)planting care

Walking into the building, you feel its serenity. The space feels bright and quiet, even with all the people in the main hall. You see plants everywhere, and the building's materials feel very natural, with the plants emitting wonderful scents. The sensory space increases your feeling of calm and peace, and walking barefoot on the moss, you feel like you've been transported to a magic realm. The Elder forest is lively with people reading, families picnicking next to the tree, grown on one of the Tower's USPs, compost from recycled human waste.

Moving upwards, you discover different spaces for having workshops for example where you can try making your own jam and soap. There's a food clinic where you can be helped with any dietary issues, and you're a member of the community garden, where you can plant your own crops and socialise with fellow gardeners. On the roof, the attractive restaurant-café is surrounded by local grasses and mosses, with butterflies and bumblebees in the wildflowers.

You take a tour of the greenhouse and are amazed to see the variety of plants growing there: how many herbs and varieties of exotic fruit and vegetables! You're excited to find out that you can buy this fresh and delicious produce at the market on the ground floor, or learn how to use the herbs for making cordials in the workshop. It's wonderfully bright in the greenhouse, with very little of those uncomfortable LEDs that hurt the eyes, and it always feels like summer.

Your last stop is at the furniture workshop, because you've just moved in to the local community and you'd like to buy a cute little table with soothing effects: here you find one repurposed from an old stool, filled with camomile.

USP's

Our concept of the care landscape, where we reconnect people with plants is our key selling point: promoting holistic care through plants.

Our design is guided by 5 design principles: resilience, circularity, adaptability, biophilia, and inclusivity. These, together with the care landscape, are the replicable elements of our design that can be taken to other projects.

The personas are a key element that have helped us to work around difficulties when considering future community residents. In line with our inclusivity principle, we made these as diverse and multicultural as reasonable: we didn't want to forget any groups.

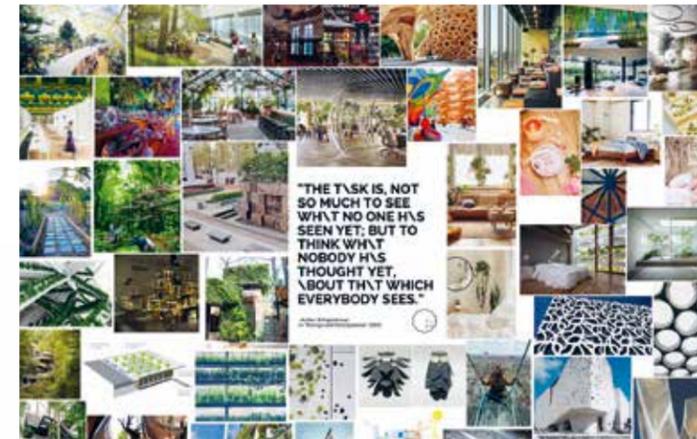
The human substrate, an output of the Elder trees was a key design element, as it allows us to bring in a dimension of care that goes beyond caring for living bodies, broadening the concept of care to include the



Laetitia Boon
Linda Novosadova
Catherine Foley
Lila Paschalidou

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Chia Ju Lin
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non-human (or no-longer-human).

Plants for body, mind, and soul, is the typology we use. By thinking about plants in this way, we make sure that all of the plants present in the building are part of the care landscape.

'Pods' in the form of plant furniture upcycled from furniture 'waste' reinforce the idea of our building as a living organism that needs to breathe, and be one with the surroundings. The pods also allow us to spread the care landscape beyond the confines of the physical borders of the building, bringing it into people's private space.

Sustainability

In terms of environmental sustainability, our building is designed to be as passive as possible: it makes use of natural lighting and its context where possible, as well as techniques for, amongst others, water filtration, using gravity and plants), or water gathering from rain-water and collecting greenhouse condensation. Streams are separated for better re-use in a decentralised sanitation system.

In terms of substrate, we have chosen a mixture of sheep's wool, homemade compost (through vermicomposting), and human compost, all of which avoid the environmental issues associated with peat extraction and rock wool.

For financial sustainability, we have devised an alternative financing system based on Susan Drion's thesis on financing sustainable farming in the Netherlands: the key to this system is the stacking of capital flows, the use of certificates as perpetual bonds, and involving stakeholders, in this case mainly the residents of the Bijlmer Bajes, in the activities of the building. This last point is key to the design of the business activities within the building, as these are diverse and reliant on the use of the building in the rituals of everyday life.

For the social sustainability, we have involved the personas explicitly in the design of the activities: both for care-oriented and for business activities.

Lessons learned

Horizontal teamwork requires a completely different set of organisational techniques; we found that using the 'scrum' way of working was very effective, but that we really needed a process coach because we no longer had a more 'traditional' vertical structure with a permanent manager.

Working with eight full-time students, the majority master students working on their thesis, didn't leave us much time to work on a project of this magnitude; depending on the level of detail desired, this could be problematic. However, working under pressure meant that our ideation phase had to be put into practice rapidly, meaning we had to commit to a certain set of ideas, instead of continuously going back and forth between possibilities.

We discovered that you don't always need to be an expert in something to find a creative new way of doing it. Sometimes all you need is a little (well – a lot of) time, a lot of energy, and Google.

The interaction of people with the greenhouse is really the most important element of our design: it cannot operate as a stand-alone building, with nobody ever visiting. We'd really like to emphasise this ideas of the building being part of a living organism, part of a vibrant urban ecosystem.

Students-driven Challenge

One of the priority areas of Wageningen University is research and education on 'Resource Use Efficiency' or the circular economy; I've been member of the core group developing this multidisciplinary theme which brings together the social sciences and the natural sciences of all five major divisions of Wageningen University and Research. When developing ideas on circular production and consumption, the core group decided to include students in our program in a bottom-up, innovative way. Following up on a very successful conference on bio-based economy organised by PhD/MSc students in 2017, the idea for a green challenge for student teams was born. The challenge should be in the field of circular food production and consumption, focusing on new, smart chains in urban settings. Because of this focus on urban flows of food, water, energy, nutrients and wastes, collaboration was established with another strategic WUR core group, 'Metropolitan Solutions'.

Blending initiatives, sciences, and ideas

When exploring the potential for a WUR challenge, we soon discovered a number of ongoing initiatives. To blend the existing initiatives, sciences and ideas into one Challenge, a working group was installed by the WUR Rector Magnificus, Arthur Mol to find support for a student challenge as part of the 100-year celebration agenda in 2018. Resources were freed up to move forward on this idea. The working group gathered support within Wageningen and visited lead actors in this field like TUDelft

and TUEindhoven. They showed us the decisive role of students in this new form of education in between honours programs and start-up activities.

Support for a challenge on Urban Food was growing, and in the end both students and staff were really enthusiastic. The Urban Food topic also very much opened up the opportunity to strengthen the collaboration between social and natural sciences; a blended, inter- and transdisciplinary approach that I as social scientist have especially learned to value.

Breaking borders

Urban food is 'in the air', also at an international level.

Since Wageningen is widely recognised for its high quality in the field of food and agriculture, it made sense to many partners that WUR would take the lead. We were aware that researchers all over the world are working on innovative Urban Greenhouse systems thanks to the strong increase in urbanisation: the city is the place to be, also for producing and consuming food. Because of this international dimension, the Student Challenge 'Design the Ultimate Urban Greenhouse' will be organised over a period of 10 years in different parts of the world. We started 'at home', in Wageningen and Amsterdam, but we aim to grow from there to China and Africa and further. This approach is much favoured by our main sponsor, the Rabobank, and gives us the opportunity to leverage both their and our strong networks in countries like China.

The Bijlmer Bajes as start location

The idea was to select a major city in the NL – and we noticed that cities like Rotterdam, Utrecht, The Hague and Amsterdam were keen to jump on this bandwagon. In the end, due to time issues, we chose Amsterdam, as WUR are part of the Amsterdam Metropolitan Solutions (AMS) project together with TUDelft and Michigan State. Jan Willem van der Schans, one of the working group members, was close to the Bijlmer Bajes prison and the new Bijlmer Kwartier redevelopment project. The tower of course formed a special element; this became a logical location in terms of scale as much of the infrastructure is already in place. The prison itself represents some specific design challenges and helped us to reflect on the general and place specific dimensions of Urban Greenhouses in cities with high densities, well developed infrastructures, and overall critical and engaged (food)consumers.

Food futures in urban settings

My vision on the future of food production and consumption is influenced by my social scientific research on (food) consumption. Wageningen research traditionally was – and some say still is - very much technology oriented and focused on production of food in rural areas. This Challenge combines technological with social innovation and has a focus on the linkages between production and consumption of food in urban settings. So overall the knowledge developed in and around the Challenge will help 'agricultural' universities around the world prepare for a radically renewed research agenda.

Gert Spaargaren: Professor at the Environmental Policy Group - WUR
Gert is member of the WUR Environmental Policy Group. His main interests and publications are in the field of environmental sociology, sustainable consumption and behaviour, practice theories, and the globalization of environmental reform. He has served as Chair of the working group developing the WUR Green Challenge for Student Teams. In 2017, he was content coordinator of the MOOC 'co-creating sustainable cities'. He has published over a hundred articles and has co-edited a number of classic books in this field, including *Food in a Sustainable World; Transitions in the consumption, retail and production of food* (Routledge, 2012) and *Practice Theory and Research* (Routledge, 2016).

Radical changes to skill sets

This project exemplifies a number of social consequences and conditions which I expect to become even more important as we move toward 2050. The relation of food, water and energy – the so-called urban food nexus – will gain high policy relevance and bring along new roles of citizens in food production and consumption. Especially the connection of food with renewable energy and smart urban energy systems is as yet not well-recognised and under-researched.

The future food system will demand radically different skills from our students and staff.

I'm really looking forward to seeing where we are in 2050.

Inspiring projects and futures

What inspires me are future solutions like those being created by designer/architect Jago van Bergen. His team also look at the social consequences of food production related to community needs, internationally; this is where I feel we should be going. We're talking about new urban formats where we reuse urban space and include food production. We will need professionals to grow our food, so we'll be looking at new generations of professional urban farmers.

So we have to find ways of getting the public involved, an issue being addressed in van Bergen's Roselaere project.

For social scientists, the question is what are the needs of citizens in this new concept, what role can they play?

Building critical mass and ensuring high quality

There's no guarantee for success.

It's all in quite an early phase, but people are enthusiastic and positive. We need to build on this and make students aware of this. We need to show that the results from this and other projects can give us the critical mass and quality, and we need to bring the learning back into our education programmes.



Gaia | The Urban Leaf

It's 10.00 on Saturday. You wake up feeling slightly worn from a busy week at work. As you turn you hear your phone beep. Begrudgingly taking a look, it shows your yoga class starts at 10.30. As you look for the snooze button, a new notification appears. Naomi from upstairs just signed up for the class, peaking your interest. She is promoting her new smoothie after the class, the one everyone has been raging about for weeks. Not wanting to miss out, you drag yourself out of bed and get dressed.

Thankfully, it's just a 5-minute walk to the Urban Leaf. On the way you run into Aniket the gym instructor, and for the 5th time you promise yourself to sign up for his aerobics class. Checking the Urban Leaf app, you see the class is almost full, and there's just one more spot available for the sauna after. Seeing your next door neighbours Meli and Dori also have a spot, you quickly reserve it. Walking inside, you hear relaxed music and excited voices coming off the climbing wall. After a quick drink, you head up the 12 stairs as a yoga warm up. Walking up, you feel yourself escaping the city and ascending into a natural paradise of green.

After the yoga and sauna session, you follow Naomi to the restaurant, this time taking the elevator. As she shows you her smoothie on the restaurant's menu, you see even more familiar faces. You feel at home here, and comfortable with the fact that you signed up your son Gabriel here for the after-school programme. As you make your way back home, you start dreaming of joining one of the many projects. Opening the Urban Leaf app, giddy with excitement, you know you'll be back tomorrow.

USP's

The Urban Leaf Concept (ULC) - What makes the Urban Leaf unique is the fact that it's not a new building but a roadmap for renovating any building in an urban environment. Used in the right way, it's possible to achieve a design for any high-rise whether in Melbourne, Mexico City or Hong Kong. With our instruction template, all you need is a dedicated, multidisciplinary team to transform any building into a flagship building the area will be proud of. The ULC elements can easily be moulded to fit a specific social and physical context. What's more, all new Urban Leafs add to the entire concept by sharing new information through iterative learning. It builds databases on crop choice, plant production systems, material and energy flows, and the app grows with each new Urban Leaf.

The Urban Leaf App - The app connects each Urban Leaf with its social environment, so the Urban Leaf is really part of people's lives. The app makes it easier to be involved in the Urban Leaf: you always know what's going



on in and around the Urban Leaf without actually being there. One of the app's main goals is making the activities in the Urban Leaf accessible to the local community, whatever people's financial capacity. The app is thus a kind of social currency. Neighbours earn points by engaging in healthy activities, social activities or tower-related activities; these can be exchanged for free Urban Leaf access, products or a discount. Reward systems stimulate and trigger people.

Crop choice table - The crop choice table is a main element of the Urban Leaf concept as it connects all the Urban Leafs. By iteratively improving the data on growing crops indoors in controlled environments, in multiple buildings, we can achieve a maximum output. Pilot projects need to be set up, however once the data is collected, every new edition of the Urban Leaf has a new head start. Eventually we can reach a maximum efficiency and share this in Urban Leafs around the globe.

Sustainability

Circularity and Flow models - An efficient resource management system will grow together with the Urban Leaf, learning from people and plants, adapting to climate conditions, seasons, and available inputs and outputs. The data improves experiences, and reduces energy and material use patterns as the Urban Leaf matures. Sustainable development starts locally and expands

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globally, making use of its iterative design and a systematic change across the technological and social environments. Ingenious use of waste to generate value inspires partners and other stakeholders to implement the same practices in their businesses and to generate significant change in industry. Ideally, our design will lead by example and create disruptive innovation. RE-design - An essential part of the Urban Leaf concept is that the old building is kept and re-designed to fit an urban greenhouse. Not only does this keep the Urban Leaf

rooted in the community as a historical landmark, it is much more sustainable than building a new greenhouse. Sustainable development - The ULC also ensures social sustainable development in demographically diverse neighbourhoods by supporting community building: people's health and safety improve as they have a place to come together and bond with their community.

Lessons learned

The challenge gave all team members a chance to experience a project group independent of their university or top-down organisation. The large and varied project group shared learning and new experiences, including team structure, communication and working together. All team members learned from each other's expertise. The fact that we come from so many different backgrounds and studies led to different inputs and ideas. Sharing these ideas and working on subjects that are not your own has given us new insights for future work. Making a team work is more difficult than we thought it would be; building a good team structure was complex and it took time to achieve this.. Thankfully we called in the help of a project manager who guided and helped us behind the scenes. We learned to reach out to experts, and that this really gets you back on track.

Other

Though a difficulty throughout the challenge, the fact that our team comes from 5 universities and includes both bachelor and master students is what made the challenge extra special. To see that we can work together even though we live in different parts of the country and all have very different schedules shows that a group of diversely-skilled students can really achieve something new. We came together and reached out to get support, and in that way really made it our own project. Many of the team members are motivated to keep the idea going, no matter what the outcome; our "Urban Leaf Concept" lends itself perfectly to this. Every time one of us spots a derelict city building, the first thing that pops into our minds will be "what if we used the Urban Leaf Concept here". We are all inspired and I believe it has been a great experience for all.



Food Safety – missing link?

My background is in civil engineering and in hydra/aquaponics; I mainly work on aspects of food safety, and that's the issue I'd like to address in this discussion on urban agriculture. Food safety is strongly linked to food security, as we're talking about the issues and difficulties of feeding growing urban communities, both now and in the future. However, there are many issues that need to be considered when looking at where urban farming will be in 30 years.

High income – low income

I work on many horticulture projects in low-income countries, and I think that it's obvious to state that there are different needs and priorities set when compared to the technological answers to urban farming solutions being introduced in high-income countries. So my first point is: we really need to consider the area of the world we're talking about: is it urban farming for need or for leisure, or for fixing other societal problems like the integration of social groups, or the reduction of criminality. We need to better discriminate the discussion on urban agriculture as this is also often not clear: are we talking about researchers working in sub-Saharan Africa or in Detroit – there's a real difference!

Economic feasibility

When looking at the better-off countries, my second point is: what is the motive for doing this? Is it in order to produce food or to fix other problems? If we intend to produce food, then this type of production has to deal with the same requirements as

production in rural areas, which means that there must be some kind of economic feasibility; we need to consider the different type of conflicts regarding land use, for example prices are high in 'downtown' areas – and this of course has an effect on the crops to be grown.

Disruptive marketing

Thirdly, we need address the issue of marketing the produce. The current trade system is not directed towards urban agriculture; it occurs on a wholesaler-based logistics. It's my guess that urban agriculture will be accepted by existing logistic systems and retailers, as long as it does not disrupt their existing model too strongly. But once it becomes a major market player, there will be a reaction, for example, if a production market arises that doesn't go through the existing chains, we will need to see changes in these systems.

Odd shapes and sizes

Even quality wise, urban agriculture needs to play by the same rules as conventional agriculture does: as an urban horticulturist, you cannot simply bring your odd-shaped or different sized products on the market just because they are local; here again you have to conform to the regulations on food quality.

'Local is safe'

I've noticed that food safety is often a forgotten part of the discussion when we look at current developments in urban agriculture.

The premise is 'local food is safe food', however this correlation does not exist.

Think of a rooftop garden on a general apartment house – you have to think carefully about what must be done, and what must not be done. The production area should not be accessible to local people, for example. How is the produce transported in the building: food should not be transported in the same elevator used by the flat's residents, so there should be a secondary lift or other form of transporting the produce. We need to teach people about the hazards that occur and how they should deal with them. There's a certain irony that when people produce their own tomatoes, they're happy about that and forget all the above!

Lovely or not?

My current projects in the sub-Saharan area are often seen as being 'lovely' because, on the surface, they address urgent needs. However, when I look at these professionally from a food safety mindset, they are not so lovely. These projects pinpoint the risks people face. In Ghana, Kenya and Ethiopia, the dangers are all too apparent. Issues like the use of water or reclaimed water, the substrate the vegetables are grown and what on, the hygienic conditions of the products being marketed etc. I really wouldn't eat raw vegetables grown on some of these projects as the resulting produce is often a showcase for infectious disease: perhaps fascinating for microbiologists! The posi-

Beatrix Alsanius: Professor Swedish University of Agricultural Sciences | SLU Department of Biosystems and Technology

Beatrix is one of three Swedish national representatives within the International Society of Horticultural Sciences (ISHS). In 2011 she was appointed member of the Royal Physiographic Society. She received her PhD at Bonn university and was quickly appointed Assistant Professor at SLU Alnarp, dealing with microbiological stabilization of closed hydroponic cropping systems, working closely with leading institutes in France (INRA) and the USA (USDA). In 2009 she was appointed Chair Professor in horticulture at SLU Alnarp. From 2010 to 2013, she acted as an Adjunct Professor in crop science at Université Laval, Québec, Canada. From 2008 to 2014, she headed the postgraduate school "Microbial Horticulture", and between 2012-2016, she served as Vice-chair of the EU COST action 1105 "BioGreenhouse".

tive side of this is that in these projects we see communities trying to cope with adverse conditions. Things like a sense of initiative, the willingness to improve their lives; these are really encouraging.

Controlled sterility

On the other hand everything is controlled; there's absolutely no disease risk.

People think that the food grown in these new vertical farms are almost completely sterile.

However, that's also not true – it's not at all sterile; microbes are quite capable of existing in these conditions. The plants we grow from seedlings are themselves not sterile; there are microbes in the substrates used etc. Although their diversity may be less, this can have a downside as the plants may be more open to diseases like e-coli, and as there is no other microbes to compete, then you can have massive proliferation – so this also is an important consideration.

Basil-based economy

I'd advise the new young horticulturalists is to have a good plan – not only about the cropping system – but what to grow, when to produce it, be aware of consumer needs: what do they want.

You can't feed a population on basil alone!

You need niche crops that add value! So planning is key; and as a horticulturist, you need to buy in the other skills – it's not simply about growing the crop: if the IT system breaks down, you lose your complete crop! Someone's got to be on hand to fix this!

The hard work starts after the plan has been written!



Technotitlan | The EcoTower

Entering the tower through one of the two main entrances brings you to the lobby, where you can order a drink in the cafe and relax, read about the prison's history and the sustainable character of Johan Cruijff Arena's special grass pitch, and buy locally grown products in the shop. A large cylindrical translucent water tank catches your eye. The lobby area has raised gardens, green walls, green roofs and columns covered with climbing plants, giving it a park-like atmosphere. Fresh smells fill the area. There's an inviting promenade which leads to the building's upper floors.

First, you see the community garden and educational module where children and adults work on their crops, learning and having get-togethers. There's a feeling of familiarity and camaraderie. You continue climbing. You get a great view of the new Bijlmer Bajes areas from the terraces. You enter the museum where three floors are dedicated to teaching you interactively about the building's history, its sustainability and circularity principles, and about the different types of agriculture in the world. Amazingly, your walk takes you even further, up to the production modules. There you'll find strange food alternatives, things like mushrooms growing out of Christmas trees, an automated sprout growing system, and, wait, insects and a garden of snails! You didn't expect that. Anyway, after all that walking, you've developed an appetite, and, as luck would have it, the building has an amazing rooftop restaurant with a beautiful garden. This building really has it all.

USP's

We believe that our concept is composed of diverse, well designed matching elements. We focused on creating a building where the pieces are flexible; modules that could work in any building separated from the source, but that also fit together to create something greater than the sum of their parts. In our building, each module has the ability to change its purpose in order to adapt to an ever-changing future. We aimed to create a new icon in the city.

In our design, the general shape and structure of the old Women's Tower is retained in order to minimize restructuring costs and maximize material reuse. The tower represents the historic and cultural value of the Bijlmer Bajes area; an important aspect for the future of this building, as the rest of the neighbourhood will undergo a radical transformation. The tower features numerous innovations concerning food production, greenhouse management and energy production, all connected to the Internet of Things Greenhouse. This smart system allows the greenhouse to be controlled remotely using encrypted data through the application of

sensors and other technologies. Some of these technologies include the team's own designs such as the Pleurotus Forest with tree-like structures where mushrooms grow, and the Greenwall. Significant food production takes place in the tower: insects, snails, several types of mushrooms, and various sorts of sprouts will be farmed here, with quality and transparency. These will be sold under the brand *Bajesvoer (Bajes food)* in the lobby, in dishes in the restaurant, on the website, and in



other local restaurants. This brand encompasses the ideals and the story of the new neighbourhood: sustainable design, local food production, transparency, inclusivity and education. This local focus will have an international allure, drawing tourists as well as Amsterdam's own residents.

Sustainability

One of the main challenges is to make the building circular, as demand tends to surpass the supply capacity provided by the current renewable sources. This problem led us to take a decentralized approach based on the three key rules of the Urban Harvest Approach (UHA): reduce demand, reduce waste or outputs, and multisource the rest of the demand. In layman's terms: use less resources, make the best use of the resources you already have (i.e. recycle, cascading, etc.), and finally, find different sources, preferably more sustainable ones. This approach has resulted in low energy requirements, and has also helped us make a design that produces 89% of its own energy. In addition, 29% of the water use comes from rainwater, all of our production modules require low amounts of water, and our system recovers over 3776.6 kg worth of nutrients usable in an agricultural setting. We understood that in an urban setting resources are hard to come by, that's why our choices are adapted to the building's conditions, instead of adapting the building to our preferences.

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Romero
Claudia Fernández
González
Elías Hernández Valera
Everardo Rodríguez
Galván
Francisco David Ruiz
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Niels Gunnar van
Weezel Errens
Héctor Martín Gabriel
Reider de la Garza
Jingyi Wang
Mattia Bosoni
Thomas Bastiaan
Siderius
Yafté Yakín Gómez
Álvarez

Wageningen University & Research



Lessons learned

The project has taught us some remarkable lessons. In the beginning, it was difficult to merge and combine so many ideas and ideals into one coherent goal, but we managed. We wanted to create a project that would last and impact society for the better, to create an icon or a symbol of progress. Of course, that wasn't our only goal, as we wanted to challenge and prove ourselves; we wanted to win and grow as people. These goals formed us and made us a solid team. We motivated each other, shared and solved any problems, and persevered. We slowly became a family, trusting each other. We knew that we were stronger together, that the team was greater than the sum of its parts.

And what did we learn from this? A project that we believe is strong, sure and a network of contacts for our futures, of course. But most importantly it has changed how we approach and view things. It has given us a glimpse of what we can achieve. It's given us a family and the willingness to expand it to include anybody willing to work towards a better future.

Other

Techno means technology and titlan means place; this is derived from the city founded by the Aztecs, now known as Mexico-City. The Aztec capital is renowned for its ingenious city planning and infrastructural wonder. A literal translation of Technotitlan from the Aztec language Nahuatl is 'Place of the Prickly Pears'. This stems from the fact that the island was full of them, providing the Aztecs with food and shelter after their long migration in search of a new home. The name Tenochtitlan also represents another important concept: Change. After the Aztecs settled on the island, they changed their name to Mexicas, a name that would eventually lead to Mexico. This migration and evolution relates to our team, a blend of Chinese, Italians, Dutch and mostly Mexicans, who all came to Wageningen searching for a future, who came to a place filled with technology that gave them shelter, and the opportunity to set the foundations of what could eventually mark a city, our own personal Technotitlan.

Integral urban solutions

I envision a future where vertical greenhouses are an integral part of the urban fabric, that cities have embraced this model as a necessary tool to achieve sustainable and successful futures. By 2050, 80% of the world's population will live in cities, this fact is at once a substantial challenge and an opportunity. At the same time, food deserts, where affordable and healthy food is difficult to obtain, are becoming more common in urban neighbourhoods. Add to this the fact that available land, healthy top soils, and water are becoming scarce commodities, and that costs of energy and transporting food are increasing.

New responses to the way we grow food are a must to respond to the challenges of the future.

Architect and visionary

I'm an architect, and from my professional view I see the opportunities in this field are much more than just about creating space. Architecture has the potential to respond to a community need, but at the same time, reflect a community's values and have great impact beyond the limitations of the building. It is this belief that architecture can be the physical act of social change that cemented my dedication to the idea of vertical farming. In the past ten years, the focus of my work has been to create a viable model to build cost-effective hydroponic vertical greenhouses in urban areas that not only act as innovative, environmentally sustainable

models for growing fresh food, but have a substantial social impact.

Innovative investment

We need innovative partnerships to support this vision. At this juncture, urban food production in the form of vertical farming is challenged by the cost of land, capital costs and the cost of energy. Public/private partnerships with vertical farming businesses and municipalities can help mitigate these barriers to entry by working with operators to secure unused land, invest in this unique and productive type of public infrastructure, and create opportunities to use renewable energy. Our cities leaders need to invest in tools to help drive the impact they want to see in their communities.

Sustained success

Commercial scale urban agriculture, much like traditional agriculture, is riddled with potential pitfalls and challenges. How to run a successful vertical farm, and then following - how to sustain that success is based on experience. In this nascent and exciting industry.

It is by learning from each other's experiences that will we be able to collectively achieve and sustain success.

Of the industry as a whole. Until the industry is able to embrace a truly collaborative approach, we will be vulnerable to the multiple challenges that we all face.

Year round fresh produce

Vertical Harvest of Jackson Hole in Wyoming USA responds to two significant needs in our community: Jackson has a 4-month growing season and imports the majority of its produce from outside of Wyoming. Jackson is now home to one of the world's first vertical greenhouses located on vacant land next to a downtown parking garage. This 13,500 sq. ft. three-story stacked greenhouse utilizes a 1/10 of an acre to grow an annual amount of produce equivalent to 10 acres of traditional agriculture. Our project enables the community to grow produce 365 days a year despite difficulties posed by the harsh climate.

Do good, do well

Our community impact model cultivates an empowered, healthy, sustainable, and connected community.

We sell locally grown, vegetables year round to Jackson restaurants, grocery stores and directly to consumers. In addition to fresh produce, Vertical Harvest produces jobs for individuals with different-abilities. Our mission is simple - we provide consistent, meaningful employment for people with disabilities (typically a 78% unemployment rate) by cultivating nutritious food for the community. Our impact is much larger - we utilise public/private partnerships as a model to create positive economic and social impact for communities. One of the primary reasons

Nona Yehia: Co-Founder/CEO @ Vertical Harvest, Principal @ GYDE Architects

Nona is both a practicing architect and the Co-Founder, Owner, and CEO of a cutting edge greenhouse, Vertical Harvest at Jackson Hole. She graduated in architecture at University of Michigan and Columbia University Graduate School of Architecture, Planning and Preservation. In 2009, after 10 years of being a partner in the architecture firm E/Ye Design, Nona started work on Vertical Harvest Jackson Hole. Combining a passion for local food and her desire to help people with developmental disabilities, she conceived a three-story hydroponic greenhouse employing people with developmental disabilities, producing local food for the community. In 2016, the flagship project Vertical Harvest opened its doors as a social impact business that can 'do good while doing well'.

vertical farms fail is due to labour challenges, however we are resisting the trend of moving towards greater automation and are instead looking at our labour model as an opportunity to achieve success. Employees benefit from multiple dividends; this a positive effect on our co-workers, the company's bottom line and the community.

| We do good by doing well.

Metric-driven growers

We see ourselves as growers first and foremost. Technology with regards to vertical farming is advancing at an astonishing rate, and while efficiency and optimization in production is always a key priority, understanding how to evaluate all of the options available to our farms is particularly challenging. Our dual mission of employing a unique population in conjunction with growing as much food as possible resulted in multiple efficiencies and innovations in our design that strengthens the bottom line of everything we are doing.

Vertical Harvest is essentially 3 greenhouses stacked on top of one another - this creates different microclimates on each floor. This structure allows for the development of a portfolio of crops that have different price points as well as risk factors. Take our lettuce carousels: these are continuous rotating systems that span the vertical southern façade of our building as well as move horizontally into the 30' depth of our building. These unique

growing systems solve three problems at once. They balance natural and artificial light, essential to managing energy costs, add a fourth floor to our three story greenhouse, and finally bring the plant directly to our farmers for transplanting and harvesting. We strive to use this metric to evaluate all of our choices in terms of technology.

Collaborative passion

My first piece of advice would be to embrace your passion: passion is convincing.

Once you are passionate about an idea, there is no choice but to see it to fruition. Persistence is the key to bringing an idea to reality. I like to remind people that when you are trying to accomplish something innovative, you need to embrace your detractors as much as your supporters. It is embracing the hard questions that will give strength to your idea. My second piece of advice would be to be collaborative. Urban farming is too big of an idea to go it alone. Being a part a multi-disciplinary team is key to successful outcomes in this field. Surrounding yourself with people who are just as passionate but come at it from a different perspective is essential to building a successful future.



UC Davis | Horticultura

Standing outside the building, you look up and see an elegant, red, curved glass roof that stands out from the surrounding urban environment. If you move to the eastern and northern sides, you see a contrasting mosaic of textures and materials including wood, green walls, and glass. If you move to the western side, you see the airfoil created to house the wind turbines in a visually pleasing way. Here, a beautiful shimmering, metallic effect on a vertical surface of the airfoil mimics ripples of water.

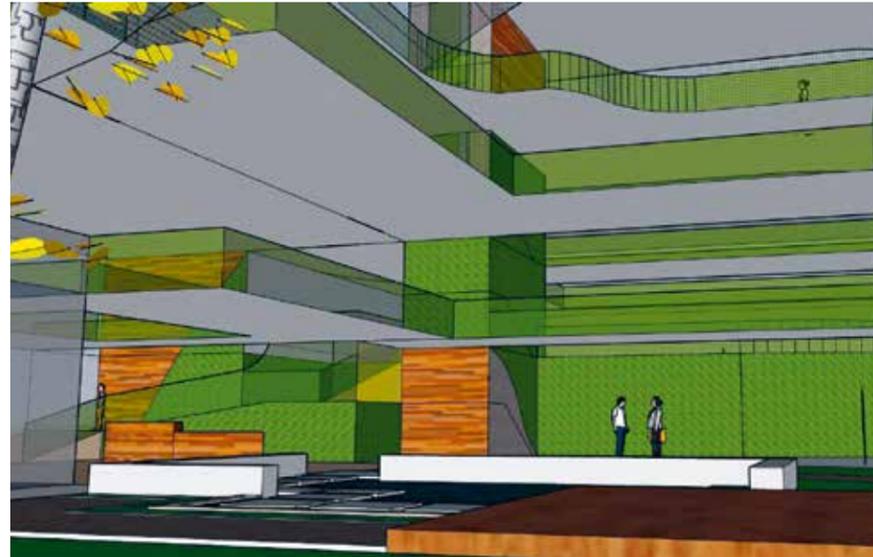
You can enter the building at either of the two main entrances on the eastern and southern corners. The eastern entrance leads into the market and the Café and community kitchen spaces; the southern entrance leads you to the main gardens, with access to the building's upper floors.

You choose the southern entrance and enter the soaring five-story atrium with its natural landscape and reflection pool. You look upwards and see the market, café, community kitchen and office spaces on the balconies. Going up the stairs to the second floor, you reach the Edible Gardens, housed in a second atrium at the base of the original tower building. Walking through this garden, you are one with the plants, both as a source of food and beauty.

On the six floor of the original tower, you enter the Headhouse, the operation-centre for the entire building with preparation, storage, and cleaning spaces. Continue upwards and you pass through a series of floors with specially designed environments, optimised for crop-growing. These include annual and perennial crops in state-of-the-art, custom growing systems.

On the top floor you discover the Tropical Garden with a mix of tropical crops including bananas, coconuts, pineapples, papaya, passion fruit, vanilla, mangoes, cinnamon, cocoa, coffee and others. Continue upward from the garden to the viewing deck and enjoy the view of the newly redeveloped Bijlmer Kwartier.

Inside the building there's a sense of openness and light; all floors have high (3-4 metre) ceilings, numerous balconies, gardens, green walls and natural wood surfaces. These natural elements contrast and unite with the urban polished concrete floors and white plaster walls. The entire building maximises light, both natural and artificial, which enhances its openness. The gardens and building have been designed to allow you to wander freely and enjoy each space fully.



USP's

The main concept of our design was to create a building that reflected the past and that looks forward to the future, using innovative technologies and modern design. On the building's exterior, we included two novel technological elements: the airflow on the north-west corner for wind energy production, and the red acrylic solar panels on the roofs as an energy-source.

Inside the building a number of technological innovations include unique growing and lighting systems. Additionally we have included a bioreactor hosting Waste Transforming technology, and a urine recycler for fertilizer production: both are unique.

For crop production, we have focused on growing unique, exotic, heirloom, and out-of-season high-value fruits and vegetables. Our primary systems include citrus and perennial fruits, leafy greens, potatoes, herbs, strawberries and many other tropical fruits and crops. Moreover, we have the flexibility to grow any crop we wish depending on seasonal demand. We also intend to emphasize horticulture education and innovation throughout the building.

Omar Samara
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Ryan Bua
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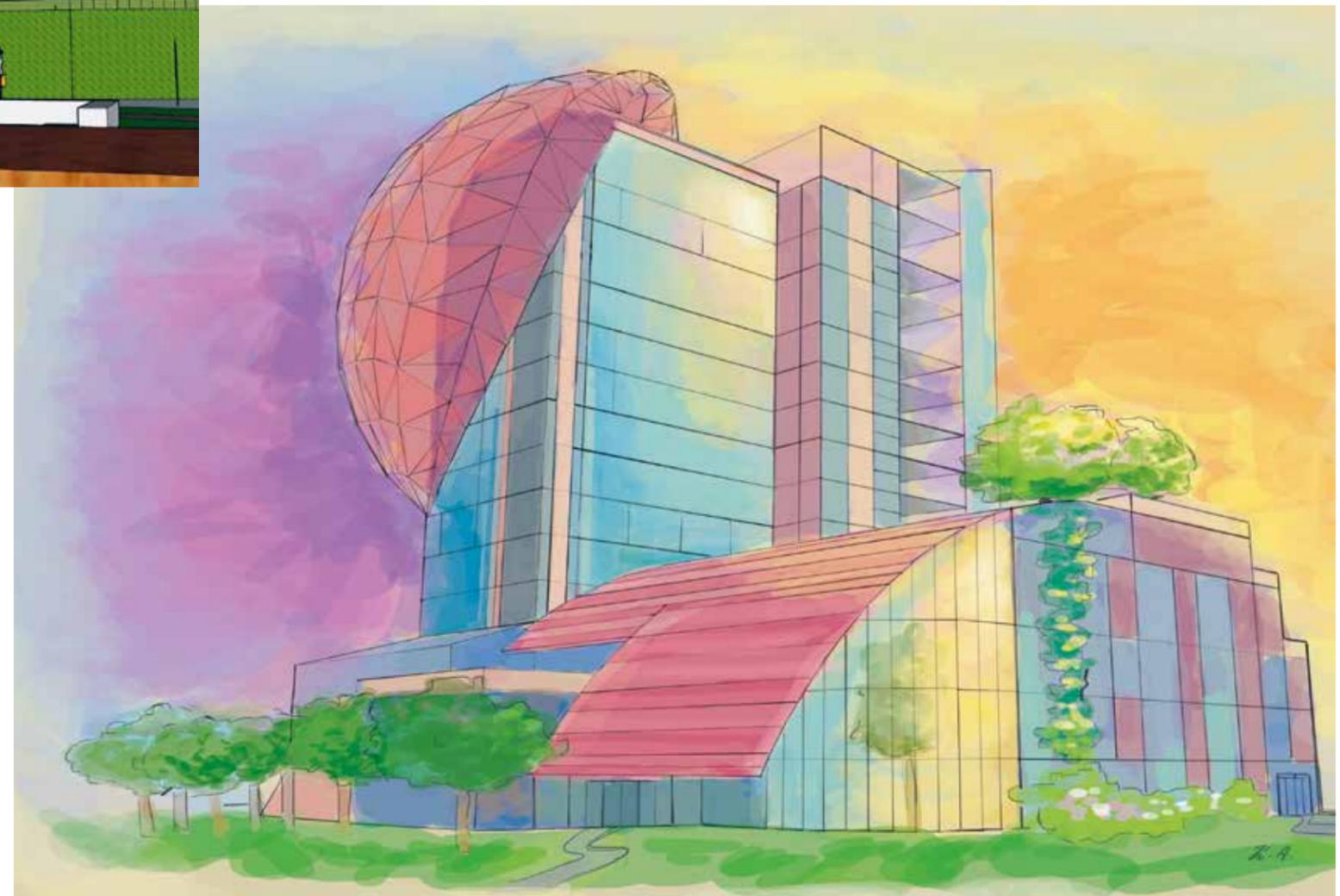


Sustainability

Some sustainable parts of our design include our ability to capture both solar energy, rain water, and wind, and to produce biogas, reducing our carbon footprint. However, we won't be completely independent in the beginning; we expect and plan to be able to update the most recent technology in the building as new innovations become available.

Lessons learned

By signing up for the Challenge, we have learned to work together as a diverse team, as well as learning to utilise a number of planning strategies enabling us to bring this major project to completion. We've also learned that creating highly sustainable new buildings, and, in particular, the remodelling of older buildings, is an extremely complex problem that requires insights from a diverse range of specialists.



A Natural Ecology: balancing programme, landscape and natural resources

I founded Van Bergen Kolpa Architects together with Evert Kolpa in 2000. Our philosophy is to engage with clients, stakeholders and innovators to create sustainable buildings with a natural ecology: programme (economy), landscape (space) and natural resources (social relevance); finding a natural equilibrium. Things are really rolling these days, there's great interest in getting food into the city, aiming for a green healthy city, not just in the Netherlands, but all over the world.

Close interaction

I think that from my perspective, in 2025 to 2050 we're talking about the realisation of the projects that are now on the drawing board.

There'll be a much closer interaction between city residents and their food in terms of distance; food will be integrated in the city, in its' buildings.

The future today!

Food is now becoming closer in a nutritional sense; it tastes better, but also in a didactic sense, as people become aware of how food is produced, but even in an emotional sense, as this leads to a green and healthy city. We're now working on a great project in Belgium that will be completely up & running in 2025 -producing food on the city's roofs: it's not that far away!

In Belgium we're looking at a substantial size of greenhouse on rooftops; 10,000 square metres, where research will be done on leafy and fruity vegetables. It's physically connected to existing buildings – but it's really a circular approach, with the city making use of all kinds of flows. Half of it will be different climate chambers for different vegetables – you can imagine that leafy vegetables will have different needs to fruity vegetables- and we also have a public domain, where the public can get in contact, and that's pretty unique. We work together with Inagro – the West-Vlaanderen research group, similar to what Wageningen does in Bleijswijk. We designed a new, very visible Agrotopia living-lab facility on the roof of the auction market in Rouselare in Belgium, the major vegetable auction location in Belgium. Its uniqueness lies in its combined function of providing direct links to the short chain, the people in the city, as well as to the longer chain horticultural connections – what we know as the more traditional stream of production and sales – from France to Germany.

We believe in parallel worlds – there's no single solution.

Bouquet of horticulture

There'll always be a diversity – a conventional one combined with innovational forms. Even in the conventional form, we also see a lot of innovation – so it's a bouquet of forms, but in the future there'll be a more direct link to the city. Touching on the innovational aspects, for us it's not

only the agricultural innovation, it's also the architectural and urban planning innovations that make up this bouquet. The Agrotopia project has public programming – so it becomes a public icon for the city. In itself it's an attraction, a highly visible steel and glass vision, and it communicates its important role in society by producing food. We're now 're-introducing' greenhouse architecture in an exciting new way into a publicly accessible building.

Bears on the path

At the moment, things are exciting with many experiments and pilots- take this Challenge as an example, and we're moving into pilots that are now being built.

However, we're doing a lot of this for the first time; it's very brave of our client to take on the risk of doing something new – it's a lot of money, and we don't know for sure that it will be successful.

The bear on the way is that people will not take the risk – basic economic risks. Some pilots are now stopping; don't forget that not all pilots work out – they can also fail. What we need to do is accept that and learn from why some project fail.

In our project, we introduce new risks by inviting the public to be part of it, which of course brings risk elements like disease and contamination of these very techno-

Jago van Bergen: Owner and co-founder of Van Bergen Kolpa architects

Jago founded Van Bergen Kolpa Architects with Evert Kolpa in 2000 as a firm specialising in Architecture for Food. Prior to this, Jago gained experience as project Architect for Anderson Architects in New York USA and Neutelings Riedijk Architects Rotterdam NL. He currently teaches and sets up research projects together with the Academies of Architecture in Amsterdam and Rotterdam, the Design Academy Eindhoven, the Berlage Institute and the Universities of Delft, Wageningen and Eindhoven and Universities worldwide. The firm has an international scope and has received several awards and nominations, including the Prix de Rome for urban design and landscape, Charlotte Köhler Prize, World Architecture Award, the Rotterdam Architecture Prize and the Hedy d'Ancona Prize for excellent health Architecture.

logical environments. We've designed solutions for this, so we have thought about this; but there are open areas – a 12 metre high greenhouse with a vertical farm – with public access – this is unique; don't forget that its already on top of an existing building.

Diversity is back

Horticulture is all about efficient production, keeping costs down, making high quality products available to the public.

Now we want to embrace a greater diversity that appeals to a diverse society.

For example in Rotterdam we have 177 culinary cultures, that's the beauty of the city. This is being celebrated in the diversity available in retail and restaurants, so there's this sociological aspect as well. Don't forget the 18th century paintings where you see a rich and diverse range of vegetable and fruit thanks to our trading skills. But after the war, we concentrated on producing a few items well, and that considerably reduced the variety available but made us incredibly efficient. We're one of the world's greatest food exporters, which is weird for such a small country. Now we're using the same technology to effectively improve our diversity.

Preach what I practice

When I look at my own development; it's a generation thing. Landscape architecture was in my family, as was a spatial interest in openness and connectivity But, let's

look at the world then: in the 70s there was a lot of emphasis on the environmental impact of what we're doing, and being vegetarian and vegan was really seen as alternative. Now these are mainstream. I expect new generations to take this further.

An architectural degree should be broader and consider aspects like food production and social needs.

I teach at many universities, and try to bring what I do directly into the classroom.



It's a beautiful day in the Bajes Kwartier. April is walking down the path towards the InTouch greenhouse to have a nice organic lunch with her friends. She passes the algae tubes in front of the building. A couple of teenagers are sitting on the specially designed tube furniture, playing chess.

She walks through the tower and gets a fresh orange juice from the ground-floor market and starts on her journey. She takes the red staircase and gets to the first floor. Then she follows the algae tubes to get to the following red location; this floor smells yummy. She passes through the common greenhouse on her way, and sees her grandmother picking tomatoes. Her grandmother loves to grow plants, to cook and to discover new recipes from her friends in the community kitchen and garden. She says 'hi' and moves on up to the next level, where she hears the noise of the goats and sheep while she's still on the escalator. She sees kids and their parents petting animals. She walks up the ramp to the next floor, where she feels the grass under her feet. On the next floor, a kid is having his birthday party and his friends are playing in the playground there. She uses the escalators and gets to the cave leading to the park. The study room next to the cave seems like a nice place for studying. A fresh breeze hits her face as she leaves the cave. She sits for a second on the park's hills and enjoys the view and greenery. She climbs the hills and gets to the next red staircase to visit the greenhouse and eventually to get to the restaurant and bar on the tower's uppermost floor.

USP: Healthy eating

The InTouch concept has been designed to revitalize people's emotional relationship between the world's different elements. Four main organisational relationships have been identified; the relationship between people, the link between people and the world, the relation of the people with the building, and the connection of the built environment to the world. We have included all four links in our design, so the result is a building that creates a strong sense of unity.

The tower has 15 floors and this makes it hard for visitors to see all its layers at once. By designing scenarios, visitors are led through each scenario, enjoying every corner of the tower. Visitors are encouraged to use the many escalators so they arrive at the top fit and fresh. The routing plays an important role by enabling casual encounters between different groups of people. The path, from bottom to top, is coloured red to make the way clear and instinctive to follow. The colour was chosen from the red LSC panels which cover the volume of the escalators lo-



cated on the northeast facade, in such a way that people's journeys inside the building are also visible from the outside.

The green and red algae tubes run through the building like a system of veins that emphasise the experience. These interventions ensure that visitors build a relationship with the tower. To connect people with each other and the world, the choice of the functions in the design brief were crucial. Therefore the building hosts many communal activities and activities in relation to nature, matching its architectural and technological design: it's completely aligned with the natural world and its surroundings.

Sustainability

One of the essential principles of InTouch is the creation of a building designed with a connection to its natural surroundings; there is no environmental burden. The building's original structure has been retained and designed in such a way that it consumes the least amount of energy. Its shape maximises sunlight for the growth of crops instead of using LED lighting, and the underground heating and cooling storage units create a circular system for stabilising the temperature. The ventilation is also partially aided by nature; by adding a park in the middle of the tower, the accumulated heat on the top floors is

Josien de Koning
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reduced. In addition, the building produces a lot of its own energy requirements by using waste transformers, the power nest on top of the tower, and the LSC and solar panels on the façade. The LSC panels are red and transparent so they generate energy while letting in the red wavelength most suitable for plant growth. The solar panels on the south façade create shade for the communal spaces that do not need direct sunlight, and which use the absorbed light to generate energy.

Lessons learned

Most of our team are architecture students, and therefore

we were unaware of the huge impact of urban agriculture on the environment and society. We believe this concept should be applied to many urban and architectural projects in the future, and we feel our responsibility to create this awareness among our fellow students. In the past year, we have learned how to organise a complex design project and to increase our comfort zones. We had many questions related to the fields of agriculture and business for which we had to find answers. All these difficulties have made our resulting design concept all the sweeter.



Less is more!

In the long term, it's all about feeding the city economically; I work for a bank so it has to make economic sense! We participate in all kinds of fascinating projects to see where urban farming will go, building information, analysing the resulting data, looking at technology.

At the moment I've yet to see really new viable ways of feeding the city... it's still better to produce stuff outside the city.

For example importing tomatoes from Morocco and / or Spain logistically and economically is still a better deal than growing tomatoes in the centre of Utrecht in a vertical farm.

Global Challenges

However, the world is changing fast. There's more awareness of the impact of climate change. This, combined with new methods and technology are changing our way of production. I think that it's important to realize that the major issues are far away from the Netherlands. For example if you look at the metropolitan area of Mexico city, with about 21 million people and growing rapidly... this is bigger than the total population of the Netherlands! So how do we feed these new city dwellers efficiently? That's the real issue.

We see the city of Mexico as a client, and we're working together with partners to develop supply chains to feed 2-3 million people. We're working on consortium-

building, aligning parties with shared beliefs, finding investors and looking at the future based on the product innovation side.

And yes – new ways of growing things on a small scale is really important! It provides the first innovatory steps and data that we can use to solve these major issues.

Technology is not enough

Where are we now? Technologically we see developments like vertical farms, rooftop farms etc. in the cities. We have wonderful initiatives like the 2022 Floriade in Almere with the theme, Growing Green Cities. But we think it's too early yet to prove a good business case. The Netherlands is a centre of expertise – certainly if you look at Wageningen University. Louise Fresco has already stated that, from a tech point of view, science can do it. From our point of view it's more about 'how do you do it'; how do you organize this for cities like Mexico.

So that's what really excites me about this Challenge. What I'm looking for is, how can we do more with less! It's the combination of small entrepreneurial initiatives that will start providing data, data and more data.

We really need to measure things.

The Rabobank has more than 80 researchers and experts working in the field of food and agribusiness. They are working together with the universities -not only 'green' universities, but also the tech. universities in the Netherlands and abroad. Our website is full of exciting projects, for example the effect of Blockchain on the food and agri-supply chain. We also organise our own worldwide challenge, Food Bytes, the discovery platform for F&A innovation.

Taking it to the next level

These challenges produce winners, often in the form of small viable business cases. For me that's not enough: it's about the next steps – when people combine the data resulting from these new ideas into packages that can be used by the farmers. Don't forget – our farmers are also active, they take a lot of innovations on board, however they don't have that much time to do extensive research. What they need is easily accessible information that can be used in practice.

An example of where less is more is incredibly important is water use. This year in the Netherlands has been exceptionally dry and there are problems with water management, but they're actually quite trivial. Don't forget that we can pretty much move water all around the country, and we hardly even use the water that's in the IJsselmeer! Our farmers already work hard to work with sustainable ways of water management including irrigation. But let's look at countries like Australia, the US or South Africa, where long term

Michiel Klompenhouwer: Head F&A Sectormanagement & Innovatie at Rabobank, The Netherlands

Michiel studied Environmental Economics at Wageningen University. Since then, he has worked in the field of Food & Agri Business for Rabobank in several roles. Between 2014 and 2017, Michiel led the Dutch corporate market team in the F&A sector and was responsible for strengthening local F&A teams and, more importantly, the challenge to create a point of contact for innovative companies in Rabobank. Currently he heads a team of 25 sector specialists in different industries across the F&A chains and on specific topics like Innovation and Climate. He is a jury member of the prestigious Rabobank Innovation Award and the Accenture Innovation award, and since March 2018, Supervisory Board member of Startlife.

drought – we're talking a number of years – has caused serious issues around water shortage and effective management. We've got projects going in California and Australia, but it's often based on the innovations and knowledge that take place right here.

So, the main pitfall regarding these urban green challenges is that, at the moment, traditional farming practices and logistics are still more economically viable.

Price is an issue

Price is always an issue! I see that consumers are unwilling to pay higher prices for innovative foods – I'm talking about the majority of people, not the few per cent who set and drive the trend towards higher quality food products because they can afford to – morally and financially. Even in the Netherlands, we have more than one million people who simply don't have that much to spend – they live at or below what we have defined as poverty level. And this holds, even more so, when you go outside the richer north-western European countries.

From a research point of view - we've made great steps. There are lots of ways to organise urban farming – greenhouses, vertical farms etc. The world's rapidly increasing population is driving us to find innovative food production and look at other than the traditional foods. Global pressure will speed up the current trends

a bit - but all initiatives will have difficulties scaling up; it's going to take us 10 years to make major steps forward.

The difference will come when we are able or forced to introduce the 'climate' equation into the costs of our products.

As long as we can fly in vegetables, fruit and flowers from all around the world without really paying for them, then the Spanish and / or Moroccan tomatoes will remain cheaper than locally produced ones.

Be knowledgeable

If I was to advise young professionals I'd say, apart from joining my group here at the bank, that I expect traditional players to move into this new industry.

We need the entrepreneurial types who are willing to bust their heads a number of times before they are successful.

In the complete agribusiness chain, for example in the area of cultured meat. I'd say be knowledgeable – work for several players in the value chain, form a knowledge network with entrepreneurs from other disciplines, and don't be afraid to take the next step.



Evergreen | The Evergreen Tower

Once the prison where the worst criminals of the Netherlands were locked up far from society, the Bijlmerbajes would no longer be recognizable to its former residents. By transforming the Bijlmerbajes into the Bajes Kwartier, Amsterdam is well on the way to accomplishing its mission to become a front-runner of sustainable building and living – the Evergreen Tower being its most important showcase.

Bajes Kwartier is a new community development that showcases Healthy Urban Living. Its residents will lead active lives in spacious green surroundings. The epicentre of this lifestyle of Bajes Kwartier is located in the Evergreen Tower. Whilst the entire neighbourhood subtly breathes sustainability and health, the Evergreen Tower enables residents and visitors to fully indulge in this lifestyle. As an embodiment of its name, the Evergreen Tower and its year-round green physique welcomes visitors and residents to a new, sustainable Amsterdam.

Evergreen: year-round benefits of nature

The six towers of the former prison have been a landmark since when they were built in the 70s. After the demolition of five of the towers, the Evergreen Tower will take over this role of honour. The Evergreen Tower provides a sustainable green living environment, only 15 minutes from the bustling centre of Amsterdam. From a distance, whether it be from the metro passing by, or from one of city's skyscrapers, the Evergreen Tower will catch people's eyes due to its three green Skywalks providing sky-high entrances to the Tower. The plants growing inside its smart climate chambers can be seen from all over the Bajes Kwartier thanks to the glass façades, an all-year-round evergreen vista.

On entering the Evergreen Tower, you encounter the Spiral, running all the way from the ground floor to the roof, producing fresh corn salad for the neighbourhood. The Spiral is a unique plant production system that combines food production with modern architecture. It is the spine of the Evergreen Tower, visible from every floor. A pedestrian spiral-shaped staircase encircles the plant spiral, providing a passageway to all 11 floors. Young corn salad plants are transplanted at the top, and continue their growth cycle until they are harvested at the bottom.

As you enter the tower on one of the skywalks, the entrance paths, made of re-used façades, will remind you of the building's former identity as a prison. If you look more closely, you'll see that every floor has a green belt; an L-shaped climate chamber producing all kinds of crops. The plant produce grown in the Tower varies with time, always responding to local demand, as well as to the latest developments in indoor plant cultivation.

Modularity: a basis for optimally adaptive plant production

Modularity allows small plant production modules that can be easily moved, connected and replaced, making production less static than in conventional large scale plant production systems. The modular system is designed to support many different crops. Over time, frequent visitors will see all their favourite fruits and vegetables grow, but will also be introduced to many they might never have heard of. The modular crop production is indispensable to the tower's continual greenness, helping people to reconnect with the way their food is produced.



The modular plant production system provides a unique opportunity for people to interact with the source of their food. Some of these chambers are accessible to Bajes Kwartier residents, providing berries and herbs to be picked as they wish; other chambers are only open to the professionals who intensively cultivate the highest quality of produce for the neighbourhood and for visitors.

The Evergreen Tower community

The Bajes Kwartier has been designed to exemplify community-based life in the city. The island characteristics, which once isolated the prison from the world, now feed a sense of neighbourhood unity. At the same time, the tower is open to the many tourists interested in a healthy and sustainable lifestyle. Flooded with visitors, the residents might lose their sense of community, so the Evergreen Tower enhances social cohesion among residents by providing attractive communal spaces.

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These spaces embody the core value of the Evergreen Tower: to bring people together, while encouraging a sustainable and healthy lifestyle. The Community Centre is designed as a comfortable meeting spot for residents, but also as a space to invite anyone interested in the Bajes Kwartier community lifestyle. The Evergreen Gym is a space to be active in completely green surroundings. The Floating Meditation Garden is an oasis of calm where residents can practice yoga, meditate or just enjoy the exotic plants and the dripping water – with an astonishing view.

The BajesCoin

In order to boost a sense of unity, as well as to encourage a sustainable and healthy lifestyle, the residents of the Bajes Kwartier use their own cryptocurrency: the BajesCoin. This quantifies their electricity use and generation, rainwater collection, and organic waste separation. The BajesCoin is a blockchain-based sustainable community currency, providing a time-driven, decentralised and secure system. From the moment residents move in, residents have a private BajesCoin account. They gain BajesCoin by using their resources consciously, and can spend BajesCoin on the many goods and services the neighbourhood offers.

The BajesCoin system can only be sustained by its users: it is a currency designed for, but also by the community's residents. Awareness is raised by regular community meetings to provide feedback on the system, workshops on use of the digital wallet, and small competitions among users. In this way, the Bajes Kwartier functions as a Living Lab for the social integration of the BajesCoin. The BajesCoin's function has to be continuously evaluated by the residents and updated accordingly in order to fulfil its potential to be the foundation of a socially coherent, environmentally conscious neighbourhood.

The Evergreen Tower is a unique form of value creation. Amsterdam has the potential market to embrace urban agriculture, and to bring urban people back to the source of their food. The Evergreen Tower embodies the opportunities to allow them to do so.. It is the showcase of a lifestyle that is gaining increasing attention by supplying fresh local food, supporting physical and mental health, and encouraging community interaction. The integration of all these themes, supported by the tower's circular business model in combination with the BajesCoin cryptocurrency, will create a unique experience for visitors from all over the world.



Brave new Amsterdam

About 4 years ago, Amsterdam was looking for new ways to find new, often technological solutions for the city's problems related to climate, infrastructure and urban green. The city's politicians acknowledged the fact that they didn't have the skills to identify, build and test solutions for these issues.

A consortium of Dutch and international universities (Wageningen UR, TU Delft and MIT) were asked to set up the Advanced Metropolitan Solutions (AMS) Institute, a living lab of academics, citizens and (business) stakeholders who set up research projects to create a deeper 'sense' of the city. The institute is located in the city centre, in the old 'Tropen institute' building, so we experience many of the issues ourselves while on our way to or at work!

Cool city

I think the AMS institute is best illustrated by the type of projects we work on. As an example: it's common knowledge that the temperature in a city is a few degrees higher than in rural areas, creating problems for older and/or ill residents, as well as liveability issues. So how can we cool the city by, for example, increasing urban greenness? Our project teams look at new planning concepts for development areas that will minimise temperature rise: we create planning tools and models that can

be used to calculate the benefits for project developers working in and around Amsterdam, and of course for other cities facing similar problems.

City food systems

The urban greenhouse challenge is therefore right up our street!

City food systems are typically not front-of-mind issues for city politicians, so a challenge like this brings new ideas and models and experimental solutions to the heart of the city: a vertical farm in an existing tower-building.

This does fit in with people's interests though: we are now more interested in locally produced, organic, high quality food, there is a greater awareness of the unnatural ways we do things, like flying fresh beans in from Africa. But Amsterdam and other cities also suffer from local issues, for example the serious congestion issues that result from stocking centrally located supermarkets and food shops.

Research partnerships

We're a research institute, so we work together with the city council, the province of Flevoland, Aeres, the local University of Applied Sciences, and various business initiatives in Almere to find new ways of achieving this target. The polder farmlands of Flevoland traditionally produce

One of our projects is working together with the 'new' city of Almere, just a few kilometres east of Amsterdam. We're looking at ways a regional food system can become more sustainable: the (hypothetical) target set is to ensure that 20% of the city's food needs are available from regional products.

mass crops like potatoes, carrots and onions for export, rather than the fresh vegetables, fruits etc, for direct consumption by the city's population, so we also include these stakeholders as they are crucial to the model's success.

Enthusiasm!

I notice that there are a number of pitfalls when we're dealing with issues related to city farming, vertical greenhouses etc. The first of these is that people are blinded by their own enthusiasm. Is inner-city food really fresh? If you remind yourself that air pollution is a major inner-city problem, then will the vegetables and other produce grown on rooftop farms actually pass food-safety legislations – is it really fit to eat?

So let's be sensible, stick to basics, and develop models that will ensure that our solutions are realistic.

Henk Wolfert: Programme manager research, AMS institute

Henk Wolfert is program manager research at the Amsterdam Institute of Metropolitan Solutions and responsible for the Vital City research theme, which addresses the issues of urban climate resilience, metropolitan food systems and healthy urban living. He was one of the initiators of the Flevo Campus and its scientific program The Feeding City. His main interest is strategic and applied research and setting up of living labs with both public and private partners. Besides, he is coordinator of the Wageningen Research program System Earth Management.

Reproducible

A vertical farm in an old prison tower block – wow – that must be the answer! But my second pitfall is: is it? Is it economically sustainable, now and in the future. How high are the energy demands here in the Netherlands to produce fresh food 12 months a year? So here again, let's look at the business model from all angles. An example that comes to mind that seems to work is a vertical farm in Oslo. Perhaps that makes sense there because under normal climatic conditions, they have a short growing system and it's dark in the winter. And, they do have very cheap energy, so perhaps a vertical farm there makes sense, but is the same concept reproducible to all cities?

Food systems are complex systems, they involve many stakeholders, and often revolve around deep-rooted cultural issues.

Deep roots

My background? Well, I was trained as a physical geographer in Amsterdam, specialising in river systems management in Wageningen. So that has little to do with the skills I use these days. So that's what I want to see in the future from our students. I'd like to employ 'bright' students, those who are motivated by the challenges of urban farming or inner city cooling, and can, I suppose, think 'out-of-the box' and work with other specialists to produce models and solutions.

So my advice to the new generation of students is that you have to have a holistic approach – you need to know how it all works before 'jumping' to solutions and advising others.



Growen'heim | Imprison the Prison

As you walk through the Bajes Kwartier and look around, your eyes are drawn to a structure that sticks out strangely from its surroundings: a tower that looks like an artefact from the past. As you draw closer and all the obstructing buildings fade out of sight, you see a tower enclosed in an impressive 14 metre-high glass dome. Standing right in front of it, only then do you realise that this dome is packed with dense vegetation. Intrigued by this, you enter via a ramp, and now you find yourself surrounded by banana and papaya trees and other exotic plants that you wouldn't think of finding in the middle of Amsterdam.

As you carry on and soak in the tropical feeling, you see the forest flowing seamlessly into the tower. You walk down the stairs, passing a floor with greenhouse-related necessities like a cool-cell and where you see people handling the harvested vegetables. When you reach the lowest level; you're surprised to find it's filled by a good dozen tanks, each with thousands of litres of water and hundreds of kilos of fish.

You then decide to carry on climbing and exploring the tower. You pass one hydroponic grow floor after another in what seems like a sea of green. Once you reach the top, the smell of freshly cooked lunch tickles your nose and whets your appetite. You shake it off and give in to your curiosity and climb the final steps to the rooftop, where you find yourself in yet another greenhouse surrounded by different crop varieties and by people working on their laptop or enjoying their meals. From up here, you have an awe-inspiring view over the Amsterdam skyline, which concludes your experience.

USP's

Our primary focus was to dedicate as much space as possible to the production of food. Our concept has eight floors of hydroponics systems combined with a 100,000 litre plus aquaculture system for commercial-scale aquaponics. The system ensures that our design is capable of producing substantial amounts of food on a daily basis, 365 days a year, without being reliant on the weather and/or other conditions.

The critical experience we sought to create is our tropical food forest, spanning more than 1000 square meters in total. It forms the main feature of the first two floors of the tower and the glass structure surrounding the tower. It serves as the intersection between productivity and co-existence with nature, and adds the capacity for tropical fruit production as well as providing a platform for education about food production and space for experiencing the wonders of a tropical forest.

The restaurant on the top floor is where visitors can savour the tower's produce and practice new recipes in the working kitchen. This is where educational courses are held on subjects like modern indoor farming practices and state-of-the-art research in the field of vertical farming, aquaponics and closed system food cycles.

The core of our resident interaction approach is a mobile app which provides many features to involve the community with the tower. The residents are able to vote on what grows in the next hydroponics cycle; a monthly newsletter provides information on the inner workings of the tower; and they can read about and sign up for the courses held there.

Sustainability

The recirculation of the majority of the nutrients inside the food we produce is the key to the sustainability of our concept. The Tower mimics a natural ecosystem, with all trophic levels represented. The food forest and hydroponics are the producers at the lowest level, the fish and the residents are the consumers, and the black soldier flies in the insect farm act as the decomposers, ensuring that little to none of the elements essential to life leave our system for good. Beyond that, the reuse of water is also an important part of our design, so we have included aquaponic systems in our solution.

Lessons learned

Given the fact that we are already quite knowledgeable and interested in the field of urban farming and food production in general, we became more aware of the many facets of what urban food production is, what is challenging about it, and how many like-minded people have come up with thousands of innovative ideas to solve the problems of today and the future.

As our respective skill sets were not ideally suited to the challenge, we learned a lot and gained insights into what we studied. We came to appreciate the achievements of a many professional fields, stretching from urban planning and hydraulic engineering, to ecology and social studies.

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Planning and organisation is critical: we tried to organise ourselves with a flat hierarchy approach, but that left room for diffusion of responsibility. However, it worked out in the end, and we have learned how to approach tasks more efficiently in the future.

The tropical food forest is the most important element of our design-experience.



Bohemian AvantGardeners | the AvantGarden

We're the Bohemian AvantGardeners. We set out to redesign one of the towers of the former Bijlmer Bajes prison in the heart of Amsterdam to feed the community living in the newly developed Bijlmer Kwartier. So we asked ourselves, "How do we build a resilient, involved community around the concept of healthy food production from the ground up, and whose members are directly invested in its survival?"

We started by creating a cooperative, B2COOP, to connect local people, farmers, and businesses. The AvantGarden forms the beating heart of B2COOP, where we grow and buy healthy food, learn new skills, find meaningful employment, celebrate, and connect with our community: the AvantGarden has been created by people for people. Winding through the building are a variety of multi-use social spaces for B2COOP members to join cooking classes, work in study rooms and hackerspaces, and to celebrate their lives.

Inside the AvantGarden, we have designed a holistic food web of mutually beneficial cycles of aquaponics, plants, mushrooms, and insects that are not reliant on any input other than local waste streams. When we harvest, we just head downstairs to the AvantMarket. The AvantMarket is like having a farmers' market in your neighbourhood all year round. Each stand in the AvantMarket tells the story of the farmer. B2COOP provides the space for the stand and B2COOP members and employees help to ensure everything works well.

We noticed the Netherlands is quite elevationally challenged, so we designed a path to the rooftop where you can relax with a fresh juice among the trees of our garden. It's our hope that the Bajes Kwartier will be the first of many eco-urban villages in Amsterdam... and around the world.

USP: Healthy eating

B2COOP is a multi-stakeholder cooperative for Bijlmer Kwartier residents, the AvantGardeners, other local farmers and businesses, working together to build lasting relationships based on fair prices and fair wages, forming a community in a common effort to provide the essentials for a healthy and fulfilling life. B2COOP is the legal organisation that embodies the ethical principles guiding the succession to a resilient community around the AvantGarden. The AvantGarden can be divided into several parts which meet the needs of the different people and activities we address in our community:

The AvantFarm: At the AvantFarm we produce essential nutrition, primarily for ourselves, the B2COOP community. We have sought to mimic nature by designing a holistic food web connecting independent, but mutually beneficial cycles of aquaponics, plants, mushrooms, and insects. To reduce the risk of connected cycles of aquaponics and plant production, our aquaponics specialist has designed an innovative two-loop system. The fish feed formula is custom designed to support our production. Its nutritional requirements are supplied in-house by our insect chamber, algae breeding and other supporting production.

The AvantMarket is where the harvest arrives to supply essential healthy food to the Bajes Kwartier community. The harvest comes from the AvantGarden, but not exclusively; we've designed our own production to complement, not compete with other local farmers. The AvantMarket has been designed as a year-round farmers' market.

Not a single space in the common area of the AvantGarden is used for only one purpose. Apart from those spaces that are accessible based on membership or rent, there are many public areas including 'The Hill' and the rooftop Permagarden Café. For those who cannot pay in monetary terms but have time to give, we've designed the B2Coin wallet, an innovative time/money scale of payment.

Sustainability

Sustainability is a fundamental aspect of how we have designed our production systems. If it's not sustainable in the long term, it's not worth doing. There are two major objectives for our production in The AvantGarden.

The first is to feed the Bajes Kwartier community. To do this, we do not use herbicides, pesticides or synthetic nutrients, we mimic natural systems by means of aquaponics; a truly circular production model. In this way, we manage to capture, supply, and circulate nutrients for our ecosystem while creating value in all its stages.

The second objective is to pass our knowledge of growing food and engaging the community on to our B2Apprentices

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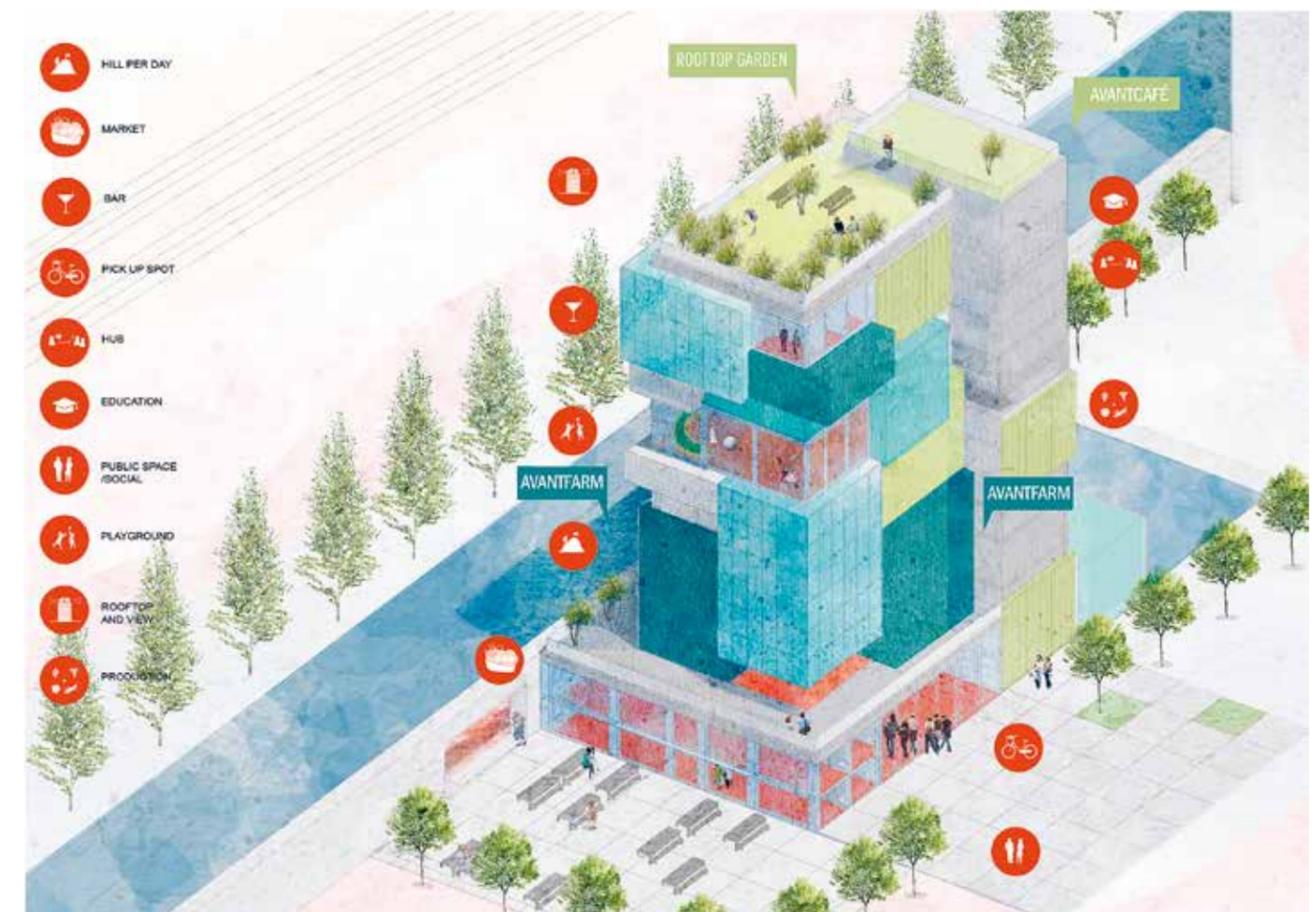
and the public. They in turn will then be able to respond and adapt to difficulties brought on by a changing climate and the unavoidable end to cheap energy. Although our model is designed specifically with the AvantGarden in mind, it is adaptable and easily replicable in just about any urban setting. We have designed the AvantFarm to be one of many viable urban food systems springing up throughout the world.

Lessons learned

'Cooperation is the basis of existing life systems and future survival.' It took us long to understand that we could not make it by each of us taking part here and there.

The moment we started truly cooperating, only then were our individual ideas shaped into a functioning and dynamic system.

We didn't know each other before starting this project. Coming from different backgrounds, we learned so much by sharing not only our knowledge, but also our abilities and life philosophies. We encouraged one another to challenge the status quo and think in terms of systems, not pieces. We see the world differently now. This challenge greatly extended all we knew and what we thought possible, especially by getting us to put our minds together.



Iconic redevelopment

So from my view as an architectural historian.

I look at the challenge designs in terms of spatial development, quality, and their place in the area. That's the first thing I like about the overall Bijlmer Kwartier project; it's not simply the concept of building green homes for an urban community.

In itself a great idea. It's also that the Bijlmer Bajes (the old prison) has been such an iconic feature of the area for so long, keeping one of the 6 towers preserves the area's identity. Luckily you see this type of 'identity retention' happening a lot in new urban development these days. And of course, redeveloping the tower as a vertical farm is enormously exciting!

Dynamic mix

I was on the redevelopment selection committee, and I personally always look for a project's added value.

We're talking about a new centre for an upcoming area very near the centre of Amsterdam.

A train station, and where the proposed housing mix should be slightly more af-

fordable than what is normal in Amsterdam these days. There'll also be a large student population, sports, a health centre, restaurants and offices, so it should also become quite a dynamic, mixed area. There's lots of green space, car ownership is actively discouraged, and the houses will be built according to our current ideas of sustainable living with regards to energy use; they won't even be on the gas network.

'Kluswoning'

Although it's not quite the same area, an example that I like is the redevelopment of the 'old' Bijlmermeer high rise estate- in the last 10-20 years most of the old 10-storey 'honeycomb flats' have been demolished and rebuilt in varied low-density housing zones with plenty of new amenities, good public transport connections etc. Here again greenness is valued, and the 'old mistakes' have been avoided.

But in my view - the heritage of the site is always important.

And one of the old flats, 'Kleiburg' was saved last minute and sold for 1 Euro by the housing association to a group of very entrepreneurial people who decided to renovate the building's basic structure and facilities like lifts, and invited the new residents to redevelop their apartment in the way they saw fit; in Dutch a 'kluswoning' - I suppose in English it would be a DIY home!

Creating Awareness

There are three main elements I'm looking for in this challenge. The first is 'creating awareness'.

One of the features of urban farming is that it helps people become more aware of where their food comes from.

To quote Carolyn Steale: 'how the city eats'. In the not so distant past, when I grew up in Arnhem, there was an urban farm ('stadsboerderij') nearby, and the farmer would come round to collect potato peel and other waste to feed his pigs - so we as residents were really aware of how the farmer and his farm worked for the city. So that's a major plus for this 'new' development!

Urban typologies

My second element is what I call 'urban typologies', where the concept of the area to be developed allows for a fully integrated lifestyle for the residents: in this case the combination of housing and space for urban agriculture; together these create the typology. As a historian, I look at the blocks of houses built along the canals in Amsterdam. They have huge gardens behind them - a sort of hidden secret - commonly used for gardens and leisure purposes. However, small areas are now often used to grow herbs, fresh vegetables, soft fruit etc. by the residents, once more - even if only on a small scale - bringing the knowledge of growing things

Aart Oxenaar: Director Monumenten en Archeologie, Gemeente Amsterdam
Dr. Aart Oxenaar is architectural historian and critic, specialised in 19th and 20th century architecture and urban development. He was founding coordinator of CAST, centre for architecture and urbanism in Tilburg; director of the Amsterdam Academy of Architecture - combining masterprograms in architecture, urbanism and landscape architecture - and, most recently, director Monuments and Archeology for the city of Amsterdam. As an advisor he chaired the committee for spatial quality (Welstand) in Amsterdam and Haarlem. He was a member of the tendercommittee responsible for the selection of plans for the redevelopment of the Bajes Quarter and Bijlmer prison.

back to the city. 'Volkstuintjes' (allotments) are an excellent example as well. But even if you only have a balcony, you can actually grow quite a lot on it; my son is now self-sufficient in fresh herbs - all grown on his balcony!

Middle Scale

Thirdly is the project's scale.

I'm looking for projects that better integrate people with the land and farming practices, projects that connect city and agriculture.

You actually only need to cycle a short distance outside Amsterdam to find farms, and there are many organic farmers selling their wares. This is embodied by the return of farmers' markets to Amsterdam: the Noordermarkt is now famous for its range of regional, organic food sold by the producers. Once this was the haven of the well-off foody 'hipsters' but no longer; it's now there for everyone. Food critics like Johannes van Dam (HetParool) have done a lot to bring local food back to the heart of the city and people's minds.

Circular skills

So, I'm looking for an integral way of designing, using intelligent mixes of skills and specialists to create new urban landscapes. These will be developed by teams who look at more than the buildings and the infrastructure, and who embody the three elements of scale, typology and awareness. So my advice to the graduates

We'll hopefully see the range of fresh local or regional vegetables and herbs extending into the supermarkets, reconnecting city dwellers with the seasons and their products, pushing out imported fresh foods flown in from all over the world.

of the future and those just starting their studies - don't do as was done in the 70s -80s, focussing on housing numbers, but look at what people are doing outside of your specialism and work with them in multidisciplinary and interdisciplinary groups to design answers to the issues of population growth, food production and the related elements of climate change. Develop new models, take risks, involve other stakeholders. Including banks and entrepreneurs, enter challenges like this one, and we'll be able to 'grow' new answers to the issues we've created.



Green Spark | From Root to Fruit

When you enter the tower, you first cross a beautiful indoor 'wetplant' that cleans the water used in the tower. On the same floor, you discover the tower's first food production facilities: this is where it all starts. Waste is given a new life and upcycled into food. If you walk into the production facilities, you'll see black soldier fly larvae, mushrooms, and biochar being produced; these are the foundation of the tower's ecosystem. Like a plant's root, these inputs are taken up and the process of transforming them into food begins.

You continue on your journey, taking the escalators to the next floor. There you see a bustling market full of fresh and unique produce sold by local farmers. There is always something new to try - black tomatoes, spicy peppers, or even seedlings which you can take away and grow at home. In the next layer, you'll find spaces for the many social activities, starting with a floor with a gym and space for classes and workshops to meet friends or learn something new.

Moving up to the third and fourth floors, you enter our botanical gardens, with space to meet and relax. We've planted many tropical species, and this is also where you'll find our algae reactor. Subsequent floors contain office space for startups, as well as open spaces to discuss ideas and showcase new innovations; all have a view on the plant production facilities so all our farm-related practices are visible throughout the tower.

Once you've reached the top, you pluck our metaphorical fruit: this is where you can enjoy the food we produce. Enjoy a bite at the restaurant, participate in the public kitchen, or join a workshop in our nursery - all with splendid views of Amsterdam and the new Bijlmer Kwartier.

USP's

Firstly, agriculture lies at the foundation of our society, and directly impacts each of our focal points. Green Spark's tower aims to be a hub for urban agriculture in Amsterdam, spreading a positive influence beyond the tower itself. Urban farms struggle to make a profit, and often this is due to a lack of differentiation. In our tower, we help local urban farms diversify their production by offering high value seedlings and supplying substrate and fertilisers. We also produce food crops, shrimps, spirulina, and oyster and shiitake mushrooms.

Secondly, the tower will become a vital organ contributing to the circularity of Amsterdam. It takes organic waste generated by the city and breathes new life into it, upcycling it into food, seedlings, biochar and fertilisers.



Lastly, Green Spark's tower aims to educate people from all walks of life about the principles of circular agriculture. Making people aware of our modern food production systems, consumption and waste is the best form of marketing. In this way, we support the growth and development of urban agriculture in the city.

Sustainability

In our system design, we have minimised the input demand and other external factors, while supporting production by multi-sourcing local waste streams. We have introduced aquaponics, mushrooms, and insects (AMI) to efficiently convert waste into high-quality food, replicating nature's own recycling process.

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Green Spark has taken the conventional AMI setup further by including shrimps and spirulina. Growing shrimps locally cuts transport costs and reduces harm to ecosystems in Asia and South America, where most shrimps are grown.

Soilless plant production systems usually leach water into their environment, causing eutrophication. In our tower, leach water is used to grow highly-nutritious spirulina. After that, any excess water leaving the tower goes through a biofilter, an indoor 'wetplant' in the entrance which works on the principles of phytoremediation.

This augmented AMI system is supplemented through a biodigester and pyrolyser. The biodigester uses black water to produce methane gas for heating. The resulting sludge is pyrolysed to produce biochar. When mixed with sawdust, biochar is an excellent substrate for plants - and once this substrate is used up, it can be used to grow mushrooms.

We have used as many of the tower's existing elements as possible, to ensure sustainable construction. Where possible, we have incorporated bio-based materials like wood into our design.

Lessons learned

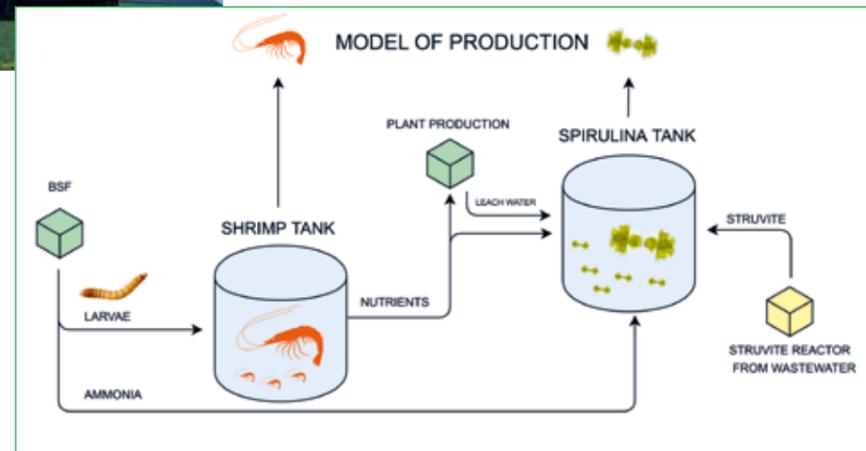
As we worked on the Challenge, we encountered many issues and found many solutions. To start with, during the ideation phase, we all realised how many different options there were when designing the ultimate urban greenhouse. There were seemingly infinite possibilities and roads to take. We learned to take decisions and go on with our choices, sharing and implementing ideas until achieving common approval.

Communication in a team of 15 people from different countries was a major task. Green Spark has members in the Netherlands, Italy, Germany, Ireland, and even the United States. Meeting in person - even if it only once - helped establish a more solid connection and human feeling within the group. We learned how to work efficiently and effectively, dividing our tasks, assigning roles to each team member, and establishing strict deadlines and goals.

Lastly, we learnt that the Greenhouse Challenge will never finish. This is just the first spark igniting the change towards a more sustainable future. Green Spark wants to be a leading actor.

Summarising, the Greenhouse Challenge was, well, quite a challenge. Absolutely worthwhile, though.

Multidisciplinary teams are always tough to coordinate, Yet Green Spark came up with a unique concept which will do more than food production in the tower itself; it will facilitate urban farming in the area by producing high value seedlings and offering support and materials to farmers.



Better than nature

We want to do things better than nature.

There are many urgent reasons for this. First and foremost, there's the problem of growing enough fresh, high quality, sustainable food and making it available to the rapidly growing urban populations in our rapidly expanding cities. To answer this, we need ever-higher production rates, and our production has to be highly controlled. So we can find solutions in systems like the vertical farms we are working on currently. They don't need much space and are indoors, they're not dependent on solar lighting, they're independent of outdoor conditions, and can produce 365 days a year: this all makes them a potential solution. Another advantage is that they can be placed in or near-by urban areas anywhere in the world.

Adding to what's there

Although high production rates can be achieved in vertical farms, they are mainly suited to growing fresh food crops; they cannot be used for growing bulk crops like soya and wheat etc. Vertical farming is simply too expensive for this, as these crops can be easily produced and transported in bulk. So in the next 30 years,

Vertical farms will grow significantly – I'm sure of that – they'll add to the current systems of open field farms and greenhouse production – these won't disappear!

I think vertical farm growth will be driven by factors like people's desire for locally produced food, from reduced environmental disturbance by, for example, sustainable reuse of water and other growth media, less transport is required, and less impact on land use. There's the additional advantage that everything can be controlled: the type of crop, the production quantities etc. to suit demand.

Improved quality

What I also find important is that we are able to produce higher quality products; products with a higher nutritional content.

Current farming systems are very dependent on uncontrollable factors, often climate related. Because in a vertical farm the climate is completely controlled – you can work on improving nutritional content.

You can pick the produce when needed and thereby improve shelf-life: at this moment many vegetables are simply thrown away because they have too short a shelf-life.

By producing all year round and on demand, there'll be much less wastage.

Current pitfalls

Vertical farms do however need large

amounts of energy, and this is an area we are currently working on; they will always need electricity in the future.

So energy use is a current pitfall as it mainly comes from fossil fuels.

Yes of course, we are able to energy in more sustainable forms; the use of PV panels, wind energy etc is growing but it's still expensive and relatively limited. Another issue related to this is the lamps we use to grow food in vertical greenhouses are expensive to manufacture; they are new and require high investments, so combined with the energy costs, vertical farms are expensive places to produce food. I'm convinced that in the near future, these current pitfalls will fade away – less energy will be needed, and the technical aspects will become cheaper.

Inspiring solutions

One of the projects that I think is a leading example is the GROWx vertical farm in Amsterdam. You see that they produce and deliver leafy vegetables and herbs directly for chefs' requirements in the local restaurants. Another Dutch project that I really like, although it's not a true 'urban' farm is the Staay Food Group facility – it's just starting. They will supply fresh vertical farm produced vegetables to their current clients, the German supermarkets. They produce fresh-packed ready to eat meal salads and similar products, and they currently buy in from all over Europe. Currently, they often have

Leo Marcelis: Head of Horticulture and Product Physiology Chair Group, Wageningen University & Research

Leo Marcelis is full professor Horticulture and Product Physiology at Wageningen University. Leo has 30 years of experience in experimental and simulation research on production, quality and physiology of horticultural plants in greenhouses and vertical farms. His main expertise is on physiology, growth and product formation of plants and plant organs. In particular fluxes of assimilates, water and nutrients in the plant, sink/source interactions and partitioning among plant organs in response to environmental growth conditions are subject of study. His research contributes to sustainable horticultural production while improving crop production and quality; this includes saving of energy, efficient use of (LED)light, efficient use of water and nutrients. He has (co-) authored about 160 scientific articles and 250 articles for growers or general public.

insufficient supply, poor quality, or even find things like insects in the food, so they want to focus on managing quality and availability by producing in their own vertical farms.

Black & white

As a teacher at Wageningen, I don't think we'll see dramatic changes in how we teach our students; we are already adding our knowledge of current vertical farming systems to our educational programmes. We prepare students for these new opportunities; they have to be able to analyse the situations and make choices.

There's no black and white solution.

They have to be able to draw evidence-based conclusions and look at the what is best for our future food needs.

So, technology won't solve all our problems: in the end as a horticulturist you have a profound knowledge of growth of plants – what does a plant need to grow optimally?

This puts technology in a secondary role, but there will be a greater need for our future graduates to work with, learn from, and integrate other people's knowledge and skills.



Photo: © Gea Hogeveen

GreenWURks | Open Bajes

Sustainability, a sustainable and healthy lifestyle, and community development are the core values that permeate our design. The Open Bajes design is embedded in the neighbourhood while simultaneously reflecting the human-biological relationship with nature. The Avatar Mountains in the Zhangjiajie National Forest Park are our source of inspiration for creating an open atmosphere: some of the original walls have been replaced by glass and solar panels, creating an open atmosphere while maintaining the prison's history and materials. The concept connects the history of the building with the innovations of the future.

Biophilia

The community plant production system that combines high tech production with people's participation. With our innovative plant production system, we will be able to feed all the 3000 residents of the newly developed Bijlmer Kwartier. Our system surpasses existing urban farming systems because it is both circular and modular. This means that our system runs on mist that sprays nutrients onto the roots of our plants. We use moss as a substrate: we produce and cut the moss into pieces so that it forms the new basis for our plants. Soil and water are no longer essential resources in this innovative and self-sufficient system. When vegetables are eaten and leftovers thrown away in the organic bin, we collect the organic waste and digest it into water, fertilizer, and even use it to produce electricity! In this way, we turn waste into food. Our plant production system will be open to the public, and should residents want to buy our fresh produce, they can either take out a subscription for doorstep delivery, or harvest the food themselves in our Open Market.

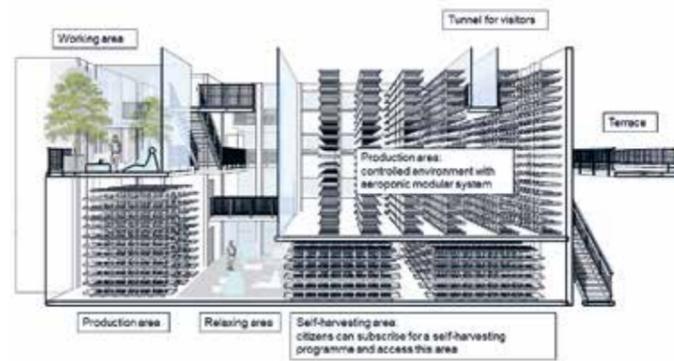
Rhythm

The App that embeds the Open Bajes in the neighbourhood. We envision the Open Bajes as a living lab, a collective learning community where the voice of the public continuously contributes to defining and shaping the building. To do so, we see the Open Bajes as an Amsterdam hotspot where people come together and learn about circular food production and consumption through experiencing and interacting with urban farming and nature. The Open Bajes will be an open and easily accessible space where social interactions are facilitated and encouraged by the building's design. Moreover, the building is equipped for functions such as workshops, art, and sports events. By designing the building this way, we aim to facilitate community development and promote a healthy lifestyle, thereby enabling a process of constant co-shaping of the building and, ultimately, its sustainability. To support the Open Bajes and coordinate its different functions, we will develop an app 'Rhythm' which

allows people to connect with the functions of the building and directly co-create their experience.

Simpli-City

The business model that creates value from the love for nature and people. Simpli-City is the business model that reshapes the role of customers by engaging them in the



continuous co-creation of value: we have designed the Open Bajes to be of the people, by the people, and for the people. Simpli-City is the basis for its revenue system and for customers to support the project's long-term feasibility. Moreover, we have envisioned a finance and investment system based on insurance companies and banks that will invest in healthiness bonds. In this way, we will not only be able to finance the Open Bajes project, but we will also support one of our main values: a healthy lifestyle. Finally, Simpli-City has been conceived to support to community development; without community engagement and the constant co-creation of the Open Bajes by the community members, we cannot ensure the project's sustainability. Hence, we have envisioned different solutions to facilitate community and collective identity: a complementary currency system, community members as shareholders of the Open Bajes, and other innovative solutions.

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Sustainability

Our priority is to reduce our input of resources by re-using resources and materials from the old prison buildings for the construction of the Open Bajes. Aligned to this, we will use moss as a substrate: growing it in our greenhouse means we will not have to purchase soil to grow our plants. Fertilizer, water, and electricity will be generated in the building using a bioreactor. Rainwater will be harvested to reduce water input from the mains. By using a mist system to spray our plants, we will reduce water usage compared to conventional irrigation systems. Our energy will be generated by solar and wind power. In addition, we will use an algae bioreactor façade. Most algal species are photoautotrophic and convert solar energy into chemical forms by means of photosynthesis. Moreover, when provided with nutrients, sunlight, and

CO₂, algae grow and produce new biomass which can be used in biofuels and bioplastics. Additionally, the produced waste can be used to generate biogas. Finally, we will investigate re-use methods for food, such as growing mushrooms on used coffee grounds.

We at GreenWURks are a devoted and multidisciplinary team from Wageningen University that believe in reconnecting people to nature. Combining our different perspectives within this challenges has not been easy, but we got there. Our determination and ambition to provide people with a bottom-up approach to experience food production and consumption has bonded us throughout this journey. A lot of late hours in our office, excursions, and doing surveys have bonded us and made us go beyond our usual perspectives on urban issues.



Creating new communities: The Bajes Kwartier – a 'Green Hot-spot'

The redevelopment of the Bijlmer Bajes, the former prison in Amsterdam is my latest project. I've worked on a number of new exciting projects in and around Amsterdam, however in this project, our team really brought something new to the table: a sustainably designed community transformation.

Growing needs

We tendered for the project with a multi-disciplinary team, looking at what we could achieve with this vast 135,000 m² 6-tower prison area. Of course housing is a primary need in Amsterdam, the rapidly growing urban population need places to live – affordable homes.

But the city of the future needs more than 'just' homes to live in.

To create a more circular environment for residents, we put forward ideas that include a blend of social housing, rented private accommodation and homes for private ownership. We also included a large student residence to house the growing number of students at Amsterdam's universities. But it also needed an added element – something that would really make a difference.

Green Tower

Neighbourhood identity is an important factor in people's lives, so although in our plans we will demolish 5 of the existing towers, we will retain one. And this is the essential element – to blend the existing

building with a completely innovative and forward looking concept: urban farming. We worked together with Jan-Willem van der Schans from Wageningen University to create plans for a vertical farm in the last remaining tower, we call it the Green Tower.

The Green Tower is a symbol of sustainability and healthy urban living, an underlying theme of the complete project.

It includes the latest technologies in energy production and storage, maximise waste reduction and encourage recycling. But more than that, it will also include the residents who can grow their own vegetables in specially reserved parts of the vertical farm. The Green Tower itself is open to the public: it's a combination of commercial and private enterprise, based on a completely circular model. It's my belief that this is the centerpiece of this huge project – both visually and innovatively.

Sustainable spirit

The other five towers will be demolished and we will develop the mix of housing described above.

Our aim is to develop a community, not just another residential estate.

The community will also provide health-care (The Health Centre) and childcare

facilities (CompaNanny), retail, hotels (Hotel Jansen) and restaurants, a gallery, as well as flexible office accommodation. Residents' sustainable living is stimulated with the Hogeschool Amsterdam's (Amsterdam University of Applied Sciences) Healthy Urban Living Lab – a place to design and explore what will make sustainable living work best for the community.

Inspiring communities

Well, another important aspect of the concept is the fact that the Bajes Kwartier is located close to the centre of Amsterdam and has a mainline railway station (Amsterdam Amstel) nearby. In line with the city council's plans to reduce the number of cars, our project actively discourages car ownership; there are limited parking spots, and we maximise opportunities for shared use of transport. We have designed the area to encourage cycling and other forms of low-polluting (electric) transport. In an effort to reduce needless energy input and encourage healthy living we have even kept lifts and escalators to a minimum, however of course the area caters well to those with special needs. Another special feature that I particularly like is the concept of shared gardens, to encourage the community spirit, as well as to create conditions for residents to grow their own vegetables, herbs, flowers and fruit.

Eva Hekkenberg: Managing Director of Bajes Kwartier Ontwikkeling C.V.

Eva Hekkenberg, is a graduate of Delft University of Technology. She has played a central role in the tender process of, among others, the redevelopment of the former Bijlmer prison, the Bajes Kwartier. Hekkenberg is currently Managing Director of Bajes Kwartier Ontwikkeling C.V., a consortium that will develop this new energy-neutral city district of Amsterdam. As development manager at AM, her main focus is on the acquisition of new projects in Amsterdam, and on innovative and co-creation development projects in the Amsterdam Metropolitan Area according to the AM business model I AM YOU. Eva was elected Amsterdam Real Estate Woman of the Year 2018 at the Amsterdam Real Estate Day, and regularly presents on conceptual themes for the real estate world and beyond.

Urban organic farm

We're doing similar things in other areas, though not quite on the same scale. In the Haarlemmermeer area south of Amsterdam, we are redeveloping the Wickevoort estate, where we will create what we call 'residential fields' located around the existing organic Hoeve Wickevoort (Wickevoort farm) farmlands. It's a tree-rich, green residential environment which also is designed to inspire community activities. It combines a very central location with leisure facilities like riding stables and a golf-course, and is water-rich environment.

Challenging deadlines

The current plans are to demolish the towers at the end of this year and start the development work in 2019, expecting to complete the major elements by the end of 2024. That's a challenge in itself. The development when completed will be home to approximately 1350 households.

We've learnt from the mistakes of earlier urban development projects, like the nearby Bijlmer area, and we're building a truly central-city 'Green hot-spot'.

We can test new energy technologies, keep waste to a minimum, and encourage healthy living. It will be a home to residents and children who will actually be able to see, feel and taste and grow locally produced vegetables and other foods. We

think this concept can be applied in many areas in Europe and the rest of the world, and of course it brings together a blend of skills; the developers of the future will have mixed disciplinary teams of people working to create innovate, sustainable concepts for new generations of city residents.



Partners about the Challenge



Rabobank

"Increasing urbanization and metropolis formation. The gap between producers and consumers. Exhausted agricultural land. These and many other themes are central to our 'Growing A Better World Together' mission to contribute to sustainable feeding a growing world population sustainably. That will not succeed by only focusing on improving the existing. Disruptive innovation is needed. The Greenhouse Challenge stimulates this disruptive innovation. We look very much forward to the process and its outcomes!"

Jacqueline Pieters - Head Banking for Food Inspiration Center (Rabobank)



we make it grow
www.klasmann-deilmann.com

"The challenge of metropolitan food production is a realistic future scenario, driven by increasing urbanization and technological possibilities allowing for new ways of food cultivation. Students get the chance to come up with creative solutions that have realistic social impact. As market leader in growing media, Klasmann-Deilmann is at the basis of growth, providing optimum rootzone conditions for plants grown worldwide. We challenge students to do the same, and think about circular and innovative ways of enabling food production in urban areas."

Sjors Beijer - Innovation Manager (Klasmann-Deilmann)



"The new energy-neutral neighbourhood Bajes Kwartier is fully dedicated to daring sustainability. We are giving this area of the former Bijlmerbajes a new destination in which health and the happiness of residents and users comes first. Together with the designers OMA, FABRICations and LOLA Landscape 'Bajes Kwartier

Ontwikkeling C.V.', a collaboration between AM, AT Capital and Cairn, develops a completely new, energy-neutral neighbourhood. One of the old prison towers will become very special: it will be a green tower with a vertical park and urban agriculture. We see the Green Challenge as a great initiative, fitting our ambition, from which we expect a lot."

Antoinette Wilmot and Eva Hekkenberg, MT Bajes Kwartier Ontwikkeling C.V.



"Focusing on urban themes such as water, energy, waste, food, data and mobility, AMS Institute focuses on developing a deep understanding of cities to research and design solutions for its challenges. The resilience of food systems in the Amsterdam

Metropolitan Area is an import topic for us. The WUR Greenhouse Challenge provides us with an exciting case study, aiming to create innovations for metropolitan food systems and improving a healthy and liveable living environment."

Arjan van Timmeren – Scientific Director (AMS Institute)

