URBAN AGRICULTURE WITH REUSED PVC

An inspiration catalogue

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URBAN AGRICULTURE WITH **REUSED PVC**







A simple internet search reveals that people all around the world have developed many creative solutions for how discarded PVC building products can be utilised in food production in cities. In the PVC industry we see great potentials in this trend. Although we recycle hundreds of thousands of tonnes of PVC every vear, many of the discarded products could be reused before recycling. In this way, the life of the products could be prolonged and thereby contribute to sustainable local food production. Imagine if your old gutter could be reborn as a lettuce bed, or if you could grow potatoes in a piece of pipe you picked up from a container at the recycling depot!

The purpose of this book is to inspire a more systematic approach to the reuse of PVC building products in urban agriculture. In actual fact, PVC is a material that is excellently suited to growing vegetables. It is long-lasting, does not rot like the wood one would normally use, and it was made to be in contact with water. Therefore, PVC is today the preferred material for urban agriculture all over the world, which is one of the aspects we cover in this booklet. It is also our intent to demonstrate that PVC waste, such as pipes and gutters, can be used in urban agriculture and thereby save resources.

In this booklet, you can read about our various partnerships contributing to the study of the potential for reusing PVC construction waste in urban agriculture. In collaboration with the second-largest public university in Denmark, Aarhus University, we have tested a prototype funded by VinyIPlus® and developed by architects Kaare Sølvsten and Maja Sønderskov, the outcome of which indicated that there are climate savings to be gained by reusing this type of waste. Furthermore, we have joined the City of Aarhus and Wavin in setting up a number of different prototypes in Aarhus to show the potential in using different types of PVC waste for urban agriculture.







Ole Grøndahl Hansen, General Manager, PVC Information Council Denmark, Copenhagen, 2019

Our idea of reuse has already gained a following: because the construction waste is free and available all over the world, nobody is excluded from building growing systems. This was emphasised when Maja Sønderskov received a sustainability award in 2016, where the jury pointed out that sustainability projects can be simple and inexpensive. The fact that the project has succeeded in bringing together many different stakeholders has also gained recognition: in 2017, the EU Commission's Climate KIC-programme recognised the project with an award, in part because we have involved industry, architects, designers, municipalities, and universities. Partnerships are particularly well aligned with the Sustainable Development Goal number 17 that emphasises that if sustainability is going to be achieved, partnerships are key.

It must be emphasised that the project is far from complete. Nonetheless, we are publishing this booklet to inspire city planners, councilmen, companies and citizens, and in this way we hope to get new partners involved in taking the project to the next level. As sustainability consultant in the City of Aarhus Christian Brødsgaard Eschen says in the booklet, the next step might be to create a distribution center, where citizens can get sorted PVC construction waste along with a guide to the easiest way to build a growing system.

With this booklet we hope that even more people can see the potential in reusing PVC in urban agriculture, and of course we are open to new partnerships. URBANISATION, LOCAL CROPS, AND THE CIRCULAR ECONOMY

In cities all over the world, city dwellers are getting into urban farming and grow crops locally on the terms of the city. The increasing share of the global population settling in urban areas is only reinforcing this trend. Urban agriculture is a natural consequence of urbanisation, which – especially in developing countries, but also in Europe – means that more and more of us live in cities.

GROWING CITIES: THE NEED FOR SUSTAINABLE URBAN DEVELOPMENT

The UN report "World Urbanization Trends" predicts that the world's population is increasingly settling in urban areas. The UN estimates that a full 66% of the world's population in 2050 will be living in urban areas, which is an increase of about 2.5 billion city dwellers compared to today. In spite of the fact that the vast majority of the massive urban population increase takes place in Africa and Asia, Europe is also experiencing significant growth in its number of city dwellers. In the wake of urbanisation, many challenges require city planners to think out of the box. Fortunately, this development also paves the way for many potential methods to develop "livable cities". It's about ensuring sustainable urban development that creates inclusive, safe, and climate proof cities in which people thrive. Many different factors have an impact on how successful the cities of the future will be. Urban agriculture is one of them.

URBAN AGRICULTURE: LOCAL FOOD PRODUCTION

Local food production in form of urban agriculture may be seen as a counter-reaction to the increased industrialisation that is changing global food production at a rapid pace. It is practically impossible for people to follow their food from farm to table when buying industrially produced foods. Additionally, when we insist on consuming seasonal items all year long, having foods oroduced on the other side of the world and shipped to our own country, we as consumers are leaving an unnecessarily high CO₂ footprint. Aside from potentially feeding part of the urban population, urban agriculture has many other positive side effects. When people living in the city grow crops in parks and on balconies and let city bees frolic on city rooftops, urban agriculture results in



IN CITIES ALL OVER THE WORLD, CITY DWELLERS ARE GETTING INTO URBAN FARMING.

greener cities, which has a positive impact on the climate. The mere visibility of greenery in the cityscape serves to remind us of the actual origin of our produce. If this also brings back respect for our planet's resources and the way we use them, then it is a winwin situation. There is also a strong social dimension associated with urban agriculture, as developing sustainable communities often involves locals joining forces.

THE CIRCULAR ECONOMY: ONE MAN'S TRASH IS ANOTHER MAN'S TREASURE

For years, environmental, social, and economic sustainability has been on the agenda of builders and politicians. As a natural extension of the sustainability journey of the construction industry, there is a strong focus on the circular economy. It makes good sense: a circular economy indicates that we do not just think in terms of cradle-to-grave in our materials consumption, but rather that we go one step further in thinking comprehensively and reuse materials or find new uses for surplus materials. Just as urban agriculture may be considered an expression of a modern version of the way our ancestors grew their crops, the circular economy may be seen as an expression of a return to the good practices associated with construction in earlier times. Historically, buildings have been our resource banks, and our cities were very much built with materials recycled from earlier structures. This was changed in step

PEOPLE ARE STARTING TO CONSIDER EXISTING BUILDINGS AND BUILDING MATERIALS AS **SUSTAINABLE RESOURCES** THAT CAN BE REVIVED.

with modernisation and with the need to erect new buildings at lightning speed – the quality of the materials used have caused many to consider these buildings and their components as waste. The circular economy is an expression of a meaningful change in our attitude towards building materials. Instead of seeing bricks, windows, and PVC as waste, people are starting to consider existing buildings and building materials as sustainable resources that can be revived.





BOSCO VERTICALE (VERTI-CAL FOREST) IN MILAN EX-EMPLIFIES HOW ARCHITEC-TURE CAN HELP MITIGATE CLIMATE CHANGE, REDUCE NOISE AND SMOG, AND IM-PROVE AIR QUALITY. 20,000 TREES AND PLANTS COVER THE TWO TOWERS.

FAO ON URBAN AGRICULTURE

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LOCALLY GROWN VEGETABLES REQUIRE LESS TRANSPORTATION AND THUS LESS COOLING, WHICH **PROTECTS THE ENVIRONMENT** AND RESULTS IN **FRESHER AND MORE NUTRITIOUS FOOD** FOR THE CITIES.

FAO is the UN Food and Agriculture Organization which works to combat hunger all over the world. One of their main efforts is the development of "urban and peri-urban agriculture", which they define as agriculture and husbandry in and around cities. FAO has identified several benefits of urban food production. Their efforts are focused primarily in third world countries – but even so, the benefits of urban agriculture apply to the western world as well. FAO emphasizes the following benefits of urban agriculture:

- Locally grown vegetables require less transportation and thus less cooling, which protects the environment and results in fresher and more nutritious food for the cities.
- Vegetables are particularly well-suited, as many vegetables have short growing times and are often ready for harvest within 60 days.

- Urban growing areas can be up to 15 times more productive than those in the country.
 For instance, an urban agriculture area of just 1 square metre can generate 20 kilos of food in a year.
- Urban agriculture can help avert food crises.
- The produce can be sold directly in places like city markets without wasting time on transportation, storage, or packaging.

1 SQUARE METRE CAN GENERATE 20 KILOS OF FOOD IN A YEAR.





URBAN AGRICULTURE WITH REUSED PVC

WHAT IS PVC?

PVC is short for polyvinyl chloride – also known as vinyl. PVC is made from salt and oil, and with an annual global production of almost 50 million tonnes, it is the third-most commonly used plastic material. PVC is a fixed part of our everyday lives. PVC pipes ensure water gets into and exits our homes, PVC gutters channel rain water, and in hospitals almost half of all medical equipment is made from PVC. PVC is also a prerequisite in the renaissance of vinyl records in recent years.



THE LARGEST SHARE OF THE PVC IS USED IN THE CONSTRUCTION INDUSTRY AS A **DURABLE** BUILDING MATERIAL.

PVC IN CONSTRUCTION

The largest share of produced PVC is used in the construction industry as a durable building material. Generally, we distinguish between rigid and soft PVC. In construction, rigid PVC is typically used for pipes, windows, roofing sheets, gutters, and for other products that are recyclable and have a lifespan of up to 100 years. Similarly, soft PVC is used primarily for construction products like vinyl flooring, roofing membranes, and cables.

PVC AND THE CIRCULAR ECONOMY

It is no secret that over the years, PVC has been subject to criticism. In response to this criticism, the European PVC industry has made a targeted effort over the last 20 years to direct production, use, and especially the waste management of PVC in an ever more sustainable direction. Specifically, there has been an ongoing effort to increase recycling. As a consequence, 4.2 million tonnes of PVC have been recycled since 2000 and the figure is growing every year.

You can read more about the PVC industry's journey towards sustainability – encapsulated in the VinyIPlus® programme – later in the book.



SAFE GARDENING IN THE CITY

When you grow vegetables in the big city, it can hardly be avoided that the crops absorb unwanted substances from soil and air. However, the quantities are so small that it is not harmful to health. As associate professor Jakob Magid of the Department of Agricultural Science at the University of Copenhagen says: "When the general health risks of living in a big city are considered, the risk of eating city-grown vegetables is negligible ... In an overall perspective, it is without a doubt beneficial that people grow their own vegetables. It provides fresh air, exercise and reestablishes the connection to how food is produced. These benefits must be weighed up against an extremely little risk."

https://www.bolius.dk/er-groentsager-dyrket-i-byens-trafikos-farlige-8037/



TOXICOLOGIST: ABSOLUTELY NO RISK ASSOCIATED WITH RIGID PVC WASTE IN URBAN AGRICULTURE.

Rigid PVC construction waste is normally divided into three waste categories: production waste, which is generated at manufacturing plants and often recycled locally; installation waste, which comes from the construction sites; and postconsumer waste. When it comes to the post-consumer products, there may be waste that contains a small percentage of heavy metals. To achieve long product life, for instance,



lead compounds were added as stabilisers before 2015. These compounds, however, are so embedded in the PVC plastic that they are not released to the environment. Among other things, this has been shown by the Danish Environmental Protection Agency in a study, in which I personally participated, where drinking water was analysed after flowing through 30-40-year-old underground PVC pipes. Thus, there is absolutely no health risk associated with reusing PVC products containing heavy metals in urban agriculture.

Dr. Lars Blom, toxicologist

Source: The Danish Environmental Protection Agency: "Field study of water supply pipes in plastic," Environmental project no. 1049, 2005, https://www2.mst.dk/udgiv/publikationer/2005/87-7614-863-7/pdf/87-7614-864-5.pdf

OUR IDEA

In the following pages you can read about our idea concerning the ways PVC building products can be reused in urban agriculture. It is a scenario that allows for the life of the products to be prolonged before recycling, which contributes to climate and energy savings and enables urban agriculture for everyone. Below, we illustrate the circular journey of PVC materials with a PVC sewer pipe as prime example.



PRODUCTION

Today, both new and recycled PVC is used to produce sewer pipes.

Plastic converting companies purchase PVC raw materials, which they process into pipes. This is done on socalled extruders, where the plastic raw material is heated and pressed through a nozzle that determines the dimensions of the pipe.



INSTALLATION

The PVC pipe is installed in buildings and in other places where piping is required.

When laying pipes in construction and landscaping projects, there will always be installation waste. The installation waste may consist of longer or shorter pieces of pipe.



USE

PVC pipes are typically used in sewer systems or to transport drinking water.

For many years, PVC pipes have been used in piping systems. They are durable, light, and require no maintenance.



WASTE

When the pipe has outlived its purpose after many years of service, it becomes waste.

When PVC pipes become waste, it often happens in connection with demolition where the pipe is not necessarily damaged. A pipe from demolition will typically retain its technical properties for many years.

WHEN PVC PRODUCTS ARE REUSED, **THEIR SERVICE LIFE IS PROLONGED.** THIS CONTRIBUTES TO CLIMATE AND ENERGY SAVINGS.



SORTING

A lot of PVC construction waste is sorted for recycling.

In addition to pipes, PVC products sorted for recycling are typically gutters, cable trays, and roofing sheets.



EVALUATING THE WASTE

Pieces for urban agriculture are set apart and sorted.

The PVC construction waste is now sorted for the purpose of using it in urban agriculture. The most obvious pieces would be pipes and gutters, but it is also possible to reuse other types of construction waste in plastic.



REUSE

The construction waste is now reused in growing systems for urban agriculture.

The construction waste can be used in hydroponic systems where no soil is used, as well as in simpler systems. There are many possible uses.



RECYCLING

After being used in urban agriculture, the PVC waste is recycled.

Once the pipe has outlived its usefulness in urban agriculture, it is sent to recycling. The pipe is crushed and can be used for production of new PVC building products — thus embarking on another round in the circular economy. URBAN AGRICULTURE WITH REUSED PVC

ARCHITECTS AND DESIGNERS GET INVOLVED

THE ARCHITECTS DISCOVERED THAT THERE IS **GREAT POTENTIAL** IN USING PVC CONSTRUCTION WASTE IN URBAN AGRICULTURE.

PVC INDUSTRY ENTERS INTO COLLABORATION WITH ARCHITECTS AND DESIGNERS

Back in 2015, PVC Information Council Denmark entered into collaboration with architects and designers Maja Sønderskov and Kaare Sølvsten. The purpose was to explore the possibilities of developing growing systems produced from PVC construction waste. The architects discovered that there is great potential in using PVC construction waste, such as pipes, gutters, cable trays, and roofing sheets, in urban agriculture. PVC has the right properties for hydroponics, a system where plants grow in water in a closed system without soil. The idea of a hydroponics system is to utilise the very properties that make PVC a top choice in construction. The system saves both water and resources, since used PVC building products are light and can tolerate contact with water – something that otherwise can pose a challenge in more traditional urban agriculture, where crops are typically grown in soil placed in wooden boxes that will eventually rot.





Architect Maja Sønderskov in the center, Dr. Martin Baitz, thinkstep AG (left) and Carmello Ricci, INOVYN.

"WHAT FASCINATED US ABOUT MAJA SØNDERSKOV'S PROJECT WAS THE **CLEVER REUSE OPTION,** WHERE THE TRANSITION REQUIRES A LIMITED EFFORT FROM THOSE INVOLVED." 18

PVC IN URBAN AGRICULTURE WINS SPECIAL AWARD AT THE INOVYN AWARDS

The collaboration transitioned naturally into the VinylPlus®-funded project "REUSE = WASTE Reduce – Sustainable urban agriculture with reuse of PVC," which explores the sustainable aspects of repurposing PVC construction waste in the development of a simple and functional growing system. Maja Sønderskov undertook an analysis of a prototype from reused PVC developed and designed by architect Kaare Sølvsten. Maja Sønderskov on the purpose of the study:

"My project treats the question about globalisation and increased population growth from a low-technological perspective. The initiative is an important step on the way to a sustainable future. When we examine the possibilities of reusing construction waste in urban agriculture, we are focusing on establishing a link between the resources embedded in the discarded PVC building products and the local communities, which currently lack options for growing their own crops in an urban environment. Hereby they can increase their mental and physical health, and get closer to nature."



Architects Maja Sønderskov and Kaare Sølvsteen.

URBAN AGRICULTURE CAN IMPROVE PHYSICAL AND MENTAL HEALTH AND BRING PEOPLE CLOSER TO NATURE.







The project is carried out by a partnership involving Maja Sønderskov, Kaare Sølvsten and PVC Information Council Denmark, and it has been honored with a sustainability award at the 2016 edition of the INOVYN Awards – a global competition celebrating the best, new, vinyl-based innovations worldwide. More than 70 projects from 17 countries were evaluated by an expert jury panel. Dr. Martin Baitz, president of thinkstep AP, member of Life Cycle Initiative under the UN's environmental programme UNEP, and representative of the jury, emphasised, among other things, the simplicity of the project:

"What fascinated us about Maja Sønderskov's project was the clever reuse option, where the transition requires a limited effort from those involved. Not only is the project appropriate for low-income groups, but the project also shows that sustainability is in fact something that also needs to take place on the local level." "NOT ONLY IS THE PROJECT APPROPRIATE FOR LOW-INCOME GROUPS, BUT THE PROJECT ALSO SHOWS THAT SUSTAINABILITY IS IN FACT SOMETHING THAT ALSO NEEDS TO TAKE PLACE ON THE LOCAL LEVEL." AARHUS UNIVERSITY TESTS PROTO-TYPE FROM ARCHITECTS

"THESE SYSTEMS MAY BE A GOOD OPTION FOR PEOPLE WHO ARE LOOKING FOR AN INEXPENSIVE SOLUTION THAT ENABLES THEM TO GROW VEGETABLES WITHOUT HAVING A GARDEN."

AARHUS UNIVERSITY EXPLORES SUSTAINABILITY ASPECTS OF PROTOTYPE

After the development of architects Maja Sonderskov and Kaare Sølvsten's prototype, PVC Information Council Denmark entered into collaboration with professor Marianne Thomsen from the Department of Environmental Science at Aarhus University in 2017. The purpose of the new partnership was to explore whether the prototype was, in fact, a solution that could be characterised as sustainable. The idea won an award at the EU-financed Climate-KIC Nordic Ideation Day, where various sustainable projects are presented to a group of environmental scientists. The award made possible the continuation of the project.

Ph.D. student at Aarhus University Daina Romeo was tasked with studying whether growing crops in PVC waste is sustainable from an environmental and economical perspective. The prototype was set up at Aarhus University, where for a period of 70 days, various vegetables were grown while collecting extensive data. The outcome is very positive: by growing vegetables in reused PVC rather than in new, greenhouse gasses



are reduced by up to 70%, and the yield from agriculture in PVC was also evaluated as high. In her report conclusion, Daina Romeo writes:

"Reusing PVC construction products for agricultural purposes is a promising way to "slow the flow", which is one of the critical steps in the direction of the circular economy. Normally, this resource is discarded before the end of its usable life, which is about 100 years. By reviving the products, the usefulness of the PVC material is maintained, whereby it can continue to benefit people."

In conclusion, Daina Romeo points out that one of the advantages of using PVC construction waste for agriculture is the flexibility of the system: "Therefore, these systems may be a good option for people who are looking for an inexpensive solution that enables them to grow vegetables without having a garden."

At the EU-funded Climate-KIC award ceremony in Aarhus, 2017. From the left: Ole Grøndahl Hansen, General Manager, PVC Information Council Denmark, Daina Romeo, Ph.D. student, Aarhus University, Tobias Johnsen, VinyIPlus®, and Marianne Thomsen, professor, Aarhus University. THE CITY OF AARHUS REUSES PVC FOR URBAN AGRICULTURE

THE CITY OF AARHUS IS ACTIVE WHEN IT COMES TO EXPLORING THE OPTIONS FOR **ESTABLISHING URBAN AGRICULTURE IN A MAJOR CITY.**

COLLABORATION WITH AARHUS MUNICIPALITY

The next step became a partnership between the City of Aarhus, the plastic pipe producer Wavin and PVC Information Council Denmark. Their goal was to establish an urban garden in the city of Aarhus made of reused PVC.

The City of Aarhus is active when it comes to exploring the options for establishing urban agriculture in a major city. Christian Brødsgaard Eschen, a sustainability consultant in Aarhus, states that the municipality is greatly interested in the interactions between municipality, industry, and the local community, and that this is precisely why they have participated actively in the project of reusing PVC construction waste in urban agriculture. "This project represents a great story about how companies that generate waste try to utilise this waste instead of allowing it to end up in places like the incineration plants. When waste is made useful in urban agriculture it means less consumption, and thereby reduced impact on the climate," says Christian Brødsgaard Eschen.



IN PARTNERSHIP WITH PVC INFORMATION COUNCIL DENMARK AND PLASTIC PIPE PRODUCER WAVIN, THE CITY OF AARHUS HAS ESTABLISHED A PILOT URBAN FARM WITH PVC.



When it comes to solving the challenges inherent in collecting the right pieces of PVC waste suitable for urban agriculture, the City of Aarhus has considerable experience to draw on. The City runs the ReUse distribution center, where the waste of one citizen finds useful purpose with other citizens. "I think it would be ideal if there were a similar 'distribution central', where citizens can go to receive sorted PVC construction waste. which they can then use in constructing their urban gardens," says Christian Brødsgaard Eschen. Eschen also sees potential in the fact that in the long term, social-economical companies may develop that will provide an alternative form of work: citizens would be employed to produce and sell attractive vertical urban agriculture systems. In this way, citizens who for whatever reason would not want to take on building their own systems could take part in sustainable food production.

So far, the partnership between PVC Information Council Denmark, Wavin, and the City of Aarhus has resulted in establishing the first urban PVC garden in Aarhus. It is in Aarhus Sydhavn, where Skraldecaféen (the Garbage Café) is also located. Meeting with the City of Aarhus, 2017. From the left: architect Maja Sønderskov, sustainability consultant Christian Brødsgaard Eschen, the City of Aarhus, and Tobias Johnsen, VinylPlus[®].

"I THINK IT WOULD BE IDEAL IF THERE WERE A 'DISTRIBUTION CENTRAL', WHERE CITIZENS CAN GO TO RECEIVE SORTED PVC CONSTRUCTION WASTE, WHICH THEY CAN THEN USE IN CONSTRUCTING THEIR URBAN GARDENS," SAYS CHRISTIAN BRØDSGAARD ESCHEN, CITY OF AARHUS.



THE CITY OF AARHUS HAS THE REUSE DISTRIBUTION CENTER WHERE **THE WASTE OF ONE CITIZEN FINDS USEFUL PURPOSE WITH OTHER CITIZENS.**

Skraldecaféen is a cooking community that focuses on cooking, food poverty, and food waste. In an area in the middle of the city, a large number of PVC pipe pieces are set up (production waste from Wavin). In those pipes, different vegetables will be cultivated, such as potatoes, tomatoes, and various herbs





SUSTAINABLE CROPS AND URBAN AGRICULTURE

URBAN AGRICULTURE IS VERY BENEFICIAL SEEN FROM AN ECONOMIC PERSPECTIVE. AND ONCE YOU HAVE A TOMATO, A CHILI PEPPER, OR A CUCUMBER, THEN YOU HAVE THE OPPORTUNITY TO KICK-START A CYCLE FROM CROP TO SEED TO CROP.





Vegetables in urban agriculture are both sustainable and wholesome, and depending on one's level of creativity, they can be included as natural ingredients in a diet of high culinary quality. Among the countless crops that can be grown in urban gardens, one is originally from the Andes, and it is one of the world's most cultivated crops.

SOLANUM TUBEROSUM AKA THE POTATO

The potato is one of the few plants a human being can survive on if unable to procure other food, and unlike many other plants, the potato is extremely easy to grow. Potatoes can grow in any container, as long as it is at least 30 cm wide and deep and equipped with a good drain hole. A piece of used PVC pipe is perfect for growing potatoes. Potatoes must sprout before planting, which can be done in egg cartons. Once the sprouts are a few centimeters long. four potatoes are placed in the PVC pipe. The soil must be about 20 cm deep, as the sprouted potatoes are covered with 10-20 cm soil. Nature will then take its course, and when the plants are blooming, the potatoes are ready to be dug up. The potato can be prepared in many different ways, and they have a very long shelf-life, as long as they are stored in a breathable sack in a cool, dry place.

A PIECE OF USED PVC PIPE IS **PERFECT FOR GROWING POTATOES.**

CIRCULAR CROPS

Urban agriculture is very beneficial seen from an economic perspective. Once you have a tomato, a chili pepper, or a cucumber, you have the opportunity to kick-start a cycle from crop to seed to crop. As such, the reused PVC construction waste is not the only element that is part of a circular system in urban agriculture; so are the cultivated crops. **CASE:** REFARMERS AND REINVENTING LOCAL FOOD PRODUCTION IN LYON

THE MISSION OF REFARMERS IS AS CLEAR AS IT IS MEANINGFUL: "IF ONE HAD TO CHOOSE, WHO WOULDN'T PREFER TO EAT FRESH, LOCAL, AND SUSTAINABLE FOOD?"



In a green spot in Lyon, France, sits a greenhouse. It is not a typical greenhouse: inside are rows upon rows of shining, white PVC profiles, in which grow colourful flowers and fresh herbs. The greenhouse is operated by the company Refarmers, established in 2015 by Eric Dargent, a local sustainability activist. Dargent has dedicated his professional life to reinventing, further developing, and spreading the word about local and sustainable food production.

RESEARCH GARDEN AND DEMO PROJECT

Refarmers pursue their ambitious goals in two ways. First of all, they offer consulting services for making the most of growing crops locally. To this end, they have, among other things, established 'La Petite Ferme du Grand Lyon' (the small farm in Greater Lyon), which is a combination of a research garden, a demonstration project, and urban agriculture. From this small farm, produce like herbs and lettuce is grown for local restaurants, of which one boasts a Michelin star. In addition, Refarmers facilitate Upstart University, an online platform that teaches future farmers how to get started with growing crops locally –

REUS

in terms of both the actual food production and the business potential of urban agriculture. "It is our mission to help people get started in urban agriculture and enable them to make a living out of it – regardless where they live or how much space is at their disposal", Eric Dargent explains.

PVC MAKES IT GROW

Food cannot be produced without the right tools. This is why Refarmers, as their other leg, runs the European agency for an American growing system that is vertical and scalable. The system is built up around UV-resistant PVC profiles combined with recycled PET bottles. It can be used practically anywhere - whether you want to grow crops vertically, establish a larger, local indoor food production, or grow produce on a roof in the very heart of the metropolis. In order to optimally exploit natural day light, the PVC profiles are shiny white. This allows them to reflect sunlight onto the plants that are not receiving sufficient sun, such as those placed behind the first row. This makes the system extremely space-saving and ideal for growing many crops in a smaller area.



REINVENTING LOCAL FOOD PRODUCTION

The Mission of ReFarmers is as clear as it is meaningful: "If one had to choose, who wouldn't prefer to eat fresh, local, and sustainable food? Modern agriculture, however, is based on large scale and monocultural cultivation methods that are also very resource-intensive. Refarmers is about reinventing local food production and producing nutritious and fresh foods where people live. By utilising resources in the smartest way possible and eventually using

IN ORDER TO EXPLOIT NATURAL DAY LIGHT OPTIMALLY, THE PVC PROFILES ARE SHINY WHITE.



only local and sustainable resources, such as recycled biowaste and renewable energy, we will transform the production of local food. An ambitious mission, which we are working hard to live up to – one step at a time", explains Eric Dargent passionately. URBAN AGRICULTURE WITH REUSED PVC

CASE: LOCAL FARMS FEED THE CUBAN PEOPLE

MORE THAN 80% OF THE FOOD PRODUCED FOR THE RESIDENTS OF HAVANA IS NOW GROWN LOCALLY.

Harris Junior Interneting

Urban agriculture has turned out to be a critical factor for the ability of Cubans to support themselves after many years of depending on financial and material help from the Soviet Union. During the Soviet era, Cuba primarily grew sugar cane for export - a monoculture that made the country highly dependent on food importation. With the collapse of the Soviet Union, the country faced a serious food crisis that resulted in its citizens losing an average of 9 kilos over a period of two years.

For more than 20 years, married couple Vilda Figueroa and José Lama have worked on developing the Cuban understanding of local food production, so as to have access to inexpensive and nourishing food year-round.







They have accomplished this by organising courses, publishing more than 20 books, and running a radio show that has successfully changed the formerly unhealthy eating habits of the Cuban people. In addition to teaching Cubans how to grow their own food, the couple has spent two decades teaching their compatriots about natural storage techniques, so that they can consume seasonal foods year-round. This makes food production hardier in the face of climate shifts, and has contributed to a quintupling of the Cuban vegetable consumption since the food crisis. Proyecto Communitario Conservación Alimentos (Community Food-Preservation Project), as their project is called, has resulted in more than 80% of the food produced for the residents of Havana now being locally grown. **CASE:** FISH FARMING AND AGRICULTURE COMBINED AT AQUAPONIRIS IN BRUSSELS

THE SMALL RESTAURANT SERVES A MENU BASED ON THE PRODUCTS PRODUCED IN THE SYSTEM.

IRE WITH REUSED

In the courtyard of Village Partenaire in the heart of Brussels, a fascinating pilot unit was installed in 2012. It serves to demonstrate how fish farming can be combined with growing vegetables in cities of the future. This kind of system is known as aquaponics, and it is wellknown in urban agriculture. It is a simple matter of combining fish farming with growing vegetables. The excrements of the fish become fertiliser for the vegetables, and the vegetables clean the polluted water, so it can be cycled back to the fish. This saves water resources.

PVC pipes play a central role to the project: as the main material used, they transport the water through the system, and are also used to grow the plants. According to the organisers,



the purpose of the installation is dual. First and foremost, they aim to demonstrate that it is possible to control the operations of a unit like this, thereby becoming self-sufficient in



procuring wholesome foods that are produced locally. Secondly, they want to attract public attention for the purpose of educating those city residents that may be interested in setting up their own unit.



THE EXCREMENTS OF THE FISH BECOME NUTRITION FOR THE VEGETABLES, AND THE VEGETABLES CLEAN THE POLLUTED WATER, SO IT CAN BE CYCLED BACK TO THE FISH. The project grows a wide variety of vegetables, such as lettuce, cabbage, tomatoes, and peppers. As for the fish, Belgian carps were the deliberate choice, because they are resistant to temperature changes and easy to source locally.

The project is connected to a small restaurant that serves a menu based on the products produced in the system: fish soup, smoked carp, tomato salad, and mint tea.

CASE: PVC TOWERS IN SINGAPORE

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THIS PVC MAZE ON TOP OF A LARGE PARKING STRUCTURE IS ACTUALLY AN **URBAN FARM** SITUATED IN ONE OF THE BIGGEST CITIES IN THE WORLD.





More than anything, it looks like a complicated maze of white plastic pipes that twist and turn, in and out and up and down. But this PVC tower on top of a large parking structure in Singapore is actually an urban farm in the middle of one of the biggest cities in the world. The so-called Growing Tower was built by Citiponics, and the founder, Mr. Teo Hwa Kok, is focusing his efforts on combining sustainability with the circular economy. With a concept that has spread to both China and Malaysia, he grows vegetables and herbs in the middle of major cities. The crops are planted in growth towers built from PVC pipes, and the soil in the pipes is fertilised by a nutrient-rich liquid that is pumped to the top of the tower – from here, gravity takes care of the rest. The system is called Aqua Organic System (AOS) and is developed to optimise sustainable food production: among other things, it is pesticide free, conserves space and energy, and utilises every single drop of rain. The constant movement of the water means that mosquitoes don't lay eggs, thus preventing the spread of tropical diseases. The mission of Citiponics is as simple as it is compelling: to produce healthier and safer vegetables in the most sustainable way possible. Overall, Citiponics has more than 150 growth towers, each with a lifespan of about 20 years, which produce a wide variety of crops, such as lettuce, dill and spinach. THE PVC INDUSTRY'S JOURNEY TOWARDS SUSTAINABILITY THE EUROPEAN PVC INDUSTRY HAS BEEN RECOGNISED BY THE EUROPEAN COMMISSION AND THE UN FOR ITS **VOLUNTARY COMMITMENT TO SUSTAINABLE DEVELOPMENT.**

As PVC is the most used plastic material in building and construction, the PVC industry has naturally focused on sustainable development for many years. The first step was to establish Vinyl 2010, a programme that united the entire value chain of the European PVC industry, from producers of raw materials and additives to PVC converting companies and recyclers. Vinyl 2010 set a number of ambitious sustainability targets. After ten years, the partners of Vinyl 2010 announced that all targets had been met. However, Vinyl 2010 was just the beginning of the sustainability master plan of the PVC industry.

VINYLPLUS® AND THE CIRCULAR ECONOMY

The PVC industry's concrete sustainability goals are manifested through VinylPlus® - a voluntary sustainability programme that entails a paradigm shift to a holistic, circular way of thinking. VinylPlus® has developed initiatives for how PVC can contribute to a sustainable society, where economic growth and human welfare go hand-in-hand with reduced consumption of natural resources.

FIVE CHALLENGES ON THE JOURNEY TOWARDS A SUSTAINABLE PVC INDUSTRY

VinylPlus® was developed in collaboration with the environmental organisation The Natural Step, which specialises in advising businesses in sustainability. The Natural Step functions as a 'critical friend,' helping, challenging, and making sure that the PVC industry moves in the right direction. Based on The Natural Step's proven approach to sustainable development, five challenges have been identified for PVC: 1) controlled-loop management, 2) organochlorine emissions, 3) sustainable use of additives, 4) sustainable use of energy and raw materials, and 5) sustainability awareness, which means that VinylPlus® is committed to promote sustainability to the rest of the world.



The European PVC industry environmental achievements.

THE SUCCESS OF VINYI PLUS® IS **BASED ON MEASURABLE TARGETS** AND DEADLINES

One of the reasons for the success of VinvIPlus® is measurable targets and deadlines, to which the involved parties are committed to pursue and observe. One of its most important targets is to annually recycle 800,000 tons of PVC waste by 2020. This number should be considered in the context of the 640.000 tonnes of PVC that were recycled in 2017. Another VinylPlus® goal is to reduce energy consumption during the production of PVC by 20%. Progress for the individual goals is published in an annual progress report, which is independently audited and verified by third parties.

Since 2013, VinylPlus® is a member of the UN Green Industry Platform, VinvIPlus® is now registered as a SMART partnership on the UN Partnerships for Sustainable Development Goals Platform and as Good Practice on the EU stakeholder platform for circular economy. VinyIPlus® has been recognised by the UN and the European Commission for the achieved results. According to Gwenole Cozigou, director, Circular Economy, DG Grow at the European Commission, "VinylPlus® can be considered as a frontrunner for the circular economy".

And. Christophe Yvetot of the UN Industrial Development Organization (UNIDO) has stated that "the vinyl industry can actively contribute to the global sustainability agenda through its continuous efforts to reduce its environmental and climate footorint and to develop new oreen products, services and jobs that will support a more sustainable world."

PVC recycled within the Vinyl 2010 and VinvIPlus[®] frameworks

800.000 tonnes Tonnes PVC 650000 600000 550000 500000 450000 400000 350000 300000 250000 200000 150000 100000 50000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2020

VinvIPlus[®] has an independent Monitoring Committee composed of representatives of the European Commission, European Parliament. consumer organisations. trade unions. academia and industry.

2020 target:

The Monitoring Committee plays an active role in evaluating VinylPlus®' actions and initiatives, provides advice and stimulates the industry to rise to new challenges in sustainable development.

"VINYLPLUS® CAN BE CONSIDERED AS A FRONTRUNNER FOR THE CIRCULAR ECONOMY," GWENOLE COZIGOU, DIRECTOR, CIRCULAR ECONOMY, DG GROW, EU COMMISSION.





OUR PARTNERS

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About VinylPlus®

VinylPlus® is the Voluntary Commitment to sustainable development by the European PVC industry. The programme was developed through open dialogue with stakeholders, including industry, NGOs, regulators, civil society representatives and PVC users. The regional scope is the EU-28 plus Norway and Switzerland. For more information: vinylplus.eu



About PVC Information Council Denmark

PVC Information Council Denmark is part of the European-wide PVC network, which communicates about PVC-related issues. The Council was established in 1995. Besides being funded by the European PVC resin manufacturers, the Council has Danish PVC converting companies as paying members. For more information: pvc.dk

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