



**greencity
solutions**



we grow fresh air

MEDIENINFORMATIONEN

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FACTSHEET GREEN CITY SOLUTIONS

Green City Solutions (GCS) is a pioneer in bio-tech air refreshing. We have developed the world's first regenerative biotech filter with a measurable impact. Powered by specific mosses, our modules absorb actively polluted air and transform harmful contaminants into biomass and fresh air. Every unit is connected to our IoT infrastructure that enables highest performance and proof of impact.

The basis of Green City Solutions is the idea of combining nature with digital technology. It utilizes the outstanding natural ability of living moss to filter fine dust and cool the ambient air. The interaction of sensors, intelligent ventilation, irrigation and software makes the natural cleaning power of moss usable and measurable.

About the CityTree

The CityTree is a combination of street furniture and biofilter - a bench at the bottom, a moss-covered surface at the top, and complex technology with an IoT interface inside. This opens up further application possibilities, e.g. in the areas of smart city, (e-mobility) infrastructure and communication.

About the CityBreeze

The CityBreeze combines natural air filtration with digital presentation technology. On one side is a green, vitalizing moss wall with active filter technology and on the other is a 75" LCD screen. This makes the CityBreeze the first out-of-home column that cools the ambient air instead of heating it up additionally. The combination, unusual at first glance, makes sense: both information and advertising as well as the microclimatic improvement of air quality is placed where as many people as possible react and benefit.

QUICK FACTS

The active moss filters can remove up to **82%** of fine dust (PM₆) from the air, measurably improving the air in the immediate vicinity

The performance and effect parameters were **evaluated** in extensive scientific measurements

Environmental performance can be detected, evaluated and controlled through the **use of sensors**

The CityTree is **never „full“**, as the fine dust is converted to natural biomass by the moss

Mosses thrive under controlled conditions in the moss farm up to **16x** faster than in nature

FOUNDING DATE

March 2014

MANAGING PARTNER

Peter Sanger

FOUNDER

Peter Sanger
Zhengliang Wu

EMPLOYEES

35 (August 2021)

MOSSFARM

1.200 qm moss cultivation
in vertical form

FUNDING

> 2 Mio. Euro through public funding
via EU projects (f.ex. Horizon 2020)

AWARDS

> 25 national and
international awards

PARTNERSHIPS

> 15 partnerships from
science (TROPOS; ILK)
and industry (Deutsche Telekom, GLS)

MOSSFILTER LOCATIONS (F.EX.)

London
Berlin
Erding
Lissabon
Cork

WEB

greencitysolutions.de

SOCIAL WEB

Instagram
YouTube
Facebook
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LinkedIn

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THE PROBLEM OF AIR POLLUTION

Air pollution is one of the world's biggest environmental issues, responsible for 1 in 7 deaths. Controlling this complex problem requires the cooperation of many different actors. Successful measures also often require long planning and implementation phases, making them difficult for cities and companies to implement. Short-term measures against air pollution are therefore of great importance.

Green City Solutions' products contribute to this by helping people in particularly polluted urban areas to enjoy cleaner air and thus better health and quality of life.

CLEAN AIR FOR ALL

Green City Solutions was founded by a young team of experts from different fields in Dresden. The intelligent combination of individually available expertise led to the basic idea of combining nature with state-of-the-art technology to improve air quality.

The vision is a world in which people can breathe clean air in urban living spaces. The core product is a moss filter - the CityTree, which combines the natural filtering properties of moss with intelligent technology to make it measurable and controllable. The CityBreeze premiered as a new member of the product family in May 2021. With its much „slimmer“ shape and dual use as a digital presentation surface, the CityBreeze will find many other useful areas in the city.



SUPERHERO MOSS

Mosses are capable of astonishing things: They bind fine dust, some are antiseptic, antiviral and fungicidal; true all-rounders for air pollution control and health. With the interplay of sensors, intelligent ventilation, irrigation and software, we can increase their natural cleaning power and make it usable and measurable.



A PIECE OF NATURE

Various moss species grow in the moss filters that can absorb and metabolise fine dust. At the same time, they produce valuable oxygen and lower the air temperature.



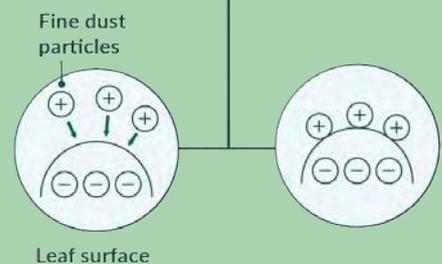
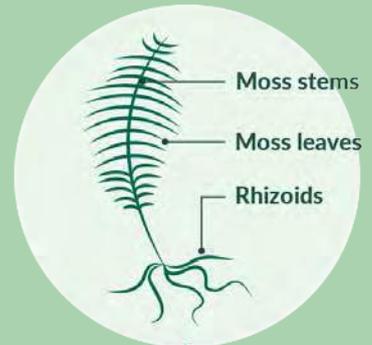
PLEASANT COOLING

Due to their enormous surface area, mosses store and evaporate large amounts of moisture. This leads to a cooling effect by up to 4°C and noticeably fresher ambient air.

MOSS NOURISHES FROM POLLUTANTS IN THE AIR

The moss surface is comparable to the human lung. It is enormously absorbent due to the fine, thin leaflets. Thus, the 2 respectively 4m² of moss used in the CityBreeze and CityTree correspond to an active moss surface of 60 respectively 120m², which can absorb fine dust from the air.

The fine dust has a negative electrical charge and is attracted and bound by the positively charged moss surface. Most of the „prey“ is metabolized and biodegraded by microorganisms and rendered harmless.



- ≈ 50% of the particulate matter are **metabolized** and thus used as food
- ≈ 25% of the fine dust are **biodegraded** by microorganisms
- ≈ 25% of the fine dust are **stored** in the sediment of the moss

THE CITYTREE

NATURE KNOWS BEST



Green City Solutions has developed the CityTree, the world's first biotech particulate filter for demonstrable improvements in air quality. The CityTree is based on the idea of combining plants with Internet of Things technology to create a natural yet intelligent air filter. Special moss cultures filter fine dust and other harmful substances from the air in the process. An innovative IoT technology concept generates both environmental performance and condition data in real time, which is displayed using specially developed software. The CityTree is an innovative solution that can provide clean air immediately and lead to a healthier life for people in highly polluted urban environments.



HEALTHIER BREATHING AIR

Using its intelligent ventilation technology, the CityTree filters breathing air for up to **7,000** people in one hour and has been proven to improve the air quality around it by up to **53%**.



TECHNOLOGY FOR A SMART CITY

The integrated IoT technology provides extensive performance and condition information in real time, as well as environmental data in the surrounding area of the CityTree.



ECOLOGICAL DESIGN

Carefully selected materials and optimized supply chains ensure a particularly good CO₂ balance.

THE CITYBREEZE GREEN MEETS SCREEN



With CityBreeze, Green City Solutions has created a way to use existing infrastructure in cities and improve air quality with immediate effect where as many people as possible will benefit.

The city is a very tightly knit and planning-intensive space, so rapid change and immediate air improvement are constrained by little space and long decision-making paths. In response to these challenges, the CityBreeze was developed. It combines natural and active air filtration with digital presentation technology in a compact steel. Due to its dual function of communication and green space, there are numerous locations that can be used for the CityBreeze in addition to fresh air generation. The costs for the purchase and maintenance of the air filter can be refinanced through advertising revenues.



HEALTHIER BREATHING AIR

Using its intelligent ventilation technology, the CityBreeze filters the breathing volume of up to **2,000** people in one hour and demonstrably improves the air quality in its surroundings.



TECHNOLOGY FOR A SMART CITY

The integrated sensor technology provides comprehensive performance and status information as well as environmental data in the CityBreeze vicinity in real time.



SMART DOUBLE BENEFIT

The CityBreeze's **75" LCD screen** provides a communication surface for public information, sustainable initiatives and surprising outdoor advertising. This is how out-of-home becomes clean-out-of-home.



QUESTIONS FOR GREEN CITY SOLUTIONS

Co-founder and Managing Director
Peter Sanger

Why was Green City Solutions founded?

Cities are the living space of the future and have many advantages. However, fresh, healthy air is not one of them in many places. My co-founder Liang had this experience in his hometown of Shanghai. I felt the same way while traveling through various European cities. When Liang and I met at university with these different but comparable experiences, we shared the desire to develop an ecological and economical solution to the problem. So, with a young team of experts in horticulture, computer science, architecture and mechanical engineering, we launched Green City Solutions in 2014.

It's important to realize: Air pollution is one of the world's biggest environmental problems and is responsible for 1 in 7 deaths. With our products, we want to help people in particularly polluted urban locations enjoy cleaner air and thus better health and quality of life.

The pandemic has made us all the more aware of how relevant our concern is. Poor air quality promotes not only cardiac arrhythmias and dementia, but also lung and respiratory diseases. In other words, these are the very conditions that have turned our families, friends and neighbors into risk groups. According to recent surveys by the Max Planck Institute, up to 26% of Covid-19 deaths are due to air pollution.

How does Green City Solutions combat air pollution?

Our core product is a moss filter. It is based on the idea of combining nature with digital technology to improve air quality. There is more to our natural superhero moss than meets the eye! Mosses bind fine dust, some are antiseptic, antiviral and fungicidal; true all-rounders for air pollution control and health. With the interaction of sensors, intelligent ventilation, irrigation and software, we can increase this natural purification performance and make it usable and measurable.

The CityTree and our new product the CityBreeze are both based on the idea of actively channeling warm and polluted city air through purifying moss mats, thus cooling and cleaning it. Through smart Internet-of-Things-technology, both the water supply to the moss is controlled and air quality plus environmental data is measured. Due to the ability of the mosses used to bind and metabolize fine dust, our biofilters are sustainable and completely free of filter waste.



Why was the CityBreeze developed to complement the CityTree?

Our mission is clear: Clean & fresh air for all city residents. To achieve this, we focus first and foremost on solutions with immediate effect. We want better air now! And we start where as many people as possible will benefit. However, the city is a very tightly meshed and planning-intensive area, so that rapid change and immediate impact are countered by little usable space and long decision-making paths. CityBreeze addresses this challenge.

On one side of the CityBreeze is a green, vitalizing moss wall and on the other is a 75" LCD screen. The slim design creates a variety of use cases. The integration of smart city technologies, such as small cell or metering techno-

logy, the large LCD screen and the clean and fresh moss breeze are a whole bouquet of arguments that allow the public space to be used in an ideal way.

Thereby, the same performance data is valid as for the moss modules in the CityTree: up to 82% of the fine dust is cleaned while the ambient air is at the same time cooled by around 4°C.



Verschmutzte, warme Luft wird von Ventilatoren angesaugt.



Die Luft strömt durch die Moosmatten und wird dabei gereinigt und gekühlt.



Das integrierte Sensorysystem dient der Moosbewässerung und misst Luftqualität sowie die Leistung des Mooses.



Die Moosfilter geben gefilterte und gekühlte Luft an die Umwelt ab.

Where does the moss used in the moss filters come from and how long does it last?

There are about 20,000 moss species all over the world, from the polar regions to the desert. Since we do not want to take the mosses out of nature, of course, and we are constantly striving to find better moss species and combinations for our purposes, we have built the world's first vertical moss farm in Bestensee near Berlin. Here, mosses grow on a good 1,200 square meters in the form of vertical moss mats.

In nature, mosses need about 4 years to grow together to form a dense moss surface. Through special cultivation and ideal supply conditions, we are able to shorten the time in our moss farm to less than 12 weeks. Once inserted into the moss filters, our special bio-algorithm ensures that the mosses are well supplied. We work with natural and sustainable filters that can regenerate themselves. However, as living

organisms, mosses can lose their vitality due to stress or disease. In order to ensure a high and constant performance, we handle the care and potential replacement. In this process, the moss mats are not destroyed at all, but revitalized in the moss farm and then returned to the CityBreeze or CityTree.

With every day that the bio-algorithm learns, the endurance of the mosses increases. By the end of 2021, we will have optimized the supply to the point where our moss mats can provide 12 months of non-stop fresh and clean air.



How long did the development of the moss filters take?

Since the launch of Green City Solutions, we have already worked with numerous cities and companies across Europe and we are incredibly grateful for the support of these early customers! The first version of CityTree was used in over 50 projects for several years.

As expected, the novelty of the technology, the complexity of linking hardware and software, and also the demands of the living creature moss brought numerous challenges in the early years. Technical problems, special site requirements, complications with maintenance services, changing water qualities, to name just a few factors, all put a strain on the organisms. As a result, at the end of 2018, it was decided to develop a completely new product generation that would take into account all the findings of the past. To this end, we opened our production site in Bestensee near Berlin in parallel. Our interdisciplinary team there includes experts from biology, engineering and software development.

The latest product generation was presented in Berlin in March 2020 as part of the European Commission's Horizon 2020 program. The CityTree 2020 focuses on keeping mosses healthy and is a low-maintenance, long-lasting system that rivals conventional, engineered filters in terms of performance.

In cooperation with the Leibniz Institute for Tropospheric Research in Leipzig and the Institute for Air and Refrigeration Technology in Dresden, the filter performance and filter effect were measured according to scientific guidelines and continuously developed.

Which is better or more effective: a normal tree or the moss modules?

This question is actually somewhat unfortunate, since both organisms provide different environmental services. We understand our product as a supplement to trees and not as their replacement. A CityBreeze can also be used in places where trees have a hard time. Trees convert CO₂ into oxygen, provide shade and are important for the climate as well as biodiversity. However, they can do little to combat air pollution caused by fine dust; in fact, they suffer massively as a result.

This is where our products come into play, because mosses can filter and „digest“ fine dust in a natural way. In addition to this natural air purification, the CityTree also produces a noticeable cooling effect, right at the height of people. Unlike trees, these environmental services can be monitored, measured and controlled through the use of sensors. A CityBreeze can be extended by many functions, for example as a charging station or WiFi hotspot.

The normal city tree and our moss filters are therefore not in competition, but rather complement each other as a solution to different problems. As a measure, a tree tends to have a long-term effect, while the moss filters have a short-to medium-term effect. Together they form a perfect team! This is precisely why we support tree planting with every purchase and encourage our customers to combine the CityTree and CityBreeze with trees in the city.



What are the plans for the future? Are there already ideas for further products?

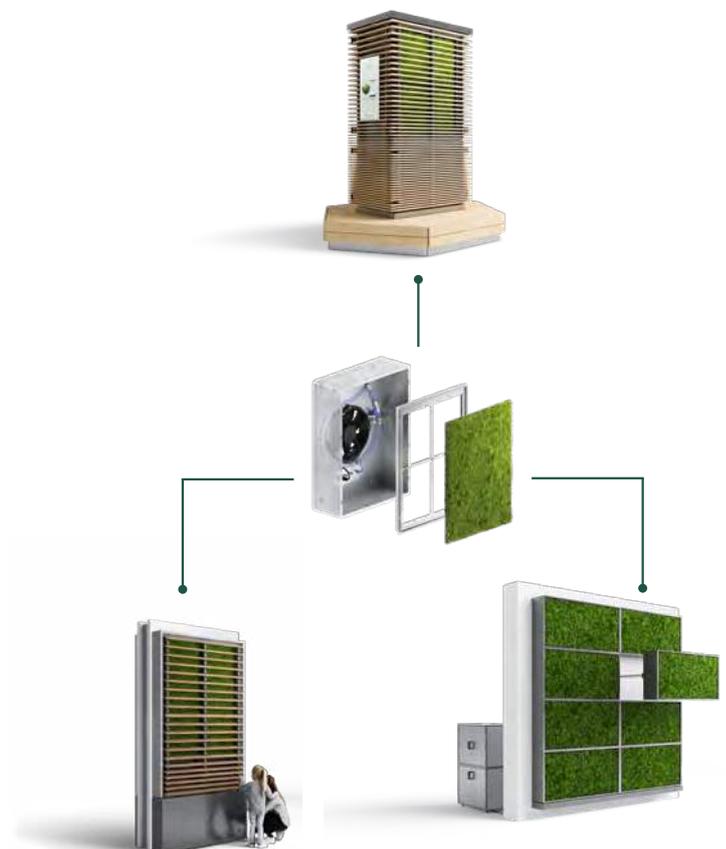
The vision of Green City Solutions is to bring fresh and clean air to everyone. After a test phase, the aim is to roll out the production-ready CityTree and CityBreeze products in many European cities. We are currently preparing this. The next phase will involve setting up Clean Air Networks with other moss-based air filters that are also suitable for end consumers, for example, or that function as vertical facade greening systems. In the long term, our moss filters will be offered nearly free of charge and will be financed through the analysis and visualization of high-quality data. In this way, we want to provide clean and fresh air for 500+ million people by 2030.

What are possible locations for the CityBreeze?

With the CityBreeze, we take up existing infrastructures and supplement them with the green, purifying mosses. Especially the connection with outdoor communication fits. On the one hand, OOH is currently undergoing an astonishing transformation. Climate-friendly and sustainable content and media dominate articles and fairs. The CityBreeze offers advertising with added value and provides the ideal presentation space for sustainable initiatives. On the other hand, advertising spaces are fixed points in cities, placed where as many people as possible can see them. This fits in perfectly with our approach of fresh air zones where as many people as possible can benefit. In this way, we combine ecology and economy and generate an immediate and sustainable improvement in urban air quality.

Who buys or rents the CityTree?

For one thing, the CityTree is bought or rented by cities and municipalities. However, it is also of interest to larger companies, private schools or universities in order to create fresh air zones to spend time in during breaks. In addition, it is real estate developers who are interested in the CityTree, because it helps to achieve sustainability standards, such as those of the German Sustainable Building Council. We provide all customers with our wide-ranging expertise in choosing the right installation site and offer detailed advice.



CUSTOMERS AND PARTNERS ABOUT THE MOSS FILTERS

Berlin is the right place for innovative solutions [...]. The Berlin-based company Green City Solutions [...] has the potential to solve urban-climatic problems that are increasingly affecting our urban areas.“

Michael Müller, **Governing Mayor of Berlin**

„That’s why startups like Green City Solutions are worth their weight in gold. Because only environmental protection paired with the latest technologies can enable sustainable locations for modern living - and with the CityTree, let city dwellers finally breathe some fresh air again.“

Deutsche Telekom AG

„We were surprised how quickly the residents at Walter-Benjamin-Platz accepted the new CityTrees.“

Ludger Hammerschidt, **OfficeFirst**

“We intend to help one of the areas with the greatest circulation in the city of Lisbon, Avenida Ribeira das Naus, to improve air quality.“

Olivier Establet, **Präsident von DPD Portugal**

“I’m delighted that this cutting-edge moss filter technology has come to Putney. We will monitor its effectiveness in absorbing air pollution on the High Street as part of our ongoing commitment to tackling climate change.”

Cllr Rory O’Broin, **Cabinet Member for Finance, Corporate Resources and Climate Sustainability**

USER EXPERIENCES

“The moss filter is really cool because it cleans the air so we can breathe and play in the clean air.“

Student of Hamstead Hill School, London (age 7)

„Since the moss filter has been at my workplace, I enjoy the fresh air and no longer need asthma spray.“

Nicole Schäfer, **ISS Facility Services**



IMAGE MATERIAL

Under this link you will find a selection of image material.

CityBreeze
Diverse
Founder + Team
Lab
Location_CityTree
Moss Farm

The use of the pictures is permitted free of charge in the context of reporting on Green City Solutions. Please note the respective copyright notice in the file name (123_(c)Firstname_Lastname).

VIDEO MATERIAL

In the Green City Solutions YouTube channel, you will find numerous videos on different topics:

General
Moss
CityTree
Company & Founder
Events



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