



AMSTERDAM
INSTITUTE FOR
ADVANCED
METROPOLITAN
SOLUTIONS

Annual Report 2022



Annual Report

2022



Core academic partners



In partnership with



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Contents

4	About AMS Institute	124	Scientific Conference 2022
10	Key Figures 2022	128	CityLab 2022
13	Directors' Report	130	Board Report
17	Education	132	8-year review: a strong foundation
23	Education in numbers	134	References
24	Entrepreneurship	136	Glossary
28	The 'boosted' teams in 2022		
35	Entrepreneurship in numbers		
36	Research and Innovation		
41	Research and Innovation in numbers		
42	Urban experimentation in the City		
44	Reinventing the City		
46	Scaling the circular built environment		
54	Creating inclusive and equitable cities		
64	Designing responsible smart systems in public space		
74	Future-proofing infrastructure assets from climate change		
86	Developing sustainable food systems as drivers of health and equity		
96	Accelerating a connected and accessible urban mobility ecosystem		
106	Transforming cities toward climate-neutrality		
114	Capitalizing urban waste streams for a circular economy		

About

AMS Institute

Home to well over half the global population, cities are at the epicenter of large technological and societal transformations. From climate-related challenges – flooding, extreme weather, sea-level rise – to biodiversity and resource loss, increased social instability and energy poverty – the list of challenges goes on. Cities must be prepared to address and adapt to current and future crises. Transitioning toward becoming inclusive, resilient, and sustainable is no longer an option, but an imperative.

How city assets and infrastructures are planned, designed and maintained determines exposure to social and ecological vulnerability and capacity for resilience. The urban challenges our cities face today are transdisciplinary and complex, demanding sustainable urban development on a global, national and local scale. Different disciplines, types of skills and expertise must be connected to create innovations that tackle both the social and ecological aspects of these challenges.

With a mission-driven approach, Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute) is tackling these urgent urban challenges. In everything we do, we create synergies between our education, entrepreneurship, and research and innovation activities. In close collaboration with our founding universities, Delft University of Technology (TU Delft), Wageningen University & Research (WUR) and Massachusetts Institute of Technology (MIT), and the City of Amsterdam, we foster collaborations between stakeholders from various disciplinary backgrounds – including citizens, knowledge institutes, private and public organizations.

With urban experimentation at the heart of our activities, we propel innovative solutions to create livable, sustainable, resilient, and just metropolitan areas. At AMS Institute we call this: reinventing cities.

A transdisciplinary community of experts

At AMS Institute, we firmly believe that solutions created by a wide range of actors are more robust and can be adopted faster – resulting in long-term impact and truly transformed living environments.

Based at Marineterrein Amsterdam, a learning and innovation hub in the city center, we educate postgraduates and (young) urban professionals, support up-and-coming entrepreneurs and startups, and have academics from our founding universities work on research projects focused on the Amsterdam Metropolitan Area (AMA) and beyond.

This vibrant community brings forth a transdisciplinary range of knowledge, networks, and experience. Students, entrepreneurs and academics continually interact with our public and private partners and the city. We approach Amsterdam as an experimental testing ground for innovation.

Developing innovations to accelerate transitions

With a mission-driven approach, we drive innovation to realize better cities. Our research portfolio revolves around six urban themes – mobility, energy, circularity, food, climate, and digitization – and is closely intertwined with the city's missions.

For AMS Institute, these missions act as frames and stimuli for innovation, they help to strengthen trans- and interdisciplinary collaborations and ensure the continuity of our research.



"We are challenged by climate change, equality of opportunity and a growing population. Only through teamwork can we accomplish a 'human' and sustainable metropole, where –present and future– generations love to live. The input of our residents, entrepreneurs and knowledge institutes, such as AMS Institute, is essential for us to reach those goals."

Josja van der Veer, Director, City of Amsterdam

Urban experimentation to steer solutions worldwide

We strongly believe that metropolitan solutions need to develop from research into solutions that are ready for society-wide implementation to really transform cities. Urban experimentation is crucial to our community's way of working. Living labs provide an innovative setting in which different people and organizations jointly test, develop and create solutions for real-life issues on a small scale. We use the feedback we gather to further develop and scale up these solutions to the city scale.

By generating ideas, educating talent, and closely interacting with the evolving local reality of the city, we cultivate and nurture an environment that enables continuous learning and experimentation and the development of innovative solutions for cities worldwide. This is how we bring about livable, sustainable, resilient, and just metropolitan areas. This is how we reinvent cities.

"It is the human touch that makes AMS Institute unique. Where else in the world would you meet 'over coffee' with a director of the KNVB, Minister of Singapore, Dean of TU Delft, and Mayor of San Diego. Here, a unique combination of professionals comes together to search for solutions to pressing problems in our societies. Professionals who are intrinsically motivated to meet as people first and foremost. To be vulnerable. And from there, to build livable and attractive cities of the future."

Sacha Stolp, Director of Innovation, City of Amsterdam



Reinventing cities

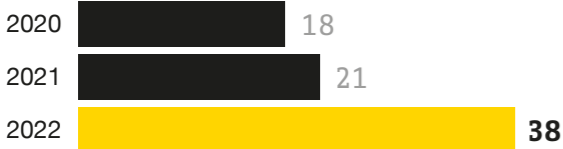
Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute) is the joint knowledge institute of Delft University of Technology (TU Delft), Wageningen University & Research (WUR) and Massachusetts Institute of Technology (MIT).

In close collaboration with the City of Amsterdam and private and public partners, the institute tackles urgent urban challenges through research and innovation, education and entrepreneurship. By this, we propel innovative solutions to create metropolitan areas that are livable, sustainable, resilient, and inclusive. At AMS Institute we call this 'reinventing cities'.

Key Figures 2022

Research and Innovation

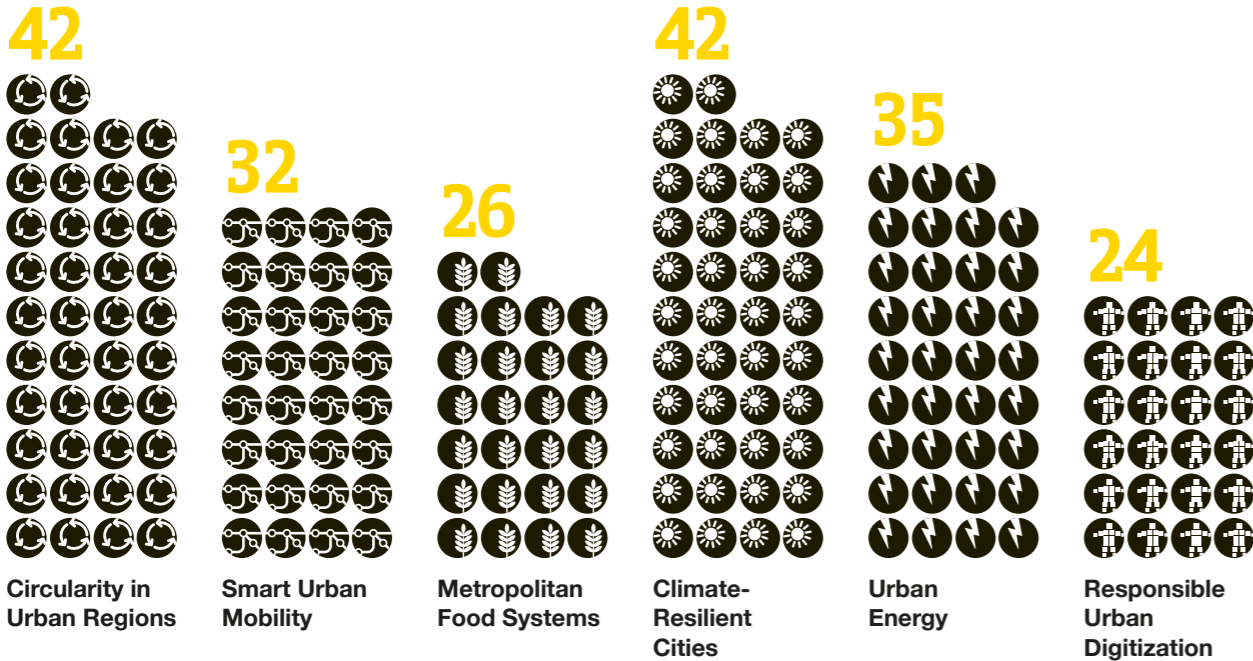
projects awarded per year



Total value per year of awarded projects



Total number of awarded projects per urban challenge (2014–2022)



201
Total number of projects

€146M
Total value of project portfolio

Education

46

New MSc MADE students in 2022



48 diplomas awarded in calendar year 2022
120 MSc MADE graduates in total 2017-2022



MOC participants in 2022

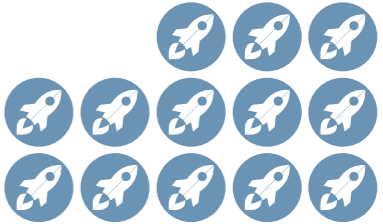
83,932

Total number of AMS MOC participants in 2017-2022

Entrepreneurship

14

Affiliated startups in 2022



AMS Startup Booster teams

Communications

	2021	2022
Website visitors	66,857	71,094
LinkedIn followers	6,899	9,062
Newsletter followers	1,893	1,936



Directors' Report

We are pleased to present the AMS Institute annual report for 2022. Even though COVID-19 lockdown measures have largely come to an end, the world is grappling with the escalating war in Ukraine, an energy crisis, food shortages, and the unavoidable effects of climate change.

Cities, home to the majority of the global population, have no choice but to increase their rate of change in response. They must decarbonize, adapt, digitize, alter production and consumption, and change norms and values to prioritize biodiversity and livability. Our 2022 annual report presents the highlights of how AMS Institute is helping to accelerate these systemic shifts.

In 2022, AMS Institute further strengthened its ties to the city of Amsterdam, the founding universities, and its public and private partners. Our diverse community of experts and professionals is dedicated to our mission-driven work in research and innovation, education, and entrepreneurship. In 2022 we worked with determination to tackle urban challenges in mobility, the circular economy, climate resilience, food production, responsible digitization, and renewable energy. We think, connect, and act.

Scalable urban solutions

At AMS Institute, the core academic partners, TU Delft, WUR, and MIT, further advanced research excellence in pursuit of scalable urban solutions and true societal impact. In cooperation with our teams of program developers, research fellows, principal investigators, living lab managers, and partners, we ran a portfolio of 60 innovative projects, acquired over EUR 25 million of new project volume, and prepared and submitted three large National Growth Fund (NGF) program proposals.

Proud of our talent

In 2022, the MSc MADE program celebrated five years of pioneering transdisciplinary education and fostering talent. We are tremendously proud of our MSc MADE students and alumni for their contributions and dedication to our mission to reinvent cities. Our pride extends to our entrepreneurs as well; the positive impact made by the more than 25 start-ups we successfully supported through our startup Booster program last year. For that reason, our commitment to fostering talent and groundbreaking ideas remains strong going into 2023.

Learning together

Our home base at Marineterrein Amsterdam has proven to be fertile ground for our mission of reinventing cities. We look forward to exploring and capitalizing on the exciting possibilities of combining art, tech, and science in partnership with Amsterdam University of the Arts (AHK) and Codam Coding College (CODAM) in the new Marineterrein knowledge coalition.



In February 2022, we organized a scientific conference called 'Reinventing Cities', where a global community of over 800 urban scientists, engineers and practitioners came together. The three-day event, co-hosted by the City of Amsterdam, instantly became a platform for sharing advances in urban sciences and engineering and connecting partners for future collaboration and impact.

Leading institute

One of 2022's milestones was an independent 8-year review of the institute by an external expert committee, who concluded: 'In the emerging field of urban engineering, AMS Institute can be recognized as a leading institution. Its profile is distinctive, especially in its effort to integrate research, education, and valorization'. The committee's findings reassure

the value of the institute's strategy and have reinforced our resolve to develop an even stronger contribution to urban innovation through research, education, and entrepreneurship.

Highlights that inspire

At AMS Institute, we are aware that there is no time to waste. We must continue to work tirelessly to create sustainable urban solutions that address the complex challenges our cities face. We hope this report inspires you to join us in our efforts to build a better future for everyone.

Eveline van Leeuwen, *Scientific Director*
Stephan van Dijk, *Director of Innovation*
Kenneth Heijns, *Managing Director*

"The partnership with the City of Amsterdam is at the core of AMS Institute. We feel it is important to share our insights and lessons learned, after almost 10 years of close collaboration. This way cities and knowledge institutions around the world can build on those experiences and setup their science based collaborations to tackle urban challenges."

Kenneth Heijns, *Managing Director, AMS Institute*

Education



At AMS Institute, we consider education to be an essential aspect of our mission, as we are an ever-learning community. We believe education is crucial to encourage the talent that is required to create solid solutions for the cities of today and tomorrow. Using Amsterdam as a living lab, we foster and develop the research, design, and innovation skills of (future) urban engineers.

In 2022, our institute continued to develop a rich set of educational activities that are deeply grounded in urban challenges. This includes our master's degree 'Metropolitan Analysis, Design & Engineering' (MSc MADE), AMS Academy for professional education, as well as Massive Open Online Courses (MOOCs). Through co-creative learning, our educational activities are geared toward accelerating transformations to create sustainable, resilient, and just cities.

"Working together with AMS Institute has been an uplifting journey. Through our collaboration, we have seen an increased sharing of research from their students as well as the documentation of the 'Reinventing the City' conference on our shared platform openresearch.amsterdam. I firmly believe that the key to our cities' development lies in the collective sharing of knowledge and I'm thrilled to see this principle come to life through our partnership."

Caroline Nevejan, Chief Science Officer, City of Amsterdam

MSc MADE: Urban engineers who tackle complex challenges

At the heart of AMS Institute's educational activities is MSc MADE – a joint degree from TU Delft and WUR. In 2022, we celebrated the program's first five years of operation.

In short, the two-year master's program focuses on cities and metropolitan challenges related to sustainability and quality of life in a rapidly urbanizing world. MSc MADE students come from a broad variety of academic backgrounds and fields of expertise; the program trains them to develop and strengthen their scientific and hands-on skills.

MSc MADE is strongly integrated with the institute's transdisciplinary research and innovation portfolio and entrepreneurship activities. During the master's program, students engage with Amsterdam as their

living lab. As part of the curriculum, we connect students to real-world challenges in Amsterdam and stakeholders within our community and network – researchers, the City of Amsterdam, businesses, and/or societal partners.

Its transdisciplinary and real-world focus allows MSc MADE to provide innovative education and deliver a new type of professional: the urban engineer. Graduates encompass the appropriate skill set – both the theoretical grounding and practical skills – to solve cities' complex, interdisciplinary challenges. During the degree, students develop a unique ability to speak the language of other disciplines and to be adaptive to the continuously changing urban environment. As a result, these young professionals can collaborate well in transdisciplinary teams, combining technical expertise with practical solutions that fit the city's current and future needs.



"A few unique qualities of MSc MADE engineers: transdisciplinary skills to combine scientific and non-scientific input to arrive at a relevant solution, can cope well with few given frameworks and is used to working autonomously, and has thoroughly explored Amsterdam-related problems during the study – also resulting in a strong network in Amsterdam."

Jess Wreyford, Coordinator Living Lab, AMS Institute





"Among this year's highlights for me: I co-supervised a MSc MADE thesis entitled 'Design for Darkness,' rethinking public lighting in Amsterdam Noord. It led to a first ever Darkness Manager position for MSc MADE alumnus Elsemieke Koole at Amsterdam Municipality. This is exactly one of those examples of how after five years of MSc MADE, the program continuously strengthens its innovative vibe thanks to the joint efforts of the education team, teachers, and every new batch of students."

Bas van Vliet, Associate Professor Environmental Sociology (WUR), PI at AMS Institute

An ever-changing urban environment requires innovative education

We make sure to continuously fit the MSc MADE curriculum to the skills our students require to become the professionals our ever-changing cities need. To illustrate, in 2022 we offered electives to MSc MADE students, including a four-week data visualization course. During these lectures, students took a deep dive into how to create data visualization. Topics included urban mining, energy networks, temperatures in urban areas, food deserts and wood flows.

Often we witness our MSc MADE students developing ideas with entrepreneurial potential during the MSc program. We offer these young entrepreneurs

guidance and support in starting or strengthening their own company. During the MSc MADE program, we invite entrepreneurial students to join our pre-incubator program, the AMS Startup Booster, to further develop their solutions for the city's most pressing urban challenges.

Furthermore, students are offered opportunities to position themselves on the openresearch.amsterdam platform. This platform was created by the Chief Science Office of Amsterdam for the sharing of knowledge within the city. We share MSc MADE students' research and knowledge on this platform to enable new connections and research collaborations within the AMA.



Get inspired by MSc MADE student portfolios on openresearch.amsterdam:



An AMS Academy for professional education and training

AMS Academy is a learning environment within our institute aimed at professionals, researchers, and entrepreneurs from all over the world. AMS Academy organizes the Urban Living Lab Winter and Summer Schools. Both week-long sessions are filled with inspiring lectures, teamwork, rapid exercises, and a toolbox with practical tools for professionals to use in their own practice.

The Winter and Summer School programs are designed to inspire participants to adopt a new mindset toward the work they do that impacts the urban fabric, and to help them build and expand their network of professionals and academics. By selecting cases together with our partners, like the City of Amsterdam, professionals get the opportunity to work on Amsterdam's key challenges.



"One of the unique aspects of the MSc MADE program is that our students are constantly collaborating in and with the city, which guarantees impactful output."

Anita van Oosten, Educational Coordinator MSc MADE, AMS Institute

Education in numbers

120 MSc MADE graduates in total (2017-2022)
105 total diploma's awarded up to and including 2022

In 2022...

we celebrated MSc MADE's first lustrum



125 total population of MSc MADE students

46 first year students

65% from the Netherlands
35% from (non-)EU



students worked on **12** MSc MADE Living Lab cases

With **8 partners**, **8 challenges** in the City of Amsterdam were addressed into assignments for students in the **Metropolitan Solutions** course

41 problems were tackled, in Amsterdam, by students in collaboration with **28 partners** and **255 additional stakeholders** as part of the MSc MADE Living Labs course

7,345 M00C participants

1,404 Nature-based Metropolitan Solutions
4,220 Nature-based Sustainable Urban Development
1,721 Co-creating Sustainable Cities

Entrepreneurship



AMS Institute is strongly committed to helping the next generation of ambitious entrepreneurs turn their ideas for sustainable urban solutions into reality. The AMS Startup Booster, our pre-incubator program, is an open invitation for early-stage urban-tech startups that want to make an impact on city life and solve metropolitan challenges.

The AMS Startup Booster: engine for innovative business activities

At AMS Institute, we stimulate entrepreneurship and propel innovative ideas toward impactful business through strategic collaboration within our network.

We regularly witness many innovative business ideas emerge within our community. Often, we encounter bright minds that need guidance on starting their company.

The AMS Startup Booster program helps launch and fast-track startups' promising business ideas in the domain of urban technology. The key components of the program help prepare startups for

successful operation. The program offers a focused entrepreneurship curriculum, mentoring and coaching by industry experts, office space and a Makerspace for prototyping.

During the AMS Startup Booster, we guide startups on their journey to reaching their problem-solution fit and developing the first concept of their product or service. Through this pre-incubator program, we cross-fertilize entrepreneurship, education, and research. This is one way we want to create a vibrant ecosystem for young entrepreneurial teams working on solutions for the city's most pressing urban challenges.

"The AMS Startup Booster emphasizes the power of collaboration and communication from the get-go, which allows entrepreneurs to build a solid foundation for long-term success. During the program, we witness participants not only rapidly develop essential skills like resilience, adaptability, leadership, and collaboration, they also undergo a crucial process of self-discovery – finding out whether entrepreneurship is the right path for them. Over the years, we've seen how this holistic approach helps entrepreneurs become the innovative leaders that shape the future of their respective industries."

Ioannis Ioannidis, Entrepreneurship Lead, AMS Institute



Learn more about the
AMS Startup Booster



The 'boosted' teams in 2022

KÄTN

Initiatives around sustainable fashion as an alternative to fast-fashion are often decentralized and don't reach a big audience. KÄTN, an interactive online platform, guides users through all the local alternatives (i.e., resell, reuse, repair, and repurpose) when it comes to sustainable fashion. In addition, this tool provides an up-to-date agenda with repair cafes, swap events, and market days. KÄTN creates a community around sustainable fashion by connecting Amsterdam initiatives and users.

One Ground Studio

This startup focuses on data and design solutions for neighborhood-scale flood mitigation strategies. One Ground Studio's approach is to analyze and visualize flood vulnerability by using location and demographic data so that municipalities can be better informed in designing flood protection strategies for their cities.

Spore

Many cities throughout the world take responsibility for their waste collection. Often they are required by law to separate biowaste at the source. The 'smart bio bins' developed by Spore include sensors that identify bio waste contamination and monitor capacity.

Spore's solution not only allows cities to separate biowaste at the source, the smart bins also allow municipalities to improve collection efficiency and reduce transportation costs by 40%. At the household level, Spore distributes composters to make composting at home easy.

CoTown

With CoTown's blockchain-based platform, governments can incentivize the involvement of community members in doing civic and sustainable tasks. Positive actions that help the community are rewarded with digital tokens that users can spend on various goods and services provided by a network of local partners, which helps to drive the local economy.

Unify

Transport companies will soon be required to transition to zero emission operations. To aid these companies, Unify offers a three-step process that makes it possible to outsource the realization of this transition to specialists so that the companies can fully focus on their current operations.

Space for Food

This is a continuation of the Space for Food research project carried out by SEMiLLA IPStar, University of Antwerp, GrowX/GrowY, Nijhuis and AMS Institute. In this project, space technology is applied to develop circular solutions for urban challenges using purple non-sulfur bacteria (PNSB).

PNSB have the ability to produce and accumulate high-value compounds that are beneficial for plant growth. The aim of this project is to find and create business opportunities in which the raceway reactor PNSB cultivation can be scaled and adapted to different urban, rural or space environments.

Farmvent

Farmvent enables restaurants and catering services to cultivate and grow their herbs and leafy greens in-house. This startup developed an automated hydroponic vertical farming solution which is steered by artificial intelligence and can be placed anywhere. As a result, the innovation not only reduces the time it takes for food to travel from farm to fork, it also decreases food waste.

Lettus Design

This startup uses gamified participatory and co-creative design processes to increase stakeholder engagement and align all those involved. Lettus Design intends to develop a data-driven digital platform that enables project leaders and architects to develop more equitable and economically viable urban spaces.

Syllogic

To optimize life-cycle infrastructure inspection and maintenance planning activities, Syllogic is developing a virtual, algorithm-based decision maker that utilizes the recent advancements in Deep Reinforcement Learning (DRL). Decisions made based on this algorithm positively impact road networks by reducing the life-cycle costs of maintenance and the carbon footprint, relieving traffic congestion caused by maintenance works, and improving comfort and safety.

AI Institute

This startup integrates AI insights directly into existing workflows; in short, AI Institute developed a platform that implements a conversational agent – the ADAM chatbot – to serve as a first line of automated support for the residents of Amsterdam. Among others, the chatbot interacts with residents in a conversational manner, providing quick and accurate information online. For this, the chatbot uses a combination of natural language and constrained option responses that will guide users to a resolution. As a result, by boosting service levels for citizens and reducing the workload for public sector workers, AI Institute’s solution makes cities more efficient.



Cyrclle

Cyrclle’s mission is to make cities more sustainable by closing the waste circle. This startup’s business idea is based on pyrolysis. In short, this technique concerns controlled burning of woody and vegetal materials in the absence of oxygen. This process creates different subproducts, including combustible gas and a specific type of charcoal known as biochar.

Biochar is carbon-negative, a unique characteristic which enables it to store carbon. Moreover, biochar can be used as a soil improver in agriculture and urban greenery. Cyrclle aims to collect and treat the cities’ green waste with pyrolysis, and will create three business cases focused on gas production, biochar production and carbon credits trade





Bicycle User Experience (BUX)

BUX is on a mission to change the way bicycle infrastructure is designed so that it is more user-friendly. To this end, this startup helps urban mobility professionals and organizations learn how to think from the perspective of diverse end-users. This startup provides courses and training programs focused on people, infrastructure, context, and mode of transport to transform their approach to street design. BUX's methods are versatile and replicable across contexts, as the framework the startup applies helps users take action immediately in their local context.

Energon Systems

Energon System, a startup that specializes in energy management focused on electric vehicle infrastructure, developed a smart software system that can be placed at local sites to allocate the right portion of electricity to car charging points. By taking the energy consumption of sites and buildings into consideration, site owners are sure that they will have enough power to heat, light and operate their facilities, while safely proposing charging services to their guests. This way, this startup helps to optimize energy flow in (urban) areas.

“Entrepreneurs and startups can play a crucial role in making Amsterdam more sustainable. They are often at the forefront of innovation and can come up with new and creative solutions to sustainability challenges. Startups are more agile [than big corporations] and can quickly adapt to changing circumstances, allowing them to experiment and iterate until they find a viable solution. By working together with existing organizations and receiving investment, startups can help accelerate the transition towards a more sustainable future.”

Ken Lam, Partnership Manager, The Talent Institute

"One of the most exciting ways to positively impact cities is when scientific knowledge takes the entrepreneurial path and turns into a successful business. Fostering innovative ideas and supporting talents to start a company is an important part of what AMS Institute does to change cities for the better. With the Startup Booster program, we not only guide entrepreneurs to translate science into impactful solutions, we support startups in the process of scaling up. In turn, the entrepreneurs boost economic growth by introducing new technologies, services and products and by creating jobs in Amsterdam and the AMA."

Stephan van Dijk, Director of Innovation, AMS Institute

Entrepreneurship in numbers

In 2019-2022

 **60** total of AMS Institute affiliated startups supported

 **30** of them were still active in 2022

27 AMS Startup Booster teams



20 ClimateLaunchpad teams



9 EIT Urban Mobility Accelerator teams



4 other AMS Institute affiliated startups



21 AMS Startup Booster teams initiated by MSc MADE students

5 AMS Startup Booster teams linked to Research and Innovation portfolio

In 2022

13 teams supported by the AMS Startup Booster

€30M+ in total raised

Research and Innovation

We believe scientific research is crucial to developing solid solutions for the cities of today and tomorrow. AMS Institute's research portfolio revolves around six urban themes: circularity, mobility, food, climate, energy, and digitization.

In the development of our six research programs – Circularity in Urban Regions, Smart Urban Mobility, Metropolitan Food Systems, Climate-Resilient Cities, Urban Energy, and Responsible Urban Digitization – we are both agenda-setting and responsive to the missions of the city. These urban missions are closely intertwined both with our research programs in general and with individual projects.

All projects in our research portfolio are defined and executed by transdisciplinary consortia of knowledge institutes and public and private partners; they are also carried out in close collaboration with the City of Amsterdam. Our education and entrepreneurship activities are strongly aligned with the institute's research programs. As part of MSc MADE and the AMS Startup Booster, we connect students and entrepreneurs to stakeholders within our (research) community and network.

The city of Amsterdam is a testbed for innovation where researchers from our founding partners learn and experiment together with relevant public and private partners. These academics work with our students and entrepreneurs to bring an transdisciplinary range of knowledge, networks, and experience to AMS Institute's research programs, which are outlined below.





Circularity in Urban Regions

This program has three innovation tracks: circular infrastructures, biobased construction, and data and monitoring. Infrastructures are the amenities that provide urban services. In this first track, we develop circular solutions for digital infrastructure, energy infrastructure, public space, and the related logistics. Combined with infrastructure, construction is responsible for the bulk of material and waste flows through the city. For that reason, the second track supports knowledge development to achieve 20% biobased construction of all new residential buildings in the AMA, from, for example, the perspective of material development, life cycle analysis, or policy building. Lastly, the data and monitoring track pertains to the identification, collection, and creation of relevant data and monitoring systems to keep track of circular economy developments in the city, support decisions, and direct investments needed to accelerate the transition.

"We need to search for integral solutions for space competing needs in our city regions – like housing, biodiversity, and food production."

Tjeerd Haccou, Founding Partner, Space&Matter



Smart Urban Mobility

The aim of this program is to positively impact mobility systems in cities and to contribute to making these systems sustainable, accessible, safe, resilient, inclusive, and affordable. The program has four innovation tracks. The first track focuses on how to transition toward becoming a 'low car city' and exploring the potential alternatives for (private) car usage. The second track, 'hubs and shared mobility', focuses on the transition toward shared and clean mobility and its integration into the existing mobility network. In the 'transition from 50 km/h to 30 km/h' track, we focus on reducing speed limits in urban areas and how reduction impacts safety and livability. This third track specifically measures the impact of the policy that will reduce the 50 km/h speed limit to 30 km/h and will be implemented in Amsterdam in 2023. In the fourth track we experiment with (new) digital mobility management tools to improve city mobility and enhance mobility flows.



Metropolitan Food Systems

To create inclusive and healthy food systems, our Metropolitan Food Systems program takes into account three local conditions: urban ecology, urban society, and urban economics. Projects that focus on ecology deal with either circularity or climate resilience. Projects with a social focus deal with informing, involving, or consulting local citizens about aspects of the food systems. Projects centered on economics focus on upscaling urban food production to allow for the local production of food. Importantly, as the urban food system is heavily intertwined with the global food system, we actively seek national and international cooperation within this program.

"When you want to reinvent the city, you need to cooperate with scientists, artists, engineers, and people in the neighborhood. This is exactly what AMS Institute together with its partners does."

Carolien Gehrels, Global Director Energy Transition, Arcadis



Climate-Resilient Cities

To make Amsterdam and cities worldwide resilient, sustainable, and livable, the Climate Resilient Cities (CRC) program researches the functioning, adaptation and resilience of the city in times of climate change. The program focuses on four research and innovation areas: urban meteorology and air quality, urban green and biodiversity, future proof assets and resilient infrastructure, and urban water management.

The CRC program focuses on climate adaptation as well as climate resilience. In doing so, we aim to create effective solutions and a climate adaptation planning approach that carefully designs and assesses interventions such as greening, sustainable (re)design, and maintenance of the city's infrastructure.



Urban Energy

The main focus of the Urban Energy program is designing and deploying smart, sustainable, and reliable energy systems that contribute to accelerating the energy transition. With our energy projects, we focus on designing systems that can meet the demand for electricity, heating, and mobility in the AMA. Primarily, these systems are geared toward retrofitting existing buildings, increasing accessibility and usability of low temperature sustainable heat sources, minimizing electric grid impact (of new solutions), and understanding and increasing societal acceptance for energy solutions.



Responsible Urban Digitization

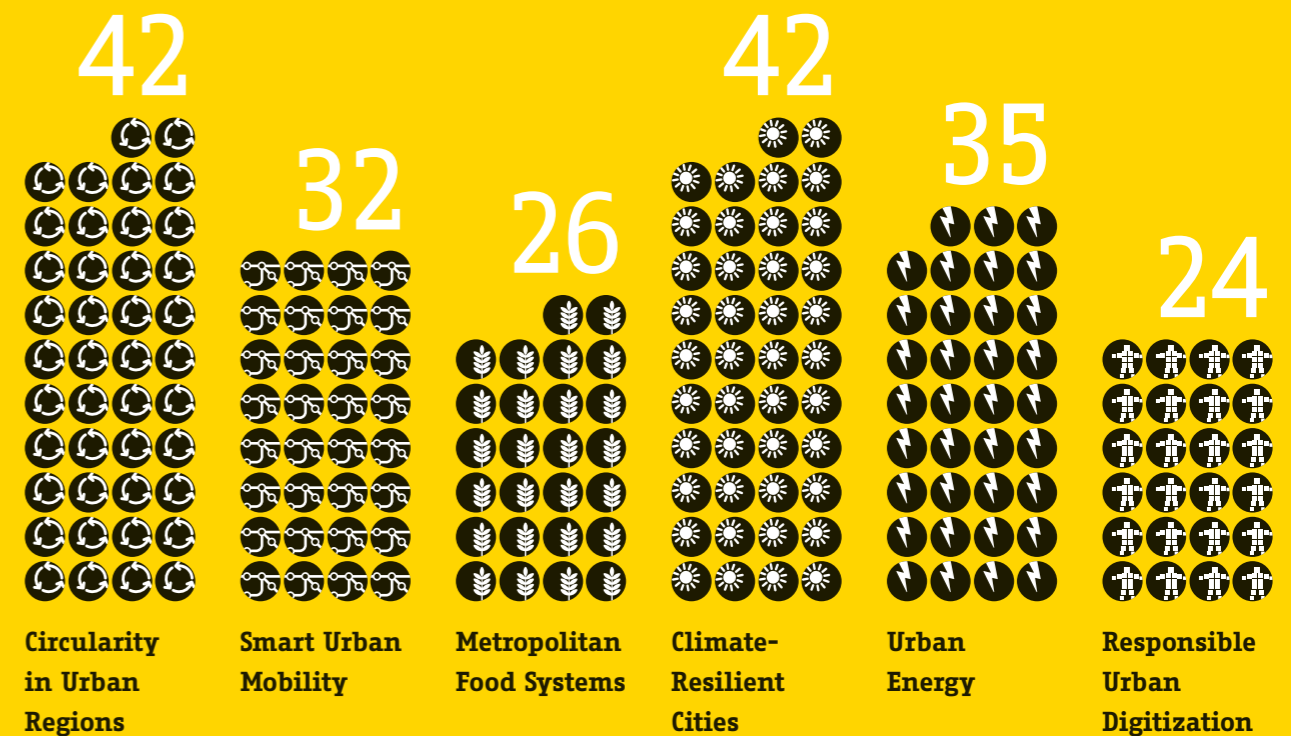
Societal concerns about the impacts of digitization on governments and infrastructures are increasing. The Responsible Urban Digitization (RUD) program aims to develop smart digital tools and technologies – related but not limited to artificial intelligence, sensors and robotics – that citizens can trust. We do this by exploring how to integrate sovereign liberal democratic values in the design of sensing systems that are placed in the public space. Experts not only investigate technologies that help run the city in a better way, they also design and test sensing systems that align with societal values such as autonomy, privacy, transparency, inclusiveness, and empowerment.

Research and Innovation in numbers

Accumulated research portfolio: **201** awarded projects

38 projects awarded in 2022 with a total value of **€26.45M**

Total number of projects per urban challenge (2014–2022):



Urban experimentation in the City

This map showcases a selection of urban experiments our community worked on in 2022. These activities are related to our education, research and innovation, and entrepreneurship efforts. In some cases, locations are plotted approximately.



Education



Research and Innovation



Entrepreneurship

Congestion analysis
Buiksloterham-Zuid/Overhoeks
 Solutions for medium voltage congestion in urban areas based on an Amsterdam case study

Solving the urban plastic soup
 Monitoring, reducing, and circular processing of the urban plastic soup

From COMposite to PROduct (COMPRO)
 Testing Re-plex, a fully biobased and circular composite material, for the construction sector

SmartHubs
 Implementation and accessibility of smart mobility hubs

Urban Comfort Lab
 Circular and sustainable design of buildings to reduce the exposure to aircraft noise

Circular Zeilfort
 A circular system for the café kitchen facility of Zeilfort Kudelstaart

CoTown
 Rewarding community involvement with digital tokens

SPATwater and Vergroenjewerk.nl
 An online tool to advance the transformation of green and climate-adaptive business parks

Drought Resilient Bajeskwartier
 Interventions to make Bajeskwartier in Amsterdam drought resilient

i-CHANGE
 Monitoring parameters that influence citizen's health, like urban thermal comfort and air quality

Value of Poo
 Circular scenarios for elephant dung

Green water hubs
 Sustainable solutions for urban water management for Artis and De Hortus Botanicus

Warm Welcome
 A framework for temporary housing processes for the economically homeless

The Leaf
 Green pergolas to increase climate-adaptivity

Buiksloterham-Zuid/Overhoeks

Marineterrein Amsterdam Living Lab
 Inner city testing ground

Senseable Amsterdam Lab
 Urban data to help cities become climate-neutral

MADE student housing
 A housing platform for students of non-traditional educational programs

SIPCAT
 Interactions of pedestrians and cyclists with automated transportation

Roboat
 World's first fleet of autonomous vessels

Responsible Sensing Lab
 Designing smart technologies that are in line with societal values

Happy Trees Monitor
 A monitor for happy trees

One Ground Studio
 A data-driven design solution to analyze flood vulnerability

Bio-receptive concrete
 Demonstrating functional performance

Insect rearing on municipal waste
 Growing insects on urban food waste for animal feed

Shuttercam
 Crowd monitoring systems outfitted with shutters

Energy Lab Zuidooost
 Scalable renovation and system transitions towards an energy-neutral district

Local Inclusive Future Energy (LIFE)
 Neighborhood energy platform

Residual Waste Heat Data Centers
 Warming up buildings with residual heat from data centers

Reigersbos Retrofit
 Deep retrofit of 288 dwellings with scaling potential of 10,000 buildings

Deep Map
 Integrate local knowledge and social values from residents in the City's design plans

Senseable Construction
 Air quality monitoring at Amsterdam's construction sites

Reusing solar panels
 Second-hand solar panels to alleviate social, environmental, and economic challenges

Urban Agriculture Academy Amsterdam
 Citizens in Amsterdam Zuidooost to work as 'prosumers', or producing consumers

Consumption and regenerative farming
 The connection between urban consumption and regenerative farming

Reinventing the City



To create solutions that truly reinvent cities, we need to connect different disciplines and types of skills and expertise. In 2022, the integration of AMS Institute's educational, entrepreneurship, and research and innovation activities was stronger than ever before. Many MSc MADE students collaborated on the institute's research and innovation projects. Teams of students, alumni, and researchers participated in our entrepreneurship program to turn their innovative ideas into businesses.

This chapter presents the highlights of 2022 in eight sections. Of all our many activities, this selection showcases how our community of experts contributed to the most pressing challenges of cities worldwide and Amsterdam in particular.

Scaling the circular built environment

Climate change, material scarcity, increasing supply risks, price fluctuations of conventional building materials, and the current housing shortage show the urgency of using or reusing (alternative) building materials. To achieve a circular built environment, we need solutions that prevent waste and minimize the use of new raw materials, while simultaneously promoting maintenance, reuse, and remanufacturing.

As part of the Climate Agreement, the Netherlands set a goal of reducing its consumption of primary raw materials by half by 2030 and to be fully circular by 2050. Through (re)design and by closing energy, water, and material loops, the AMA aims to be a global frontrunner in finding smart solutions for the limited availability of resources. For instance, the AMA signed the 'Green Deal Timber Construction in the Metropolitan Area of Amsterdam' covenant October 2021. Looking at Amsterdam, the City works on becoming the world's first circular city.

AMS Institute's activities related to this global challenge center around three cornerstones: circular infrastructures, biobased construction, and data and monitoring. Our 2022 highlights include a bench made of elephant dung that was developed by MSc MADE students in collaboration with ARTIS Zoo, and a successfully conducted lab testing phase in the process of developing fully circular concrete.

Education

- **Circular Zeilfort (MSc MADE Living Lab):** implementing a circular system for the café kitchen facility of Zeilfort Kudelstaart.
- **Value of Poo (MSc MADE Living Lab):** circular scenarios for elephant dung in the context of ARTIS zoo in Amsterdam.
- **The Housing Construction Chain in Motion (MSc MADE thesis):** a systems approach to accelerating the transition to a circular housing construction system based on circular and conceptual building.

Research and Innovation

- **Building with Timber for a Climate-neutral and Circular City:** an integrated knowledge and innovation program supporting biobased construction in the AMA.
- **Circulaw:** an online legal platform to guide policymakers and civil servants on available legal instruments that promote circularity.
- **Biobased Industrialized Zero-emission Modular High-rise Buildings in the G4:** contributing to product and process solutions for zero-emission construction of circular and wood-based modular high-rise buildings.
- **Circular Use of Pavement Materials:** quantifying the contribution to climate policy goals by applying three circular scenarios to the road network of Amsterdam.
- **Cement Recycling Using Biobased Chemicals:** developing a method to reactivate used cement from demolition waste and recycle it at room temperature, thereby decreasing the use of new cement in the construction industry and reducing CO₂ emissions.



A closer look at some of our activities focused on scaling the circular built environment

Education

Senseable Construction (MSc MADE Living Lab)

Amsterdam is growing by an average of 11,000 residents each year. To enable this growth while relieving pressure on the housing market, the City's ambition is to enable the construction of 50,000 housing units by 2025. Currently, it is unknown how this construction will impact air quality.

In 2022, a team of MSc MADE students investigated whether sensors can measure the impact of construction activities on the air quality of

Amsterdam. During the first phase of their Living Lab assignment, the team defined the direction of the project and conducted research on air pollution. The students organized a co-creation session with the City and different partners to determine the research methodology. Next, they deployed sensors on construction sites in Amsterdam Zuidoost for three weeks. Then the team was ready to take a deep-dive into the collected data. The result: a low-cost air quality sensing handbook to make it easier for other researchers and professionals to measure air quality around construction sites. The handbook consists of a guidebook and a sensor code repository.

"In 2022 a team of six MSc MADE students worked on further developing our product, which resulted in three prototypes that we could test. In the end this enabled us to officially set up a pilot project with the city council of Amstelveen. All in all, we made good progress this year and came closer to our mission of creating climate-adaptive and livable public spaces."

Gijs Verkooijen, Co-founder, The Leaf

Research and Innovation

Biobased industrialized zero-emission modular high-rise buildings in the G4

The Netherlands is facing an acute housing shortage; Amsterdam and the three other biggest cities in the country (together nicknamed the G4) alone need to construct 30,000 new houses per year. At the same time, globally the construction sector is responsible for 44% of global resource use and 38% of man-made CO₂ emissions, of which approximately a third are directly related to the extraction and production of abiotic building materials.

This project aims to accelerate the development of climate-neutral construction by mainstreaming sustainability criteria in the tender procedure for high-rise buildings. To achieve this, we are researching the feasibility and impact of low-emission and biobased materials and logistics strategies for high-rise buildings in the Netherlands. The process is guided by a co-creation process of stakeholders representatives from the public and private sector, and will culminate in a living lab that tests the outcomes in a tender in Amsterdam Zuidoost.

In 2022 the project officially kicked-off. Led by AMS Institute, this project involves a triple helix consortium with TU Delft, WUR, MIT, the City of Amsterdam, and the other G4 cities, as well as a consortium of construction and consulting companies.

Project lead: Ton Jansen (AMS Institute)

Program developer: Joke Dufourmont

Research Fellows: Petar Koljesnic (TU Delft), Titus Venverloo (MIT)

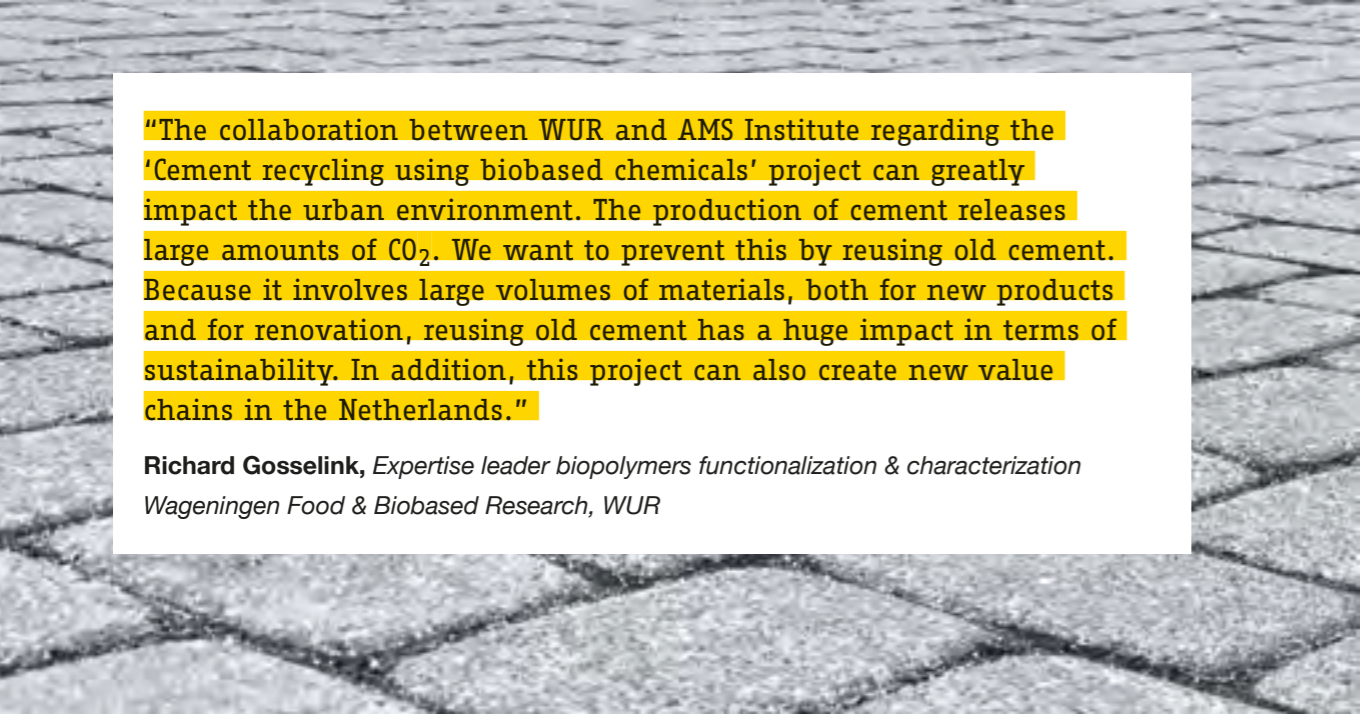
Researchers: dr. Stijn Brancart (TU Delft), Martien van den Oever (WUR), dr. Walther Ploos van Amstel (HvA), dr. Ruben Vrijhoef (TU Delft)

Partners: TU Delft, WUR, MIT, City of Amsterdam, City of Rotterdam, City of Utrecht, City of The Hague, Cirkelstad, HvA, Wooden City, Dura Vermeer, BPD Gebiedsontwikkeling, LEVS Architecten, VGG Adviseurs, Johan Cruijff Arena, Frontwise Facades, and Witteveen+Bos

Duration: 2 years

Budget: €2.1M





"The collaboration between WUR and AMS Institute regarding the 'Cement recycling using biobased chemicals' project can greatly impact the urban environment. The production of cement releases large amounts of CO₂. We want to prevent this by reusing old cement. Because it involves large volumes of materials, both for new products and for renovation, reusing old cement has a huge impact in terms of sustainability. In addition, this project can also create new value chains in the Netherlands."

Richard Gosselink, *Expertise leader biopolymers functionalization & characterization Wageningen Food & Biobased Research, WUR*

Cement recycling using biobased chemicals

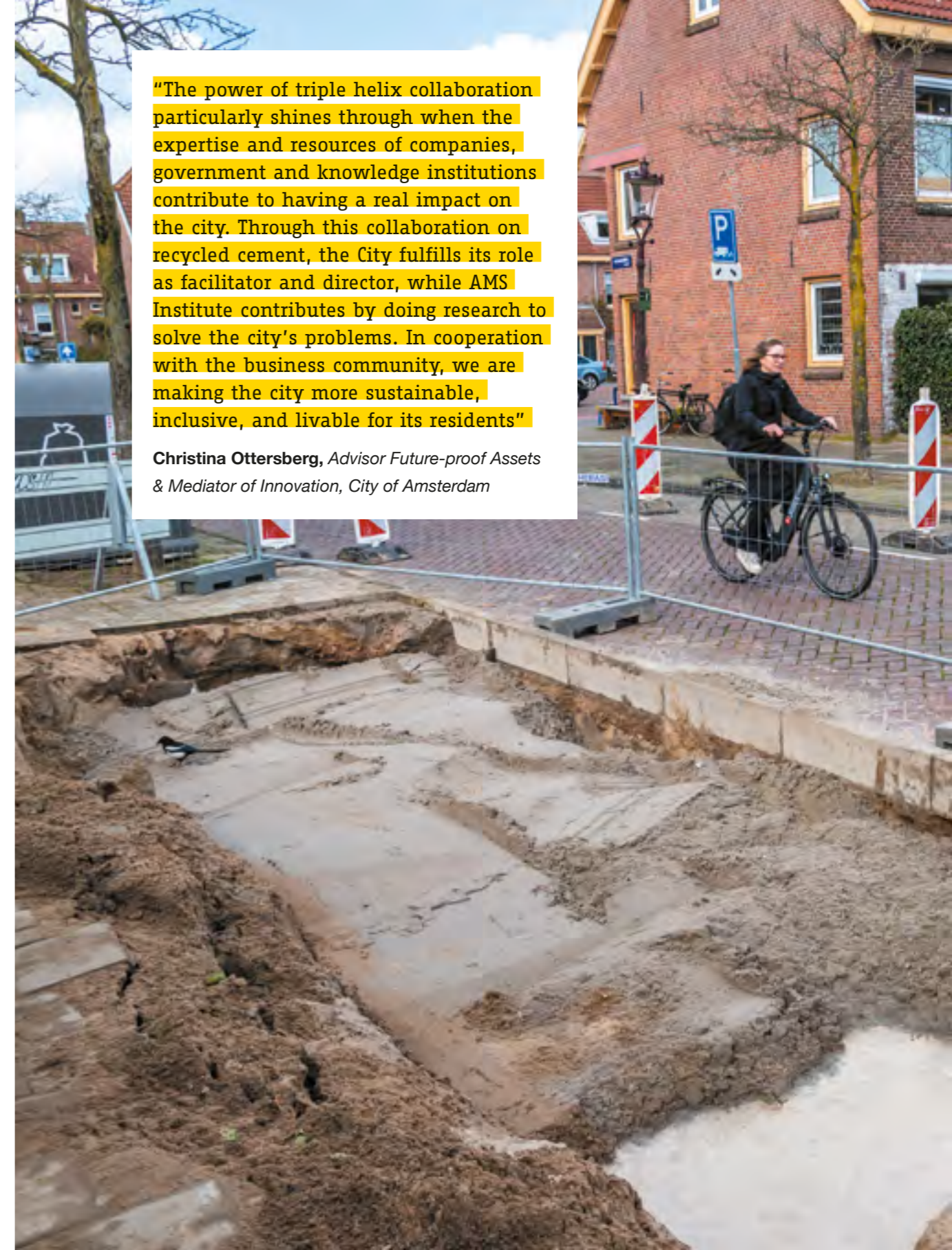
Cement manufacturing accounts for 8% of total global CO₂ emissions. Cement is an indispensable binding agent of concrete which is used as a building material for houses and city streets. Up to now, when concrete structures are demolished at the end of their lifetime, the cement stone that remains is only suitable for use as a filler in new concrete or asphalt. But concrete demolition waste contains large amounts of cured cement – a valuable resource which can be reused.

To reuse this 'spent' cement as a binding agent, it first has to be reactivated. Various methods have been tested to this end, but most are very energy-intensive and do not always produce the desired quality. In this joint project with WUR, in collaboration with TNO and industry partners, we are investigating methods to reactivate cement at room temperature with biobased additives and make cement recycling possible. This

development yields a significant reduction of both CO₂ emissions and the use of primary raw materials for the infrastructure sector. Moreover, using this method, CO₂ can be sequestered for a longer period of time.

In 2022, researchers successfully conducted the first lab tests to develop fully circular concrete. AMS Institute will initiate and coordinate field labs with circular concrete for roads and quay walls in Amsterdam in 2023-2024 in cooperation with the asset managers of the municipality.

Project lead: dr. Richard Gosselink (WUR)
Program developer: dr. Joppe van Driel
Researcher: dr. Ted Slaghek (WUR)
Partners: WUR, AMS, TNO, City of Amsterdam, Rutte Groep, Rijkswaterstaat, DuPont, Novidon, ProRail, Cugla, and Preco
Duration: 3 years
Budget: €1.4M



"The power of triple helix collaboration particularly shines through when the expertise and resources of companies, government and knowledge institutions contribute to having a real impact on the city. Through this collaboration on recycled cement, the City fulfills its role as facilitator and director, while AMS Institute contributes by doing research to solve the city's problems. In cooperation with the business community, we are making the city more sustainable, inclusive, and livable for its residents"

Christina Ottersberg, *Advisor Future-proof Assets & Mediator of Innovation, City of Amsterdam*

Creating inclusive and equitable cities

When poorly planned, urbanization can lead to increased levels of inequality and social exclusion. Uneven distribution of opportunities can result in entire neighborhoods and groups of the population lacking access to proper health care, transportation, education, employment opportunities, and affordable housing and energy.

Cities worldwide are working toward becoming inclusive and equitable for all residents. This involves setting targets for cities to foster positive economic, social, and environmental connections between urban, peri-urban, and rural areas. Also, by strengthening national and regional development planning and implementing integrated policies that work toward inclusion. For example, the City of Amsterdam aims to be an 'indivisible' inclusive city that provides equal access to opportunities everywhere in all parts of the city – for everyone.

At AMS Institute, we believe inclusivity and equitability are required to drive a true shift toward more sustainable cities. In 2022, our community's efforts to create inclusive and equitable cities touched on many areas. For example, MSc MADE students developed a housing platform for students at Marineterrein Amsterdam and entrepreneurs taking part in our Startup Booster program upscaled an app that rewards community involvement in the accomplishment of civic and sustainable tasks.

Education

- **Deep Map (MSc MADE Living Lab):** mapping local knowledge and social values from to integrate these factors in the City's design plans.
- **MADE Student Housing (MSc MADE Living Lab):** creating a housing platform for students of non-traditional educational programs like MSc MADE.
- **Warm Welcome (MSc MADE Living Lab):** building a framework for temporary housing processes for the economically homeless.
- **Future-proof 'Wildemanbuurt' (MSc MADE Metropolitan Solutions):** engaging residents to transform the Wildemanbuurt into a sustainable, inclusive, and circular neighborhood.

Research and Innovation

- **JUST PREPARE:** involve people in low-income areas of four Dutch cities to make their homes more energy-efficient.
- **Ideal(s) City:** connecting individual existing monitors, goals, and frameworks to gain a more complete view of the city's status and progress.
- **i-CHANGE:** monitoring parameters that influence citizen's health, like urban thermal comfort and air quality, in eight inner city living labs worldwide.
- **Urban Agriculture Academy Amsterdam:** creating an urban agriculture academy to work as 'prosumers', or producing consumers.
- **Circular Solar Panels for the Doughnut Economy:** giving discarded solar panels a second life to alleviate social, environmental, and economic challenges.

Entrepreneurship

- **CoTown:** an app that rewards community involvement in the accomplishment of civic and sustainable tasks with digital tokens.
- **Lettus Design:** gamified participatory and co-creative design processes to realize equitable and economically viable urban agriculture projects.
- **AI Institute:** an artificial intelligence based platform that implements a conversational agent – the ADAM chatbot – to offer a first line of automated support in crisis situations to the residents of Amsterdam.

A closer look at some of our activities focused on creating inclusive and equitable cities

Education

Deep Map (MSc MADE Living Lab)

To keep up with the housing demand in Amsterdam a new urban area is being constructed that consists of six artificial islands. During the development of new neighborhoods like IJburg, the City of Amsterdam not only considers the physical construction of new houses, but also takes into account the livability of the urban environments. This includes an attractive design of the public space, the availability of education, care, culture, and sports facilities, and the use of local knowledge and social values in the design plans. But how to map and integrate softer factors like social cohesion and emotions into the design processes?

This year MSc MADE students tried to answer this question using 'deep mapping'. In short, deep mapping is a method that visualizes the sentiments and experiences of residents. During the living lab project, students created a deep map that resonates with the feelings and experiences of IJburg's residents rather than spatial characteristics.

"For our next steps, we have signed a new pilot project in Amsterdam Zuidoost. Also, the City of Heerlen confirmed long-term usage of CoTown's platform to improve civic engagement and local economy."

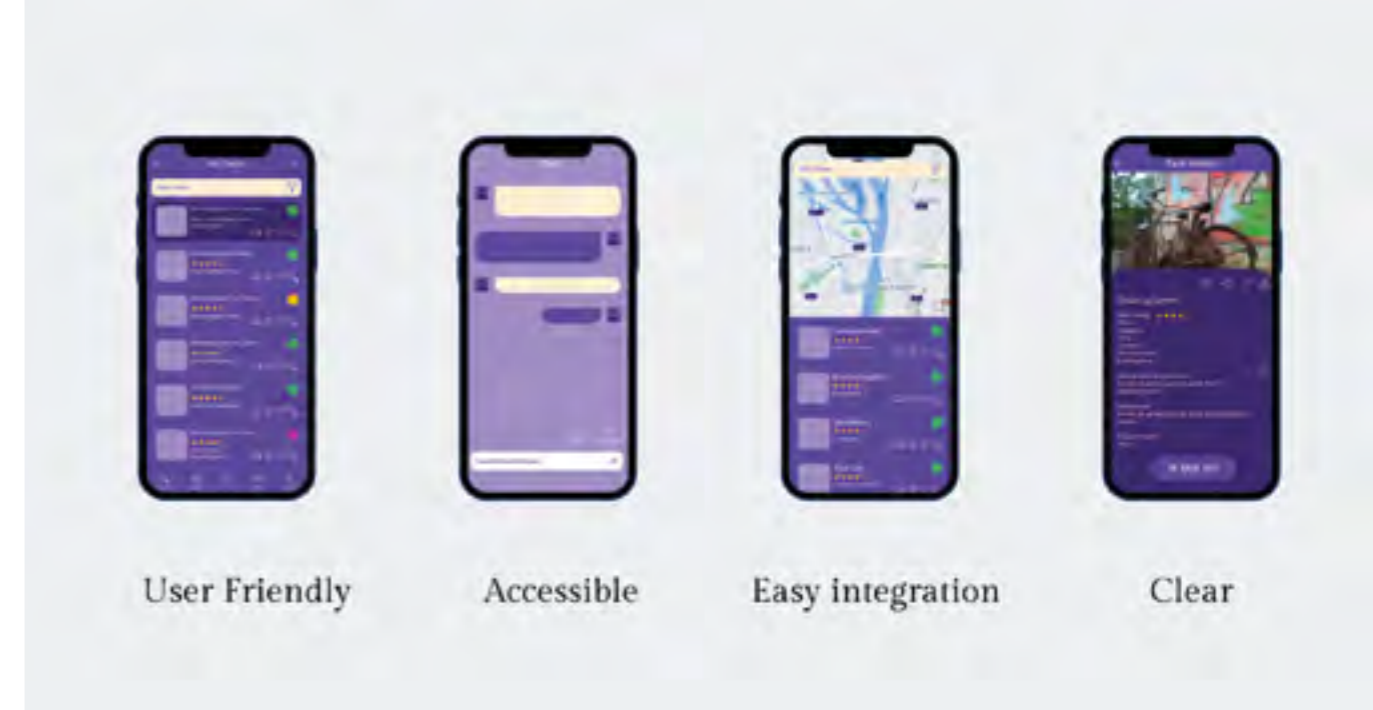
Grégoire Piette, Founder & CEO, CoTown

Education

MADE Student Housing (MSc MADE Living Lab)

Small educational institutions and non-traditional educational programs, such as MSc MADE, often lack support systems or information to provide housing solutions for their students. This affects students' academic performance. This 2022 MSc MADE living lab was developed on the grounds that student housing is a right.

This living lab assignment resulted in the development of a housing platform, which targets students enrolled in programs of educational institutions located at Marineterrein Amsterdam. This includes MSc MADE students from AMS Institute as well as scholars from CODAM and AHK. The platform provides students with short-term housing solutions offered by companies and individuals from Marineterrein Amsterdam's community.



Entrepreneurship

CoTown

With CoTown's blockchain-based platform, governments can encourage community members to participate in civic and sustainable activities. The startup's app rewards community involvement with digital tokens, which in turn can be used for various goods and services offered by a network of local partners to drive the local economy.

In 2018, the startup began exploring this idea and launched the first proof of concept, 't Heerlen's Heitje, with the City of Heerlen in the south of the Netherlands by the end of 2021. Citizens of Heerlen were rewarded for their help with small neighborhood jobs like renovating a bench or a bin. By mid-2022, citizens had done over 200 tasks. Also, about 30 shops joined the program and 7000 euros worth of 'Heitje coins' were converted.

The entrepreneurs took part in the AMS Startup Booster program this year to work on developing a more scalable platform and clearer product and market fit. Now, the team looks forward to launching new projects and features to bring civic engagement and the local economy even further. The goal of this entrepreneurial team is to successfully scale up their solution and move to new markets like Belgium, Germany, or France.

Entrepreneurship

Lettus Design

Engaging communities in creating public spaces often takes a lot of time and project resources. Lettus Design builds tools that make it easier for the public to express themselves, use community input to plan, and instantly visualize public green spaces. To ease the initiation and realization of urban agriculture projects, this startup uses gamified participatory and co-creative design processes.

The co-creation challenges are addressed through a fun and familiar activity – such as playing a board game – in which the outcome is a data-driven visualized site plan. The decision-making tool streamlines stakeholder voices into a unified project. The tool also shows the possibilities of urban food systems. Through this process, projects will reach long-term economic, environmental, and social sustainability goals while reducing land-use negotiation time. In this way, Lettus Design contributes to the development of more equitable and economically viable urban spaces.

In 2022, Lettus Design won the Global Urban Greenhouse Challenge at WUR. Thereafter, the three founders of the startup continued developing their business idea by taking part in the AMS Startup Booster program.

Research and Innovation

Ideal(s) City

Just like other cities, Amsterdam faces social and ecological challenges, such as housing shortages, poverty and debt, air pollution, greenhouse gas emissions, and declining biodiversity. Most of these issues are intertwined. Improving the city thus requires approaches and solutions that address challenges simultaneously and broad progress monitoring. As part of the Ideal(s) City project, we work on combining different monitors into one ‘ideals framework’.

In 2022, we identified seven ideals of Amsterdam through workshops and policy analysis. These ideals are being:

- 1 a collective city in which citizens, civil servants, and companies collaborate;
- 2 a city with equal opportunities;
- 3 a city with good governance;
- 4 a place where people are open minded and live in freedom;
- 5 a city that stays within planetary boundaries;
- 6 a city that thrives and progresses, and;
- 7 a city in which people are safe and healthy.

In addition, by comparing eight existing monitors currently used by the City of Amsterdam to track performance on ecological, social and economic policy goals, we created an overview of the indicators used, how monitors are thematically connected, overlap and differ.

In the future, ideals and indicators will be combined in a first version of the ideal framework. The framework will be further developed and validated with experts, and it will be tested in practice on two cases. As a result, the City will gain a more complete picture of Amsterdam that can help strategic decision making that will improve the City.

Project lead: dr. Lieke Dreijerink (WUR)

Principal Investigators: prof.dr. Ellen van Bueren (TU Delft), prof.dr. Eveline van Leeuwen (WUR)

Researchers: dr. Lieke Dreijerink (WUR), Arnout Sabbe (TU Delft), Fabio Tejedor (MIT)

Partners: City of Amsterdam, TU Delft, and WUR

Duration: 2 years

Budget: €436K



Research and Innovation

i-CHANGE

The number of people exposed to extreme heat is growing because of urbanization and climate change. The overall concept of the i-CHANGE project is based on the idea that knowledge is power. Citizens and civil society have a central role in the definition of environmental protection and climate action. Their direct involvement is essential to drive a true shift and promote behavioral change toward more sustainable patterns. With WUR, we set up a living lab in Amsterdam to monitor indoor and outdoor atmospheric parameters that influence citizens' health, like temperature, CO₂ concentrations, and humidity.

In 2022, about fifty homes received full installation of sensors in living and sleeping rooms. One of this year's highlights was when the first heat wave took place, and data of indoor temperatures was registered. At night, the temperature in some houses did not drop below 28 degrees Celsius. In terms of health, that is obviously a very low point, but it perfectly illustrates the problem this project focuses on and aims to combat.

This project creates more knowledge for municipal officials on the one hand, and the citizens who participate on the other. By taking part in the experiment, citizens can gain a better understanding of healthier ways to live as well as what they can do to mitigate the effects of extreme climate situations in their homes, for example, in the event of a heatwave.

Project lead: Esther Peerlings (WUR)

Program developer: dr. Gerben Mol

Principal Investigator: dr. Gert-Jan Steeneveld (WUR)

Living Lab Coordinator: Hans Roeland Poolman (AMS Institute)

Partners: CIMA Research Foundation Department of Meteorology and Climatology, University of Bologna, Tel Aviv University Water Research Center, National Research Council Italy, University College Dublin, University of Barcelona, Wageningen University & Research, Universiteit Hasselt, European Centre for Medium-Range Weather Forecasts, Natural Resources Institute, Danish Board of Technology, DEN Institute, Kajo Services, Techne Consulting, Climate Media Factory, and the West African Science Service Center on Climate Change and Adapted Land Use.

Duration: 4 years

Budget: €1.3M



"Until now relatively little was known about the impact of heat waves on homes in urban areas and how trapped heat affects the health and well-being of residents. With i-CHANGE, we not only learn about experiences from Amsterdam residents during heat waves, we also focus on changing citizen behavior. We generate impact by sharing knowledge with residents about short term solutions such as effective ventilation and cooling methods and by giving advice on long term solutions related to home investments and the reduction of greenhouse gas emissions."

Gert-Jan Steeneveld, Associate Professor Meteorology (WUR), PI at AMS Institute



Research and Innovation

JUST PREPARE

In the process of realizing the energy transition, there are mismatches found between the retrofitting of poorly isolated houses and residents' energy practices, and between residents and those actors planning and implementing solutions. This is amongst others related to a lack of knowledge about the diversity of energy related household practices, and how to involve residents in planning and implementation of housing renovation. This puts pressure on realizing an effective and equitable (i.e. distribution of benefits and burdens; degree of access to decision-making; and recognition of how vulnerable groups are affected by the energy transition) energy transition in these neighborhoods.

JUST PREPARE focuses on developing the required knowledge in four different municipalities; applying the gained expertise to create solutions in living labs in collaboration with municipalities, housing corporations, residents and other relevant actors; improving these solutions accordingly; and preparing the findings for use elsewhere. In 2022, the NWO granted funding to the JUST PREPARE consortium.

Urban Living Lab Program developer: Mark Kauw (AMS Institute)

Program developer: Paul Voskuilen

Researchers: prof.dr. Henk Visscher, dr. Aksel Ersoy, dr. Thomas Hoppe, dr. Thaleia Konstantinou, (TU Delft)

Partners: UvA, HvA, Radboud Universiteit, TU Delft, Technische Universiteit Eindhoven, Hogeschool Arnhem/Nijmegen, and over 40 ((co)funding) partners including provinces, municipalities, housing associations, energy companies and consultants

Duration: 4 years

Budget: €888K

Designing responsible smart systems in public space

Governments around the world are making cities 'smarter'. Digital (data-intensive) technologies can be powerful tools to create efficient and livable urban environments. For example, smart meters that help manage energy consumption or monitor water quality, smart sensors to improve traffic flow and transport efficiency or applications that analyze crowdedness in cities in real-time. However, these technological developments can also negatively impact autonomy and privacy.

Going forward, a key question for decision-makers is how to find the right balance between benefits and privacy. In the Netherlands, ministries and implementing organizations are required by law to give explicit consideration to issues such as information security and privacy when making new laws and regulations. With the development of its 'Digital Agenda', the City of Amsterdam aims to ensure responsible and fair use of technology for all Amsterdam residents.

At AMS Institute, we explore how to integrate sovereign liberal democratic values in the design of sensing systems that are placed in public space. In 2022, one of our MSc MADE students examined, with and for the City of Amsterdam, how to successfully introduce a robot that can help keep public spaces clean. As part of the Responsible Sensing Lab, a collaboration was launched with several municipalities to realize a national standard for communication on sensors in public space.

Education

- **Senseable Construction (MSc MADE Living Lab):** air quality monitoring at Amsterdam's construction sites.
- **A Cleaner Public Space Through Robots (MSc MADE thesis):** an exploratory research project into the introduction of a cleaning robot in the Amsterdam 'school' (in English: clean) department.

Research and Innovation

Responsible Sensing Lab: the projects in this lab focus on exploring how to integrate social values in the design of sensing systems in the public space:

- **Shuttercam:** experimenting with crowd monitoring systems outfitted with shutters to show the public when the cameras are monitoring and to ensure that only the data that is strictly necessary is collected.
- **Human Values for Smarter Cities:** designing understandable machine-vision systems in public spaces
- **Contestable AI:** exploring algorithmic decision-making systems that are open and responsive to dispute.
- **Citizen Communication and Participation regarding Sensors:** standardizing a communication approach to enhance awareness among citizens on the use of sensors in public space.

Entrepreneurship

- **AI Institute:** an artificial intelligence based platform that implements a conversational agent – the ADAM chatbot – to offer a first line of automated support in crisis situations to the residents of Amsterdam.

A closer look at some of our activities focused on designing responsible smart systems in public space

Education

A cleaner public space through robots

Like many cities around the world, Amsterdam has a waste problem. Growth of the city population will amplify this problem, so the City needs to increase the productivity of the Amsterdam 'schoon' (in English: clean) department. Working with the City of Amsterdam, one of our MSc MADE students conducted master's thesis research in 2022 on the responsible and effective introduction of a cleaning robot in Amsterdam.

The thesis outlines a number of recommendations for a future cleaning robot. The results indicate that a cleaning robot could best take on an assisting role during the sweeping the streets and the emptying

the waste bins. This frees up manpower that can be utilized to increase the productivity of these shifts. The future robot should also be user-friendly for everyone in the department. Furthermore, the robot must be able to communicate its status, plans, possible requests for and offers of assistance to City employees.

Overall, the introduction of a cleaning robot can improve the cleanliness of the City of Amsterdam if the design incorporates the themes important for the job satisfaction of employees, aims at an efficient human-robot collaboration through clear communication, and combines the right type of autonomy with the challenging urban environment of the city.

Entrepreneurship

AI Institute

In the event of public (health) emergencies, vital information is typically made available by the City. This often leads to heavy traffic on city systems, restricting the number of citizens who can be provided with quick, accurate, and reliable information

AI Institute believes that big-data and AI-driven solutions can make cities more efficient, improve quality of life, and increase overall economic prosperity. This startup integrates AI insights directly into existing workflows; in short, this startup developed a platform that implements a conversational agent – the ADAM chatbot – to serve as a first line of automated support for the residents of Amsterdam. Among others, the chatbot interacts

with residents in a conversational manner, providing quick and accurate information online. For this, the chatbot uses a combination of natural language and constrained option responses that will guide users to a resolution. As a result, by boosting service levels for citizens and reducing the workload for public sector workers, AI Institute's solution makes cities more efficient.

In 2022 AI Institute took part in the AMS Startup Booster. Currently, the startup focuses on establishing connections and setting up its first pilots with Dutch municipalities. By conducting thorough research to gain a comprehensive understanding of each city's unique challenges, AI Institute can develop custom solutions that are tailored to each municipality's specific requirements and individual needs.

"While working in the academic sphere and industry, we observed a disconnect between business practices and research. We saw that AI and big data analytics were not being implemented or were being adopted with a considerable delay, even though the business benefits are obvious. This inspired us to found AI Institute to help bridge the gap between business practices and state-of-the-art AI implementation."

Camelia Minica, Co-founder, AI Institute



Research and Innovation Responsible Sensing Lab

With the City of Amsterdam, we launched the Responsible Sensing Lab (RSL) – a testbed for conducting rigorous, transparent, and replicable research on how the smart technologies we placed in the public space can be designed responsibly for the smart city. Among the projects in the RSL portfolio are Shuttercam, Citizen Communication and Participation regarding Sensors, and Human Values for Smarter Cities designing understandable machine-vision systems in public spaces.

Shuttercam

Would citizens like to live in a city where all cameras in the public space clearly show *if* and *when* they're in use? A Shuttercam is a remote camera with a physical cover that visibly blocks the view of the camera when not in use, similar to a webcam slider on a laptop. After earlier experiments at Amsterdam Marineterrein, we started a pilot in 2022 with two Shuttercams on the grounds near the Johan Cruijff ArenA in Amsterdam. These two Shuttercams are the first to be deployed in a 'real' environment and by a national market player – VCS Observation.

At the ArenA, the Shuttercams monitor the crowd around the stadium during events like soccer games to help prevent congestion and unsafe situations. They are an addition to the Public Eye project of the City of Amsterdam and the ArenA. Within that project, an algorithm analyzes camera images without employee intervention and converts them into counts. Amsterdam is the first municipality to combine these two innovations. In this way, the City carries out its tasks efficiently, while safeguarding the privacy of Amsterdam's residents and visitors.

The pilot will run until January 2023, after which Responsible Sensing Lab will use the results to design new, responsible forms of camera surveillance for cities. If successful, VCS Observation will further develop the technique and the project can be scaled up within Amsterdam and other municipalities.

Project lead: Sam Smits (City of Amsterdam)

Program developer: Thijs Turèl

Principal Investigator: prof.dr. Gerd Kortuem (TU Delft)

Researchers: Kars Alfrink (TU Delft), dr. Mike de Kreek (HvA)

Partners: VCS Observation, City of Amsterdam, and LIFE electronics

Duration: 1 year

"The Shuttercam project can provide a practically feasible solution in numerous situations for government organizations that want to better ensure the privacy of their citizens."

Marvin Fonteijn, Account Manager, VCS Observation





Citizen Communication and Participation regarding Sensors

Currently there is no standard approach for communicating about sensors and creating interaction with citizens living in smart cities, which can create confusion among residents. Awareness and accountability are essential for a functioning democracy. Only when citizens are aware of smart applications and these systems have been clearly explained is it possible for them to ask questions and address undesirable situations.

In 2022, this project on effective and inclusive communication about sensors was officially launched. We are working with national partners toward standardizing a communication approach to enhance awareness on the use of sensors in the public space and the systems they belong to. What makes this research project special is the empirical approach. We investigate, for example, what works and what does

not work for residents and passers-by on the street and ask them directly what information is needed.

With this project, we are increasing the involvement of citizens and ensuring that democratic values like privacy, transparency, and accountability are preserved. Next to knowledge development, the long-term goal is to create a national standard for explaining sensors.

Project lead: Sam Smits (City of Amsterdam)

Program developer: Thijs Turèl

Researcher: dr. Pieter van Langen (TU Delft)

Partners: City of Amsterdam, VNG, Province of Noord-Brabant, City of The Hague, City of Rotterdam, and City of Utrecht

Duration: 1 year

Budget: €225K

"Municipalities want to be transparent about the deployment of sensors while creating a beautiful, peaceful outdoor space for all citizens. This can be realized simultaneously, and in this project we are learning how."

Dirk van Brederode, Public Values Manager, Association of Netherlands Municipalities (VNG)

Human Values for Smarter Cities

Cities around the world are launching manifestos and declarations, such as the TADA manifesto and the Cities Coalition for Digital Rights call, expressing the importance of developing smart city technologies from a human and civic perspective. However, often professionals working in the field – like government officials and tech developers – find it challenging to translate abstract principles from such manifestos into concrete specifications during the development of smart city technologies.

As part of this project, we are working with several partners on a research-through-design trajectory to develop a prototype for an ethical scan car. Throughout the Netherlands, municipalities use scan cars to localize waste, assist in tree maintenance, and to enforce the city's parking policy. Scan cars are a highly suitable case study, as they combine the promise of smart city technologies (e.g., more efficient and safer cities) with challenges concerning human and public values such as privacy, transparency, and accountability.

In 2022 Human Values for Smarter Cities officially started. In the next phase of the project, the consortium aims to develop a prototype for an ethical scan car that explains its functioning in public space. As part of that process, a platform for participatory machine learning will be developed to include citizens in discussions about the design and functionalities of the scan car. Ultimately, the scan car is used as a concrete case to develop a design process for public institutions to leverage human values and engage citizens in evaluating other smart city technologies.

Project lead: Martijn de Waal (HvA)

Program developer: Thijs Turèl

Principal Investigator: prof.dr. Gerd Kortuem (TU Delft)

Researchers: Kars Alfrink (TU Delft), dr. Mike de Kreek (HvA)

Partners: HvA, City of Amsterdam, TU Delft, Media Architecture Biennale, Waag Futurelab, ARVOO Group, tapp, City of Rotterdam, and City of The Hague

Duration: 3.5 years

Budget: €1M

"Next to establishing these systems legitimately, it is of great importance for governments to explain these systems and their applications, and to encourage citizens to actively contribute their ideas on the use of sensors."

Thijs Turèl, Program Manager Urban Data & Intelligence, AMS Institute



Future-proofing infrastructure assets from climate change

How city assets are planned, designed, and maintained determines exposure, social and physical vulnerability, and capacity for resilience. For example, interventions related to greening need to be implemented, systems to prevent flooding in streets also have to be established, roads and bridges need to be built or adapted to withstand higher temperatures and more intense precipitation.

Worldwide, (local) governments are key actors in facilitating and strengthening the response to climate change. To prepare for the consequences of climate change, the Netherlands developed a national approach based on two programs: the National Climate Adaptation Strategy and the Delta Program. On a local level, the City of Amsterdam implemented a climate adaptation strategy for a climate-proof city to be as prepared as possible for the changing climate by 2050.

Among this year's milestones are a collaboration between MSc MADE students and Research Fellows, who laid the foundation to build a monitor for urban tree happiness. 2022 also marked the start of a research program that includes three projects that will contribute to innovations relevant to the maintenance, repair, and renewal of historic urban bridges and quay walls. In terms of entrepreneurship, one of our Startup Booster teams worked on a data-driven solution to design for neighborhood-scale flood mitigation and protection strategies.

Education

- **Happy Tree Monitor (MSc MADE Living Lab):** the foundation to build a monitor for tree happiness.
- **Drought Resilient Bajeskwartier (MSc MADE Living Lab):** making Bajeskwartier in Amsterdam drought resilient.
- **Climate-proof Business Parks (MSc MADE Living Lab):** making business parks climate resilient.
- **Senseable Construction (MSc MADE Living Lab):** air quality monitoring at Amsterdam's construction sites.

Research and Innovation

- **Amsterdam Quayside Bulge Experiment:** investigating how much pressure the historic quays can take before they bulge or collapse.
- **Urbiquay:** contributing to innovations relevant to the maintenance, repair, and renewal of urban bridges and quay walls.
- **RED&BLUE:** developing integrative climate adaptation strategies for the built environment.
- **i-CHANGE:** monitoring parameters that influence citizen's health in eight living labs worldwide.
- **Urban Comfort Lab:** testing circular and sustainable designs of buildings to reduce the exposure to aircraft noise.
- **AquaConnect:** developing scientific concepts for solutions that ensure fresh water provision.
- **Happy Tree Monitor:** the foundation to build a monitor for tree happiness.

Entrepreneurship

- **One Ground Studio:** a data-driven design solution that analyzes flood vulnerability to design neighborhood-scale flood mitigation and protection strategies.
- **Syllogic:** an algorithm-based decision-maker that assists asset managers with the planning of life-cycle inspections and other maintenance actions.



A closer look at some of our activities focused on future-proofing infrastructure assets from climate change

Education

Happy Tree Monitor (MSc MADE Living Lab)

Trees in general, but also in urban areas, provide many advantages for the wellbeing and quality of life of people. But what about the wellbeing of city trees themselves? In the Happy Tree Monitor project a team of Research Fellows use urban data to analyze the happiness of trees in Amsterdam. The team investigates what defines tree happiness, what are suitable indicators to measure this concept, and what data is already available. Moreover, the researchers explore what senses a tree has to perceive its environment and what a sensor for tree happiness would entail.

In 2022, as part of this research and innovation project, MSc MADE students took part in a MSc MADE Living Lab. The student team acquired input variables and indicators, including ecosystem, abiotic, human related, and tree-specific factors. They developed an extensive overview of (sub)categories and variables by, among others, interviewing a diverse range of experts, facilitating co-creation sessions and organizing an expert validation meeting. Based on their work, the Research Fellow team developed follow-up plans to develop a Happy Tree Sensor, a Happy Tree scanner, and a Happy Tree Heat Map.

Education

Drought Resilient Bajeskwartier (MSc MADE Living Lab)

The Bajeskwartier neighborhood in Amsterdam is set to be fully completed by 2027, with a strong focus on creating a sustainable, healthy, and creative community. One of the key features of the neighborhood is its thoughtfully designed green spaces, which have been carefully planned to drain extensive rainfall and mitigate heat stress, as part of a comprehensive climate-adaptive strategy.

As part of the AquaConnect research project, this MSc MADE living lab was set up to provide insights into the desired functions and boundary conditions of the area with regard to drought resilience. The MSc MADE students conducted expert interviews and co-creation sessions and built a water shortage model. These efforts enabled the team to develop a functional design with clear interventions for the Bajeskwartier development consortium. Some of the key interventions recommended by the team included adding organic matter to soil, having households harvest rainwater, and implementing a gray water system. These creative solutions are designed to make the urban green spaces in the neighborhood drought resilient from now until at least 2085.

Education

Climate-proof Business Parks (MSc MADE Living Lab)

A big part of the built environment in the Netherlands consists of business parks. Buildings in business parks are often made from impermeable, solid surfaces such as concrete, stone, or brick. Because these surfaces cannot be penetrated by water, business parks are susceptible to multiple effects of climate change, such as flooding during heavy rainfall. How can we make these business parks climate resilient?

For this year's MSc MADE Living Lab assignments, there was a fruitful collaboration between one of our AMS Startup Booster 2021 alumni and a team of MSc

MADE scholars. SPATwater, a hydrological consulting startup is on a mission to make urban spaces in the Netherlands future-proof through spatial smart data-analysis.

Working together with the Green Business Club, Waternet, 'Samen Klimaatbestendig', and the City of Amsterdam, the entrepreneurs and students developed an online tool called 'vergroenjewerk.nl' (green your work). This free tool provides a step-by-step approach with information, a calculation tool, and a communication toolkit to help advance the transformation of traditional business parks into green and climate-adaptive ones.

"Participating in the AMS Startup Booster convinced us that you need to inform and engage the people who will experience the consequences of a changing climate the most. In our case: the people who work at business parks. That is why we started working together with local stakeholders and asked AMS Institute students to help us come up with a solution."

Timo van den Berg, Co-founder, SPATwater



Entrepreneurship

One Ground Studio

One Ground Studio (OGS), is a consultancy that develops data-driven architecture, engineering and planning solutions for flood mitigation and adaptation at a neighborhood scale. One Ground Studio's approach is to analyze and visualize flood vulnerability by using location and demographic data. This way, municipalities can be better informed about designing flood protection strategies for their cities.

The startup consists of four MSc MADE students. Their journey started in November 2021. During the MSc MADE course 'Entrepreneurial Thinking', the group formed because of a shared passion for flood-resilient design that respects local context and

methods. There is no one-size-fits-all solution to protect vulnerable areas and increase their resilience. Therefore, their focus is to closely link data and design to provide the best possible advice for each individual case.

Taking part in the AMS Startup Booster in 2022, the startup focused on customer identification and refining consultancy services around the team's core skills, and closing their first client. One Ground Studio is currently working on a paid pilot project and a prototype. The former focuses on roof interventions to prevent localized building flooding, while the latter on flood adaptation and explores planning advice for areas in need of flood adaptation strategies.



“Urbiquay's kick-off was certainly a highlight. With different stakeholders – from researchers, city officials to resident representatives – we walked through Amsterdam's city center, passing the historic bridges and quay walls. We unanimously agreed that immediate action is required to renovate the quays and bridges. At the same time, there are many conflicting interests that arise due to the scale and complexity of this challenge.”

Maartje van Dijk, Program Officer, NWO

Research and Innovation

Urbiquay

In many cities around the world, historic bridges and quay walls are vulnerable and in poor condition. Amsterdam is no exception. The inner city contains many quay walls and bridges that were built up to 300 years ago – these are not designed for our modern day infrastructure. The City of Amsterdam thus faces a challenge in renewing its historic quay wall infrastructure. Not only are these maintenance tasks timely and costly, but short-term challenges like livability also coincide with long-term transitions in climate adaptation, circularity, and transport.

In 2022, NWO officially launched the Urbiquay program, which consists of three research projects; LiveQuay, Stability and Logiquay. The program was initiated by the City of Amsterdam, in cooperation with the Ministry of Infrastructure and Water Management, with AMS Institute being involved as a valorization

partner. In short, in these projects the consortium works on monitoring the condition of bridges and quay walls, environmentally friendly repair methods, and methods for improving the (circular) approach and logistics of these types of complex projects. The overall aim of the program is to contribute to and deliver concrete knowledge for the City of Amsterdam's existing 'Bridges and Quay Walls' program, while simultaneously contributing to the transferability of that knowledge to other contexts (i.e., other locations, circumstances, problems, or other municipalities).

Project leads: dr. Andreas Hartmann (University of Twente), dr. Mandy Korff (TU Delft), dr. Ruben Vrijhoef (TU Delft)

Program developer: dr. Henk Wolfert

Partners: City of Amsterdam, NWO, TU Delft, and University of Twente

Duration: 4 years

Budget: €3.3M



"Our commitment is to bring different worlds together: climate research, risk modeling, real estate and real estate finance, spatial planning, water management, and area development. If we all do it our own way, we either won't get there, or we won't get far enough. That much is clear, so a shared strategy is needed."

Ellen van Bueren, Professor of Urban Development Management (TU Delft), PI at AMS Institute

Research and Innovation RED&BLUE

Climate change brings new risks for real estate and infrastructure, such as rising sea levels, extreme rain, and drought. Especially lower lying urban areas around the world, like the Netherlands, are affected by the impacts of climate change.

To make urban areas climate resilient and adaptive, transdisciplinary knowledge is urgently needed. This project brings together stakeholders from different disciplines – research institutes, public and private organizations – to conduct risk assessments and develop integrative climate adaptation strategies for the built environment in lower lying urban areas. In the next five years, researchers from AMS Institute will contribute to the co-development of integrative urban climate finance and governance strategies for resilient Dutch Delta Cities. Along the way, efforts will be made to develop innovative concepts and strategies to cope with rising water.

In Amsterdam a living lab was developed to investigate a number of areas in the city. City officials are especially keen on acquiring practical knowledge

of the financial and governance aspects of creating climate resilient, future-proof infrastructure. 2022 marked the official start of the project and centered around detailing the work plan with respect to both the urban case selection and the proper research questions to be addressed by the researchers.

Program developer: dr. Gerben Mol

Principal Investigator: prof.dr. Ellen van Bueren (TU Delft)

Partners: Delft University of Technology, VU Amsterdam, Wageningen University & Research, Maastricht University, Rotterdam University of Applied Sciences, Deltares, AMS Institute, Vereniging Delta Metropool, Arcadis, APG, Bouwinvest, PGGM, Cushman & Wakefield, Waternet AGV, Municipality of Amsterdam, Municipality of Rotterdam, Municipality of Dordrecht, Province Noord-Holland, Vesteda, Verbond van Verzekeraars, Sustainable Finance Lab, Stichting Kennis Gebiedsontwikkeling, Ministry of Infrastructure and Water Management (I&W), National Delta Programme, Province Zuid-Holland, and Urban Land Institute

Duration: 5 years

Budget: €5.5M





"As engineers we have this constant urge to perfect the technical aspect of the product, working countless hours on it. While taking part in the AMS Startup Booster program we realized that talking with actual potential customers in the road maintenance field is all our startup needed at the beginning of our journey. The program really pushed us to go out there, validate our ideas and develop something that actually creates value for our customers. And that's only just the first step towards making the roads in the cities that we all live in safer and more sustainable."

Giannis Kotsakiachidis, Co-founder, Syllogic

Entrepreneurship

Syllogic

To ensure high quality of roads, road safety, and commuter comfort, efficient and timely road maintenance is required. Road maintenance is often costly, and municipalities regularly exceed the budgets secured for the required actions.

To address this issue, Syllogic developed an algorithm-based decision-maker that utilizes the recent advancements in Deep Reinforcement Learning (DRL). This AI solution assists asset managers regarding the planning of life-cycle inspections and other maintenance actions. Syllogic calculated that by scheduling such activities with this tool, cities can save up to 30% in lifecycle costs. At the same time, Syllogic's solution allows users to carefully select the best maintenance action sequence over time. This helps cities to substantially reduce CO₂ emissions and traffic congestion caused by maintenance works.

In 2022, Syllogic took part in the AMS Startup Booster. During the program, the founders focused on connecting with potential customers in the road maintenance field to validate ideas and create a solution that has truly impacts and has value for experts in the field.

Developing sustainable food systems as drivers of health and equity

Food systems worldwide are facing challenges. These include, among others, an increasing demand for food for a growing population, climate variability and extremes, overexploitation of natural resources, loss of biodiversity, and food loss and waste. Both globally and on a local scale, food systems must be re-designed to meet the needs of present and future generations, while ensuring profitability, environmental health, and social and economic equity.

In the Netherlands, for example, companies and governmental agencies are working together in the Alliance for Sustainable Food focusing on factors related to the climate; circular economy; biodiversity; sustainable and healthy. With its food strategy, the City of Amsterdam aims to decrease waste and develop shorter lines between farmers and citizens and to reduce the consumption of meat and processed food.

As the urban food system is heavily intertwined with the global food system, our experts actively seek national and international cooperation. In 2022, a research project was launched to develop methods and tools aimed at scaling up short chains in food supply. Also, MSc MADE students explored the connection between urban consumption and regenerative farming at a farm in the Netherlands and, while taking part in the Startup Booster program, one of the startups further developed its AI-led vertical farming solution.

Education

- **Consumption and Regenerative Farming (MSc MADE Living Lab):** exploring the connection between urban consumption and regenerative farming at Eyckenstein Farm in Utrecht.
- **WUR Urban Greenhouse Challenge and AMS Caterpillars:** third prize for urban farming concept with environmental and social impact in the United States.
- **Circular Zeilfort (MSc MADE Living Lab):** implementing a circular system for the cafe kitchen facility of Zeilfort Kudelstaart.

Research and Innovation

- **Insect Rearing on Municipal Waste from IJburg:** examining the possibility of growing insects on urban food waste for animal feed.
- **CustUNize:** stimulating inclusive food production for local supply and producing urban food for all citizens.
- **Urban Agriculture Academy Amsterdam:** creating an urban agriculture academy to train citizens in Amsterdam Zuidoost to work as 'prosumers', or producing consumers.
- **EU4Advice:** developing methods and tools aimed at scaling up short chains in food supply worldwide.

Entrepreneurship

- **Farmvent:** an automated vertical farming solution led by artificial intelligence that can be placed anywhere.
- **Lettus Design:** gamified participatory and co-creative design processes that increase stakeholder engagement to realize equitable and economically viable urban agriculture projects.
- **Spore:** smart bio bins that help cities adhere to biowaste laws, improve collection efficiency, and reduce transportation costs.



"With our urban greenhouse concept, we foster community spirit through an adaptive, self-sustaining urban farm that ensures local food security and economic viability, infrastructure longevity, and meaningful public space. The community-centered design draws from AMS Institute's Living Lab approach, which brings research into society-wide implementation through incorporating co-creation of different disciplines and stakeholders."

Mees Deknatel, MSc MADE student

A closer look at some of our activities focused on developing food systems as drivers of health and equity

Education

WUR Urban Greenhouse Challenge and AMS Caterpillars

Urban growth presents opportunities as well as challenges concerning food systems. As a result, many cities around the world explore how to create livable and healthy environments for their citizens that also integrate sustainable ways to produce food. To support these developments and explore the potential of urban farming, WUR organizes a yearly Urban Greenhouse Challenge. Students from all over the world who are participating in the challenge are developing an urban farming business plan that will be implemented in one of the world's major metropolises.

In 2022, WUR challenged student teams to develop a design concept for an urban farm in the United

States, located in Washington D.C., that not only ensures food production but also generates income for local residents. Specifically, the development plan for the site should enable robust and resilient year-round sustainable food production, while creating social impact in a neighborhood that struggles with persistent and complex problems, including poverty, unemployment, and the lack of access to affordable and nutritious food, health services, and good education.

AMS Caterpillars, a group of MSc MADE students, won the third prize and was awarded the 'Local Resident's Prize'. The community-centered design draws from AMS Institute's living lab approach that brings research into society-wide implementation by incorporating the co-creation of different disciplines and stakeholders.

"Farmvent is a vertical farming module that lets you grow sustainable greens affordably from seed to harvest – whenever and wherever you want. In collaboration with the AMS Startup Booster, Farmvent grew into an impactful business."

Nikolaos Alfieris, Founder & CEO, Farmvent



Entrepreneurship

Farmvent

Nowadays, food is transported over long distances and to different continents. That makes the food chain more extended and fragmented. Farmvent enables restaurants and catering services to cultivate and grow their herbs and leafy greens in-house. This startup developed an automated vertical farming solution, which is led by artificial intelligence and can be placed anywhere. As a result, the innovation not only reduces the time it takes for food to travel from farm to fork, it also decreases food waste.

Before taking part in the AMS Startup Booster, Farmvent tested the initial prototype in the market while getting feedback from small pilots in Wageningen. In 2022, with the help of AMS Startup Booster's experts, the entrepreneurs formulated a stronger value proposition and learned the importance of conducting small experiments and setting targets to reach overall company goals.

In 2022, Farmvent deployed three farms in the Benelux area: one at the Wicc Hotel Wageningen, Unilever Food Innovation Centre, and Microsoft Center Brussels. Farmvent aims to install 100 farms within 2 years in the Netherlands and then expand globally.

Research and Innovation

CustUNize

Public health and sustainable development are negatively affected by population growth, and imbalance in food systems. Therefore, the worldwide vision on food and food production needs to be transformed to a system where food is produced more locally and sustainably.

In 2022, a group of entrepreneurs, knowledge providers, and policy makers joined forces to develop a new perspective on healthy food intake for urban customized groups. They created the 'Customized Urban Nutrition' (CustUNize) perspective, which focuses on sustainably producing nutritious and delicious food, at any time, anywhere in the world, with hands-on involvement of consumers.

To translate this perspective into projects, WUR, AMS Institute and knowledge institutions in Singapore submitted the CustUNize concept under the project name of 'Singfarms' to the National Research Foundation (NRF) of Singapore. In 2022, the NRF confirmed that it will fund this project. The urgency is very high for Singapore, as it relies heavily on local food production. However, these findings can be translated to cities worldwide.

Program developers: dr. Willie van den Broek, dr. Alexander Laarman

Principal Investigators: prof.dr. Leo Marcelis, prof.dr. Huub Rijnaarts (WUR)

Partners: WUR and Growy

Duration: 10 years

Budget: €17M

Research and Innovation EU4Advice

Currently, farmers and consumers must partially connect the dots between short chains, climate adaptation, and mitigation of negative environmental impacts. Adding to this, independent advisors often lack sufficient knowledge to provide advice on all topics. Shortening food chains is a means for farmers to improve their bargaining position within the chain. For consumers, shorter chains contribute to transparency of the food system, and to the quality and safety of their food.

For this reason, the EU4Advice project aims to boost the role of short chain food advisors as knowledge flow catalysts who connect research to practice. From 2022 onward, the EU4Advice project connects consultants, policy makers, researchers, farmers, and consumers to work together in living labs. EU4Advice aims to lay the foundation for the creation of an EU network of Short Food Supply Chain (SFSC) advisors that will be appropriately structured and connected to a variety of stakeholders within national chains called Agricultural Knowledge and Innovation Systems (AKIS).

In 2022, the twenty one partners of the project participated in a series of activities organized in Amsterdam and at the International Horticultural Fair 'Floriade' to establish connections between the partners and the tasks to be developed during the five years that the project will last.

Project lead: Louise Méhauzen (Innogestiona)

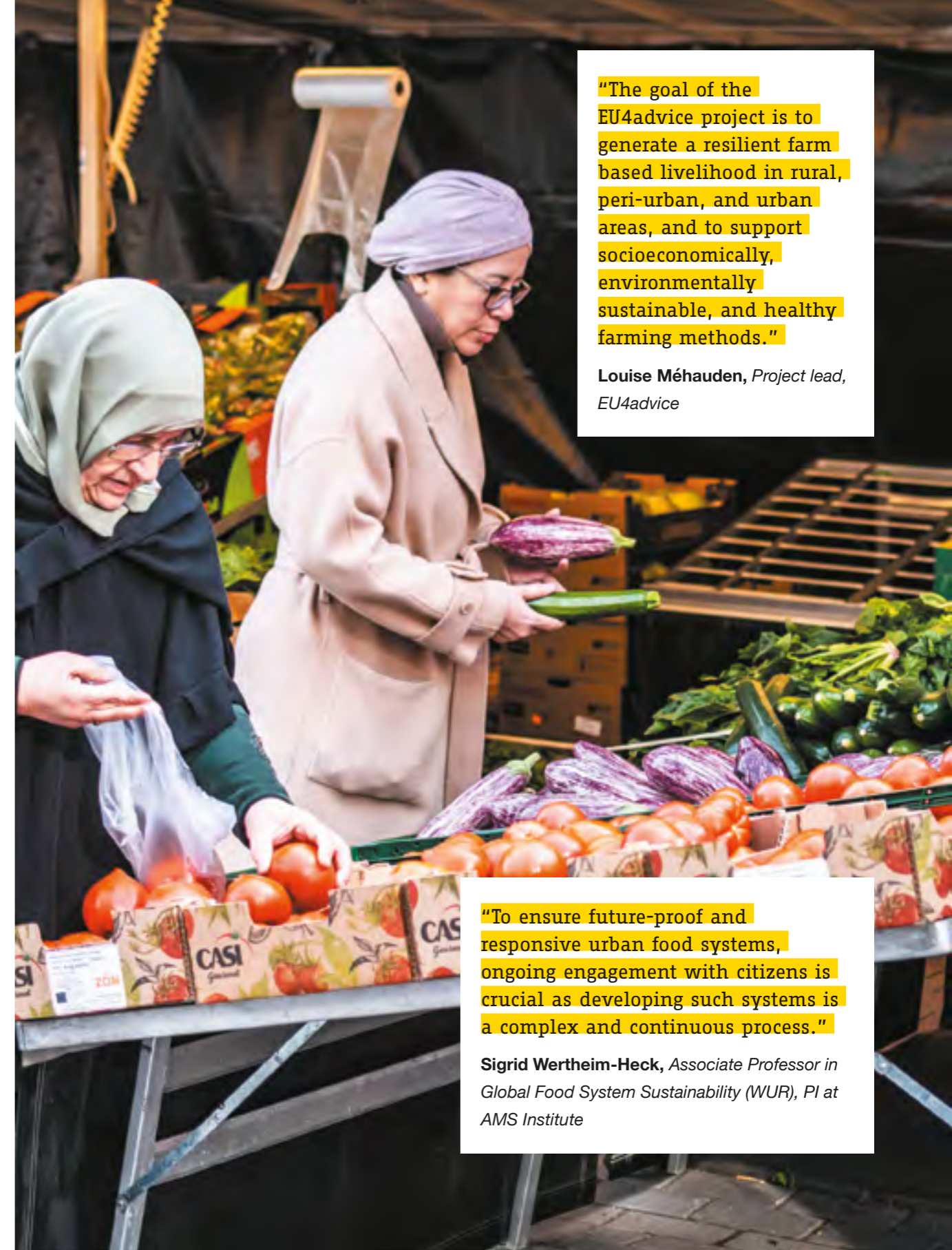
Program developer: dr. Alexander Laarman

Principal Investigator: dr. Sigrid Wertheim-Heck (WUR)

Partners: Wageningen Plant Research, Wageningen Social Sciences, AMPED Concepts B.V., A Kisléptékű Termékelőállítók Országos Érdekképviseletének Egyesülete (KIS), Campden BRI Magyarország Nonprofit Kft. (CBHU), Universität Hohenheim (UH OH), University College Dublin, National University of Ireland, Universiteit Gent (UGent), Copa Cogeca, ISEKI-Food Association, Province Flevoland, Centre Technique de la Conservation des Produits Agricoles (CTCPA), European Grants International Academy (EGINA), Fundatia Centrul Educational Spektrum (SPECTRU), UNISOT - The Universal Source Of Truth, Devenish Research Development and Innovation Limited (DEVENISH), Fundación Entretantos, Czech Agriculture University, Prague (UPRAG), and Innogestiona Ambiental SL (INNO).

Duration: 5 years

Budget: €914K



"The goal of the EU4Advice project is to generate a resilient farm based livelihood in rural, peri-urban, and urban areas, and to support socioeconomically, environmentally sustainable, and healthy farming methods."

Louise Méhauzen, *Project lead, EU4Advice*

"To ensure future-proof and responsive urban food systems, ongoing engagement with citizens is crucial as developing such systems is a complex and continuous process."

Sigrid Wertheim-Heck, *Associate Professor in Global Food System Sustainability (WUR), PI at AMS Institute*

"We want to use our knowledge in the best possible way to serve the social interest. Organizing an urban agriculture academy could become a form of organization to further scale up the utilization of this knowledge to achieve more and safe local cultivation of fruits and vegetables."

Marcel Vijn, *Project lead Urban Agriculture Academy, WUR*

Research and Innovation **Urban Agriculture Academy** **Amsterdam**

Recently, the Netherlands has experienced sharp price increases in supermarkets. In particular, fresh fruits and vegetables have become increasingly expensive. In Amsterdam, the residents of Zuidoost have a particularly unfavorable socio-economic position: 30% of households in this neighborhood have a low income. Also, residents' health status – in terms of obesity, loneliness, and psychological complaints – is on average lower than Amsterdam as a whole.

Having said that, Zuidoost also has a rich tradition of neighborhood initiatives and a spirit of working together. Historically it was an area with many farms that supplied food to Amsterdam's city dwellers. This led Venzo – a foundation that acts as a liaison platform for social engagement in Amsterdam Zuidoost – to wonder whether it would also be possible to find a solution for the problem of increasingly expensive fruit and vegetables through the local residents' informal network.

This project, which kicked-off in 2022, investigates the possibility of creating an urban agriculture academy to train citizens who can work as 'prosumers', or producing consumers of fruit and vegetables in Amsterdam Zuidoost. In order to set up such an infrastructure, this project works on defining what the most effective governance and structure would be to enable accessibility and to offer continuity in the sharing of knowledge and experience among residents.

Project lead: dr. Marcel Vijn (WUR)

Program developer: dr. Alexander Laarman

Principal Investigator: prof.dr. Eveline van Leeuwen (WUR)

Partners: Venzo and Wetenschapswinkel

Duration: 1 year

Budget: €45K



Accelerating a connected and accessible urban mobility ecosystem

Worldwide, logistics are indispensable to the city. This includes delivery vans and trucks that provide supplies to stores and restaurants, as well as construction logistics necessary for building projects (e.g., housing construction and repair of streets and bridges) or waste collection to ensure a clean urban environment. At the same time, all these mobility movements are a key source of environmental pressures and contribute to climate change, air pollution, and noise. In addition, transport requires infrastructure which takes up space and contributes to urban sprawl.

Realizing a smart and sustainable traffic and transportation system is high on the agenda of the AMA to keep the region accessible, safe, and livable. Looking at Amsterdam specifically, the City wants to transition toward 'net-zero' greenhouse gas emissions by 2050. With its 'car-free program' and 'action plan for air quality', Amsterdam aims to transform urban logistics and to reduce the impact of mobility on the urban environment in the coming years.

At AMS Institute, we contribute to making urban mobility systems sustainable, accessible, safe, resilient, inclusive, and affordable. One of our 2022 projects successfully launched a decision support tool to help cities to locate hubs, as well as a procurement tool to assist with the tendering procedures. It is innovations like these that allow the city to get closer to implementing its hub vision successfully in the future.

Education

- **Low Car City (MSc MADE Living Lab):** improving accessibility of Park+Ride (P+R) as part of a mobility hub to reduce cars in cities.
- **Shared Electric Scooters (MSc MADE thesis):** how local governments can intervene in shared e-scooter services to mitigate negative societal effects and strengthen societal benefits.

Research and Innovation

- **SmartHubs:** increasing the implementation and accessibility of smart mobility hubs, and solving the last mile challenge by researching the use of shared mobility hubs in metropolitan areas.
- **DIT4TraM:** investigating the application of 'swarm intelligence' for traffic and mobility management.
- **CriticalMaaS:** Developing network, operations, and behavioral concepts, theories, and models for the emergence of mobility-on-demand services.
- **SIPCAT:** studying interactions between autonomous vehicles and humans in a 3D VR environment at Marineterrein Amsterdam Living Lab.
- **Senseable Amsterdam Lab (SAL):** making Amsterdam, and cities worldwide, become carbon neutral and enable sustainable mobility by means of evidence-based approaches such as using AI and data analytics technologies.

Entrepreneurship

- **Syllogic:** an algorithm-based decision-maker that assists asset managers with the planning of life-cycle inspections and maintenance.
- **Energion System:** a software ecosystem, that allocates the right portion of electricity to car charging points to optimize energy flow.
- **Bicycle User Experience (BUX):** training programs to transform the design of bicycle infrastructure to be more street-user-friendly.
- **Roboat:** developing autonomous navigation technology for boats in urban and inland waterways, made the first steps toward the transition of Roboat into a spin-off company that will scale up the technology to waterways worldwide.

A closer look at some of our activities focused on accelerating a connected and accessible urban mobility ecosystem

Education

Low Car City (MSc MADE Living Lab)

Eighteen percent of CO₂ emissions in Amsterdam comes from transportation, of which cars are the main emitter. In addition, a big part of the public space in Amsterdam is allocated to (car) infrastructure. Instead, this space could be allocated to other purposes such as bike lanes or greenery. For reasons like these, Amsterdam wants to become a low-car city.

For this MSc MADE living lab, the students investigated how the P+R system in the Netherlands can act as a transition tool to help advance the goal of becoming a low-car city. In short, P+R's are strategically located facilities that allow motorists to

park their cars outside an urban area and transfer to public transport to reach the inner city.

The MSc MADE students found that P+R's can be a temporary solution for a low-car city. However, they also identified problems (e.g., a lack of uniformity or regional strategy, and fragmented information provision for end-users) that need to be tackled, for which they developed two end products.

The MSc MADE students created a report for decision-makers and P+R managers describing practical adjustments to the system's operation. In addition, they conceptualized an information platform for end-users, in the form of an app that offers easy access and navigation to P+R's.



"We empower professionals to make everyday cycling a reality in their cities by providing the necessary skills for planning user-friendly infrastructure and fostering community support and sustainability of cycling plans."

Valeria Leyva, *Communication and promotion coordinator, BUX*

Entrepreneurship

Energon System

The rapid adoption of electric vehicles impacts electricity consumption. As a result of this, a renovation of the electric power distribution is necessary to cope with the increasing demand. Energon System, a startup that specializes in energy management focused on electric vehicle infrastructure, developed a smart software system that can be placed at local sites to allocate the right portion of electricity to car charging points. By taking the energy consumption of sites and buildings into consideration, site owners are sure that they will have enough power to heat, light, and operate their facilities, while safely offering charging services to their guests. This is how Energon System is helping to optimize energy flow in (urban) areas.

In 2022, Energon System took part in the AMS Startup Booster program during which the founders conducted customer validation and market studies. At the same time, the team grew with technical co-founders joining the startup.

Entrepreneurship

Bicycle User Experience (BUX)

Cycling as a mode of transportation has gained popularity in recent years as a sustainable and environmentally friendly option. However, the design and implementation of cycling infrastructure have often neglected the needs and experiences of the end users, resulting in inadequate and unusable infrastructure that does not align with the intended vision.

BUX's mission is to improve the design and implementation of cycling projects by focusing on the needs and experiences of end users. To this end, this startup offers courses and training programs about creating user-friendly cycling infrastructure for urban mobility professionals and organizations. The programs are focused on people, infrastructure, context, and mode of transport to transform the approach to street design. BUX's methods are versatile and replicable across contexts, as the startup's applied framework helps users take action immediately in their local context.

In 2022, BUX took part in the AMS Startup Booster program.

"The establishment of the Senseable Amsterdam Lab is a successful step toward expanding the impact of the work done by the Senseable City Lab in different parts of the world. Amsterdam will serve as a testbed for scientific research on achieving a carbon net-zero city for other cities worldwide to follow suit."

Carlo Ratti, Professor of Urban Technology and Director of Senseable City Lab (MIT), PI at AMS Institute

Research and Innovation

Senseable Amsterdam Lab (SAL)

Nowadays, cities around the world have sensors embedded in public space, which generate data at unprecedented scales. All this data provides unique opportunities to understand and (re)design cities in new ways. A new partnership with MIT and the City of Amsterdam marked the beginning of the development of SAL at AMS Institute.

SAL focuses its research and innovation activities on the newest AI and urban data analytics technologies to help Amsterdam and cities worldwide to achieve their missions towards carbon neutrality and sustainable mobility. The lab has three research tracks: autonomous navigation, visual intelligence, and carbon neutrality in Amsterdam. These research tracks are crucial in the ambition to make Amsterdam a carbon net-zero city.

In 2022, as part of SAL, the Bike Trafficking project investigated bike theft by placing 100 locked GPS-

traceable bikes in Amsterdam. With an estimated 80,000 bikes stolen in Amsterdam each year, the City of Amsterdam is looking to make it harder for thieves. Over the course of five months, seventy bikes were stolen. Researchers tracked these stolen bikes, logging every start and end point of each trip, enabling them to uncover how stolen bikes move through the city. The main conclusion from the research project is that for the used prize category of bikes, which is in the lower segment, stolen bikes remain close to the city they are stolen in.

Program leads: dr. Stephan van Dijk (AMS Institute), Titus Venverloo (MIT)

Program developer: Thijs Turèl

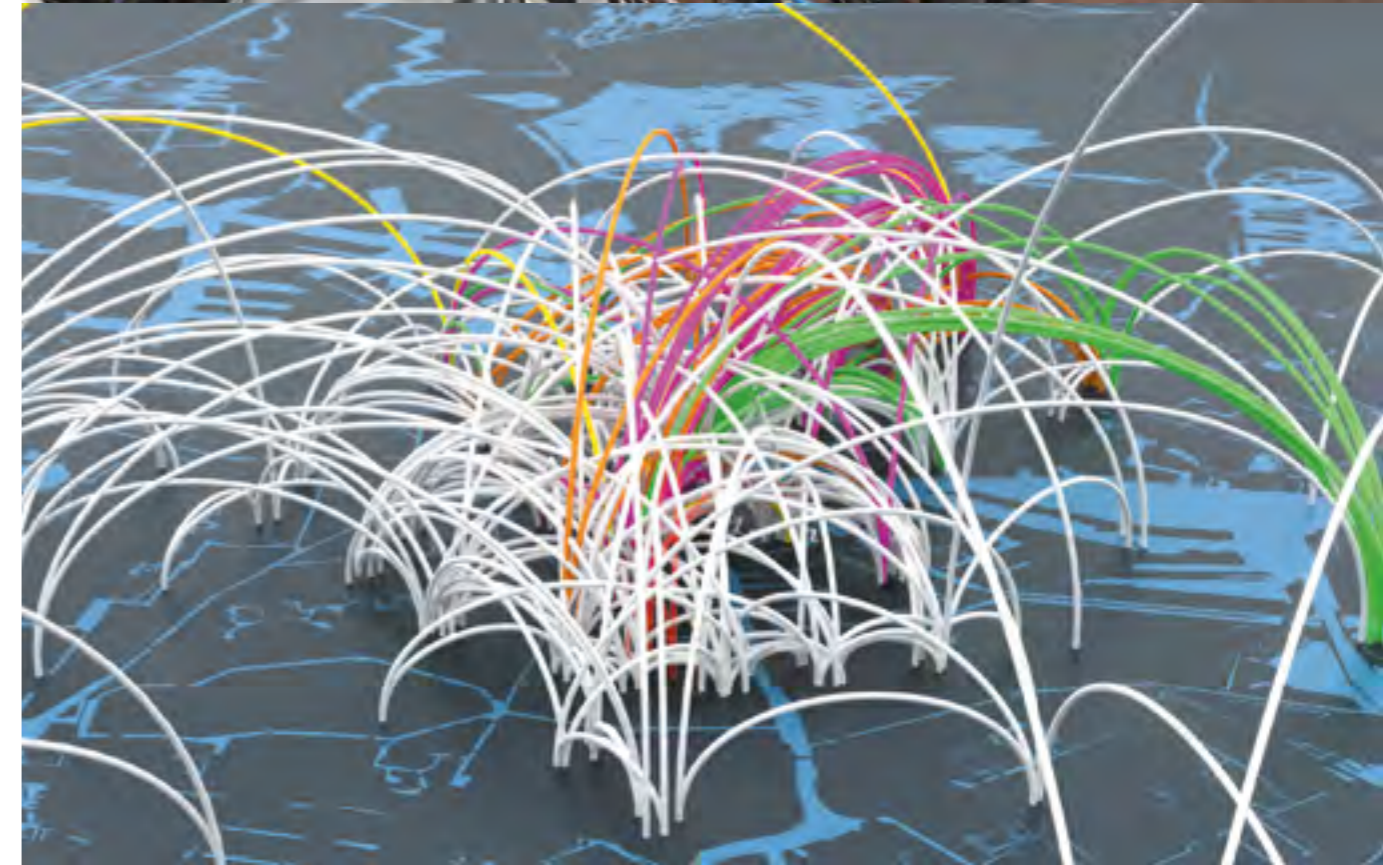
Principal Investigators: dr. Fábio Duarte, prof. Carlo Ratti, prof. Daniela Rus, prof. Andrew Whittle, prof.dr. Siqi Zheng (MIT)

Research Fellow: Titus Venverloo (MIT)

Partners: MIT and City of Amsterdam

Duration: 2 years

Budget: €3M



Research and Innovation SmartHubs

Due to rapid urbanization, a solution like shared mobility can decrease the pressure on urban space and keep cities livable and accessible for residents and visitors. The SmartHubs project aims to accelerate the implementation of the hubs, maximizing citizens' accessibility and reducing transport invasiveness. When focusing on Amsterdam, the goal is to reduce the parking pressure in the city, free up public space, and realize a more sustainable traffic system for a growing city.

In 2022, the SmartHubs project generated a decision support tool to help cities locate hubs and a procurement tool to assist with the tendering procedures. The business models were evaluated and a business model toolkit was developed. This project generated numerous insights in the functioning of indoor mobility hubs and hubs on private grounds for the city of Amsterdam. This allows the city to get closer to implementing its hub vision successfully in the future.

"It is very useful to share all the necessary perspectives on city development and really test how mobility hubs can facilitate this."

Matthijs Boon, Head of Commerce, Hely

Following this project, AMS Institute contributes to the 'RAAK Buurtlogistiek' project on neighborhood logistics to bring in the knowledge generated by SmartHubs. Also, regarding the E-lympic Mobility Hub – a new mobility hub at Stadionplein in Amsterdam Zuid which is developed by the City of Amsterdam – AMS Institute assists in the tendering procedures and setting up experiments as well as connecting the City with potential scientific partners.

Program developer: Sander Oudbier

Researchers: dr. Gonçalo Homem de Almeida Correia, dr. Natasa Roukouni (TU Delft)

Partners: EIT Urban Mobility, City of Amsterdam, City of Helmond, City of Eindhoven, City of Sant Cugat, City of Lisbon, City of Setubal, Capgemini, CARNET, UPC, TU Delft, EMEL, FGC, Hely, Mobilne Miasto, Skoda Auto, IST Lisbon, and TML Lisbon

Duration: 2 years

Budget: €2.05M





Research and Innovation

DIT4TraM

How do we optimally distribute traffic at the micro level of, say, an intersection? How do we ensure that pedestrians, cyclists, shared cars, and public transport get the priority they deserve, while coordinating the flow of car traffic as well as possible? The DIT4TraM project develops decentralized control concepts and algorithms with swarm intelligence for a wide range of applications.

The project consists of six pilot cities throughout Europe, among others in Amsterdam. In the Amsterdam pilot, the project will demonstrate the cooperation of both travelers and providers of novel mobility services in a variety of events and situations. This is done by developing a multiplayer simulation game that combines human decisions with dynamic simulation to determine the consequences on multi-modal transportation networks. More specifically,

what if the price of a trip is based on an alternative value like CO₂ emissions? Would that influence people's choices about the mode of transport they choose?

In 2022, the focus was on the development of the serious game and planning a 2023 event to play the game with citizens of Amsterdam.

Program developer: Tom Kuipers

Principal Investigator: prof.dr. Serge Hoogendoorn (TU Delft)

Research Fellow: dr. Marco Rinaldi (TU Delft)

Researchers: Jesper Provoost (TU Delft)

Partners: Cities of Amsterdam, Utrecht, Bordeaux and Glyfada. TU Delft, ETH Zurich, Bar Ilan University, Université Gustave Eiffel, Aimsun, Arane, D.E.I.A., Gertrude, NeoGLS, Technolution, Siemens, and Oseven

Duration: 3 years

Budget: €1.2M

Research and Innovation

CriticalMaaS

The shared economy can revolutionize urban mobility by blurring the traditional division between private and public transport, shifting from an ownership model to Mobility as a Service (MaaS). Think of shared (car, bike, scooter) fleets, private and shared ride-hailing services, and on-demand transport systems that offer door-to-door or access/departure connection as part of an integrated mobility system. Such services can support a car-independent lifestyle and complement public transport in places and times where it cannot be effective.

The CriticalMaaS project among others explores the potential market share of MaaS under different conditions and how on-demand services scale up. The researchers also examine how such new services coexist with conventional public transport; do they compete or complement each other? Does this mean we will end up having more congestion? How should public transport evolve in response to this changing landscape?

One of the 2022 highlights include the empirical analysis of how ride-hailing competes with and complements public transport based on comparing Uber and public transport data from six cities in the US and Europe. Researchers analyzed 3,5 million records of Uber trips and concluded that Uber services are used in both competing and

complementary circumstances. The two main findings indicate that between one and two out of five Uber trips have no viable public transport alternative and that the share of travelers that choose Uber over public transport decreases as travel time competitiveness of public transport increases.

Program developer: Tom Kuipers

Principal Investigator: prof.dr. Oded Cats (TU Delft)

Researchers: Peyman Ashkrof, Subodh Dubey, dr. Nejc Geržinič, Arjan de Ruijter (TU Delft)

Duration: 32 months

Budget: €1.3M

Transforming cities toward climate-neutrality

In order to avert the impact of climate change and preserve a livable planet, the world needs to transition toward an economy with net-zero greenhouse gas emissions – thus becoming climate-neutral. Specifically, the energy sector is the source of around three-quarters of greenhouse gas emissions today. Realizing the transition toward energy from renewable sources such as wind or solar would dramatically reduce carbon emissions.

Over 1000 cities worldwide joined the UN-backed global 'Race to Zero' campaign, pledging to halve global emissions by 2030. Not only is the City of Amsterdam working on major transformations of the current energy system, it wants to have only emission-free traffic on its roads and water by 2030 and phase out fossil fuels by 2050. In order to integrate renewables and minimize fossil energy in cities, physical changes in urban environments are inevitable. How to realize that altogether and equitably is a challenge in itself.

In 2022, our MSc MADE students – as part of a larger innovation project – investigated the value chain for reusing second-hand solar panels in Amsterdam Zuidooost to alleviate social, environmental, and economic challenges. Other highlights last year were the launch of a scalable retrofiting analysis tool for Amsterdam's entire residential historic building stock and supporting a startup that develops, among others, biogas by treating urban green waste.

Education

- **Reusing Solar Panels (MSc MADE Living Lab):** reusing second-hand solar panels to alleviate social, environmental, and economic challenges.
- **Interventions for an Inclusive Energy Transition in Amsterdam Zuidooost (MSc MADE thesis):** developing a framework for the LIFE project consisting of nine conditions for interventions to realize an inclusive energy transition – nominated for the Leonie Janssen-Jansen thesis award.

Research and Innovation

- **ReplanIT:** developing and testing a new methodology, to enable suppliers and users of IT services to manage hardware in a circular way and reduce the emissions and ecological footprint of their digital infrastructure.
- **Collect your Retrofits:** designing a replicable and collective retrofit approach in the context of monumental areas while reframing the cultural notion of energy.
- **Senseable Amsterdam Lab (SAL):** making Amsterdam, and cities worldwide, become carbon neutral and enable sustainable mobility by means of evidence-based approaches such as using AI and data analytics technologies.
- **Circular Solar Panels for the Doughnut Economy:** a living lab in Amsterdam Zuidooost where discarded solar panels are given a second life to alleviate social, environmental, and economic challenges.

Entrepreneurship

- **Cyrcle:** closing the urban waste circle by collecting and treating the green waste of cities with pyrolysis, resulting in gas production, biochar production, and carbon credits trade.
- **Energion System:** a software ecosystem which can be placed at local sites and allocates the right portion of electricity to car charging points to optimize energy flow.

A closer look at some of our activities focused on transforming cities toward climate-neutrality

Education

Reusing Solar Panels (MSc MADE Living Lab)

The number of solar panels installed in Amsterdam is increasing every year. While that is positive news in terms of renewable energy, it also poses challenges from an environmental and social perspective.

From an environmental perspective, the production of solar panels involves CO₂ emissions and pollution. Moreover, production requires non-renewable critical raw materials, which are becoming scarce and monopolized. Discarded solar panels also end up in the e-waste stream. Taking into account a social perspective, over 80% of our solar panels come from China, where they are produced partly with forced labor. Closer to home, the energy transition tends to increase social inequality. While energy bills are rising, families with lower incomes are unable to invest in cost-reducing insulation and solar panels.

How can we create an environmentally friendly and inclusive energy transition? As part of the research project 'Circular solar panels for the doughnut economy', the MSc MADE students investigated whether the reuse of discarded solar panels can help solve these pressing environmental and social issues. In many cases, discarded panels can still generate electricity for years to come. Making these solar panels available to low-income families can tackle two problems: the environmental impact of the PV sector and energy poverty.

Entrepreneurship

Cyrclle

As cities grow and the world becomes more urbanized, waste management becomes a more pressing issue. By 2050, nearly 7 out of 10 people in the world will live in urban areas, making it essential to find new and innovative solutions for waste management.

Cyrclle's mission is to make cities more sustainable by closing the waste circle. This startup's business idea is based on pyrolysis, meaning the controlled burning of woody and vegetal materials without oxygen. This leads to different sub products such as combustible

gas and a specific type of charcoal, also known as biochar, which is carbon-negative, meaning that it is able to store carbon. Moreover, biochar can be used as a soil improver, is useful in agriculture and urban greenery, and can be a main component of soils. Cyrclle aims to collect and treat the green waste of cities with pyrolysis, resulting in three business cases focused on gas production, biochar production, and carbon credits trade.

In 2022, Cyrclle took part in the AMS Startup Booster program with the founder's main focus being on refining their business model.

"Currently, green waste in cities is used as compost. We approach waste with the circular economy in mind. Our solution is to use green urban waste to create a carbon-negative resource, which can be used as a soil improver for agriculture and urban greenery. Not only does this improve soil quality, but it also helps to remove carbon from the atmosphere."

Melania Aufiero, Co-founder, Cyrclle

Research and Innovation

ReplanIT

The ecological footprint of our digital life is growing quickly. In particular, the AMA is a major IT consumer, as 74% of the multi-tenant data centers in the Netherlands are located in this region. Circular strategies like repair, reuse, and refurbishment of hardware are essential to minimizing the footprint of digitization. The RePlanIT project combines partners' expertise in science and industry to develop a Circular Resource Planning system for IT.

RePlanIT's system will enable IT users, purchasers, and facility managers to make better, faster, and science-based decisions, ultimately improving the sustainability of their IT environment and doubling the lifetime of the hardware. It will be tested in field labs in the City of Amsterdam and other organizations.

In 2022, two stakeholder workshops took place to define sustainability indicators for IT hardware, in which the City of Amsterdam and Rijkswaterstaat participated. TU Delft built a prototype of the data model for the RePlanIT system, focusing on laptops, data servers, and switches, and conducted qualitative research into the barriers for and acceptance of circular strategies among various decision makers in IT (purchasers, system architects, financial controllers, and directors). IDEAL&CO visualized the customer journey of the system and started working on the dashboard. Aliter Networks developed circular tender

and procurement criteria for IT hardware. In 2023, the consortium will perform various use cases in real-life IT environments for the city of Amsterdam.

Project lead: prof.dr. Ruud Balkenende (TU Delft)

Program developer: dr. Joppe van Driel

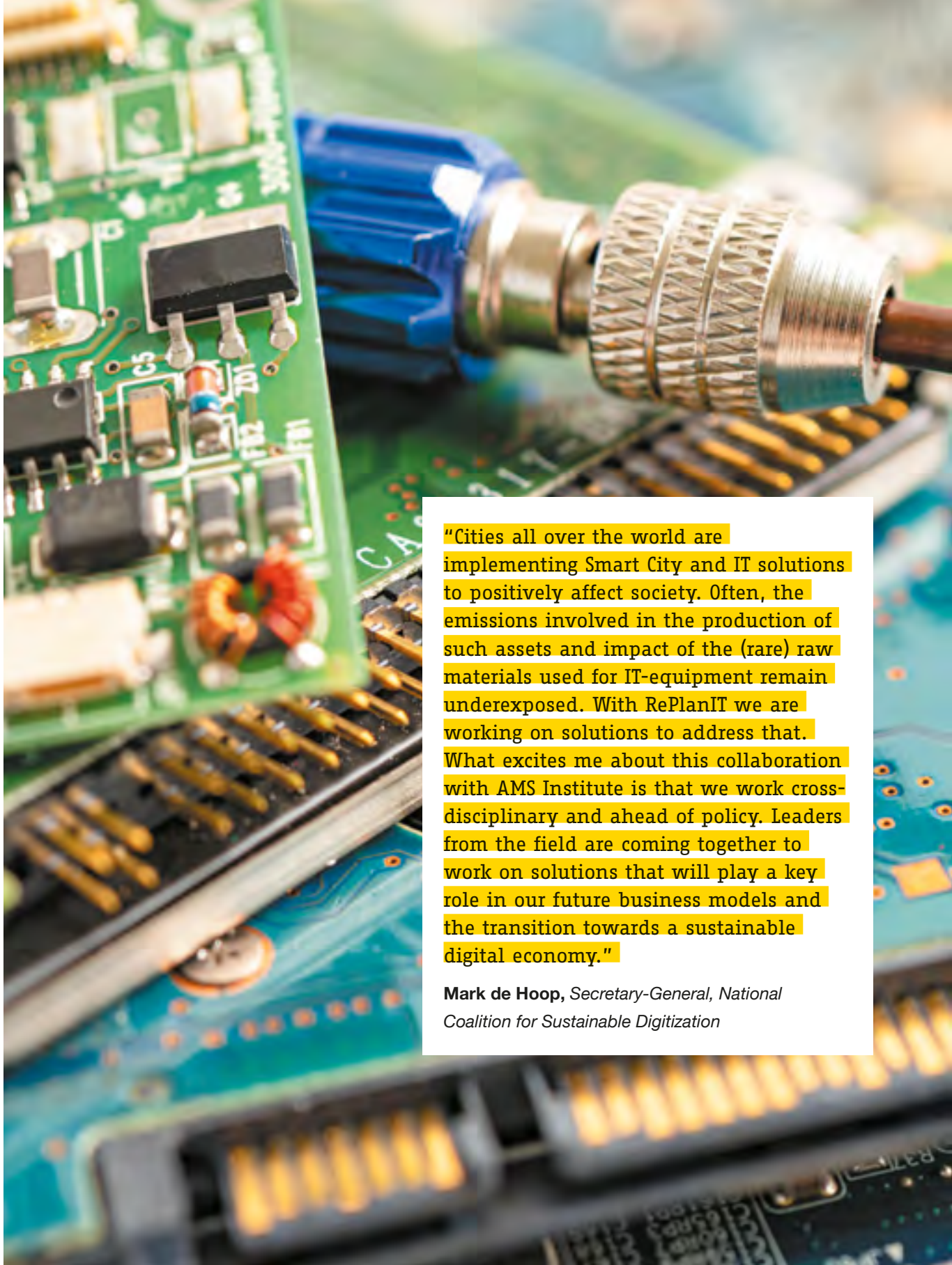
Principal Investigators: prof.dr. Alessandro Bozzon, prof.dr. Ruth Mugge (TU Delft)

Researchers: dr. Anelia Kurteva, dr. Kate McMahon (TU Delft)

Partners: TU Delft, KPN, Aliter Networks, IDEAL&CO, Green IT Amsterdam, WCoolIT, Amsterdam Economic Board, City of Amsterdam, and Rijkswaterstaat

Duration: 2 years

Budget: €1.1M



"Cities all over the world are implementing Smart City and IT solutions to positively affect society. Often, the emissions involved in the production of such assets and impact of the (rare) raw materials used for IT-equipment remain underexposed. With RePlanIT we are working on solutions to address that. What excites me about this collaboration with AMS Institute is that we work cross-disciplinary and ahead of policy. Leaders from the field are coming together to work on solutions that will play a key role in our future business models and the transition towards a sustainable digital economy."

Mark de Hoop, Secretary-General, National Coalition for Sustainable Digitization



Research and Innovation

Collect Your Retrofits

To reach the climate targets, large-scale retrofitting activities, such as insulating multiple buildings at once, are urgently needed in the Netherlands. Within the context of the energy transition in the built environment, historical buildings are one of the most complex segments to be addressed. The current process to retrofit is expensive and unattractive for owners due to monumental restrictions and the lack of a standardized approach to conducting historical building energy retrofit.

The Collect Your Retrofits project designed a generic and collective retrofit approach in the challenging context of monumental areas. Under real conditions of two Amsterdam communities, a self-organized 'woongroep' and an association of owners in the historic center of Amsterdam, the project developed a new approach to retrofitting. Retrofit designs were identified based on earlier modeling results of a previous research program 'High-Hanging Fruit' and identified based on energy performance, carbon

emissions, comfort, and costs so that a prioritization strategy can be drawn. Instead of each owner investing in their own energy retrofitting, a collective of building owners will invest in the most impactful measures to make their homes more energy efficient, thus accelerating the area's transition to a CO₂ neutral environment.

In 2022, both cases delivered tangible investment analysis for the community, detailing a decarbonization strategy of the building blocks and operationalizing a retrofitting analysis tool scalable for Amsterdam's entire residential historic building stock.

Program developer: Paul Voskuilen

Principal Investigator: prof.dr. Andy van den Dobbelaar (TU Delft)

Research Fellow: dr. Maéva Dang (TU Delft)

Partners: TU Delft, Superworld, Stichting Woon!, City of Amsterdam, De Drie Maagden

Duration: 1 year

Budget: €53K

Research and Innovation

ALIGN4energy

In the transition away from fossil-fueled heating systems, the pace of energy efficient renovation in Dutch residential buildings is not going fast enough. This is caused by a lack of information and high costs that individuals and citizen collectives face. At the same time, policymakers are expected to coordinate a complicated process that determines the overall effectiveness of the new energy system and the cost of decarbonization.

In 2022 the ALIGN4energy project kicked-off, which aims to address both challenges with a transdisciplinary consortium of scientists and practitioners. These stakeholders combine citizen engagement and personalized behavioral interventions to enable clean energy investments at scale. Project objectives include the development of open source software that can be used in online tooling to support decision-making for heating systems on an individual level, collective level (e.g., with the housing association) or the energy system level. The project will work closely with partners such as Building Blocks and Buurtwarmtewijzer (in English: Community Energy Compass) using various existing online tools. Buurtwarmtewijzer was co-founded and developed by one of our MSc MADE graduates.

In addition to AMS Institute taking the lead in knowledge dissemination for the project, we also facilitate the development in the testbeds in the AMA in close collaboration with partners such as the municipalities of Haarlemmermeer, The Hague, and Rotterdam.

Project lead: prof.dr. Pieter van Beukering (VU)

Program developer: Paul Voskuilen

Principal Investigator: prof.dr. Peter Palensky (TU Delft)

Researcher: prof.dr. Henk Visscher (TU Delft)

Partners: VU, Technical University Eindhoven, TU Delft, Erasmus University Rotterdam, CWI Amsterdam, PBL Netherlands Environmental Assessment Agency, TNO, Ministry of the Interior and Kingdom Relations, City of Rotterdam, City of The Hague, Municipality of Haarlemmermeer, Municipality of Eindhoven, Alliander, Rabobank, Waternet, Deelstroom Delft, Building Blocks Energy, The Early Birds, Het Groene Brein, VVE Belang, and 75INQ, !WOON

Duration: 4 years

Budget: €3.2M

Capitalizing urban waste streams for a circular economy

With our global population continuously growing, the worldwide demand for raw materials is increasing too. The production of new materials and goods depletes resources and accounts for more than half of global CO₂ emissions. At the same time, globally, waste continues to increase in both absolute and per capita levels. It is critical to minimize waste and maximize recycling and reuse of (waste) materials.

Although the cross-border movement of waste for materials recovery remains a major hurdle, many countries and cities around the world aim to become circular. The AMA wants to be among the most circular metropolitan regions in Europe by 2025. The region is focusing on three interrelated pillars to achieve that goal: circular procurement, resource streams, and interventions. For municipal waste streams, the City of Amsterdam has set a target of 50% recycling in 2030 and 100% in 2050.

At AMS Institute we aim to design and redesign urban activities, including production, procurement, use, and reuse of material products and infrastructures. One of our 2022 highlights in design and redesign have been the successful testing of 3D printing pastes from organic waste streams as well as Re-plex – a fully biobased and circular composite material for the construction sector. Also, by developing smart bio bins, one of the startups we support, helps cities to improve collection efficiency and reduce transportation costs. It is solutions like these that enable cities to close resource loops and to reach the greater goal becoming circular.

Education

- **Value of Poo (MSc MADE Living Lab):** circular scenarios for elephant dung in the context of the ARTIS zoo in Amsterdam.
- **Circular Zeilfort (MSc MADE Living Lab):** implementing a circular system for the cafe kitchen facility of Zeilfort Kudelstaart.
- **Plant-based Food Waste Valorization (MSc MADE thesis):** a model for matchmaking between plant-based food waste and valorization technologies to predict valorization performance.

Research and Innovation

- **From COMposite to PROduct (COMPRO):** testing the durability and biodegradability of Re-plex, a fully biobased and circular composite material, for the construction sector.
- **Solving the Urban Plastic Soup:** working toward a cleaner and healthier public space in Amsterdam by monitoring, reducing, and circular processing of the urban plastic soup.
- **Biobased 3D Print Project:** developing a 3D printing paste from organic waste to create a business case for the separate collection and treatment of organic waste.
- **Green Water Hubs:** developing sustainable solutions for urban water management for Artis and De Hortus Botanicus.
- **Insect Rearing on Municipal Waste from IJburg:** examining the possibility of growing insects on urban food waste for animal feed.

Entrepreneurship

- **Spore:** smart bio bins that help cities adhere to biowaste laws, improve collection efficiency, and reduce transportation costs.
- **Cyrcl:** closing the urban waste circle by collecting and treating the green waste of cities with pyrolysis, resulting in gas production, biochar production, and carbon credits trade.

A closer look at some of our activities focused on capitalizing urban waste streams for a circular economy

Education

Value of Poo (MSc MADE Living Lab)

In the past, waste was often seen as an inevitable by-product of our consumption-driven society. But at ARTIS Zoo in the heart of Amsterdam, waste is viewed as a valuable resource. The zoo deals with 17 different types of waste streams, with organic waste being the largest at a staggering 600,000 metric tons yearly. Within that organic waste stream elephant dung takes up the largest share – with up to 150,000 kg in total annually, elephant dung can be a valuable resource. Therefore, the goal of this MSc MADE living

lab was to co-create a local circular solution for this product that would complement the organization's character.

The student team interviewed experts on circular strategies, expanded them to scenarios in the context of ARTIS Zoo, and reduced them to six viable circular scenarios and three proposals for circular dung management in the zoo, including optimizing the current scenario of composting at the farm, setting up a pilot with a dung bench, and exploring the possibility of eComposing in the Plantagebuurt neighborhood.



Entrepreneurship

Spore

In Amsterdam alone, the average person generates hundred kilograms of organic waste per year. Spore is a start-up that taps into the field of bio waste separation and collection.

At the starting phase of the business, Spore, a startup that developed smart bio waste bins, was solely focused on a consumer segment. In 2022, while taking part in the AMS Startup Booster program, the team learned that for cities, contamination – typically food packaging or chemical contamination such as PFAS – is one of their biggest problems as this prevents biowaste from being composted or upcycled

into compost products. Contamination reduces the value of the end product, and prevents the market for compost products from growing. As a result of the pre-incubator program, Spore shifted its business focus to bio waste bin sensors that gather useful data on contamination and capacity in order to scale up their composters to a metropolitan level.

Now, Spore's bio waste bins are equipped with sensors that help municipalities identify contamination at the source. This makes it easier for cities to adhere to laws involved with bio waste separation and collection. In addition, the smart bins monitor capacity too – this allows municipalities to improve collection efficiency and reduce transportation costs by 40%.



"Using Re-plex we can transform waste from the city into urban building material. What if we could turn wastewater treatment facilities into building material producers?"

Peter Mooij, *Postdoctoral Research Fellow, AMS Institute*

Research and Innovation

From COMposite to PROduct (COMPRO)

How can we rethink and redesign the flow of resources in urban areas, including building materials, water, food, and energy? With the development of a biobased and waste-based composite material, the COMPRO project consortium wants to revolutionize the construction industry and pave the way for a more sustainable future.

The project team develops the composite material from waste water. Composites consist of fibers held together by a glue. For the fibrous material, the researchers retrieve cellulose fibers originating from toilet paper and use Kaumera, produced by bacteria in the Nereda® wastewater treatment process, as an organic glue. Together, these can be used to yield a fully biobased and waste-based composite material called Re-plex. The material has interesting mechanical, biodegradable, and fire resistance properties that can be of valuable use in the city.

In 2022, researchers tested Re-plex for two use-cases. For the first use case, the material is tested in the water for nature restoration. The goal is to support the growth of vulnerable plants. Prototypes are being tested in fresh and salt water in the Netherlands. The main objective of this use-case is to test how long the material holds. It should not break down too easily to protect young, growing plants but the materials should also not take too long to degrade to

prove its biodegradability. For the second use case, the consortium installed a test rig in Bajeskwartier in Amsterdam to evaluate the use of Re-plex as a building material for façade cladding. The rig aims to evaluate the material's ability to withstand various weather conditions, including sun, rain, and wind, and the influence of orientation (north, south, etc.) on the lifespan of Re-plex.

Project leads: dr. Peter Mooij, dr. Mariet Sauerwein (TU Delft)

Program developer: Joke Dufourmont

Principal Investigator: prof.dr. Mark van Loosdrecht (TU Delft)

Research Fellows: dr. Peter Mooij, dr. Mariet Sauerwein (TU Delft)

Partners: TU Delft, BAM Infra, BAM Bouw en Techniek, NPSP, and Chaincraft

Duration: 3 years

Budget: €570K

"Amsterdam can and should be a role model for other cities. Here, we are not afraid to experiment, to confront, to stimulate, or to inspire. These elements are necessary to transition toward less plastic waste. The collaboration with AMS Institute has been decisive in carrying out the 'Solving the Urban Plastic Soup' project in Amsterdam. The institute provides valuable knowledge and expertise in guiding and conducting research."

Constance Steenkamp-Faaij, Program manager Amsterdam Plastic Smart City, City of Amsterdam

Research and Innovation Solving the Urban Plastic Soup

An estimated 80% of the plastic soup in the oceans originates in urban areas. In Amsterdam, plastic leaks through the canals and the IJ river toward the sea and coastal areas. Understanding the mechanisms behind plastic moving from urban areas to the oceans is one of the keys to effectively addressing the problem.

In 2022, we launched the Urban Plastic Soup project, which aims to provide insights into the origin and behavior of plastic pollution in urban areas – in this case the Amsterdam canals – and possible solutions to it. Through this project, we are working on creating innovative and marketable solutions for the reduction and upcycling of plastic litter. These innovations in waste reduction and upcycling are also supported by the development of a new monitoring system. The monitoring system will provide the city with structural insight into the size and causes of the plastic problem and the most cost-effective measures to solve it. The latter will be scalable and replicable.

This year, WUR developed the monitoring protocol, made a first hot spot map of plastic pollution in Amsterdam canals, and tested the monitoring approach for plastic waste in urban water systems. Together, the consortium selected preliminary locations to develop solutions for the urban plastic soup in a living lab setting. To support these developments, AMS Institute set up the project management, finalized a communication plan, and hosted various workshops, including the Amsterdam Plastic Smart City team of the City.

Project lead: Irene Luque Martin (AMS Institute)

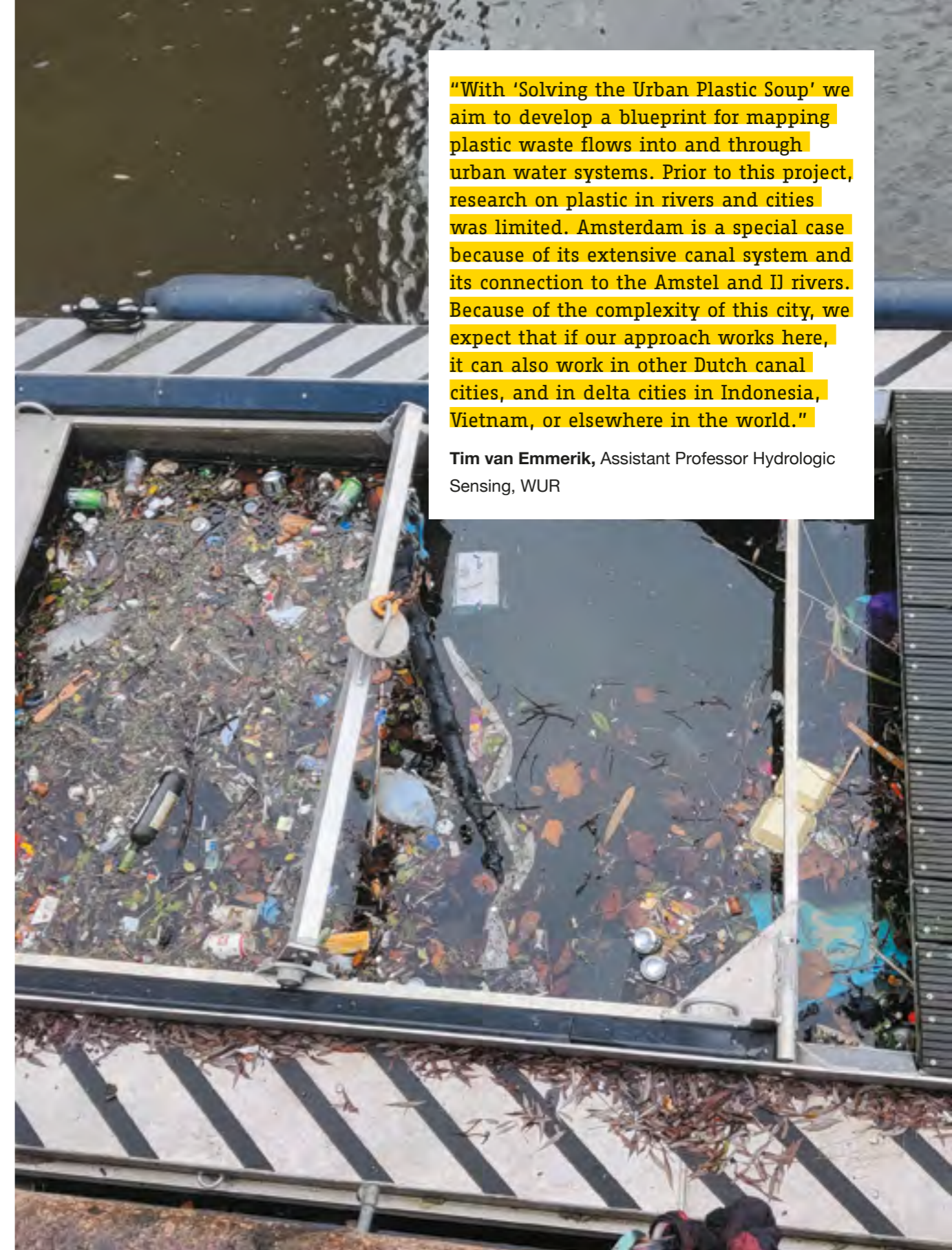
Program developer: dr. Joppe van Driel

Research Fellows: dr. Tim van Emmerik, Paolo Tasseron (WUR)

Partners: WUR, City of Amsterdam, TAUW, TAUW Foundation, Noria, and The Great Bubble Barrier

Duration: 4 years

Budget: €806K



"With 'Solving the Urban Plastic Soup' we aim to develop a blueprint for mapping plastic waste flows into and through urban water systems. Prior to this project, research on plastic in rivers and cities was limited. Amsterdam is a special case because of its extensive canal system and its connection to the Amstel and IJ rivers. Because of the complexity of this city, we expect that if our approach works here, it can also work in other Dutch canal cities, and in delta cities in Indonesia, Vietnam, or elsewhere in the world."

Tim van Emmerik, Assistant Professor Hydrologic Sensing, WUR



"With fully biobased and waste-based pastes for 3D printing, we are moving beyond recycled plastics and taking the next step from a circular to a regenerative maker movement and economy."

Jasper Middendorp, Researcher, Junai Foundation

Research and Innovation

Innovation Hub Biobased 3D Printing

In Amsterdam, every person throws away an average of 86 kilos of organic waste (vegetable, fruit, and food scraps) per year. The ambition of this project is to develop 3D printing materials based on food waste, which are also fully biodegradable and reusable without loss of quality. Furthermore, in the project a production method for 3D printing is developed using cold-paste extrusion (including prototype hardware, paste and filament, and a regional supply chain). This will help to create a business case for the separate collection and treatment of organic waste, thereby closing the loop of organic materials in the city.

Mid-2022 the non-profit organization Junai Foundation was set up that will make the knowledge and designs open-source so that manufacturers, makers, and designers can deploy them and further drive related sustainable job and value creation. Researchers from AMS Institute and Junai Foundation have installed

a 3D printing station at the Makerspace of AMS Institute, and developed and tested the first recipes of 3D printing pastes from organic waste streams. The first tests were conducted with oyster, saw dust, olive pit, paper pulp and cocoa shell powders since these are readily available to experiment with. The goal is to focus on what is available from the region's hospitality and catering industry – such as mussels, shrimps, oysters, egg shells, and nuts.

Project lead: Jasper Middendorp (Junai Foundation)

Program developer: Joke Dufourmont

Principal Investigator: prof.dr. Mark van Loosdrecht (TU Delft)

Research Fellow: dr. Mariet Sauerwein (TU Delft)

Partners: Junai Foundation, TU Delft, Spark 904, and Omlab

Duration: 2 years

Budget: €249K

Research and Innovation

Insect Rearing on Municipal Waste from IJburg

Cities need to work towards extracting as much value from waste streams as possible. Since insects are naturally well suited to thrive on various types of biomasses, researchers wondered: could black soldier flies form part of the solution for a circular economy?

Currently, kitchen waste is not allowed back into the food system. This project investigates an intermediate step: the possibility of using black soldier flies and worms to process kitchen waste. The larvae of the flies are cultivated on kitchen waste, and in turn the larvae can be fed to animals such as chickens. Kitchen waste from the Amsterdam residential area IJburg will be collected and first tested for its quality performance: physical parameters (e.g., stones, glass, metals), microbial parameters (e.g., bacteria, viruses), pharmaceutical parameters, and chemical and metal traces. After passing the quality test, the waste material's performance at cultivating insects will be tested. Dietary quality and cultivation performance will be tested for its practical applicability.

In 2022, for the third time, 160 kg of food waste samples were collected from the green collection containers in IJburg. This time, the samples were tested in a commercial production facility for insect rearing. Results on growth performance and sample composition are expected in Q2 2023.

Project lead: dr. Marko Appel (WUR)

Program developer: dr. Willie van den Broek (WUR)

Partners: WUR, HAS Hogeschool, VENIK, AVINED, Nijssen, NEVEDI, Darling Ingredients, The Insectory, Ingredient Odyssey, Dorset, Meatco, and Wadudu

Total budget: €1.6M

Duration: 40 months exploration



Scientific Conference 2022

How can cities transform their systems, to become more livable, resilient and sustainable, while offering economic stability? To explore this and more, AMS Institute organized a three-day scientific conference 'Reinventing the City' in collaboration with the City of Amsterdam. A broad global community of over 800 urban scientists and practitioners came together, sharing advances in urban sciences and engineering and connecting for future collaboration and impact.



"Cities are always changing and transforming. We as politicians need to facilitate change and be agile. Often this doesn't come naturally. We need to send a strong message to ask for innovation and solutions."

Anna König Jerlmyr, Mayor, Stockholm



In this collection you will find recordings from the scientific conference, paper presentations and results from workshops:



"The conference brought together people from all over the world to rethink sustainable cities. From the Mayor of Stockholm to the Chief Science and Chief Technology Officers of Amsterdam, a wide range of Dutch policymakers and PhD students. Jointly, we raised the bar of what an interdisciplinary multi-stakeholder conference can entail. In various forms and set-ups, information and inspiration was shared. We are already looking forward to the second edition in 2024."

Eveline van Leeuwen, *Scientific Director, AMS Institute*

"We live in a rapidly changing society. With the rise of digitization, it is an interesting question of who takes ownership. Do we let technology make decisions for us or do we, humanity, decide what technology will do for us?"

Ger Baron, *Director Digital and Innovation, City of Amsterdam/CTO*



CityLab 2022

In 2022, the Bloomberg CityLab took place, bringing together mayors from cities worldwide alongside scientists, business leaders, urban experts and other stakeholders to discuss solutions to pressing global issues. In Amsterdam, a group of more than five hundred people joined representing cities across six continents. In addition, more than forty mayors attended CityLab Amsterdam – coming from cities in the U.S., Europe, Africa, and Latin America.



"The spaghetti structure of this institution is really inspiring. This is an institution that does not sanitize things and cut them apart but at AMS Institute the real dirtiness of problems seem to be embraced."

Tim Moreland, Deputy Admin, City of Chattanooga



"Student teams seem to be very engaged in the delivery of the projects which was impressive. For those of us to recruit the best minds in public services, it's such people that express they want to do what they learned here at AMS Institute that we need. To be expansive, take risks and innovate."

MarySue Barrett, Nonresident Senior Fellow, Brookings Institution



"At AMS Institute, they managed to bring a hyper local focus to urban technology [...] trusting that if you do so, broader future opportunities will emerge."

Bryan Boyer, Faculty Director Urban Technology program, University of Michigan, Taubman College

Board Report

AMS Institutes' board was founded on August 26, 2014 and is registered with the Amsterdam Chamber of Commerce (KVK 854305610). It consists of four representatives – two from each of our founding partners: Delft University of Technology and Wageningen University & Research.

In 2022, the composition of the AMS Institute Board was as follows:

- **R. Mazier**
Chair, Wageningen University & Research
- **H.P.S. Althuis**
Member, Delft University of Technology
- **J.G.A.J. van der Vorst**
Member, Wageningen University & Research
(till September 2022)
- **D.E. van Gameren**
Member, Delft University of Technology

The board was supported by the executive secretary **Rosalie Lemmen** (Delft University of Technology).

Board member J.G.A.J. van der Vorst was present in the first two board meetings, after which he went on sick leave. After the summer holiday he decided to leave the board. The WUR Executive Board is looking for a new board member within Wageningen University & Research.

The board met 7 times, including once with representatives from the executive boards of Wageningen University & Research and Delft University of Technology, and one informal dinner meeting with representatives from the municipality of Amsterdam. The visit of the full executive board of Wageningen University & Research and Delft University of Technology has been rescheduled from September 2022 to February 2023.

During these meetings, the board addresses a broad range of topics, including:

- The 2021 Annual Report and the 2022 Budget and Annual Plan.
- The visit of mayor Femke Halsema in January 2022.
- The Scientific Conference of AMS Institute in February 2022.
- The preparation of the 8-year Review program, which took place in May 2022.
- Input for the vision-report for the strategy of AMS Institute in the next ten years.
- The Impact Analysis on the output of AMS Institute.
- The steering group AHK-CODAM-AMS and the future of the innovation hub at 'Marineterrein'.
- The strengthening of the Principal Investigator and Research Fellow community within the institute and the composition of Principal Investigators for the years 2023-2025.



- The renewal of the housing contract of AMS Institute at 'Marineterrein'.
- Research and Valorisation developments, innovation flagship-projects, entrepreneurship programs and professional education offerings.
- The joined-degree master MADE: the progress of student-projects, applications for the new academic year and the housing problems experienced by (international) students.
- Preparation of important events in 2023, including: the visit of the executive boards of Wageningen University & Research and Delft University of Technology in February 2023.

- The approval of Research Projects, including:
 - SmartHubs 2022
 - Urban Plastic Soup
 - Responsible Sensing Lab 2022
 - Align4Energy
 - Munition
 - Emissieloze hoogbouw
 - Circulaw
 - LogiCELL

The overall R&I portfolio reached a grand total of 38 projects with a total of €26.45M.

8-year review: a strong foundation

In 2022 an external committee conducted an independent 8-year review of AMS Institute, recognizing the institute as leading in the field of urban engineering. Overall, the committee concluded that AMS Institute has delivered, with regard to the progress made since the midterm evaluation in June 2019. AMS Institute is filling a gap in academic and applied technology in Amsterdam, thereby clearly adding value to the existing knowledge infrastructure of the metropolitan region. AMS Institute has established a strong track record regarding the specific knowledge, experience, expertise, and networks it can bring to the table. The committee concluded that AMS Institute laid a strong foundation to contribute to urban innovation through education, entrepreneurship and research and innovation. With special regard to the following:

MSc MADE

The in-house MSc creates a stable and long-term cooperation between the founding partners. It produces on average 60 highly sought-after 21st century urban engineers for the city each year and is valued for its focus on quality. MSc MADE forms a viable bridge between traditional disciplines (and Institutes), and to anticipate societal challenges of the future.

Amsterdam as a living lab

A unique selling point of AMS Institute is to be working in Amsterdam as its Living lab, creating hands-on experience in doing research in a context-rich setting. AMS Institute is a unique symbiosis between a City with a long history and identity, and academic founders with a strong track record. Cities across the globe are dealing with similar issues, and AMS Institute is more and more approached by international delegations to share their experiences.

Research to impact

Research results feed into new policy, new tender procedures, and innovative practices that are future oriented. The network around AMS Institute has grown substantially, and it is becoming more visible that AMS Institute creates impact in the municipality of Amsterdam. AMS Institute is currently developing larger programs, which allow for more impact, more synergy and more sustainability.

Unique ecosystem

AMS Institute has really created its (own) ecosystem with its own urban context, tapping into the knowledge base of the founders, with its own location, building, identity, and brand. Passionate people feel connected and attracted by this.



Marineterrein Amsterdam

Being located at Marineterrein Amsterdam is a true asset. The area is still developing itself into an innovation hub for research and experimentation in a real-life setting. The Marineterrein Living lab hosts

about 30 AMS Institute experiments, sometimes – naturally – finding synergies. It ensures that people from different disciplines and organizations meet with each other, resulting in real cooperation.

“In the emerging field of urban engineering, AMS Institute can be recognized as a leading institution. Its profile is distinctive, especially in its effort to integrate research, education, and valorization.”

External review committee

Victor van der Chijs, Pieter Litjens, Daphne den Hollander (*secretary*), Matthias Ruth, Iduna Vollinga

References

On the cover

Power from solar panels on Amsterdam houses: comparison of 2016 and 5 years on.
Source of data: Municipality of Amsterdam
Image by Caspar Egas

Page 4-5

The office of AMS Institute at the Marineterrein Amsterdam
Photo by Alex Schröder

Page 6

AMS Institute Startup Booster
Photo by Maarten Nauw

Page 7 top

A crowded tram station in front of Amsterdam Central Train Station
Photo by Alex Schröder

Page 9

AMS Institute Research Fellow and colleague from the City of Amsterdam making adjustments to the mmWave-sensor together
Photo by Alex Schröder

Page 12 top

Visit of the WUR and the mayor of Wageningen to AMS Institute
Photo by Maarten Nauw

Page 12 bottom

Talkshow live recording during the Reinventing the City conference at AMS Institute
Photo by Maarten Nauw

Page 14 top

Live recordings and after talk during the Reinventing the City conference at AMS Institute
Photo by Maarten Nauw

Page 14 bottom

Managing Director of AMS Institute speaking during the Reinventing the City conference
Photo by Maarten Nauw

Page 16-17

MSc MADE team Drought Resilience at Bajeskwartier Amsterdam
Photo by Alex Schröder

Page 19 top

AMS Institute Introduction of 2022
Photo by Maarten Nauw

Page 19 bottom

MSc MADE students working in Makerspace AMS Institute
Photo by Alex Schröder

Page 20

AMS Institute Introduction of 2022
Photo by Maarten Nauw

Page 21

AMS Institute Introduction of 2022
Photo by Maarten Nauw

Page 22

Visitation of a filming crew for the MSc MADE
Photo by Marcel Bilow

Page 24-25

The Leaf project on Innovation Workplace at Hanzehogeschool Groningen
Photo by the Hanzehogeschool Groningen

Page 26

Presentation about the AMS Start-up Booster during the AMS Institute intro of 2022
Photo by Maarten Nauw

Page 30

Meeting of a boosted team at AMS Startup Booster
Photo by Maarten Nauw

Page 31

AMS Institute Startup Booster
Photo by Maarten Nauw

Page 32

User of an e-bike
Photo by Hely

Page 36-37

Visit of the WUR and the mayor of Wageningen to AMS Institute
Photo by Maarten Nauw

Page 44-45

The underground bicycle parking in front of Amsterdam Central Train Station
Photo by Alex Schröder

Page 46-47

Building with timber for the Mooijburg project by Natruified Architecture
Photo by Joke Dufourmont

Page 48 top

Use of a machine for the The Leaf project by Hanzehogeschool Groningen
Photo by the Hanzehogeschool Groningen

Page 48 bottom

Project presentations at AMS Institute for Bloomberg CityLab
Photo by Maarten Nauw

Page 51

Timber construction at Zeeburgereiland Amsterdam
Photo by Alex Schröder

Page 52

Pavement
Photo by Shane McKnight on Unsplash

Page 53

Street under construction
Photo by Alex Schröder

Page 54-55

Celebration of inclusivity
Photo by Unsplash

Page 57

Visuals for the phone use of the CoTown en uw Buurt platform
Photo by CoTown

Page 59

AMS Research Fellow and colleague of the City of Amsterdam discussing the data visualization of the Ideal(s) City project
Photo by Alex Schröder

Page 61

Project Member and Research Fellow discussing the i-CHANGE project at the AMS Institute office
Photo by Alex Schröder

Page 62

View on Amsterdam with the IJ river
Photo by Alex Schröder

Page 64-65

The Shuttercam
Photo by Sjoerd Ponstein

Page 66

Recording a video in the green screen studio
Photo by Maarten Nauw

Page 69

The Shuttercam at Bijlmer Arena
Photo by Sjoerd Ponstein

Page 70

Drone operator in Amsterdam city center
Photo by Alex Schröder

Page 73

Camera surveillance in Amsterdam city center
Photo by Alex Schröder

Page 74-75

Construction on quay walls
Photo by Alex Schröder

Page 76 top

AMS Institute employees working on the Happy Tree Monitor Living Lab
Photo by Alex Schröder

Page 76 bottom

Team of MSc MADE students working on the Drought Resilient Bajeskwartier project
Photo by Alex Schröder

Page 79 top

AMS Institute Startup Booster
Photo by Maarten Nauw

Page 80

Construction on quay walls
Photo by Alex Schröder

Page 81

Practical research on quay walls with an AMS Institute Research Fellow
Photo by TU Delft / Frank Auperlé

Page 83 top

An event discussing the project RED&BLUE
Photo by Simon Pugh Photography

Page 83 bottom

Heavy rain
Photo by Alex Schröder

Page 84

Road under construction
Photo by Alex Schröder

Page 86-87

Gardening in the city
Photo by Alex Schröder

Page 88

Visualization of an urban greenhouse
Photo by MADE Caterpillars

Page 90

Vertical farming
Photo by Farmvent

Page 93

Vegetable stall on the local market (Dappermarkt) in Amsterdam East
Photo by Alex Schröder

Page 95

A small vertical farm at AMS Institute
Photo by Alex Schröder

Page 96-97

Citizens leaving a ferry in Amsterdam
Photo by Alex Schröder

Page 98

MSc MADE Students doing fieldwork
Photo by Alex Schröder

Page 101 top

Researcher working on the Bike Traff|cknig project
Photo by Sophieke van Beek

Page 101 bottom

Data visualization for the Bike Traff|cknig project
Photo by the Data visualization team of AMS Institute

Page 103 top

A mobility hub
Photo by Hely

Page 103 bottom

Bikes for the promotion of the SmartHubs project
Photo by Hely

Page 104 top

Crowds at a ferry in Amsterdam
Photo by Alex Schröder

Page 106-107

Placement of solar panels on rooftop
Photo by Nuon

Page 111

Components of IT-hardware
Photo by Alex Schröder

Page 112

Card game related to the Collect your Retrofits project
Photo by AMS Institute

Page 114-115

Children separate waste at garbage container
Photo by Alex Schröder

Page 116

MSc MADE project on sustainable use of elephant dung
Privately taken photo

Page 117

Spore's bio waste bins
Privately taken photo

Page 118

Researcher at AMS Institute working on biobased and waste-based material for 3D printing
Photo by Alex Schröder

Page 121

The Great Bubble Barrier catching plastic pollution
Photo by Pablo Tasseron

Page 122

3D printed specimens
Photo by Maarten Nauw

Page 123

Cleaning of a container used for insect rearing
Photo by Willie van den Broek

Page 124

Set-up of a preliminary session during the Reinventing the City conference
Photo by Maarten Nauw

Page 125 top

Workshop during the Reinventing the City conference
Photo by Maarten Nauw

Page 125 bottom

Broadcast during the Reinventing the City conference in the AMS green screen studio
Photo by Maarten Nauw

Page 126-127

Scientific Director (AMS Institute) and the Chief Technology Officer (City of Amsterdam) during the opening of the Reinventing the City conference
Photo by Maarten Nauw

Page 128

Visitors sightseeing during the Bloomberg CityLab
Photo by Maarten Nauw

Page 129

Welcoming visitors during the Bloomberg CityLab at the AMS Institute building
Photo by Maarten Nauw

Page 129

Presentation during the Bloomberg CityLab
Photo by Maarten Nauw

Page 131

Visit of Wageningen University and Research and the mayor of Wageningen at AMS Institute
Photo by Maarten Nauw

Page 133

The 8-year review committee
Photo by AMS Institute

Glossary

AMA

Amsterdam Metropolitan Area

CTO

Chief Technology Office of the City of Amsterdam

HvA

Amsterdam University of Applied Sciences

MALL

Marineterrein Amsterdam Living Lab

MIT

Massachusetts Institute of Technology

MSc MADE

Metropolitan Analysis, Design & Engineering

PI

Principal Investigator

RF

Research Fellow

RSL

Responsible Sensing Lab

SAL

Senseable Amsterdam Lab

TU Delft

Delft University of Technology

UvA

University of Amsterdam

WUR

Wageningen University & Research



