AMS

AMSTERDAM
INSTITUTE FOR
ADVANCED
METROPOLITAN
SOLUTIONS

Annual Report 2023

On the cover:

The Ideal(s) City Project

The best way to organize a city is in line with its ideals. But what exactly are those ideals and how do you prevent losing sight of them when solving metropolitan challenges?

Many of the major challenges that cities like Amsterdam face, are interconnected. Yet in practice, these challenges are often tackled “problem by problem,” and one ideal is lost at the expense of the other. The Ideal(s) City project untangles these urban challenges and uses numerous data sources to support the choices that must lead to the realization of the ideals that live in a city.

The project team identified, analyzed, and mapped how different monitors in Amsterdam differ and overlay. In addition, they pinpointed what topics these monitors might miss and if the right indicators and data are used to measure what really matters. The analysis and comparison of eight initial monitors resulted in a dazzling overview of almost 550 different indicators, which you can see on the cover of this report.

Read more about the project:

Annual Report 2023

AMSTERDAM INSTITUTE FOR **ADVANCED METROPOLITAN SOLUTIONS**

Core academic partners

TU Delft · Wageningen University & Research · MIT

In partnership with

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Directors' Report

As we present our annual report, we invite you to delve into highlights that inspire – stories of impact, innovation, and dedication. The collective efforts of our community, the forged partnerships, and the achieved milestones fill us with enthusiasm for the years to come.

Founded in 2014, AMS Institute has developed from a vision on paper into an internationally leading institution dedicated to urban engineering through research and innovation, education, and entrepreneurship. In our pursuit of scalable urban solutions, 2023 was no exception.

This annual report provides just a taste of what can happen when a growing community of impact-driven talents pushes bold new ideas and works together on a shared mission: to reinvent cities. From groundbreaking research projects to innovative master's theses and real-world urban solutions, the spirit of collaboration shines brightly in everything we do. As a director's team we take pride in proving that when we join forces, there's no limit to what we can achieve.

Innovation and Impact

Where do you find students conducting research on biodigesters for solving food waste streams while simultaneously spearheading the implementation of an actual biodigester with stakeholders in the city? Can you imagine creating an advanced model to assess the structural health of quay walls while at the same time translating the results of this model into city policy, resulting in immediate benefits for the city and its citizens? How often do you observe policymakers, top-notch researchers and students collaborating to envision an inclusive energy transition for our cities?

Together with our teams of program developers, research fellows, principal investigators, living lab managers, students, entrepreneurs, staff and partners, 2023 emerged as a year of significant achievements. This was evident not only from making a meaningful impact with our ongoing projects, but also in securing funding for several highly relevant programs. The research and innovation initiatives we took on with partners received acknowledgment, amongst others through the approval of two substantial National Growth Fund program proposals, focused on developing digital urban mobility solutions and creating a future-proof living environment.

As every year, our education program served as the launchpad for numerous students to kickstart their professional urban engineering careers. Our Startup Booster and newly started Amsterdam Circular initiatives played a pivotal role in fostering startup growth and sustainable-tech entrepreneurship in the city.

Forging a Decade-Long Partnership

As cities confront urgent challenges that demand transformation, ongoing research and collaboration to drive real, field-tested solutions for urban areas are essential. In 2023, TU Delft, Wageningen University & Research, and Massachusetts Institute of Technology (MIT), AMS Institute's core academic partners, continued to excel in researching scalable urban solutions with tangible societal impacts. To solidify this joint decade-long commitment between TU Delft, Wageningen University & Research, and the City of Amsterdam, these partners signed a letter of intent in 2023 to continue their unique partnership. It signifies a shared vision for the future and emphasizes the importance of sustained collaboration in research, innovation, and education for the next 10 years.

A Report with Highlights that Inspire

In closing, we express our gratitude to our dedicated community, partners, and stakeholders, who are, as always, the backbone of our journey. Together, we look to the future with optimism, trusting that AMS Institute will continue to be a driving force in shaping resilient, sustainable, and livable cities.

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

About AMS Institute

Home to well over half the global population, metropolitan regions are at the epicenter of technological and societal transformations. Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute) is driven by the belief that guiding cities towards inclusivity, resilience, and sustainability is no longer an option, but an imperative. At our institute, different disciplines, skills, and expertises are combined to tackle urban challenges that cities of today face.

In everything we do, we create synergies between our education, entrepreneurship, and research and innovation activities. We work in close collaboration with the City of Amsterdam and our founding universities, Delft University of Technology (TU Delft), Wageningen University & Research (WUR), and Massachusetts Institute of Technology (MIT), as well as several partners with complementary backgrounds—including citizens, knowledge institutes, and private and public organizations.

With urban experimentation at the heart of our activities, we propel innovative solutions to create livable, sustainable, resilient, and inclusive metropolitan areas. This is what we at AMS Institute call “reinventing cities”.

A Transdisciplinary Approach to Fostering Transformative Change in Cities

Based at Marineterrein Amsterdam, a learning and innovation hub in the city center, we educate MSc students and urban professionals, support up-and-coming entrepreneurs and startups, and have academics from our founding universities work on research projects. This vibrant community continually interacts with our public and private partners and the city, thus creating a transdisciplinary range of knowledge, networks, and experience.

Our research portfolio revolves around six urban challenges—mobility, energy, circularity, food, climate resilience, and digitalization—and is closely intertwined with critical issues in the city's longer term urban development.

Urban Experimentation to Steer Solutions Worldwide

We believe that to really transform cities, research must develop metropolitan solutions that are ready for society-wide implementation. Therefore, 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 real-world solutions that have the potential to scale up globally. By generating ideas, educating talent, and closely interacting with the evolving local context of the city, we cultivate and nurture an environment that enables continuous learning and experimentation and the development of innovative solutions for livable cities worldwide. This is how we bring about sustainable, resilient, and inclusive metropolitan areas. This is how we reinvent cities.

"With AMS Institute we focus on tangible solutions rooted in reality, not on abstract theories. It's about concrete, realistic solutions that address the needs of real people, cities, and environments. Solutions that emerge from the interplay between theory and practice, between civil service and the best of science."

Ger Baron, *Chief Technology Officer at the Municipality of Amsterdam*

Education

Education is crucial to boost the talent that is required to create solid solutions for the cities of today and tomorrow. With Amsterdam as our living lab, we foster and develop the analysis, design, and engineering skills of the urban engineers of the future.

In 2023, our institute continued to develop a rich set of educational activities that are grounded in urban challenges. This includes our master's degree "Metropolitan Analysis, Design & Engineering" (MSc MADE), the AMS Academy for professional education, and Massive Open Online Courses (MOOCs). Through co-creative learning, our educational activities are geared toward accelerating urban transformation.

MSc MADE: Urban Engineers Tackling Complex Challenges

At the heart of AMS Institute's educational activities is MSc MADE—a joint degree from TU Delft and WUR. 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 inextricably 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. We connect students to real-world challenges in the city and to stakeholders within our community and network—researchers, the City of Amsterdam, businesses, and societal partners.

In May of 2023, 33 first- and second-year MSc MADE students traveled to Istanbul for the yearly MADE IT study trip. The students worked on a research project aiming to propose a range of possible solutions to address metropolitan challenges in Yedikule, a neighborhood in Fatih, a municipality and district in Istanbul province.

An Ever-Changing Urban Environment Requires Innovative Education

We make sure to continuously adapt the MSc MADE curriculum to the knowledge, skills, and attitudes our students require to become the professionals our ever-changing cities need.

MSc MADE is characterized by innovative education and delivers a new type of professional: the urban engineer. Graduates possess the right combination of knowledge, attitude, and skills to solve cities' complex, interdisciplinary challenges. During the degree, students develop a unique ability to speak the language of other disciplines and learn to adapt to the continuously changing urban environment. As a result, these young professionals can collaborate well in transdisciplinary teams, combining technical and social expertise with practical solutions that fit cities' current and future needs. Many students secure employment within the Amsterdam Metropolitan Area (AMA), thereby expanding their influence on sustainable urban development.

In addition to preparing students for future careers, MSc MADE invigorates their entrepreneurial mindset, resulting in many ideas with commercial potential. To support them in starting or strengthening their own companies, students and graduates can join our pre-incubator program: the AMS Startup Booster. They can avail of the coaching and training the program offers and get access to relevant customers and investors to help turn their ideas into impactful businesses.

Furthermore, MSc MADE students can showcase and disseminate their work on the openresearch.amsterdam (ORA) platform. Created by the Chief Science Office of Amsterdam, this platform facilitates knowledge sharing and enables collaboration within the city.

"During my MSc MADE program, I got the opportunity to collaborate with the Municipality of Amsterdam on a drought resilience strategy for Bajeskwartier and a just energy transition in K-buurt in Amsterdam Zuidoost. It was rewarding to integrate AMS Institute's sustainability themes into these real-life projects in the city. Now, as advisor sustainable area development at the Municipality of Amsterdam, I work on the development of the Marineterrein and have submitted several Living Lab proposals to foster future collaboration between AMS Institute and the Municipality."

Ludo van Muilekom, *advisor sustainable area development at the Municipality of Amsterdam, and former MSc MADE student*

An AMS Academy for Professional Education and Training

The AMS Academy is a learning environment within our institute aimed at providing professionals with the knowledge, skills and attitude they need to become leaders in sustainable and innovative urban development. The AMS Academy utilizes knowledge from the institute and translates it to the practical level of professionals. Learning sessions are built on the Urban Living Lab methodology, scientific research and tools, and real-life cases. This way, professionals are enabled to enlarge their impact, break silos, and stimulate innovation.

"Last November, I attended a knowledge module for the research project ALIGN4energy, organized by the AMS Academy. Me and 13 other professionals–mainly policy makers and advisors in the energy transition–worked on challenges and solutions to engage homeowners in making their homes more sustainable. The homeowner perspective is often missing in discussions about the energy transition. The training bridged this gap between research and practice."

Noor Veenhoven, *Program Manger Energy and Circularity at Amsterdam Smart City*

Entrepre-neurship

AMS Institute is strongly committed to helping the next generation of ambitious entrepreneurs turn their ideas for sustainable urban solutions into reality and scale up subsequently. The AMS Startup Booster, our pre-incubation program, supports early-stage urban-tech startups seeking to make a positive impact on cities. In addition, the Amsterdam Circular program further supports more advanced startups by bridging the funding gap for early-stage ventures in the circular economy.

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

The AMS Startup Booster: Guidance for Innovative Business Activities

The AMS Startup Booster helps launch and fast-track startups' promising business ideas in the domain of urban technology. The program offers a focused entrepreneurship curriculum, mentoring and coaching by industry and city experts, office space, and a Makerspace for prototyping and testing solutions.

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

"During the program, you get the chance to talk to all kinds of experts. We took home so many connections, which is extremely valuable."

Rawan Khater, *co-founder of NAUTI, winner of the 6th Startup Booster Program*

"Dutch startups need more support to further develop the circular economic model, and we're confident that the Amsterdam Circular program will play a major role in driving progress within the sector."

Rune Theill, *CEO and co-founder, Rockstart*

Amsterdam Circular: Getting Investor Ready

In 2023, our Entrepreneurship program expanded with the introduction of a new initiative called Amsterdam Circular, developed in collaboration with Rockstart and the City of Amsterdam. Amsterdam Circular is a two-month, cost-free financing program that seeks to bridge the funding gap for early-stage circular ventures. It connects startups with private and public investors, while exploring alternative forms of financing for startups. Founders spend four to eight hours per week participating in workshops, deep dives, training sessions, and other helpful insights into building a lasting business.

Research and Innovation

We believe that scientific research and urban experimentation are crucial for propelling innovation and developing robust solutions for the cities of today and tomorrow. Our six research and innovation programs—Circularity in Urban Regions, Smart Urban Mobility, Metropolitan Food Systems, Climate Resilient Cities, Urban Energy, and Responsible Urban Digitalization—set the agenda for responding to the key challenges facing cities and actively address them.

"Urban innovation is inherently a messy process, similar to natural evolution where numerous attempts and variations are necessary. Some initiatives will succeed, while others will not. During this process, it is very important to have places such as AMS Institute, that really become actuators of the living lab, in this case, Amsterdam."

Prof.Dr. Carlo Ratti, *PI at AMS Institute and Professor at MIT Senseable City Lab*

The City of Amsterdam functions as a testbed for innovation where leading researchers from our founding partners can learn and experiment with professionals from relevant public and private partners. Our Principal Investigators (PIs) and Research Fellows (RFs) work together with our students, entrepreneurs, and program developers to bring a wealth of transdisciplinary knowledge, networks, and experience to AMS Institute's research programs and the city.

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 and other cities in Europe and beyond. Our education and entrepreneurship activities are also strongly aligned with the institute's research and innovation programs to enable cross-fertilization.

"AMS Institute stands out because of its unique Living Lab approach, which actively integrates the urban environment and all its stakeholders with scientists from TU Delft, WUR, and MIT. This direct collaboration fosters distinctive and innovative research."

Prof.dr. Huub Rijnaards, *PI at AMS Institute and professor Environment and Water Technology at Wageningen University & Research*

"Developing solutions in a lab or behind a desk often differs from real-world applications. Therefore, it is crucial to work directly with practitioners in the city. Having AMS Institute operate within the city ensures that we develop scientific solutions that directly address the current societal and environmental challenges in Amsterdam."

Prof.dr. Jantien Stoter, *PI at AMS Institute and Professor 3D Geoinformation at TU Delft*

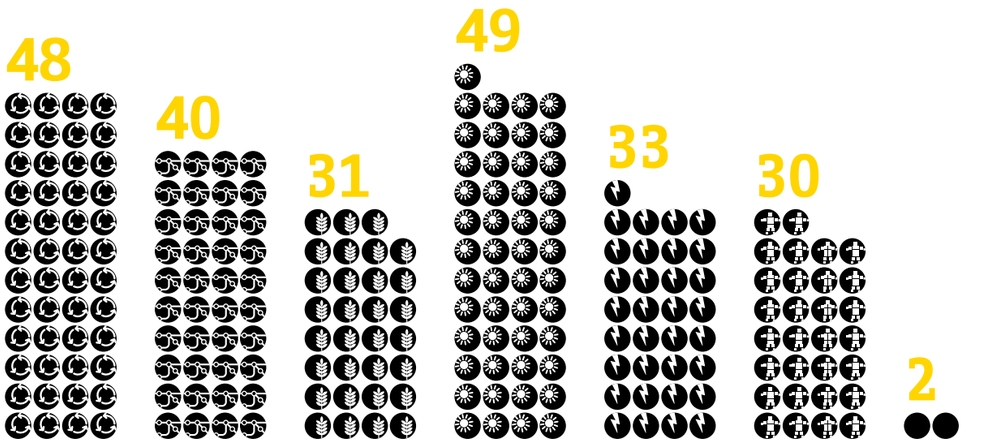
Key Figures 2023

Research and Innovation

 # projects awarded per year

Total value per year of awarded projects

Total number of awarded projects per urban challenge (2014–2023)



233
Total number of projects

€169.4M
Total value of project portfolio

Education

55
New MSc MADE students in 2023

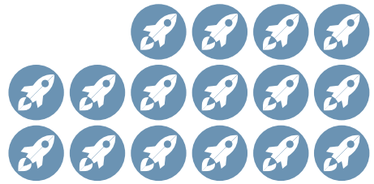
50 diplomas awarded in calender year 2023
163 MSc MADE graduates in total 2017-2023

3,729
MOOC participants in 2023

87,661
Total number of AMS MOOC participants in 2017-2023

Entrepreneurship

37
Affiliated startups in 2023



16
AMS Startup Booster teams

Communications	2022	2023
Website visitors	71,094	**83,697**
LinkedIn followers	9,062	**11,474**
Newsletter followers	1,936	**2,102**

Community Highlights

Bringing together like-minded individuals and organizations within our community is a fundamental part of our approach. Witnessing how this came to fruition in 2023 sparks joy and new inspiration. Below we present a selection of memorable moments in our community last year.

Important Step in Continuing Partnership

On June 15, 2023, the Mayor of Amsterdam (Femke Halsema) and the Presidents of the Executive Boards of Wageningen University & Research (Sjoukje Heimovaara) and TU Delft (Tim van der Hagen) visited AMS Institute. During their visit, they signed a letter of intent for the next phase of AMS Institute.

Since the establishment of AMS Institute in 2014, the partners have been working closely together on sustainable, future-proof innovations for the city. By signing the letter of intent, the City of Amsterdam, WUR, and TU Delft took an important step towards a renewed, long-term collaboration. This renewed collaboration gives the partners the opportunity to continue large-scale impact-driven research and innovation programs and new education and entrepreneurship possibilities.

"Who would have thought this 10 years ago? I find it incredible what AMS Institute has built in such a creative and innovative way over the past decade. This letter of intent is also an expression of how happy we are to continue together on this path. Amsterdam is proud!"

Femke Halsema, *Mayor of Amsterdam*

"AMS Institute is an important part of TU Delft. We and our partners have set the bar high over the past 10 years to accelerate urban innovation. The social urgency for this is only increasing and for that reason we foresee continued growth for our impactful activities in Amsterdam in the coming years."

Tim van der Hagen, *Rector Magnificus TU Delft*

"Amsterdam is brave to tackle urban innovation and does not shy away from experimenting in the urban environment, with proven success. Working with urban living labs in Amsterdam is an important way for Wageningen University & Research to realize societal and scientific impact. AMS Institute is of strategic importance to WUR."

Sjoukje Heimovaara, *President of the Executive Board WUR*

Amsterdam Innofestival

We live in an increasingly complex world with a rising number of challenges for cities. Almost all these challenges are innovation issues: how can we organize things differently and better? What choices do we have to make? And how do we ensure that the city remains inclusive and a livable place for all its residents?

On October 6, 2023, the Municipality of Amsterdam and AMS Institute organized the “Innofestival” to discuss these topics. A diverse selection of speakers and panelists discussed the central question of how we can shape the city of the future together. In multiple break-out sessions, participants joined interactive sessions on topics such as Digital Urban Planning, Intelligent Speed Adaptation, and floating residential areas.

“The approval of this proposal means that we can accelerate the transition initiated in the infrastructure sector. As AMS Institute, we contribute to new technologies, research, and design methods that will provide solutions to make our assets as future-proof as possible.”

Maike Simmes, *former Program Developer Future Proof Assets, AMS Institute*

National Growth Fund: “Future-Proof Living Environment” Proposal Approved

On February 24th, 2023, the National Growth Fund commission approved an extensive program proposal submitted by more than 130 partners under the umbrella of TKI Bouw en Techniek. The partners aim for the program to give an impulse to realizing sustainable economic growth and a transition within the infrastructure sector, working on emission-free, circular, and climate-proof solutions. The commission allocates €100 million to the program.

AMS Institute is lead of the program and coordinates the collaboration within the testbeds, focusing on innovations and scientific validation.

Weekend of Science

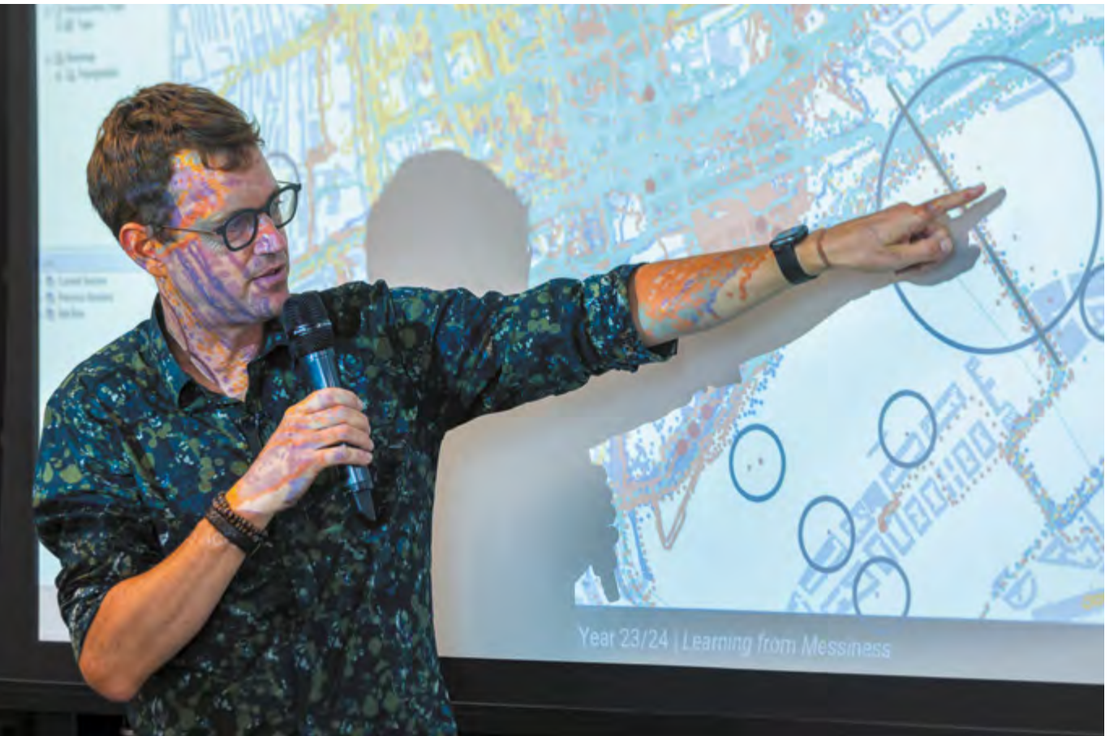
The Marineterrein brought together scientists, researchers, and curious families to delve into the world of science and technology during the “Weekend van de Wetenschap” (Weekend of Science) on October 7th and 8th, 2023. The weekend was filled with exciting activities, workshops, and demonstrations. The event engaged a diverse audience: members of the local community, innovators, students, and practical implementers of innovation for the city. AMS Institute showed a glimpse of the possibilities that science and technology hold for the city and for personal careers.

For example, we organized a 3D printing workshop with organic materials. The workshop provided children and their families a hands-on experience that merged science, technology, and creativity. Along with other organizations at the Marineterrein, we also seized the opportunity to inspire and engage students of the ROC Weekend College Zuidoost. We hoped to get students enthusiastic about these fields and inspire them to consider both theoretical and practical careers in the field of urban innovation.

Opening of the Academic Year

On September 11th, we celebrated the opening of the academic year at AMS Institute. During the event, we delved into this year's theme, "Reinventing Messiness". Speakers included prof.dr. Caroline Nevejan (Chief Science Officer of the City of Amsterdam), prof.dr. Sanda Lenzholzer (Principal Investigator at AMS Institute and Professor of Landscape Architecture at Wageningen University & Research), and dr. Stefan van der Spek (Program Director MSc MADE).

During the event, we examined how urban innovators of the future envision solutions to complex urban issues and compared their perspectives with those of established experts. Topics included the necessity of a healthy research ecology, open-ended forms of design for interventions in the city, and the (interpretation of) data-driven research in the city. Through an interactive student panel, we aimed to uncover new insights and promote mutual learning. The opening of the academic year set the tone for a year filled with exciting opportunities for learning, growth, connection, and collaboration.



Stolen Bike-Athon

This year, we launched the Open Education and Knowledge Coalition, together with Amsterdam University of the Arts (AHK) and Codam Coding College. Together, we aim to promote the collaboration between art, technology, and science at the Marineterrein.

In a collaboration between the newly formed knowledge coalition and MIT Senseable City Lab, the Marineterrein in Amsterdam became the hub for an innovation event called the "Stolen bike-athon". Researchers, software engineers, and urban design students came together to tackle the challenge of tracking stolen bikes in the city. Hundreds of thousands of bikes are stolen in the Netherlands annually, resulting in around €600 million in damages. This hackathon aimed to harness the power of emerging technology and urban analysis to address a prevalent urban issue.

The hackathon's deliverables included engaging presentations and pitches, innovative product ideas, and scripts written for data analysis and visualization. By involving key players such as policy advisers from the City of Amsterdam, the Amsterdam Police, insurance companies, bike producers, and cyclists themselves, the event sought to foster collaboration and collective action towards reducing bike theft.

Reinventing the City

This chapter presents the highlights of 2023, categorized by our six urban challenges. This selection of research projects, “boosted” startups, and MSc. theses showcases how our community of experts and professionals collaborated last year on the most pressing challenges in metropolitan regions.

Our Six Urban Challenges

Circularity in Urban Regions

Amsterdam aims to become fully circular by 2050. Our circularity program supports this transition by redesigning urban activities surrounding production, procurement, use and reuse of material products and infrastructures, as well as planning, governance, and civic engagement of the circular transition.

Metropolitan Food Systems

The complexity of Amsterdam's current food system, which uncouples production and consumption of food, raises concerns about its impact on society and on the environment. Our Metropolitan Food Systems program works on the creation of inclusive and healthy food systems, both nationally and internationally.

Smart Urban Mobility

The metropolitan area of Amsterdam continues to grow, which puts more pressure on urban space and infrastructure. The aim of this program is therefore to positively impact mobility systems in cities and to contribute to making these systems sustainable, accessible, safe, resilient, inclusive, and affordable.

Climate-Resilient Cities

To make Amsterdam and cities worldwide resilient, sustainable, and livable, the Climate Resilient Cities program researches the functioning, adaptation, and resilience of the city in times of climate change. The program focuses on climate adaptation as well as climate resilience.

Urban Energy

Amsterdam has the ambition to reduce CO_2 emissions by 55% in 2030 and 95% in 2050. The main focus of the Urban Energy program is designing and deploying smart, sustainable, and reliable energy systems that contribute to accelerating this energy transition.

Responsible Urban Digitalization

Societal concerns about the impacts of digitalization on governments and infrastructures are increasing. The Responsible Urban Digitalization program aims to develop smart digital tools and technologies—related but not limited to artificial intelligence, sensors, and robotics—that citizens can trust.

Urban Experimentation in the City

This map showcases a selection of urban experiments our community worked on in 2023. 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

Effective Green for Climate Adaptation in the City
Exploring the function and importance of green in cities

Industrialized, Modular, and Low Emission High-Rise Buildings
Researching different aspects of sustainable high-rise buildings

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

Urbiquay
Research into the maintenance, repair, and renewal of urban bridges and quay walls

EU4Advice
Strengthening short food supply chains for a sustainable future

Re-Thinking Public Lighting
A decision tree to guide the City of Amsterdam in making informed decisions about public light brightness levels

Growth Fund DRO-DMI
Developing digital tools to better manage the use of public space

Amsterdam on Foot
An interactive walkability dashboard of Amsterdam's street

Simply Positive
Supporting innovative and ambitious cities and municipalities to become Positive Energy Districts

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

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

Marineterrein Amsterdam Living Lab
Inner city testing ground

Biosphere Solar
Developing a fair, modular, and circular solar panel that can be repaired and recycled

TILER
An e-Tile that charges e-bikes through the kickstand

Urban Biodigester
Research into the potential of small-scale biodigesters in Amsterdam

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

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

Happy Tree Sensor
A monitor for happy trees

Bio-Receptive Concrete
Demonstrating functional performance

Aquaconnect
Climate resilient water harvesting for urban greenery

Growth Fund Future Proof Assets
Research into emission-free, circular, and climate-proof solutions for the infrastructure sector

RePlanIT
Developing a Circular Resource Planning system for IT

Shuttercam
Crowd monitoring systems outfitted with shutters

XCARCITY
Exploring alternatives to private car use

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

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

Local Inclusive Future Energy (LIFE)
Neighborhood energy platform

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

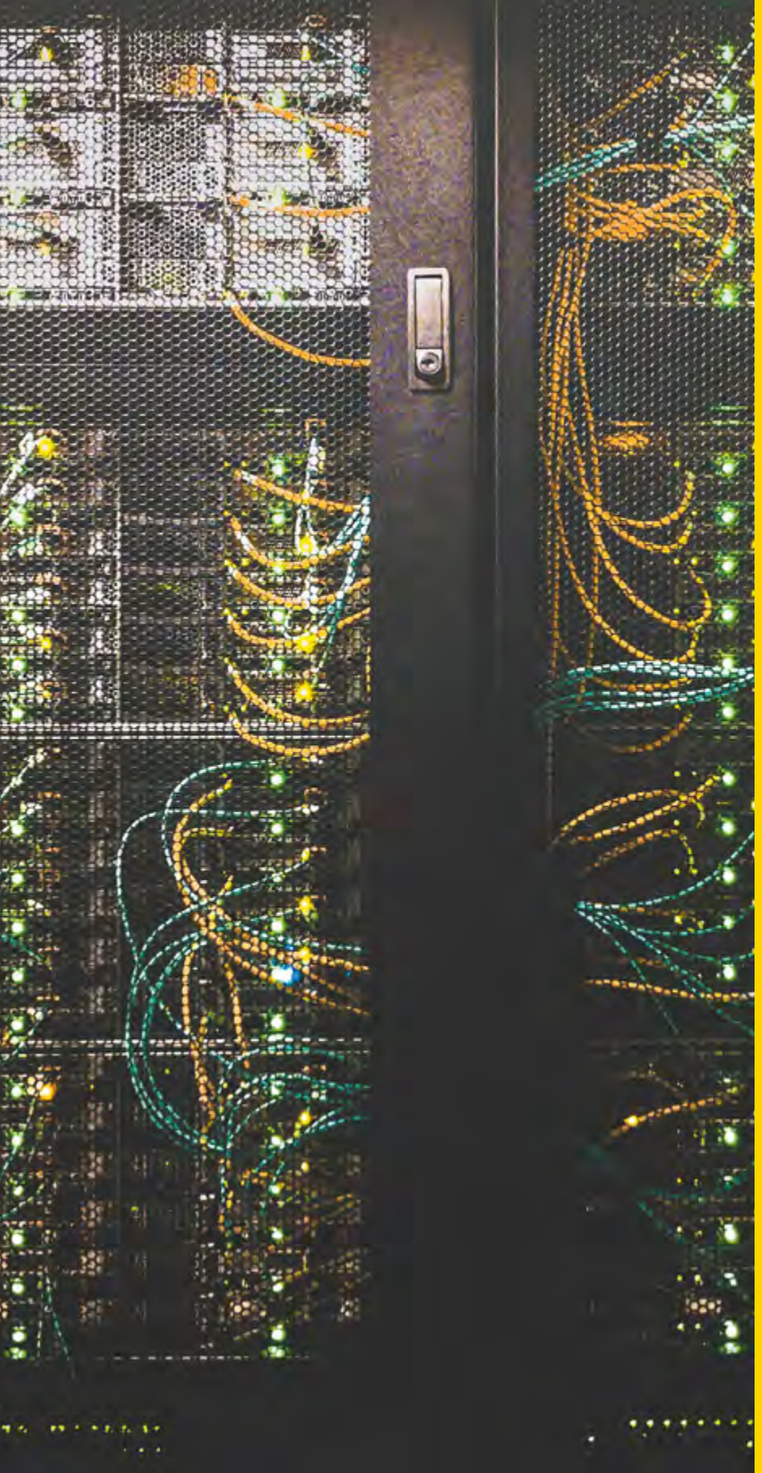
Bio-Based Insulation Materials in Residential High-Rises in Amsterdam
Sustainable densification of urban areas

Circularity in Urban Regions

To achieve circularity in the AMA, we must completely rethink and redesign the flow of resources that drive urban activities. The goal is to reuse resources, instead of disposing of them as we do now, making the whole economic model resilient and sustainable.

Amsterdam has set clear policy goals: the city is committed to reducing material consumption by 50% in 2030 and to becoming fully circular by 2050. In the *Implementation Agenda for a Circular Amsterdam*, the municipal government defined 70 actions to plan and carry out with citizens in the coming four years. The City focusses on three value chains: circularity of consumer goods, the built environment and food and organic waste streams.

AMS Institute actively contributes to Amsterdam's circular transition by researching circular infrastructures, bio-based construction, and data and governance of the circular transition in the city. Research projects include knowledge development to achieve 20% bio-based construction of all new residential buildings in the AMA, as well as the identification, collection, and creation of relevant data and monitoring systems to keep track of circular developments in the city.



Project lead
AMS Institute

Project duration
June 2022 - May 2024

Project partners
TU Delft,
KPN,
Aliter Networks,
IDEAL&CO,
Green IT Amsterdam,
WCoolIT,
Amsterdam Economic Board,
City of Amsterdam,
Rijkswaterstaat

Project budget
€1.1M

Research & Innovation

RePlanIT

We only use IT hardware for an average of three to four years before buying something new. This is not sustainable, and the amount of electronic waste is growing quickly because of increasing digitalization. "RePlanIT" combines partners' expertise in science and the IT industry to develop circular resource planning for IT.

Physical Digitalization

We often think of digitalization as something taking place in a purely virtual world. Yet all these datacenters surrounding Amsterdam remind us just how physical IT really is. The ecological footprint of our digital life is growing quickly (currently around 2%-4% of all European CO_2 emissions). Furthermore, laptops, smartphones, and servers are energy-intensive products and have recycling rates close to zero.

Circular Resource Planning for IT

Circular strategies like the reduction, repair, reuse, and refurbishment of hardware are essential to minimizing the footprint of digitalization. RePlanIT will enable IT users, purchasers, and facility managers to make better, science-based decisions to improve the sustainability of their IT environment and double the lifetime of the hardware. The prototype will be tested in City of Amsterdam field labs and other sites.

Science-Based Circular Choices

The project resulted, firstly, in a validated circular resource planning model and planning tool. A software/web-based prototype was developed for the tool. Secondly, with its research into preconditions for trust, behavior, and the acceptance of circular IT, the project provides insight into how to include stakeholders so that they actually make circular choices.

Design Session in Almere

In 2023, the project team developed and tested a circular resource planning tool for the use case of business laptops, which are generally replaced after four years. The tool reveals alternative strategies and their environmental benefits. For example, 194 kg CO_2 equivalent is saved for each year that a typical business laptop is kept in service after its initial four years. Refurbishing it first saves 174 kg CO_2 equivalent. The planning tool was tested at the City of Amsterdam and Rijkswaterstaat.

"The project consortium has worked very hard to arrive at a Paris Proof tender procedure. Based on, among other things, practice and software pertaining to The New Normal standard such as the Carbon Cost Tracker, parties can now reasonably estimate what is currently feasible around standards for building sustainability and net-zero construction (e.g., MPG and BENG in the Netherlands) and CO_2 before a tender is issued. That means there is no longer any excuse for not complying with feasible minimum requirements."

Mario de Rooij, *Program Manager Zero-Emission Construction, TNO*

Project lead
AMS Institute

Project duration
September 2022 - June 2024

Project partners
Dura Vermeer, VolkerWessels, Municipality of Amsterdam, VGG Adviseurs, Witteveen+Bos, Cirkelstad, Wageningen University & Research, Copper8 BV, Amsterdam ArenA, Wooden City, BPD Bouwfonds Gebiedsontwikkeling, Ballast Nedam Development, Municipality of Den Haag, Municipality of Rotterdam, Municipality of Utrecht, Frontwise Facades, LEVS Architects, Vorm Holding bv, Amsterdam University of Applied Sciences (HvA)

Project budget
€2M

Research & Innovation

Industrialized, Modular, and Low Emission High-Rise Buildings

In order to tackle the housing and climate crisis at the same time, we need affordable, low-emission construction. The consortium behind this project is researching different aspects of sustainable high-rise buildings and aims to translate their findings into tendering rules across the Netherlands.

Sustainability Versus Efficiency

The Dutch construction industry faces a complicated double challenge. Currently, there is a shortage of over 331,000 homes. Eliminating this shortage requires an acceleration in construction. For example, the G4, the four biggest cities in the Netherlands, aim to build 30,000 homes per year up to 2030, yet the actual realized capacity is far below this ambition. At the same time, the construction industry is responsible for 44% of global CO_2 emissions; continuing business as usual—never mind accelerating construction—jeopardizes the realization of climate goals.

Co-Creation Process

Sustainability and efficiency *can* go hand in hand; by using industrialized and modular construction methods, efficient and sustainable logistics, and low-emission materials. The project aims to accelerate the development of climate-neutral construction in the G4 by mainstreaming sustainability criteria in the tender procedure for high-rise buildings. It does so by researching the feasibility and impact of low emission and bio-based materials and logistics strategies for high-rise buildings in the Netherlands. The process is guided by a co-creation process of stakeholders and representatives from the public and private sector, and will culminate in a living lab that tests the outcomes in a tender in Amsterdam Zuidoost.

The New Normal

In 2023, 14 different parties worked on 7 studies, each contributing to uniform sustainable tendering in their own way. Research subjects included air quality, transport, and materials and results were presented in a booklet called "Hoog Hout haalbaar" that included conclusions and recommendations for contracting municipalities. The studies' final findings will be translated into policy through the framework for a circular construction standard known as "Het Nieuwe Normaal" (The New Normal) that will be applicable to tender rules across the Netherlands.

Thesis author
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City of Amsterdam

External supervisor
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"Bio-based insulation materials provide massive carbon-storage potential in the Netherlands. In addition to mitigating climate change, materials like hemp and straw can be locally grown. They contribute to local production chains and the agricultural transition. The Dutch government adopted and launched the National Approach to Bio-Based Construction in November 2023."

Jonas van der Ham, *MSc MADE graduate*

Highlighted thesis

Education

Bio-Based Insulation Materials in Residential High-Rises in Amsterdam

Sustainable densification of urban areas is imperative. However, traditional construction materials contribute significantly to emissions, which exacerbates climate change. Through the uptake of atmospheric carbon, bio-based insulation materials (BBIM) provide a potential solution.

Gains in the Built Environment

The built environment, responsible for nearly 40% of global energy-related CO_2 emissions, is a crucial focus for mitigation efforts. This study shows the potential of bio-based insulation materials and provides valuable insights into leveraging BBIM to reduce emissions in Amsterdam's high-rise buildings, thus contributing to sustainable urban development and climate resilience.

Straw and Hemp

By evaluating the viability of BBIM in high-rise buildings, the study directly addresses the city's sustainability goals. Through dynamic Life Cycle Assessment, the project assesses the global warming impact of various BBIM compared to conventional insulation materials. Materials with high biogenic carbon content and low production emissions, such as straw and hemp, demonstrate the potential for mitigating global warming. The study forecasts substantial emissions savings, highlighting the viability of BBIM in high-rise buildings and their potential to reduce climate change effectively.

Scaling Up Use of BBIM

The study recommends scaling up BBIM implementation by prioritizing materials with optimal GWI (Global Warming Impact) performance. While low-rise buildings offer immediate opportunities for adoption, further development of prefabricated façades can facilitate BBIM use in high-rise construction. The city can support this transition through incentives and experimentation, thereby advancing its climate neutrality objectives.

Highlighted startup

Entrepreneurship

Noord See Lights

Lamps are often mass-produced, not sustainable, and not recyclable. Noord See Lights offers customers the opportunity to design their own lamps, 3D printed with bio-based material.

Sustainable Production

Mass production and sustainability do not go well together. Noord See Lights seeks a more future-proof form of manufacturing lamps. The start-up gives consumers the freedom to create their own lamp using their online tool. Lamps can be created from scratch: color, design, and size are all customizable. A 3D printer brings the product to life. And because 3D printers only use the material they need, there is no waste. Everything is produced on demand only.

Bio-Based Materials

Materials are an important part of the innovation at Noord See Lights. Their lamps are made with a bio-based material called PLA. PLA is a compostable material made from renewable resources like corn cobs or sugarcane. This composition means that the lamps can be easily recycled after they have reached the end of their life. PLA is also very easy to 3D print and results in a robust and attractive material after cooling.

Official Launch

The company is still in its early stages: it has successfully made some sales through the Startup Booster and is currently operating two pilot projects. With a marketable Minimum Viable Product (MVP) and a functional online tool already in place, the primary focus is now on enhancing their online platform and increasing their market presence. In 2024, North See Lights will work towards the next milestone: officially launching the company and gearing up for participation in an accelerator program. They also aim to grow as a company by employing people who have business acumen and marketing experience.

Team

Mick Simmering,
Juliette Mohamed

Smart Urban Mobility

The metropolitan area of Amsterdam continues to grow, which puts more pressure on urban space and infrastructure. Furthermore, all these mobility movements are a key source of environmental pressures and contribute to climate change, air pollution, and noise.

By 2030, Amsterdam's population density will have increased from 5,100 residents per square kilometer to 5,700. But there is simply not enough space to accommodate pedestrians, bikes, cars, and public transport in this growing city. In order to keep Amsterdam livable and accessible, the City has formulated three key goals in their *Mobility Implementation Plan*: creating more space in the city center, improving traffic flow on important routes, and linking Amsterdam's city center with its suburbs.

AMS Institute aims to contribute to these goals by researching and testing ways to make mobility systems more sustainable, accessible, safe, resilient, inclusive, and affordable. These Smart Urban Mobility solutions include the transition toward becoming a "low car city", shared mobility hubs, the transition from 50 km/h to 30 km/h, and innovative digital mobility management tools to improve urban mobility, the use of public space and efficient mobility flows.

"Currently, specialists mostly defend the benefits of their own solutions. This means that an integrated perspective is often missing. We no longer have the space to guarantee all the conditions for each specialty 100%– Ecology, Mobility, Energy, Housing, Work, Living, Climate, Food. We need to focus much more on combining these conditions for our city. Innovation in individual fields, while considering the integral aspects, is increasingly important. We need renewal not for the sake of renewal but to create a better-balanced living environment for residents, entrepreneurs, and visitors."

Paola Huijding, *employer for XCARCITY from Almere Pampus*

Project lead
TU Delft

Project duration
June 2023 - June 2027

Project partners
Open Remote, The New Base, Technolution, RET, Rijkswaterstaat, City of Almere, City of Rotterdam, The Future Mobility Network, Connekt, City of Amsterdam, Metropolitan Region Rotterdam The Hague, BAM, Goudappel, Vervoerregio Amsterdam, Map Traffic Management, DTV Consultants, Witteveen+Bos, Ministry of Infrastructure and Water Management, PON, Mobycon, Fietsersbond, CROW, Royal Haskoning DHV, Planbureau voor de Leefomgeving, Buck Consultants International, Stichting Wetenschappelijk Onderzoek Verkeersveiligheid, ABB, Foundation for Sustainable Development, Eindhoven University of Technology, TNO, University of Twente

Project budget
€5.8M

Highlighted project

Research & Innovation

XCARCITY

An Amsterdam without private cars is almost unimaginable. But maintaining the accessibility and livability of urban regions in a sustainable way is becoming increasingly challenging, which means alternatives to private car use need to be explored.

As cities are becoming busier, the number of trips is increasing and the accessibility of city centers is decreasing. Many individuals still opt for private cars when traveling within and to Amsterdam. All these cars take up a lot of space that could also be used for other purposes, such as recreation, green, leisure, or for pedestrians and cyclists. Other forms of mobility need to be explored. These potential smart mobility solutions consist of flexible combinations of walking and cycling, shared electric vehicles, and transport hubs. But how can we model, predict, and test these integrated solutions without burdening the city with pilots and experiments?

Digital Twins

XCARCITY is a five-year project designed to work on these solutions using the latest modeling and digital tools. The project will develop (realistic) digital replicas ("digital twins") of low-car areas in Amsterdam, Almere, and Rotterdam. The consortium uses these digital twins to study how people use different smart mobility services and what the effects can be.

Scientific Challenges

The project is packed with research and pilots, aimed at making urban regions sustainably accessible. Thirty-two partners work together on topics ranging from in-depth research on mobility flows to the co-creation of solutions for new mobility systems. Results of XCARCITY will help cities, area developers, and mobility providers to make informed decisions about smart mobility, ensuring that low-car urban regions of the future remain accessible. More specifically, the project output will enable mobility providers to offer cost-efficient mobility services, help public authorities develop an action plan for smart mobility solutions, and can also help digital infrastructure consultancies and engineering companies develop the right tools to support the private and public sector alike.

Design Session in Almere

In its initial phase, project members focused on setting up the scientific framework of the project and more clearly defining the use cases for the different cities and regions involved. In October 2023, a first "design session" was organized in Almere to help that city devise a low-car scenario for Almere Pampus.

Education

Amsterdam on Foot

Walkability, or the extent to which the built environment encourages walking, has been linked to increased physical activity and improved health. But what makes us decide whether to walk or not while making our way through the city?

City Characteristics

While various studies have developed indicators to assess walkability, limited attention has been given to the influence of city-specific characteristics on residents' perceptions of walkability. Therefore, this study proposes the development of a context-specific walkability index for Amsterdam.

Weighted Walkability Index

Through a mixed methods approach, the study explores subjective viewpoints on what defines a walkable street and identifies the most significant walkability factors for the urban region of Amsterdam specifically. These factors are then incorporated into a "weighted walkability index," which provides street-level scores.

Walkability Is Not a Uniform Concept

The findings emphasize that walkability in Amsterdam is not a uniform concept, as individual walking behavior is influenced not only by the environment but also by personal factors. The resulting walkability index underscores the importance of factors such as traffic safety, crime safety, pedestrian infrastructure, and proximity to amenities in shaping residents' decisions to walk on specific streets.

Considering Subjective Perspectives Helps Enhance Healthy Lifestyles

This study highlights the significance of participatory approaches and the inclusion of citizen's opinions when evaluating walkability. By considering both objective indicators and subjective viewpoints, cities can develop more meaningful strategies to enhance walkability and create environments that promote active and healthy lifestyles.

The results of this study were published in an interactive walkability dashboard where citizens and municipality officers can check the scores for any street or neighborhood in the city.

Thesis author

Matias Cardoso Suter

Academic supervisors

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PhD Candidate Vasileios Milias, TU Delft

Highlighted startup

Entrepreneurship

JOYN Mobility

Accounting for almost 50% of all the kilometers driven in the Netherlands, commuter traffic is a big contributor to our carbon footprint. JOYN enables employees and companies to reduce their carbon footprint by providing an understanding of commuting patterns and facilitating the creation of tailored benefit packages to encourage sustainable commuting practices.

Green Commutes

As part of new EU laws, companies with more than 100 employees need to start reporting the CO_2 emissions of their employees' commutes from July 2024 onwards. JOYN offers businesses a tool that gives insight into these emissions while also promoting positive behavioral changes. It links individuals' motivation to commute to the opportunities employers can provide to support them in an environmentally friendly way. The service helps HR-managers to plan their employee expenses by providing an overview into commuting patterns and budgets.

Algorithmic Approach

At the core of JOYN lies its algorithm, which calculates the potential for green commuting in various scenarios. This algorithmic approach makes it possible to identify obstacles that could hinder the realization of this potential. After the obstacles have been identified, employers can address them by implementing incentive plans, cities can enhance infrastructure planning, and commuters can make lasting changes to their behavior. The technology learns from patterns and improves the experience each time it is used.

First Client

After joining the AMS startup booster in 2023, JOYN made a working prototype for the SaaS (Software as a service) and is now in the process of signing a pilot with a potential first client.

Team

Irina Damascan,
Ana Maria Petre,
George Tataru

Highlighted startup

Entrepreneurship

TILER

With TILER, charging your e-bike is as simple as parking it. The bike is inductively charged by the TILER e-Tile through their bike-agnostic e-Stand.

Convenient Charging

More than half of all journeys by car are shorter than 7.5 km. These distances could easily be covered with an e-bike. However, the inconvenience of charging e-bikes—cables, clutter, and the need to carry batteries around—often holds people back from using them. TILER is addressing this challenge by introducing a wireless charging solution for e-bikes.

Universal, Fast, and Sustainable

TILER offers a user-friendly, universal, and scalable fast charging solution suitable for indoor and outdoor use. The kickstand is suitable for all e-bikes, regardless the brand and battery. The tile can be laid like a normal paving tile and is connected to the regular power grid: no electricians or digging equipment required. By reducing charging costs for fleet providers by up to 80%, TILER facilitates the growth of micro-mobility and contributes to the revitalization of cities, making them more human-centric and environmentally friendly.

Milestones

TILER had a very busy year in 2023: in the summer, TILER started serial production in partnership with its contract manufacturer in Eindhoven. TILER was ranked as the best Charging solution by Micromobility World, and the milestone of installing the 100th e-Tile was reached. Besides recurring orders for rental e-bikes at hotels, TILER initiated two projects with municipalities, one of which was with the city of The Hague, with a last mile Park & Charge Hub in Binckhorst. The other project was a result of the selection for Amsterdam Circular. TILER and the municipality of Amsterdam opened the world's first e-Hub to charge both public sharing and private vehicles, both for e-bikes and e-cargobikes.

Team

Christiaan van Nispen,
Olivier Coops,
Joris Koudijs

Metropolitan Food Systems

The complexity of our current food system, in which the production of food is decoupled from its consumption, raises concerns. In Amsterdam, unhealthy food supplies and consumption dominate, and not everyone has access to affordable food.

Healthy food is more expensive, less available and accessible, and less promoted than unhealthy food. Moreover, the present food system causes the degradation of soil, air, water, and biodiversity. Both globally and on a local scale, food systems must be redesigned to meet the needs of present and future generations, while ensuring profitability, environmental health, and social and economic equity. International and national treaties to change the current food system have been signed and goals have been set. The City of Amsterdam has created a food strategy on topics such as the reduction of food waste, affordable and healthy food for everyone, and shorter supply chains.

AMS Institute supports this food strategy by researching the creation of inclusive and healthy food systems, both nationally and internationally. It initiates innovation activities to make healthy food accessible for lower income households and to make citizens aware of the ecological aspects of food, such as animal welfare, biodiversity, and circularity.

Project lead
Innogestonia Ambiental

Project duration
September 2022 - September 2027

Project partners
Wageningen University & Research,
Kislépték,
AMPED Concepts B.V.,
Campden BRI Magyarország Nonprofit Kft.,
Centre Technique de la Conservation des Produits Agricoles,
Copa Cogeca,
Devenish Research Development and Innovation Limite,
European Grants International Academy,
Fundación Entretantos,
Fundația Centrul Educațional Spektrum,
ISEKI-Food Association,
Province Flevoland,
Tsjechische Landbouwuniversiteit Praag,
UNIOT,
Universität Hohenheim,
Universiteit Gent,
University College Dublin

Project budget
€3.8M

Research & Innovation

EU4Advice

A food supply chain refers to the journey of your food from farm to fork. Shorter food chains can have economic, environmental, and social benefits. Advisers play a crucial role in realizing shorter food supply chains.

Better Value Chains

Short food supply chains (SFSC) present solutions to the pressing challenges within our current food system: they are a means for both producers and consumers to gain better positions in the value chain as well as to improve trust, transparency, food quality, and safety. The European Commission funded “EU4Advice” in an effort to strengthen SFSC across Europe. EU4Advice’s objective is to integrate SFSC advisers into national advisory systems while simultaneously creating an international network of SFSC advisers and policy makers.

Real-World Testing

Within EU4Advice, four Living Labs are established as testing grounds for the implementation and validation of SFSC advisory systems. The four Living Labs, located in Hungary, Ireland, the Netherlands, and Spain, represent a diverse cross-section of socioeconomic, political, cultural, and legal contexts.

These pilot regions serve as dynamic environments in which local food system stakeholders, including producers, advisers, and policy makers collaborate, experiment, and evaluate the practicality and effectiveness of the project materials, such as training modules and policy proposals, designed to support SFSC. The living labs facilitate real-world testing, ensuring that the project’s outcomes are tailored to the unique needs and challenges of each participating region.

Solutions to Multifaceted Challenges

The Dutch Living Lab has a distinctive position due to the strong and efficient food and agriculture sector in the Netherlands. But creating a strong Dutch SFSC system, one that can compete with the current food system, is a financial, logistics, and technological challenge. The Dutch Living Lab team recognizes the potential of this network of policy makers, farmers, academics, and retailers as an opportunity to find solutions for these multifaceted challenges.

Design Session in Almere

In the past year, the four living labs challenged SFSC opportunities in their local context, focusing on knowledge sharing (Hungary), local food production (Ireland), creation of business opportunities (Netherlands), and policy design (Spain). The discussions between local authorities and SFSC practitioners have shaped the narrative around the role of the adviser and form the basis for the educational tools for SFSC advisers being launched in the living labs this year.

Project members
Abbe Hekkert,
Helen Huang,
Maurice Bolle,
Nils Wolff,
Stijn Bruijsten

Case initiators
Peter Hoogendijk,
Groene Hub,
Willie van den Broek,
AMS Institute

Academic supervisor
PhD Candidate Anna Batallé Garcia,
TU Delft

"On our journey towards the doughnut deal, we learned how to create partnerships and connect their interests, resulting in a multi stakeholder project (revised by Kate Raworth). This showed the potential for the Marineterrein to evolve into a circular ecosystem fueled by the organic waste produced by its restaurants."

Abbe Hekkert, *MSc MADE student*

Education

Urban Biodigester

Cities have a powerful resource in the form of food waste for producing biogas. As Amsterdam aims to become climate-neutral by 2050, biogas from biodigestion plays a crucial role in the city's energy transition and circular economy. The five students in the Urban Biodigestion Living Lab delved into the potential of small-scale biodigesters in Amsterdam.

How a Biodigester Works

A biodigester is a machine in which bacteria decompose food waste. It converts as many carbon-containing substances as possible into biogas. Only a fraction remains, which contains many valuable nutrients and can, for example, be used as soil or fertilizer. This makes the process fully circular. However, implementing biodigesters in cities is challenging due to their niche status.

Huge Potential

The potential benefits of biogas are huge and touch on crucial aspects like climate change, local energy production, and food waste reduction. The City of Amsterdam currently incinerates a substantial 70,000 tons of household food waste annually, despite more cost-effective, cleaner, and sustainable alternatives like digestion and composting.

Developing Key Tools for Implementation

The five students in the Urban Biodigestion Living Lab delved into the potential of small-scale biodigesters in Amsterdam. Their research, employing a living lab approach, involved collaboration with experts to identify challenges, brainstorm solutions, and convert them into practical requirements. Three key tools emerged from this process: an implementation guide, a doughnut deal, and a GIS Tool. The first tool addresses the "how" of the biodigester implementation challenge. It serves as a roadmap that offers guidance on the step-by-step process of successfully integrating small-scale biodigesters into urban settings.

The second tool, the doughnut deal, symbolizes commitment. Six stakeholders pledged their commitment to actively work towards establishing a biodigester on the Marineterrein. The third tool is the GIS tool that pinpoints suitable locations for small-scale biodigesters in Amsterdam. This tool streamlines the planning and implementation process by identifying optimal sites, making biodigestion more feasible in urban environments.

Making It a Reality

The Urban Biodigestion Living Lab identified the potential of biodigestion and is actively working towards making it a reality in Amsterdam. The students aim to turn food waste into a valuable asset for the city's sustainability goals through practical tools and commitments.

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Dr. ir. Wei-Shan Chen,
WUR Environmental Technologies,
Dr. Arnout Sabbe,
TU Delft Environmental Technology and Design,
PhD Rusnė Šilerytė,
TU Delft Environmental Technology and Design

"I'm driven to obtain a better understanding of how to make strategic decisions in organic waste valorization. Understanding what is technically possible and what the environmental outcome of a decision might be is the beginning of assessing organic waste valorization strategies more holistically."

Yannick Schrik, *MSc MADE graduate*

Highlighted thesis

Education

Plant-Based Food Waste Valorization: Technical Matchmaking and Performance Prediction

Amsterdam is on a mission to transform itself into a fully circular city. It aims to drastically reduce carbon emissions and reliance on imported resources by 2050 and to also phase out natural gas by 2040. However, there are significant challenges for waste, particularly biomass, which currently has much untapped potential and is even leading to negative environmental impacts.

Fruit and Vegetables Are a Valuable Resource

Part of this challenge is using the potential of Plant-Based Food Waste (PBFW), mainly consisting of fruit and vegetable waste, to its fullest. PBFW in the wider Amsterdam area originate mainly from food processing industries and are thus available in large, homogeneously composed quantities. PBFW contains beneficial bioactive compounds, making it an untapped asset for bio-based applications like energy or feed production. The student that wrote this thesis set the objective of understanding what is needed to match PBFW streams with processing technologies and harness the potential of PBFW as a resource for the circular economy.

Practical Model to Aid in Decision Making

To achieve this goal, the author developed a practical model that uses the composition of PBFW streams to make matches with processing technologies based on their technical compatibility.

The products' yield and quality are calculated to determine their potential for reducing Global Warming Potential. This makes it easy to compare and match them with different processing technologies. The model was tested in different scenarios that matched actual PBFW streams with suitable processing technologies and compared the results with how the PBFW streams are currently processed.

A Circular Future

By providing a straightforward method to match PBFW with suitable technologies, the model empowers decision-makers to make informed choices that benefit both the environment and the economy. Moreover, by expanding and refining the model, greater potential for waste valorization and resource utilization can be unlocked, moving Amsterdam one step closer to a circular and sustainable future.

"Did you know that today in France, there are 36% more non-nutritive additives in drinks compared to 2007? We want to change that and make sure we can offer solutions to consumers that are both respectful and impactful for the body and the environment."

Marie Degoulet, *Founder of OJOA*

Entrepreneurship

OJOA

Healthy eating should be accessible, natural, and circular, according to the founders of OJOA, a group tackling the challenge of food waste in Europe by upcycling imperfect fruits and addressing the lack of healthy products in the market.

Perfect Fruit

Almost half of all cultivated plants and fruits are discarded annually because of strict aesthetic criteria. All this waste is bad for the environment and has negative economic repercussions. In Europe alone, 39 million tons of fruits and vegetables could be saved each year. Even though they are deemed "imperfect," these fruits retain their nutritional value and flavor.

Algorithmic Approach

OJOA takes a proactive stance on two crucial fronts: addressing the unnecessary disposal of fruit that falls short of market aesthetics and responding to the challenge of offering health-conscious consumers flavorful and wholesome products. OJOA's team makes a line of 100% natural products made from imperfect fruit. Their products contain no additives and retain the nutritional benefits and vitamins of the fruit. OJOA's innovative approach encourages individuals to embrace healthier choices that benefit both personal well-being and the environment.

Vision and Visibility

OJOA discovered the AMS Startup Booster program while looking for a place to continue their product tests and development. The program helped OJOA to go back to the foundations of their project, making them stronger and more aligned with their vision. In 2023, OJOA's main goal was to reinforce the visibility of the project and generate increasing traction to demonstrate this growing market opportunity in Europe.

Team

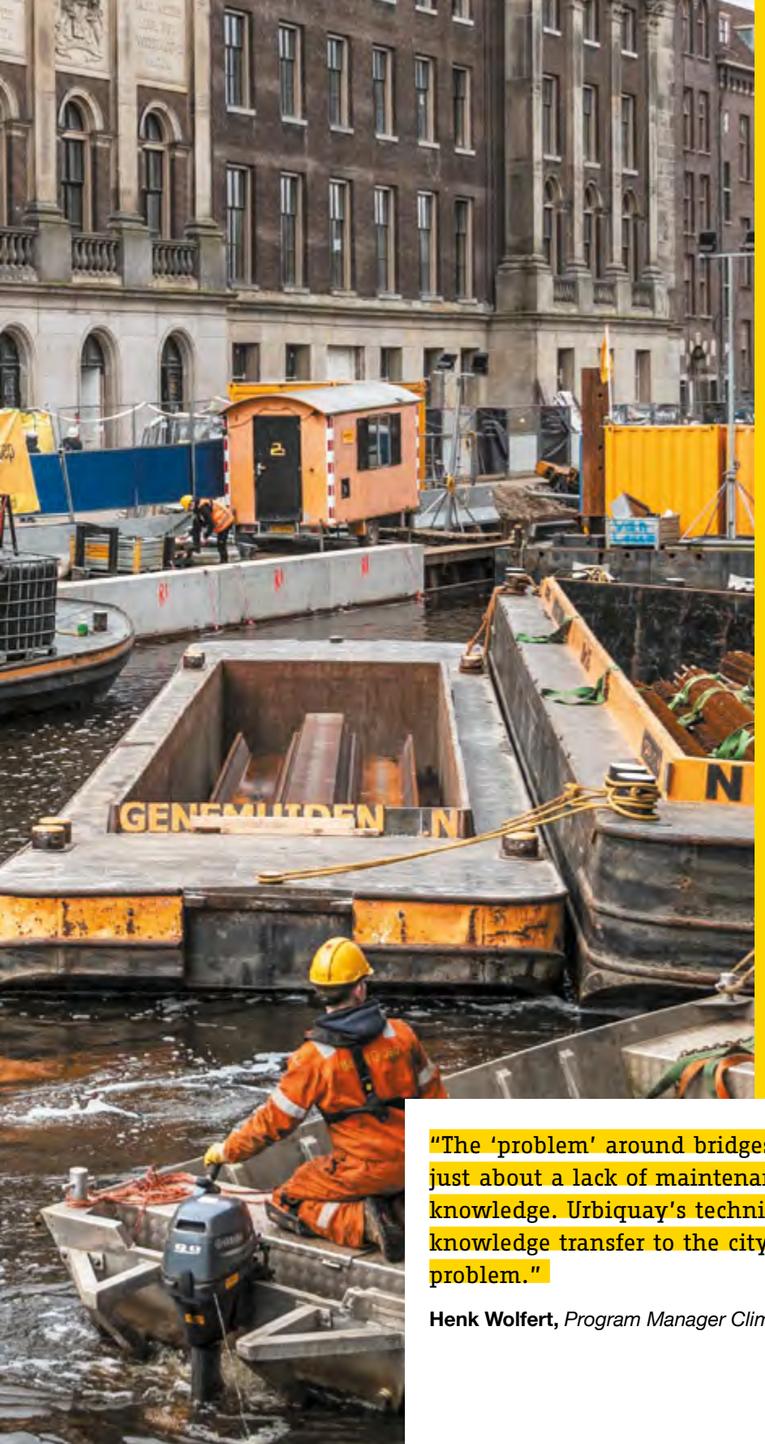
Marie Degoulet

Climate-Resilient Cities

Higher temperatures, rising sea levels, heavier rainfall and storms, drought, and other consequences of climate change all present challenges to the quality of city life. Moreover, due to increasing urbanization, the number of people having to deal with these consequences is also growing.

As a result, cities across the globe need to prepare for the impact of climate change on urban life. The City of Amsterdam is aware of this and is committed to becoming as climate-proof as possible by 2050. The municipal council wants to make the most of the next few years to achieve the climate targets in time. To that end, the council has compiled current and new plans for creating a healthy, green, and climate resilient city in an action plan called *Our City of Tomorrow*.

AMS Institute's Climate Resilient Cities program researches the functioning, adaptation, and resilience of the city in times of climate change, and aims to support the City of Amsterdam with knowledge to achieve its goals. The program focuses on climate adaptation as well as climate resilience. AMS Institute aims to create effective solutions and assess interventions such as greening, sustainable (re)design, and maintenance of the city's infrastructure.



Program lead
NWO

Program duration
June 2022 - October 2026

Program partners
Municipality of Amsterdam,
TU Delft,
University of Twente,
Ministry of Infrastructure and
Water Management

Program budget
€4.3M

"The 'problem' around bridges and quay walls isn't just about a lack of maintenance, but also a lack of knowledge. Urbiquay's technical and value-based knowledge transfer to the city is essential to solving this problem."

Henk Wolfert, *Program Manager Climate Resilient Cities, AMS Institute*

Highlighted project

Research & Innovation

Urbiquay

Many Dutch cities are experiencing increasing pressure on urban bridges and quay walls. Urbiquay contributes to innovations relevant to the maintenance, repair, and renewal of this infrastructure.

Increasing Pressure

In Amsterdam, many bridges and several kilometers of quay walls are vulnerable and in poor condition. This problem extends beyond Amsterdam though. Other municipalities also need help with the increasing pressure on their infrastructure, which is sometimes hundreds of years old and not designed for the amount and weight of today's traffic and transport. Due to this growing number of vehicles and people, it is increasingly important to ensure that the bridges and quay walls remain safe and reliable. Moreover, this provides an immediate opportunity to align with transitions in climate adaptation, circularity, energy, and transport.

Innovative Solutions

The program "Urban Bridge and Quay Wall Innovations," abbreviated to Urbiquay, focuses on sustainable, innovative solutions relevant to the maintenance, repair, and renewal of this civil infrastructure. The program aims 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: other locations, circumstances, problems, or other municipalities.

Knowledge Transfer

From the outset, researchers collaborate with the involved municipalities—besides Amsterdam, also Zwolle and The Hague—and with companies and other stakeholders in the city. They initially focus on the urgent tasks: securing, repairing, and renewing bridges and quay walls. However, the ambition is to arrive at sustainable, future-proof solutions and a shared public-private responsibility.

Four Research Projects

Urbiquay consists of four research projects: LiveQuay, STABILITY, Logiquay, and UBQ4. LiveQuay provides an integrated assessment of the safety and performance of bridges and quay walls in an interactive decision-support platform. STABILITY researches the required methods to maintain historic structures while reducing construction waste and emissions, preserving the cultural heritage of cities, and keeping cities accessible, attractive, and liveable. Logiquay aims to develop circular logistic methods and control solutions to accelerate the speed of renovations, increase control, and improve sustainability. The fourth project, UBQ4, was granted in 2023 and will create an overarching framework of the three other projects, taking into account public values and scaling opportunities and synthesizing overlapping topics.

Research & Innovation

Highlighted Research on Bridges and Quay Walls: A New Model That Predicts the Safety of Amsterdam's Quaysides

Many quay walls are vulnerable, but which ones should take priority? And which ones are still safe? Research by AMS Institute and TU Delft, conducted in collaboration with the City of Amsterdam, has resulted in a new model that provides insight into the construction, load, and failure of Amsterdam's quaysides. Mart-Jan Hemel defended his doctoral thesis on this topic at TU Delft on November 30, 2023.

Built on wooden piles within a basin of soft peat-clay subsoil, Amsterdam has traditionally required continuous maintenance, particularly for its quaysides. The city's 205 km of quayside structures are supported meters below the water surface by a historic wooden framework—a kind of "wooden table construction," as Mart-Jan described it. If something goes wrong with that construction, a so-called failure mechanism, the risk of collapse is imminent: "Within a few minutes, twenty meters of quayside can just disappear into the canal".

Insight into Failure Mechanism

To gain a thorough understanding of the failure mechanism of historical quaysides, Mart Jan, along with a large team of partners, executed a unique experimental program on an existing historic quay supported by wooden piles. Using sensors and applying various loads to the quaysides, Mart-Jan mapped out how the failure of pile foundations unfolds. Subsequently, he developed a computational model to precisely predict which quaysides are at risk of failure. The model is 40% more accurate than previous models at identifying quaysides at risk of failure.

"Our beautiful urban spaces present a monumental task of replacement due to aging, altered use from their original purpose, and the effects of climate change. Mart-Jan's research in this unique collaboration at AMS Institute sets entirely new standards that directly benefit practical applications. Call it literally applied science; it is a phenomenal result."

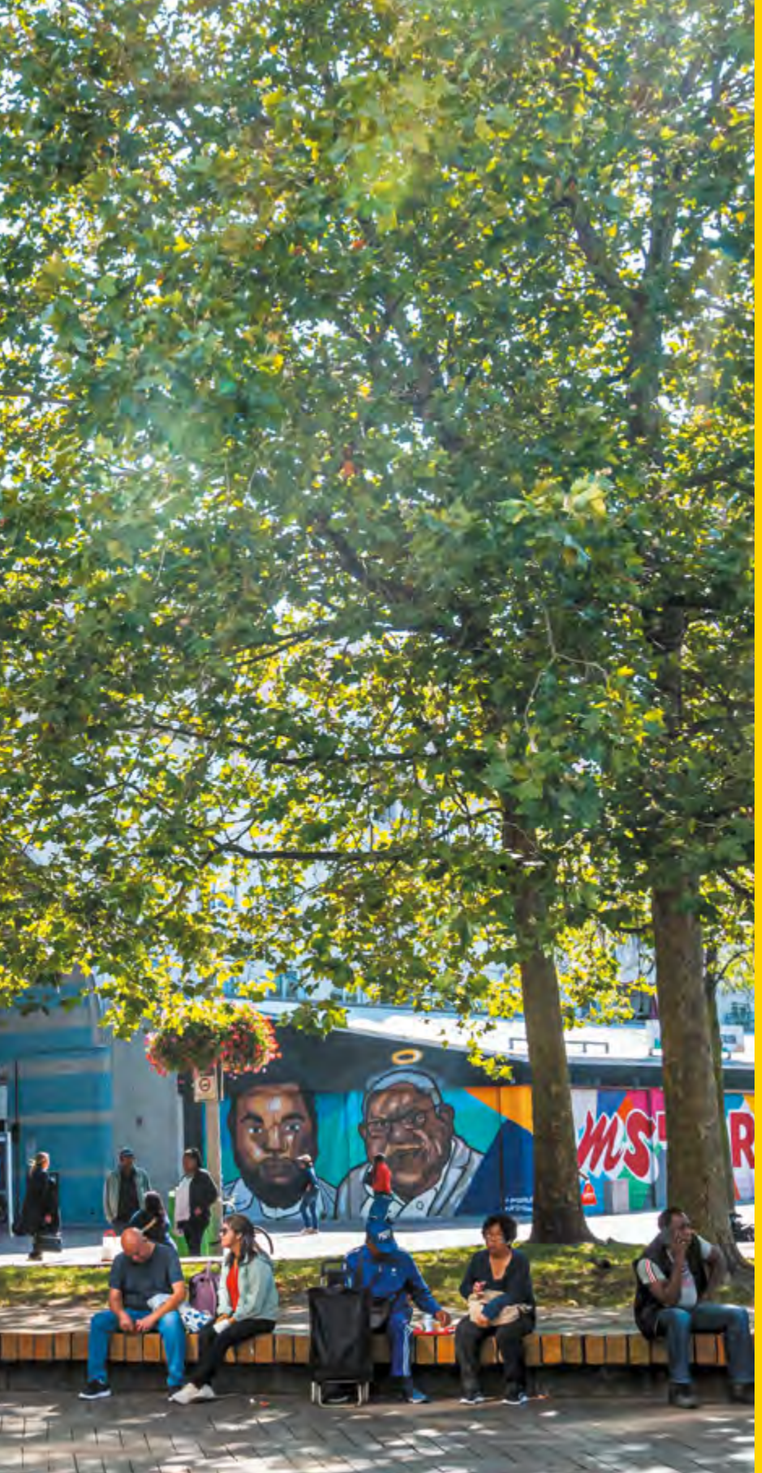
Sasha Stolp, *Director of Innovation, City of Amsterdam*

Crucial Insights for Policy

The new insights provide the city with crucial knowledge to enhance control over the safety of quaysides and support decisions regarding safe usage, remaining lifespan, and the necessity for replacement. The research is not only relevant for Amsterdam; the Netherlands has 1700 km of historical quayside. For cities like Delft and Leiden, as well as Venice (Italy) and Boston (USA), quays built on wood and their sustainability and preservation are significant points of concern.

AMS Institute's Comprehensive Collaboration Crucial for Research Results

The research results stem from a close collaboration between academia and urban practice, with a clear focus on developing practical solutions for societal issues. Mart-Jan: "In the face of such complex challenges, conventional methodologies and monodisciplinary analyses fall short. For me, AMS Institute is the perfect infrastructure where diverse stakeholders from the realms of knowledge, industry, and government come together to tackle significant technical challenges in the city, driven by impact. In our case, this included various engineering firms, the municipality, and researchers from TU Delft".



Project lead
Wageningen University & Research

Project duration
February 2019 - December 2023

Project partners
Municipality of Amsterdam,
Municipality of The Hague,
Municipality of Meppel,
Municipality of Haarlem,
Municipality of Wageningen,
Oogstfonds,
Vereniging Stadswerk Nederland,
Hogeschool van Amsterdam,
Branchevereniging VHG,
De Groene Stad,
Hogeschool Van Hall Larenstein,
Aeres University of Applied Sciences,
Floriade 2022 BV,
Royal Flora Holland,
Koninklijke Vereniging van
Hoveniers en Groenvoorzieners,
Van den Berk boomkwekerijen,
Boomkwekerijen
M. van den Oever & Zonen,
Boot & Dart Boomkwekerijen,
Boomkwekerij Ebben,
Boomkwekerij Udenhout,
Royal Anthos

Project budget
€762K

Highlighted project

Research & Innovation

Effective Green for Climate Adaptation in the City

Plants, trees, and other greenery are vital instruments for climate adaptation. The need for scientific knowledge about this function of green is also growing. “Effective Green for Climate Adaptation in the City” provides this knowledge and tailors it so that it can be applied in practice.

Benefits of Greenery

Climate adaptation is one of the major challenges for urban areas in the Netherlands. Greening public space in combination with urban redevelopment is one of the most promising measures for climate adaptation, especially for lowering temperature during heat waves. Planting trees and landscaping also have other benefits, such as increased health and well-being, biodiversity, air quality, water management, and recreational opportunities. But what does effective climate greening in urban areas look like, and how do you realize it?

Interrelated Lines of Research

A consortium of researchers, professionals from the green sector, designers, landscape architects, and managers of urban green space are simultaneously pursuing three interrelated and mutually influencing lines of research into green urban areas. Firstly, a science-based database of urban tree species will be generated indicating known benefits of the various urban tree species. Secondly, the impact of various species will be quantified more precisely by means of *in situ* measurements of temperature reduction and 3D modeling of urban settings with ENVIMET software. Finally, optimum designs of public green in various types of common Dutch neighborhoods will be generated and visualized.

Practice-Oriented Guidelines

The results of the project consist of a set of practice-oriented guidelines and criteria for the construction and design of green elements for the purpose of climate adaptation in the city on the one hand, and on the other, a set of general example types (templates) for climate adaptation (temperature and water management) in a number of standard situations in the city. In addition to climate aspects, attention will also be paid to other benefits of green space, such as support for biodiversity and improving air quality.

Effective Measures

In 2023, the project team did an analysis in the Niersstraat in Amsterdam. The Niersstraat is a typical example of an urban building block type of neighborhood. The ENVIMET analysis showed that the cooling capacity of the present trees is limited. The situation can be improved substantially with new street layouts involving features such as pergolas, permeable pavement, green wadis or—most beneficially—a central, public, green coolspot.

Project members
Daphne Palza Aleman,
Mike Cleintuar,
Thomas van der Deijl,
Yun-Ching Wu,
Yulin Yang

Case initiators
Frits Ruyten, Ruyteninstituut,
Girish Vaidya, AMS Institute,
Lukas Beuster, AMS Institute,
Juanita Devi, AMS Institute

Academic supervisor
dr. Juliane Fry, WUR

"Happy Tree Sensor is a project including aspects of design, technology, and plant physiology. Such a combination was encouraged by the living lab method, which emphasizes the interdisciplinary perspective of a challenge and the extension of stakeholder engagement in a practical context. During the process, technical support given by AMS Institute and MIT Sensable Lab greatly facilitated our success in making our physical product."

Yulin Yang, *MSc MADE student*

Education

Happy Tree Sensor

In the era of climate change, trees are crucial in urban areas for their adaptive benefits. Yet, their well-being is often overlooked. In this Living Lab, students explored ways to raise awareness about and enhance appreciation for trees' vital role.

Vital Role for Urban Living

Trees play a vital role in urban areas. They host over 100 bird species, offer shade, reduce temperatures by up to 3°C, and contribute to water retention while absorbing pollutants, purifying approximately 1,000 tons of air pollution annually. Beyond their ecological role, trees shape the city's identity by providing comfort, pleasing aesthetics, and biodiversity support. As cities evolve, the role of trees becomes integral to mitigating environmental issues and enhancing the quality of life. However, the public often overlooks the well-being of these trees.

Enhancing Awareness

Building on results from a Living Lab course in 2022, the five students in this Living Lab worked on a "Happy Tree Sensor" to retain trees' benefits by enhancing public awareness and engagement. To achieve this, they developed methods to measure tree happiness using sensors and communicated the data to the public.

How Is Elm Tree Andrew Feeling?

The Happy Tree Sensor the students developed is an innovative device that combines sensor technology, physical interaction elements, and a dashboard to provide insights into a tree's well-being. Focusing on "Andrew," a longstanding elm at the Marineterrein, the students equipped the tree with their sensor, measuring variables such as soil moisture, soil temperature, and sway, similar to the way humans monitor their health with smartwatches. The dashboard personifies the tree by featuring a happiness score and detailing its current state. The design includes information about the tree's history, its network with fellow trees, and visual representations of its condition over time.

Next Steps

To expand beyond the pilot with Andrew, the team shared designs and code on GitHub and Thingiverse. Offering the sensing system as a purchasable or rentable product could serve as a catalyst for raising awareness within neighborhoods and organizations. Green Mile Foundation's interest in a pilot program highlights scalability and establishing a network of Happy Trees.

Urban Energy

Right now, most of Amsterdam's supplied energy is still fossil-based and produced outside the city limits. The City aims for 80% of the energy used by households to come from solar and wind energy by 2030, and to be a natural gas-free city by 2040. This requires a major transformation of the current energy system.

Amsterdam's municipal government already promotes the production and use of renewable energy. For example by connecting homes to heating networks, and by using more solar and wind power. Furthermore, citizens can apply for low-cost loans and can get free energy advice. The City has adopted the *Heat Transition Vision*, which sets out the main steps for becoming a natural gas-free city.

The main focus of the Urban Energy program at AMS Institute is designing and deploying smart, sustainable, and reliable energy systems that contribute to accelerating the energy transition. Projects focus on designing systems that can meet demand for electricity, heating, and mobility in the AMA. The designed 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 acceprance for and behavior towards novel energy solutions.

"The interdisciplinary nature of our consortium has been pivotal in addressing the multifaceted challenges of the energy transition. I'm very happy that AMS Institute is a project partner: knowledge dissemination and valorization are essential in our collaborative efforts towards a more sustainable future."

Dr. Sanchayan Banerjee, ALIGN4energy Project Leader, Vrije Universiteit Amsterdam

Project lead
Vrije Universiteit Amsterdam

Project duration
November 2022 - November 2026

Project partners
Municipality of Haarlemmermeer,
Building Blocks Energy,
The Earlybirds,
Ministry of the Interior and Kingdom Relations,
Municipality of The Hague,
Rabobank,
Waternet,
Woonbond,
Municipality of Rotterdam,
Het Groene Brein,
Municipality of Eindhoven,
Stichting VvE Belang,
75INQ,
Alliander,
Coöperatie Deelstroom Delft,
Centrum Wiskunde & Informatica,
Eindhoven University of Technology,
Erasmus University Rotterdam,
Planbureau voor de Leefomgeving,
TNO,
TU Delft

Project budget
€5.7M

Highlighted project

Research & Innovation

ALIGN4energy

Working towards a climate-neutral country in 2050 requires making energy use in homes more sustainable and ending dependence on natural gas. The interdisciplinary ALIGN4energy consortium is helping to accelerate this energy transition in the Dutch residential sector.

Aligning Solutions

The current pace of energy-efficient renovation is far too slow. Individuals, groups of citizens, associations of owners, and housing corporations only make limited investment decisions due to a lack of information, knowledge, coordination, and/or funds. For policymakers, the large-scale decarbonization of the residential sector is a complex process that is challenging to steer. The multidisciplinary ALIGN4energy consortium is working on solutions that align these citizens, policymakers, and energy system developers so that the necessary transition can be made.

The SAMEN Modules

This project uses a bottom-up, data-driven strategy to align and integrate research on human systems (e.g., individual and group decisions and social dynamics) with energy system modeling. This allows for the simultaneous optimization of investments in clean energy at the individual, collective, and energy system level. The resulting digital decision-support tools are known as SAMEN modules (System-optimized, AI-driven Maximization of Clean Energy Investments) and will provide tailored information about sustainable energy measures. Subsequent policy measures can be aligned with citizens' preferences and societal needs.

Two Training Events

AMS Institute is leading the integration of the different elements of research. In this context, the AMS Academy organized an ALIGN4energy Spring School in March of 2023. During this week, 12 PhD and post-doc researchers had the opportunity to collaborate, co-create, and design integral research activities for the project's first year.

AMS Institute is also responsible for knowledge dissemination in the project and aims for early disclosure of new insights to practitioners. Therefore, in November of this year, the ALIGN4energy team and the AMS Academy hosted a training event focused on citizen engagement strategies for the energy transition in the built environment.

Project lead
Sonnenplatz Großschönau GmbH

Project duration
January 2023 - December 2024

Project partners
TU Delft,
City of Settimo Torinese,
PV Works B.V.,
Denkstatt Romania,
City of Reșița,
University of Applied Sciences
Technikum Wien

Project budget
€1.2M

Highlighted project

Research & Innovation

Simply Positive

Reduction of energy and CO_2 is only possible if all organizations, including local authorities, step up their climate action. Simply Positive aims to support innovative and ambitious cities and municipalities to become Positive Energy Districts.

Urban Potential

Around 80% of European citizens live in an urban environment. This means that most of the energy that is needed is used in cities and towns. Therefore, cities are the best positioned to improve energy conservation, use energy more efficiently, and use renewable energy sources as clean, sustainable solutions. Simply Positive aims to support the development of Positive Energy Districts (or PEDs, urban areas and neighborhoods that are supplied clean heat and electricity) and promote the transition to creating climate neutral cities across Europe.

Four Testing Sites

The project focuses on four key areas: maximizing the use of solar energy through traditional solar PV panels or PVT panels (panels that generate both electrical and thermal energy and which have the potential to effectively provide heat for the built environment), integrating electric vehicles in mobility and as energy storage, improving energy usage patterns, and developing common climate and energy action plans. The project involves testing these strategies in four districts—including Amsterdam—in various European countries to demonstrate how urban areas can effectively undergo an energy transition. A crucial aspect of the project is the establishment of a common framework for defining PEDs in existing urban areas. This includes ensuring active stakeholder participation to motivate cities to adopt similar approaches.

PV Potential

In Amsterdam, the project will mainly focus on the optimum usage of rooftops for solar energy, creating a detailed multi-layer map to analyze PV(T) potential across the city. Research will consider various factors such as rooftop usage and will develop a prioritization strategy for installing PV systems that takes into account economic, energetic, architectural, and governance factors.

From Insights to Practice

In 2023, TU Delft researchers developed new models to simulate the performance of solar thermal panels for Amsterdam, integrally connected to AMS Institute's expertise on making the built environment natural gas free. Additionally, to make sure new insights can be used in practice, AMS Institute surveyed the functional requirements of such models for municipalities, such as data visual formats and analysis, information formats and key areas of interest for future research.

Project members
Hidde Zweekhorst,
Jacob Zakrzewicz,
Judith Nijman,
Sem Apon,
Thanaphat Sangkharom

Case initiator
Elsemieke Koole,
Department of Traffic and Public Space, Team Light, City of Amsterdam

Academic supervisor
Juliana Gonçalves,
Department of Urbanism, TU Delft

"A lot of public lighting is currently not adapted to human needs, but to car traffic. At home, we make our lighting cozy and atmospheric, so why wouldn't we also do that outside?"

Sem Apon, *MSc MADE graduate*

Education

Re-Thinking Public Lighting

Public lighting, including streetlights, is crucial for visibility, safety, and beautifying public spaces. However, the unintended consequences of excessive artificial lighting (or light pollution) are often underestimated. It impacts our view of stars, poses risks to human health, disrupts ecosystems, increases energy consumption, and challenges our sense of safety.

Minimizing Harmful Effects of Lighting

Light pollution is a global concern and has increased in the last 10 years as we started to implement LED lighting. The adverse effects of light pollution demand attention. Therefore, in the Living Lab case "Re-Thinking Public Lighting," five students aimed to create an inclusive lighting solution that minimizes harmful effects by considering diverse urban stakeholder perspectives with the intention of reshaping the approach to public lighting.

Phenomenology-Based Approach

Through co-creation methods, the students engaged with various stakeholders to develop an inclusive lighting solution from a phenomenology-based approach, focusing on how people experience public space. To find answers, they, for example, did a night walk in Amsterdam Zuid where the students dimmed the public lighting in two streets (as much as 67% lower than usual) and asked residents if they still felt comfortable and safe. The most important finding from the research is that the time of night turned out to be the most important indicator for what people need from lighting in public space. For example, in the evening people value ambience more, while at night people have a very functional requirement from public lighting: surveillance and wayfinding.

Too Bright?

The research resulted in a decision tree designed to guide the City of Amsterdam in making informed decisions about public light brightness levels. This shifts the focus from a car-centric, wayfinding approach to a more socially conscious perspective.

Striking a Balance

The project's aim was not just to provide illumination but to do so in a way that respects the environment, human well-being, and safety. By acknowledging the diverse needs of urban stakeholders, the students propose a solution that balances functionality with the reduction of light pollution.

> “Through the program we managed to lay the groundwork for a subsidy application, which is now enabling us to complete our product development towards market introduction, deploy a circular product passport, and deploy a demonstrator at the Marineterrein Living Lab.”
>
> **Siemen Brinksma,** co-founder of Biosphere Solar

Entrepreneurship

Biosphere Solar

Current solar panels are hard to repair and recycle. Biosphere Solar is a sustainable startup that works on developing a fair, modular, and circular solar panel that can be repaired and recycled.

Impossible Repair and Recycling

Although solar energy is very sustainable, the use of solar panels and their inability to be repaired or recycled creates a massive waste stream. This is mainly because of the use of a specific kind of glue called EVA laminate that makes it very difficult to take apart solar panels. Replacing individual parts of the panel is therefore almost impossible. The glue also makes the recycling of materials very hard.

Towards Fair and Circular Solar

Biosphere Solar has created a solar panel that is free of EVA laminate. This enables repairs and recycling and reduces degradation over time. The design is similar to insulating glass, where all components can be separated without contamination for high-value recycling. Moreover, components are transparently sourced from sustainable suppliers and can be upgraded with new technology. The hardware that Biosphere Solar develops is open source, enabling standardization and collaboration to make fair and circular solar a reality.

Potential as a Research Partner

Biosphere Solar took huge steps in 2023. At first, due to being an early stage, steward-owned, and open-source company, not many investors saw the revenue potential. As of 2023, that picture has changed entirely, and Biosphere Solar has secured three major approved subsidies and the Municipality of The Hague as a launching customer. The team has shifted their strategy with the ambition to become a nimble research party, leaving the large production to the established industry. However, finding those industrial partners is still proving to be difficult, especially since the market is still largely undefined. The team is now looking for an extra engineer and a designer, with whom they will hopefully be able to go to market before the end of 2024.

Team

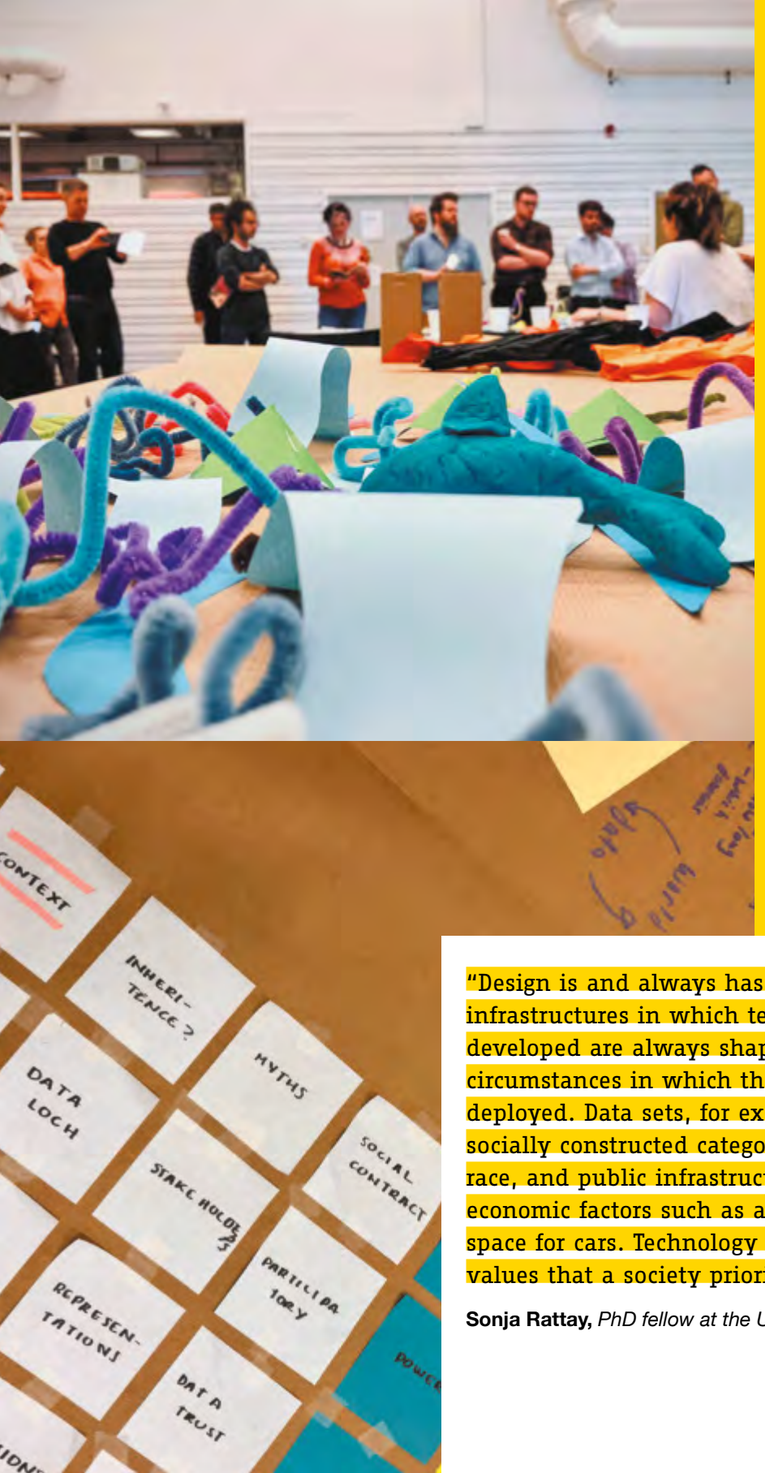
Perine Fleury,
Tim Kaasjager,
Siemen Brinksma

Responsible Urban Digitalization

New digital tools and technologies can help solve Amsterdam's most pressing urban challenges: tech can improve the quality of life in the city and enhance sustainability, livability, and citizen engagement and empowerment. At the same time, societal concerns about the impacts of digitalization on governments and infrastructures are increasing.

In 2023, the City of Amsterdam published the second *Digital City Agenda*, which describes urban challenges and opportunities to reinforce existing objectives through the use of digitialization. Amsterdam works with national and international partners such as research institutions, organizations committed to digital rights, other cities and governments, and its citizens in order to safeguard digital rights.

The Responsible Urban Digitalization program at AMS Institute aims to develop smart digital tools and technologies to improve the quality of life in the city and to help solve urban challenges. Simultaneously, the program researches the central values of society and citizens on topics surrounding these new tools and technologies, such as autonomy, privacy, transparency, inclusiveness, and empowerment.



Project lead
TU Delft

Project duration
February 2021 – February 2025

Project partners
Advanced Care Research Centre,
Centrum Cyfrowe,
ClearBox AI Solutions,
myTomorrows,
Philips,
Riga Technical University,
RISE Interactive,
Umeå University,
University of Copenhagen,
University of Edinburgh

Project budget
€4.2M

"Design is and always has been political. The infrastructures in which technology is being developed are always shaped by the sociopolitical circumstances in which the technology will be deployed. Data sets, for example, are shaped by socially constructed categories such as gender and race, and public infrastructure is shaped by socio-economic factors such as access to public transport or space for cars. Technology is always a mirror of the values that a society prioritizes."

Sonja Rattay, *PhD fellow at the University of Copenhagen*

Highlighted project

Research & Innovation

DCODE

A fundamentally new kind of design competence is needed to anticipate the digital transformation of society and to create the conditions for responsible and sustainable futures. DCODE will train researchers and designers to guide this transformation.

Beneficial Interactions with Autonomous Technologies

We are living in the middle of a digital transformation. Yet, a lot of design practices are stuck in the past and struggle to integrate both human values and algorithmic logics into socially, economically, and politically sustainable models. We lack the knowledge, skills, and roles within companies and organizations to design for interaction with autonomous technologies in ways that are beneficial to humankind.

Human-Centric Design

DCODE therefore aims to train researchers and designers to guide society's digital transformation towards inclusive, sustainable futures, cutting across industries and sectors. The project will train 15 PhD students from various disciplines, equipping them with the holistic understanding that is needed for human-centric design of product service systems powered by Big Data, Machine Learning, and Artificial Intelligence.

Prototeams

The project includes five interdisciplinary key research challenges that enable responsible digital transformation, while keeping in mind sustainability, mobility, and healthcare. DCODE also introduces a post-disciplinary mode of working called "prototeams," which fosters interdisciplinary understanding and helps develop future professional design roles and practices.

Collaboration and New Foundations

DCODE brings together an exceptional team of internationally leading researchers and non-academic partners. The goal is to create new foundations for design and equip researchers with the skills and knowledge necessary for shaping responsible and sustainable digital futures, ultimately facilitating inclusive and anticipatory digital transformation.

Though AMS Institute, PhD fellow Sonja joined the project in 2023. She is conducting research inclusion of ethics in the development of technological solutions, collaborating with researchers at AMS Institute.

Project lead
AMS Institute

Project duration
April 2019 – December 2024

Project partner
Municipality of Amsterdam

Project budget
€2.3M

Highlighted project

Research & Innovation

Responsible Sensing Lab

Smart sensors can be found all throughout cities. As their numbers and functions multiply, there is also a risk that citizens will begin to feel increasingly uncomfortable with their presence. The Responsible Sensing Lab aims to produce guidelines to ensure that democratic values are built in at the design stage.

Good Intentions

Amsterdam has hundreds of sensors in place—cameras, air quality monitors, and beacons for mobile app signals. These “smart” sensors take input from the physical environment and process it, to then perform pre-defined functions. They aim to make the city safer, more efficient, and sustainable. But they also have unwanted effects, such as feelings of privacy being invaded and a loss of control. Even as the number and functions of smart sensors increase, the acceptance of these technologies by the public cannot be taken for granted. Wouldn’t it be better if social values such as privacy and inclusivity were already taken into consideration when developing new sensors?

Connecting the Experts

This project aims to produce guidelines for developers of smart sensors, so that societal values are built in at the design stage. Responsible Sensing Lab (RSL) brings together designers, hardware and software engineers, policy makers, and psychologists to apply their expertise to the challenge of re-imagining sensors with societal values at the forefront. A Responsible Sensing Toolkit was developed by combining the city’s TADA values—a manifesto of six shared values for a responsible digital city—with value-sensitive design principles.

Socially Responsible Urban Technology

With the Toolkit in place, municipalities and organizations can follow its guidelines so that they implement public sensors responsibly. The Toolkit is also being used as a reference for new projects involving the design, prototyping, and testing of digital sensors.

From Theory to Practice

2023 was a busy year for RSL. The consortium developed a standard for the communication on the use of sensors in public space. An iconography was made and tested with citizens in various places in the Netherlands. Next, RSL finalized the work with the ESDIT (Ethics of Socially Disruptive Technologies) consortium on the relationship between the drivers of experienced autonomy and the acceptance of navigational aids that intelligently steer their behavior based on public values. Lastly, RSL started the formation of a national consortium to tackle the increasingly problematic issue of Smart doorbells in highly urban areas.

Highlighted thesis

Education

Creating Sustainable Value in the Dutch Food and Beverage Retail Sector with Internet of Things

The retail sector has always been important for the functioning of cities, interpersonal interactions, and quality of life. Due to digital advancements, the retail landscape has undergone significant shifts that present both opportunities and disruptions to retailers. How capable are these digital advancements at improving sustainability in retail?

Digitalization to Boost Sustainable Value Creation

This study explores how the Internet of Things (IoT) fosters sustainable value creation in the Food and Beverages (F&B) retail sector and presents a framework for analyzing its impact. Through qualitative sampling, interviews with major retail stores in the Netherlands revealed 12 best practices across waste, stock, asset, delivery, and transparency management, each accompanied by real-world examples. These findings, combined with literature review results, culminated in a comprehensive analysis framework comprising IoT, barriers and drivers, sustainable business models, and sustainable value creation.

Potential for Positive Impact

The qualitative research suggests IoT systems could positively impact Dutch F&B retail by serving lower-income customers and streamlining waste treatment. These actions lead to cost savings, emissions reduction, and optimized inventories. Moreover, energy usage, overtime, and maintenance costs can be minimized through efficient scheduling. These initiatives also enhance consumers' awareness of sustainability.

Practical Tool

The findings provide practical insights for retailers to enhance sustainable value creation and support future IoT implementations. The presented framework serves as a practical tool to identify and analyze opportunities for enhancing sustainability in retail. Future research should focus on developing user-friendly guidelines for managers to implement IoT technologies and sustainable practices effectively. As IoT adoption becomes widespread in retail, collaborative and data-driven initiatives are expected to proliferate, promising further advancements across the retail value chain.

Thesis author

Rianne Fleur Oudekerken

Academic supervisors

dr. Lisa Ploum, WUR

dr. Cor Verdouw, WUR

"We are actively engaging with stakeholders in the maritime industry, municipalities, and government to test our hardware, creating a pathway for economically feasible water cleanups."

Rawan Khater, *co-founder of NAUTI*

Highlighted startup

Entrepreneurship

NAUTI

Our waterbodies are in danger. They are polluted by multiple streams of contamination such as chemicals, waste, and agricultural runoff. Nauti has developed a device that combats biological pollution in waterbodies by measuring, dosing, and ejecting biological remedies.

A Healthy Water Ecosystem

Nauti specializes in developing innovative, sustainable solutions to create a healthy water ecosystem. They have created a bio-remediating device that cleans water bodies by breaking down pollutants into non-toxic substances, making use of biological remedies that are less harmful to aquatic ecosystems than existing methods. Continuous monitoring of water contamination allows the device to detect pollution hotspots within urbanized areas.

Piloting in Dutch Waters

Nauti joined the Start-Up Booster Program in October of 2023, seeking to accelerate growth and expand their network within the sustainable technology sector by realizing a pilot with renowned partners and institutions. Since then, Nauti has reached their piloting phase and is now replicating research first performed in Latin America in Dutch waters. Nauti actively engages with stakeholders in the maritime industry, municipalities, and government bodies to test their hardware, creating a pathway for economically feasible water cleanups.

Partnerships and a Sustainable Ecosystem

Nauti have secured a pilot at the Marineterrein to test their technologies in 2024. They aim to gain deeper insight into sustainable business practices, forge strategic partnerships, and attract investment to fuel growth of their startup. Nauti also hopes to increase their visibility in the sustainable technology ecosystem by linking their technology to other impactful start-ups.

Team

Johannes Trebe,
Rawan Khater

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 2023, 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
- **G.I.J. Feunekes**
  Member, Wageningen University & Research (since May 2023)
- **D.E. van Gameren**
  Member, Delft University of Technology

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

In 2023, the Executive Board of Wageningen University & Research selected a new board member. During the board meeting of May 17, Gerda Feunekes was officially introduced as the new board member on behalf of Wageningen University & Research and joined her first board meeting. Gerda was onboarded and introduced to AMS Institute in May.

The board met five times in regular board meetings, complemented with:

- One online meeting with representatives (Rectores) from the executive boards of Wageningen University & Research and Delft University of Technology (April).
- One visit with the representatives from Wageningen University & Research and Delft University of Technology (Rectores), and the Municipality of Amsterdam (October).
- The board meeting in July was complemented with an informal conversation to discuss the alignment of financial commitments from the university. The evening ended with a dinner with Jack van der Vorst to thank him for his time as part of the board.

The meeting and visit with the representatives from Wageningen University & Research and Delft University of Technology focused on close coordination of the process of the extension of the collaborative agreement between the universities and the municipality of Amsterdam.

During the regular board meetings, the board addressed a broad range of topics, including:

- The 2022 Annual Report and the 2023 Budget and Annual Plan.
- The progress of multiple National Growth Fund proposals.
- The collaboration of AMS Institute with AHK, CODAM, and the Marineterrein.
- The Scientific Conference (planned for April 2024) and plans for 10-year celebrations of AMS Institute.
- The progress towards the privatization of Roboat.
- The PI and Research Fellow community.
- The progress towards a new collaborative agreement between Wageningen University & Research and Delft University of Technology and the Municipality of Amsterdam, including financial commitments.
- The visit of Mayor Femke Halsema and the presidents of Wageningen University & Research and Delft University of Technology in June 2023.
- The extension of the partnership with Massachusetts Institute of Technology.
- The recruitment process for the vacancy of Managing Director.
- The operational organization of AMS Institute, including a new organogram and new roles.
- Research and Valorization developments, innovation flagship projects, entrepreneurship programs, and professional education offerings.
- The joint-degree master MADE: the progress of student projects, applications for the new academic year, and preparation for the accreditation review of the master's degree (planned in 2024).
- The progress of research projects, including the approval of:
  - XCARCITY,
  - Biobased cementrecycling,
  - Circular Urban Food Production,
  - Multicare,
  - Protein Monitoring, and
  - Ideal(s) City: Integrale monitor.

In 2023, the overall Research & Innovation portfolio reached a total of 34 projects valued at a total of €23.6M.

"I'm very happy to have joined the AMS board this year. Being a part of this board allows me to contribute to the important development of solutions for sustainable, smart and inclusive cities."

Gerda Feunekes, *Member of the Board from Wageningen University & Research*

References

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An overview of almost 550 different indicators of the Ideals City Project
Image by Caspar Egas

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Eveline van Leeuwen speaking during the opening of the academic year
Photo by Maarten Nauw

Page 4 bottom
Stephan van Dijk speaking during a PI event
Photo by Iris Duvekot

Page 7 top
Kenneth Heijns during a Directors Team meeting
Photo by Alex Schröder

Page 7 bottom
All three directors during a Directors Team meeting
Photo by Alex Schröder

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AMS Institute office at the Marineterrein in Amsterdam
Photo by Alex Schröder

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AMS Institute office and logo
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Research Fellow meeting
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Students during the opening of the academic year
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MSc MADE students on their study trip to Istanbul
Photo by Pearl Yeh

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MSc MADE students at work
Photo by Alex Schröder

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Participants of a knowledge module hosted by the AMS Academy
Photo by Rajaa Bennaoui

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A pitch by one of the AMS Startup Booster participants
Photo by Maarten Nauw

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One of the Startup Booster winners
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AMS Startup Booster event
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Program Developers during a meeting at AMS Institute
Photo by Iris Duvekot

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People crossing a busy street
Photo by Alex Schröder

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Researchers at AMS Institute
Photo by Alex Schröder

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Panelists during the opening of the academic year
Photo by Maarten Nauw

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Sjoukje Heimovaara, Femke Halsema and Tim van der Hagen signing the letter of intent
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Group photo during the visit of mayor Femke Halsema
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Group photo during the visit of mayor Femke Halsema
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Getting people ready for workshops during Innofestival
Photo by Sophieke van Beek

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A workshop during Innofestival
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A brick stacking machine, part of one of the Living Labs for the Future Proof Assets program
Photo by Alex Schröder

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Students of the ROC Weekend College Zuidoost during the Weekend of Science on the Marineterrein
Photo by Juanita Devis

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One of the participants of our 3D printing workshop during the Weekend of Science
Photo by Sophieke van Beek

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Directors of Codam, AHK, and AMS Institute signing the letter of intent of the Open Knowledge coalition
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People walking on the Zuidas
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Work on a wooden, modular building
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Servers in a datacenter
Photo by Taylor Vick via Unsplash

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A modular building
Photo by Joke Dufourmont

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Jonas van der Ham with different kinds of insulation materials
Photo by Alex Schröder

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Jonas van der Ham with different kinds of insulation materials
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A lamp by Noord See Lights
Photo by the Noord See Lights team

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A farmer jumping over a fence
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The Urban Biodigester Team
Photo provided by the Biodigester team

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The Biotransformer50, the biodigester that the students worked with
Photo by Circ Energy

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Photo provided by Mart-Jan Hemel

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Photo by Alex Schröder

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Photo provided by the Happy Tree team

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Photo provided by the Happy Tree team

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Photo by Tom Feenstra

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Photo by Alex Schröder

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Citizens in a neighborhood with solar panels
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A solar farm
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Research on the perception of public lighting
Photo provided by the Re-Thinking Public Lighting team

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Field research on the perception of public lighting
Photo provided by the Re-Thinking Public Lighting team

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The Biosphere Solar team at work on their modular solar panels
Photo provided by the Biosphere Solar team

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The Biosphere Solar team at work on their modular solar panels
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A drone with cameras near Amsterdam Central Station
Photo by Alex Schröder

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A DCODE workshop
Photo provided by Fabian Geiser

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A DCODE workshop
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A panel during the Responsible Sensing Lab event
Photo by Marcel Israel

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Cameras in the Amsterdam City Center
Photo by Alex Schröder

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Long lines in a Dutch supermarket
Photo by www.hollandfoto.net via Shutterstock

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Empty shelves in a Dutch supermarket
Photo by Martijn Baudoin via Unsplash

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A presentation by Nauti, winner of the AMS Startup Booster Batch 6
Photo by Maarten Nauw

Glossary

AMA
Amsterdam Metropolitan Area

AHK
Amsterdam University of the Arts

CTO
Chief Technology Office of the City of Amsterdam

MIT
Massachusetts Institute of Technology

MOOC
Massive Online Open Course

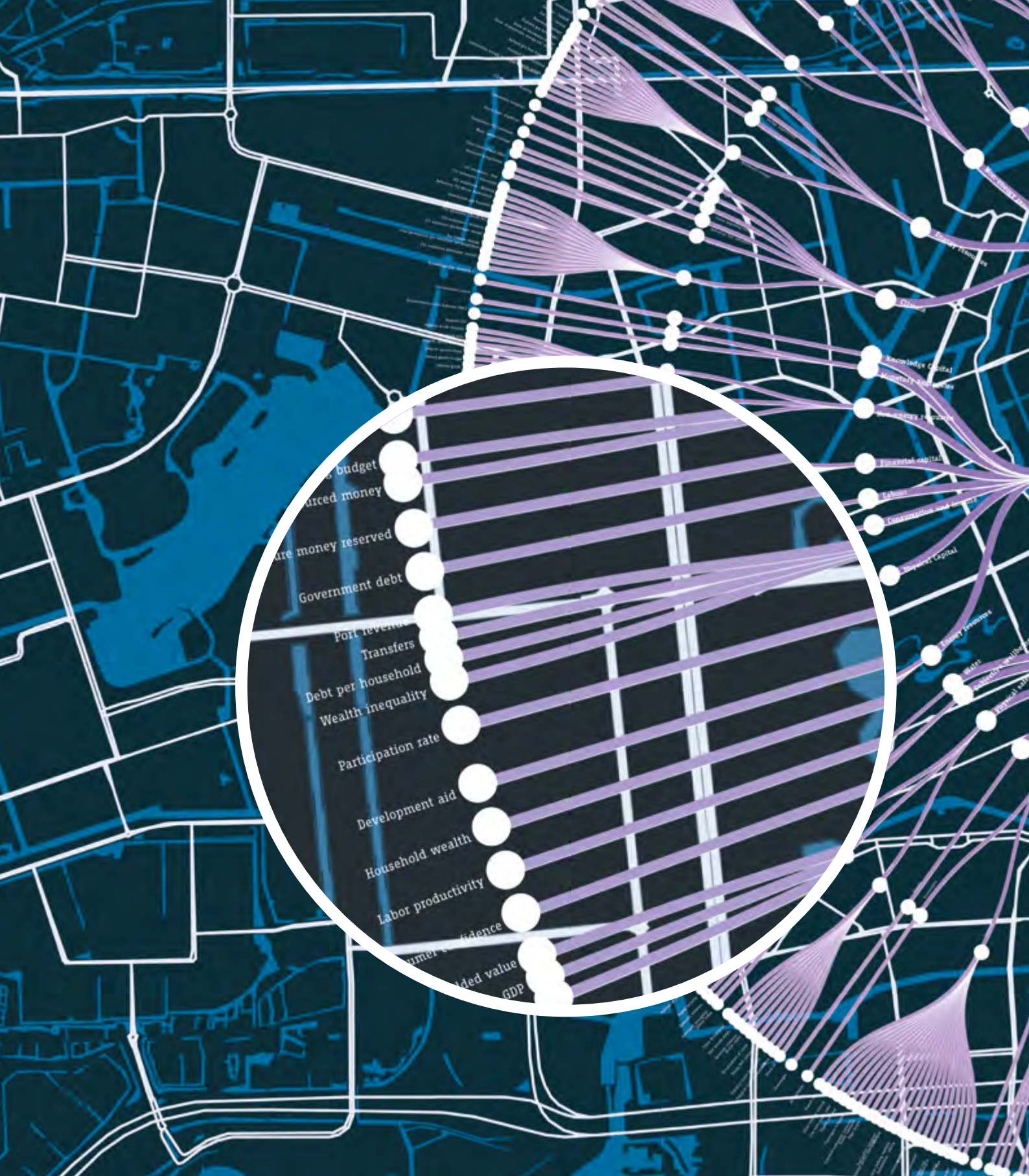
MSc MADE
Master of Science Metropolitan Analysis, Design & Engineering

PI
Principal Investigator

RSL
Responsible Sensing Lab

TU Delft
Delft University of Technology

WUR
Wageningen University & Research


budget
urced money
re money reserved
Government debt
Transfers
Debt per household
Wealth inequality
Participation rate
Development aid
Household wealth
Labor productivity
GDP