AMS

AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS

Annual Report

2020

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Contents

Reinventing the city

Like many cities worldwide, Amsterdam aims to be a sustainable, resilient and just city, for current and future generations. To achieve this ambition, AMS Institute plays a vital role in research and innovation, education and entrepreneurship. By realizing synergies between experts from various interdisciplinary backgrounds, the institute jointly creates scalable solutions to tackle the city's most pressing urban challenges.

Committed to urban innovation

Our ambition is to create sustainable metropolitan solutions by cross-fertilization of ideas: in our research, innovation and educational activities, but also by creating an innovative environment where connections are made between knowledge institutes, private and public organizations. We focus on six urban domains: mobility, energy, circularity, food, climate and responsible digitization.

Amsterdam as a 'living lab'

We use the Amsterdam Metropolitan Area (AMA) as our living lab. Living labs – a co-innovation approach that provides a setting for multiple stakeholders to jointly create, develop, and test solutions for real-life issues – are important when it comes to designing metropolitan solutions that deliver long-term impact and transformations. On various locations throughout the city, we experiment towards sustainable solutions together with users, private and public partners, as well as knowledge institutes. Why? Because solutions that are co-created by all parties involved are better and can be adopted faster – resulting in truly improved living environments.

Solutions with impact

To create impact for the city of Amsterdam, AMS Institute focuses on three main activities:

Research & Innovation: Our dedicated portfolio, that in 2020 consisted of 140 projects and programs, is developed and executed by interdisciplinary consortia of knowledge institutes and private companies, in cooperation with the City of Amsterdam and its citizen platforms.

Our Research & Innovation program is set up to achieve mission-oriented open innovation. The process to achieve this is distinguished by three different stages (each with its own set of activities):

1 Explore and mobilize;
2 Research and validate;
3 Launch and scale-up.

Education: At the heart of AMS Institute is the two-year master program Metropolitan Analysis, Design & Engineering (MSc MADE). Our program provides innovative education and delivers excellent, interdisciplinary urban engineers with the right balance between theoretical grounding and practical skills to deal with the complex challenges of cities. Just like our MSc MADE targets and attracts top students from all over the world, our innovative Massive Open Online Courses (MOOCs), summer schools and professional training activities do so too.

Collaboration & Entrepreneurship: We aim to propel innovative ideas, create impact through strategic collaborations within our network, and stimulate entrepreneurship. Plenty of opportunities for new business ideas arise from our research & valorization activities, education activities and collaborations. Moreover, our own entrepreneurship programs help boost early-stage startups that want to make an impact on city life and solve metropolitan challenges.

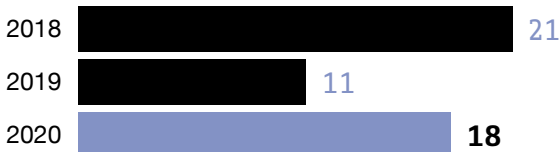### An internationally leading knowledge institute

AMS Institute was founded in 2014 by three core academic partners: **Delft University of Technology** (TU Delft), **Wageningen University & Research** (WUR) and **Massachusetts Institute of Technology** (MIT). AMS Institute is an internationally leading knowledge institute. We design solutions for urban challenges and educate tomorrow's engineers.

Key Figures 2020

Research & Innovation

Projects awarded

Year		Value
2018		21
2019		11
2020		**18**

Total value of awarded projects

Year		Value
2018		€15.9M
2019		€18.6M
2020		**€15.9M**

Accumulated research portfolio

Total number of projects **140**

- **27** Smart Urban Mobility
- **26** Circularity in Urban Regions
- **22** Responsible Urban Digitization
- **19** Metropolitan Food Systems
- **22** Climate Resilient Cities
- **24** Urban Energy
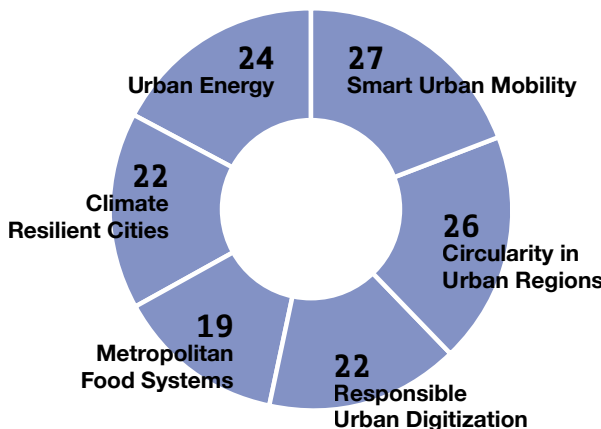
Value accumulated research portfolio

Total value project portfolio **€96.4M**

- **42.6%** Smart Urban Mobility
- **10.7%** Circularity in Urban Regions
- **10.4%** Responsible Urban Digitization
- **5.5%** Metropolitan Food Systems
- **7.5%** Climate Resilient Cities
- **23.3%** Urban Energy
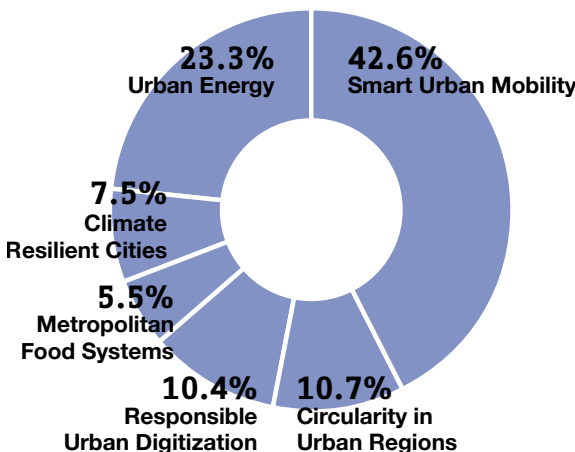
Education

61
New MSc MADE students in 2020
36 in 2019

18 MSc MADE graduates in 2020
8 in 2019

10,564
MOOC participants in 2020
11,241 in 2019

65,352
Total number of MOOC participants

Communications

		2019	2020
f	Facebook followers	2,838	3,188
	Twitter followers	3,834	4,213
in	LinkedIn followers	3,974	4,765
	Instagram followers	704	1,507
	Newsletter subscriptions	1,434	1,702

Directors Report

Due to the COVID-19 pandemic 2020 was a year with unexpected surprises and challenges. Like everyone, we had to adapt, be flexible and creative. We had to find new ways to interact, to do research, to teach, to define what really matters, for ourselves and for the city.

Distance took on a whole new meaning and the attractive high-density inner city of Amsterdam suddenly became a different place. Many activities and processes came to a stop and city life changed drastically: the city became a place where social distancing was difficult to put into practice, as our Social Distancing Monitor clearly showed. We saw a re-valuation of both inner and outer space, of green areas and public space. We even saw people leaving the city because of the changed concept of space. But the city also showed resilience with initiatives and ideas from its citizens and from the municipality. The local government wanted to make a difference by experimenting with interventions, trying to build back better, to invest in a green, just and inclusive future. As an institute we have the capability and the ambition to contribute to these questions and challenges by finding solutions. As a result, AMS Institute and the City of Amsterdam teamed up more closely than ever. We thank the municipality of Amsterdam, and especially Ger Baron and his team, for the great collaboration.

Within AMS Institute itself we also had to create new ways of working, new ways to team up. Never before has it been so vital to feel part of a team, to work jointly on the city's challenges. We are a creative and social hub to exchange ideas and experiences, with an important role for the interactions within our community. Yet we could not use the office in the 'normal' way. It was our strong sense of community that helped us to regroup, stay flexible and keep focus while working from home most of the time. For some of our new colleagues, remote working was the only way to get to know our institute. We developed all kinds of new ways for meetings and interactions, so that we could keep doing what we are good at: re-inventing the city.

The AMS Institute eco-system of scientists, lecturers, students, staff, entrepreneurs and partners is the biggest asset and the foundation of the institute. All these wonderfully talented people operating in this thriving eco-system produce the ideas, talent and collaboration required to re-invent cities. We thank them all for their unceasing efforts, adaptiveness and commitment, especially in such a challenging year. For 2020 required all of us to be both creative and resilient, to go the extra mile in the online space whilst often having to take care of family and friends around us.

The highlights from this report show that, despite the challenging circumstances, 2020 was a great year for AMS Institute.

Appointment new Scientific Director

This academic year we closed one era and opened another. Eveline van Leeuwen was appointed as our new Scientific Director when Arjan van Timmeren's 5-year term expired. The 'warm hand-over' during the summer – with some face-to-face socially distanced meetings but without handshakes – got Eveline off to a flying start. A start that coincided with the beginning of the academic year, which we celebrated with an online opening event at Pakhuis de Zwijger that also marked the festive handover.

We greatly appreciate Arjan van Timmeren's indispensable contribution to the development of AMS Institute. From the start of the institute in 2014, Arjan was a driving force in building and expanding our network of public and academic involvement. Through his active participation in the worldwide innovative eco-system, AMS Institute has also gained international recognition.

For 2021, Eveline has set a number of goals, including developing a vibrant Research Fellow community, successful collaboration with the newly appointed Principal Investigators and, of course, the development of our flagship programs. She is also very much looking forward to advancing how we contribute to creating metropolitan solutions with impact: for the city of Amsterdam in particular, and also by contributing to a worldwide exchange on the topic.

Bringing science even closer to Amsterdam

Cities and their dynamics are constantly changing. At AMS Institute we aim to be both agenda-setting and responsive to the challenges that cities face. We are very happy that we were able to appoint 12 additional Research Fellows (RFs) – funded by TUD and WUR – who are closely connected to our six dedicated urban challenges. Their research topics are defined to help accelerate urban transitions and are developed in close collaboration with the city.

The RFs range in experience from post-docs to associate professors. Their great enthusiasm, wide interests and different skills, allow for added creativity, as well as on-the-ground research in Amsterdam. The coming year, we expect to hear a lot from our RF community. Results and findings of their research can immediately be incorporated in upcoming research proposals, tested in living labs throughout the city or via prototype development, and will also contribute to the development of our flagship programs. Not less important, is the role our RFs will fulfill in connecting their research with our educational program and entrepreneurship activities, to truly bring the topics they focus on to a next stage.

Research with impact

Together with the City of Amsterdam and many regional and international partners, AMS Institute strengthened its collaborative research and innovation

activities to create impact on the six urban challenges that our research portfolio evolves around. In total AMS Institute started 18 new research and innovation projects with the City and its academic partners, with a total project value of EUR 15.9M. Despite the extra challenges posed by the corona pandemic, most of our research activities could still continue as planned.

In the area of metropolitan food systems, project activities on production and supply of circular urban food increased: from the culinary heritage of Amsterdam's citizens to applying space technology for urban food system development. On the topic of smart urban mobility, AMS Institute continues to collaborate closely with the City of Amsterdam on pedestrian and crowd monitoring systems (which became even more relevant during COVID-19 lockdowns). As part of our responsible digitization program, we launched our Responsible Sensing Lab together with the City of Amsterdam. In this lab, we design, among others, crowd monitoring solutions that incorporate and safeguard values such as citizen privacy. AMS Institute intensified the development of the joint innovation center for digital mobility management with the City, which lead to two large EIT Urban Mobility-supported projects. In addition, the Roboat project launched the first 1:1 large-scale prototype of its autonomous vessel. Known as 'Lucy', the full-scale boat will be tested and further developed in the waters of Marineterrein Amsterdam in 2021.

We worked on various challenges related to climate adaptation and the urgent renovation of the old quay walls and bridges in Amsterdam. The result was investigations into the impact of sea level rise on Amsterdam, the rapid assessment of a collapsed quay wall (Grimburgwal) and the development of the research program (EUR 4M UrbiQuay NWA). The latter is an innovation program that focuses on developing innovative solutions for future-proof quay wall restoration. Finally, Energy Lab Zuid-Oost will spur the energy transition and works on the smart- energy renovation of building stock in Amsterdam Zuid-Oost and deep retrofitting strategies.

At the end of 2020, AMS Institute has a full pipeline of projects in development, thanks to great teamwork by and between AMS PIs, RFs and program developers, the City of Amsterdam, and our public and private partners.

Living labs to scale up urban innovation

Researching and developing new solutions for the complex and multifaceted urban challenges our cities face is not an easy task. It requires a combination of diverse expertise and perspectives to create feasible and meaningful innovations. AMS Institute initiated and supported several new urban living labs in Amsterdam, to bring together practitioners, researchers, companies and citizens to co-develop and co-create these necessary innovations. The

Marineterrein Amsterdam Living Lab, next to AMS Institute's home base, enabled projects like CINDERELA, Space for Food, Roboat and the Responsible Sensing Lab to set up experiments to validate their prototypes and involve citizens and users. These living labs are a helpful step to develop and scale up innovations more quickly.

AMS Institute supported six living labs in the city of Amsterdam for the innovation program to future-proof the city's centuries-old quay walls and bridges. Together with AM and Bajes Kwartier Ontwikkeling (BKO), AMS Institute also initiated the Green Tower Living Lab at Bajeskwartier. Here the intention is to open up innovation in the construction industry and within real estate development to accelerate the transition to more sustainable, circular, and healthy city neighborhoods.

New partnerships

In the complex setting of metropolitan areas, partnerships are essential to achieve our mission towards real-world impact. Our partnership with the City of Amsterdam is at the core of AMS Institute and we signed various collaboration agreements in 2020 relating to digital mobility management, waste and resources, city maintenance, and bridges & quay walls. More structural partnerships with Waternet, ARTIS, Bajeskwartier, Urban Tree Village and Marineterrein Amsterdam were developed. All partnerships enable longer-term and dedicated

collaboration to open up urban experimentation in living labs for research, innovation and educational purposes and create pathways to develop, launch and scale up solutions and talent.

Equipping Amsterdam's future urban engineers

Highly educated talent is indispensable, if we are to re-invent cities. AMS Institute provides higher education-level training for young talent and professionals, on campus and (massively) online. In 2020, AMS Institute saw a big uptake in the number of first year MSc MADE students. A total of 61 students started the program in September, representing a seventy-five percent increase on 2019. Despite the COVID-19 situation, thirty percent of students were from outside the Netherlands, some of whom even started fully online from their home country. Due to the global pandemic, most of the program was brought online. Within the VSNU-protocol, AMS Institute did all that was possible to support students in what has been a tremendously difficult academic year.

Professional education

In 2020, we developed a vision for AMS Institute professional education alongside the 5-day Urban Living Labs (ULL) program. The ULL program builds on the didactic innovation within MSc MADE. It helps professionals develop solutions to their real-world challenges collaboratively and learn and

experiment with new skills, attitudes and knowledge. The program ran twice in 2020 to train and coach researchers and urban professionals in the AMS Living Lab methodology to effectively set up and organize living labs. In 2021 AMS Institute intends to expand its professional education offering.

Startups to accelerate urban impact

Last year, AMS Institute took a significant step to create more impact with the innovations that are being developed in AMS research projects or by MSc MADE students: the launch of the AMS Startup Booster program to support entrepreneurial teams of students, researchers and young professionals with the creation of a company based on their research activities and innovations.

The AMS Startup Booster coaches the teams with the validation of their proposition, how to understand their customer, improve their business model, and scrutinize any false assumptions they might have. After the Booster program, the teams should be ready to start their business. In total, AMS supported eight different startup teams in 2020, of which four startup ideas were initiated by AMS students and researchers, notably Mublio, Container Collectief, Future Fish and City Analytics.

We also continued with the ClimateLaunchpad and city hackathons. In addition, AMS Institute, together with Dutch EIT Urban Mobility partners and the City of Amsterdam, further developed the Urban Mobility Accelerator program. It is designed to specifically support start-ups in the area of smart and sustainable urban mobility, making use of the extensive network, living labs and experience in the Amsterdam ecosystem.

Scaling up for the future

Looking forward, we envision that AMS Institute will continue to work at the forefront of metropolitan solutions globally and be known for its societal impact, its talents and alumni, novel partnerships, and for its continuous innovation in blending excellence in science with societal challenges. We expect the AMS Institute ecosystem to strengthen and be a niche for learning and innovation, experimentation and new modes of operating for urban impact.

We also aim to contribute more to monitoring sustainability and livability in cities. "If we cannot measure it, we cannot improve it" said Lord Kelvin. We therefore need to understand the elements that are key to our future cities: such as livability, inclusivity, climate neutrality, competitiveness. Then we need to find efficient indicators to measure and monitor them. Finally, we must interpret and communicate the results in such way that they are meaningful to all urban stakeholders.

Over the next two years we will transform our research and innovation programs, focusing their scope whilst increasing their real-world impact. We will expand MSc-education into new areas, develop new modes of professional education, create urban living labs, strengthen our corporate partnerships and broaden our instruments to help entrepreneurs realize their dreams and scale up their solutions.

Join our journey

In 2014, our core academic partners TU Delft, Wageningen UR and MIT together with the City of Amsterdam set out on a journey called AMS Institute. Today, the institute is stronger and, more importantly, more relevant than ever. Never has there been a more important or urgent need to transform metropolitan areas to remain or become prosperous, sustainable, resilient and just. Yet these are complicated transformations that require collaboration between local, regional and national government, private companies, public organizations, knowledge institutions and citizens. We look forward to collaborating with you in our mission to re-invent cities!

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

The AMS Living Lab Approach

The urban challenges we face today are multidisciplinary by nature. Different disciplines and types of knowledge must be connected to create solutions. Yet, for a solution to really make impact, it needs to develop from fundamental research to a solution that is ready for society-wide implementation. This requires the involvement of different stakeholders. To realize this, living labs are our guiding principle and fundamental to our way of working. Living labs provide a co-innovative setting in which different stakeholders jointly test, develop and create metropolitan solutions.
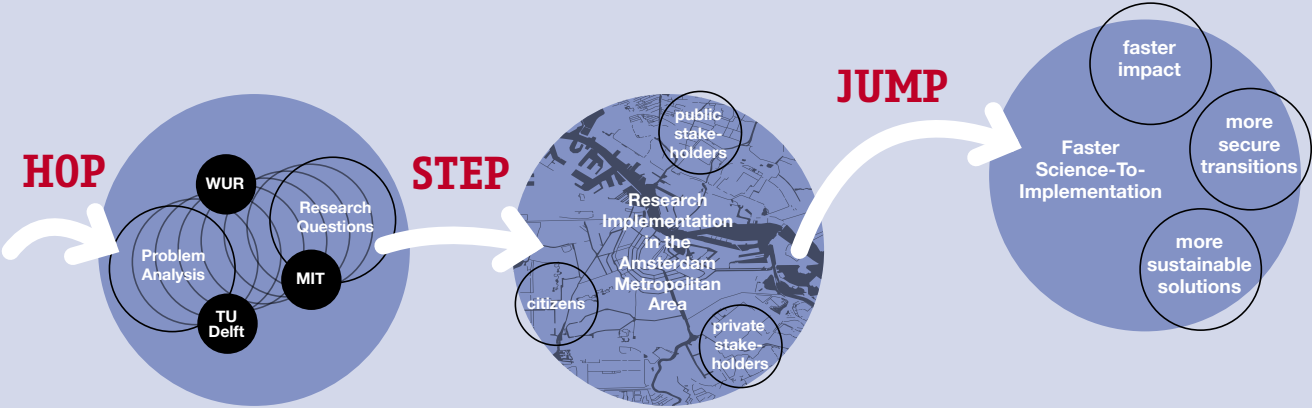
From science to implementation

The goal within our living labs is to make impact by developing new products on a small scale. We then scale-up these solutions and implement them on city scale. The products could be an object, a service, a technology, an application, or a system.

This is done in a real-life and co-creating setting in which different stakeholders shape the innovation process. The stakeholders are a mix of users, private and public actors and academics. The feedback gathered from use and evaluation of the product is used to accelerate further development. Since the product is implemented in a real-life setting and validated by the actors, it is more likely to be adopted smoothly and swiftly by all involved. And, in turn, to make a significant and rapid impact in the city.

"In order to innovate the complex systems that cities comprise of, we need to share knowledge, be optimistic, trust and cooperate. A living lab environment creates the grounds to do so."

Sacha Stolp, *Director of Innovation, Future Proof Assets Program, City of Amsterdam*

HOP

WUR

Research Questions

Problem Analysis

MIT

TU Delft

STEP

public stake-holders

Research Implementation in the Amsterdam Metropolitan Area

citizens

private stake-holders

JUMP

faster impact

more secure transitions

Faster Science-To-Implementation

more sustainable solutions

More information on our Living Labs:

Amsterdam as a Living Lab

We are involved in several living labs throughout the city. This year we added the Green Tower in Bajeskwartier and ARTIS zoo to our primary locations of urban experimentation. We are also closely involved in assisting the City of Amsterdam to apply the living lab approach on the renovation of its bridges & quay walls. Alongside their multiple research projects, our MSc MADE students are also connected to our network to set up various living labs as part of their graduation courses.

Research & Innovation

Education

Entrepreneurship

SUMMALab
Learning-space connecting Dutch living labs on urban mobility

ATELIER
Transforming neighborhoods in Amsterdam and Bilbao into 'Energy Positive Districts'

Festival Environment Impact
Co-realizing the quantification and digitalization of DGTL festival's circularity goals

Future Fish
Co-developing a plant-based alternative to the highly endangered eel

ARTIS Circularity Lab
Co-creating an educational product on Artis' largest waste stream: elephant manure – and upcycling it into paper

ARTIS Analytics Lab
Co-creating a model to predict the number of visitors to Artis

Green Tower Living Lab
Testbed to integrate sustainable urban innovations in the development of Bajeskwartier

Accenture
Investigating the impact on mobility and energy industries, when banning all fossil fuel vehicles from Amsterdam by 2030

Circularity by Design
Developing the concept of Circularity by Design for food systems, with various living labs

Make Some Noise
How can buildings be designed to reduce the exposure to aircraft noise and air pollution in a circular and sustainable way?

Marineterrein Amsterdam Living Lab
Inner-city testground for a sustainable living environment

Space for Food
Using space technology to improve circularity in the city

Husky
Experimenting human interaction with autonomous robots in urban environments

Roboat
World's first fleet of autonomous boats

Living Lab Business Modelling
Exploring a viable and self-sustaining business model for Marineterrein Amsterdam Living Lab

CINDERELA
Demonstration plant that transforms urine into a nutrient-rich fertilizer

IDM
Innovation Centre Digital Mobility Management

Responsible Sensing Lab
Designing sensing systems that people are comfortable with

Pampus
Find the best wastewater treatment system to make Pampus Island more sustainable and self-sufficient

Strandeiland DemoS
Developing a participation method for Strandeiland that is based on consensus instead of compromise

Moss Receptive Concrete for Liveable Cities
Demonstrating the functional performance of innovative bio-receptive concrete for different urban applications

Energy Lab Zuidoost
Setting up exponentially scalable renovation and system transitions towards an energy neutral district

Residual Heat Data Centers
Developing a blueprint to warm up buildings with residual heat from data centers

Smartgrid ArenAPoort
Developing and testing a neighborhood energy platform for a large variety of stakeholders

Facade Renovation Reigersbos
Deep retrofit of 288 dwellings with scaling potential to 10,000 buildings

Culinary Heritage of Cities
Developing new types of urban farming for a multicultural society in Amsterdam

> "In the Green Tower Living Lab, we test sustainable innovations based on 'learning by doing'. Promising innovations can then be scaled up to solutions that we can deploy for broader sustainable renewal."

Stephan van Dijk, *Director of Innovation, AMS Institute*

Green Tower Living Lab in Bajeskwartier

Together with development partners at Bajes Kwartier Ontwikkeling C.V. – we started with the development of a new living lab in the only remaining tower of the former Bijlmerbajes penitentiary. This tower will become the beating sustainable heart of the new Bajeskwartier in the years to come. The 'Green Tower Living Lab' in this healthy green city district will be vertical city park as well as an innovation testing ground that is accessible to a wider public.

Marineterrein Amsterdam Living Lab

The Marineterrein Amsterdam Living Lab (MALL) was in full development the past year. Progress was made in both the governance side and the implementation and running of experiments, including: CINDERELA, Space for Food, Roboat, Responsible Sensing Lab, and Moss Receptive Concrete. The main goal is to develop scalable innovations that make and keep cities livable.

> "With iconic experiments on land, water and air – including Roboat, CINDERELA, and Space for Food – MALL adds a strategic layer to Marineterrein Amsterdam's potential as city of tomorrow."

Liesbeth Jansen, *Director, Marineterrein Amsterdam*

Energy Lab Zuidoost

The energy transition in Amsterdam Zuidoost requires systematic change. On both a technical and social level. Which is why the Energy Lab Zuidoost brings together various stakeholders and scientific expertise from different disciplines in a living lab environment. The aim is to accelerate the energy transition by implementing and scaling innovations and solutions, focusing on three themes:

1 renovation of houses;
2 local smart energy systems;
3 sustainable heat.

Urban Living Lab: from exhibition to online

In their graduation year, the MSc MADE students work on a Living Lab project. The students are connected to partners in the AMS Institute network and work on a challenge in a real-life setting. Due to corona restrictions, the planned exhibition of their results at NEMO Studio was canceled. The students therefore transformed their Living Lab products and stories to make them completely accessible online: **madelivinglabs2020.com**.

"The Living Lab methodology immerses you in the real-life context by becoming part of this context. Being stationed in ARTIS let me grasp the complex dynamics of the zoo and allowed for easy contact with a large variety of actors, creating support for the project's continuation after our departure."
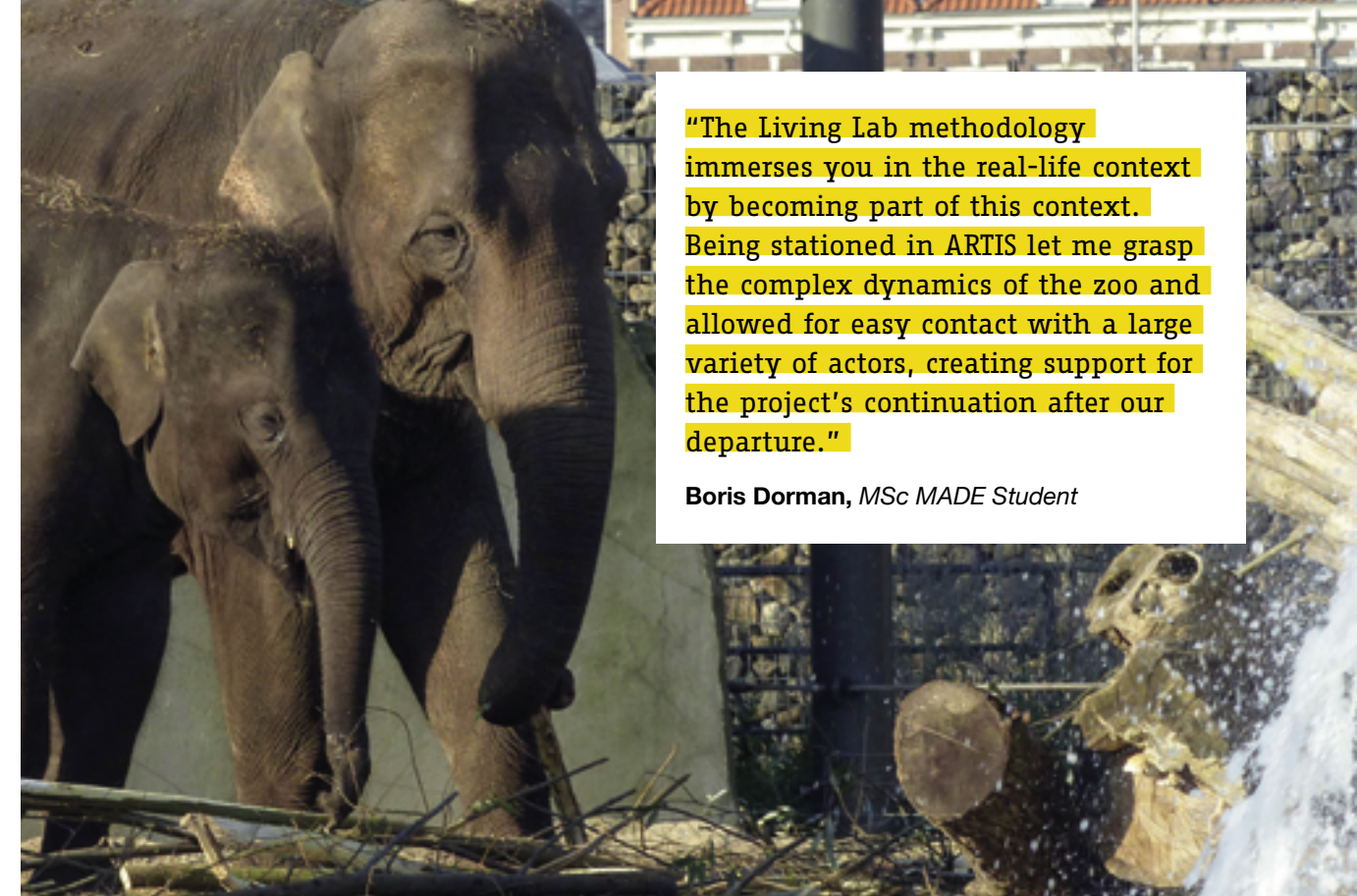
Boris Dorman, *MSc MADE Student*

"The Energy Lab Zuidoost is a catalyst for inventing an energy transition in which the differences between rich and poor do not increase, but in fact become smaller. By combining a highly practical approach on the one hand, and solid scientific knowledge on the other - this ambitious consortium aims to make a substantial technological, economic and social difference for Amsterdam Zuidoost."

Prof. dr. Caroline Nevejan, *Chief Science Officer, City of Amsterdam*

Future Fish

Team Future Fish has co-developed a plant-based alternative to the highly endangered eel. Their 'unagi' resembles eel as it is consumed on sushi. Simultaneously, these MSc MADE students set-up a self-study module on food, the sea and the city to inspire high school students and relieve teachers from some of their duties during the current crisis. Following this living lab assignment, the entrepreneurial team of students decided to join the AMS Startup Booster, to find out if this concept could be turned into a startup.

Strandeiland DemoS

DemoS Living Lab gives citizens an opportunity to directly influence their living environment at IJburg Strandeiland. Teaming up with the DemoS research project team, civilians and civil servants, the MSc MADE students developed a participation method based on consensus instead of compromise. They provided a valuable addition to the research, demonstrating the right citizens have to the city and the crucial role they play in the transitions to a more sustainable future!

ARTIS

Following the close collaboration with ARTIS zoo, two groups of students worked on different challenges:
1 ARTIS Living Lab Circularity co-created an educational product that tells the story of waste based on ARTIS' largest waste stream: elephant manure. Together with ARTIS the MADE students developed a workshop where visitors can learn about circularity by making paper out of elephant manure and experience the value of waste;
2 ARTIS Analytics Living Lab dives into the reasoning and behavior of zoo visitors: why do people go to the zoo? What routes do they take in the park? What insights can be gained for park operations from understanding these behaviors? ARTIS and the students co-created a model that can predict the number of park visitors.

Education

Education is essential to form engagement with our urban environments as well as to develop solid solutions for the cities of today and tomorrow. In 2020, AMS Institute continued to develop its educational activities – ranging from our MSc MADE, MOOCs, and professional education. As always, our educational activities were geared towards accelerating transformations through iterative, co-creative learning to create sustainable, resilient and just cities. And, what better way than to utilize Amsterdam as a living lab to foster and develop the research, design and innovation skills of our (future) urban engineers?

MSc MADE: A new type of professional

The Metropolitan Analysis, Design & Engineering master (MSc MADE) forms the core of AMS Institute's educational activities. The two-year program – a combination of in-situ and online education – focuses on the metropolitan challenges of Amsterdam, and as such uses the city as a case study and a living lab.

The MSc MADE students, representing a broad variety of academic backgrounds and fields of expertise, are challenged to strengthen their academic knowledge and hands-on skills in real-world projects in the city. During the master program, we connect them to the institute's multidisciplinary Research & Innovation portfolio, real-life cases in Amsterdam and stakeholders from our network – be it case-owners from the City of Amsterdam, businesses and societal partners. In close collaboration with these stakeholders, we're educating a new type of professional – urban engineers – to address questions such as:

- How can we keep our cities connected?
- How can urban environments safeguard their vitality?
- How can we create truly circular cities?

Trained to try and test their innovative ideas in practice, these urban engineers are ready to, in an interdisciplinary way, tackle the challenges of today's and tomorrow's cities. To create better, just and more resilient urban environments.

"This year, and maybe even more so as a result of COVID-19, the set-up of our educational program has proved itself again. Our collaboration with the City of Amsterdam intensified, and I'm proud to see how rapidly our team and MSc MADE students redesigned the program to fit the current situation."

Arjen Zegwaard, *Program Director MSc MADE, AMS Institute*

A record number of new students

In 2017, the first cohort of students started their two-year MADE master with classes on metropolitan challenges, entrepreneurial skills and data analysis in the urban context. In 2020 we already waved goodbye to the second cohort of MADE students. With their graduation, Amsterdam gained another 18 urban engineers to take on the city's challenges. In September 2020 we not only said "goodbye for now" to those students, we also welcomed 61 students for the fourth MSc MADE cohort.

Education transforms into a hybrid program

At the core of MADE's curriculum is the capacity to deal with changing circumstances. Our students certainly rose to this challenge in 2020. Overnight educational activities had to switch to online and courses were redeveloped to match current circumstances as a result of COVID-19.

For example, instead of going on a planned study trip to Munich this spring, our MSc MADE staff and students created the 'learning from a crisis' course. An impressive showcase of their adaptability.

Increased integration Education and Research & Innovation portfolio

The integration of educational activities and collaboration of MSc MADE students in AMS Institute's Research & Innovation portfolio was tighter than ever before. To illustrate, our first year MSc MADE students took a deep-dive into two Amsterdam-based cases as part of the Metropolitan Solutions course.

"For the students' living lab assignments and their thesis, collaboration is increasingly taking place within the context of AMS Institute's Research & Innovation projects."

Toine Andernach, *Coordinator MSc MADE, AMS Institute*

Innovations for climate adaptive quays

As part of the City of Amsterdam's bridges and quays program, 200 kilometers of quay walls are being renovated. This opens up opportunities for AMS Institute and the City of Amsterdam to also address other challenges such as the impact of climate change on the city.

One group of 16 MSc MADE students took on a consulting role and shared their expertise with, among others, case-owners from the municipality on how to integrate climate adaptive functions with the renovation of the historic quay walls.

"The Living Lab renewal of the bridges and quay walls program asked the MSc MADE students to come up with out-of-the-box solutions for climate adaptive quay walls. We were inspired by the solutions and visuals the students created, they were always well prepared and professional! It was pleasant to work with the students and course coordinators."

Miriam de Graaff, *Junior Advisor Innovation and Development, City of Amsterdam*

Circularity in the tourism sector

Accommodation facilities within the tourism sector – such as hotels, Bed & Breakfasts and vacation parks – are major users of cheap and easily accessible non-renewable, scarce and finite resources. How can we change this linear take-make-dispose model in the sector to a more circular one?

Stayokay Amsterdam East, part of the largest and oldest Dutch hostel branch, asked a group of 17 MSc MADE students to help them in reaching the goal to become fully circular by 2030. Alongside an extensive advisory report, the students developed a vision for the hostel and created a roadmap visualization.

See what the students developed:

Education in numbers

137 applications **from all over the world** in 2020

55 from **the Netherlands**

33 from the **EU**

49 non-EU

In 2020:

120 Total number of **MADE students**

8 MSc MADE students worked on different **living lab cases**

18 newly graduated **urban engineers** for Amsterdam

5 MSc MADE startups, of which **one** **urban consultancy**

99 applications **accepted in 2020,** of which **61** students started the fourth cohort in 2020.

79 <25 years old

58 >25 years old

Great variety in backgrounds:

17% Architecture

11% Future Planet Studies

10% Global Sustainablility Science

62% other backgrounds

58 Winter school participants

58 Summer school participants
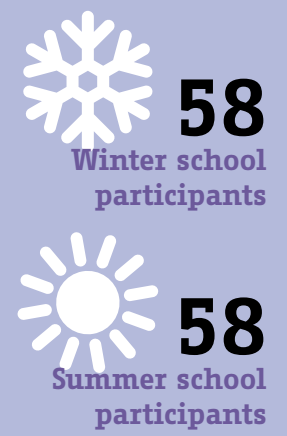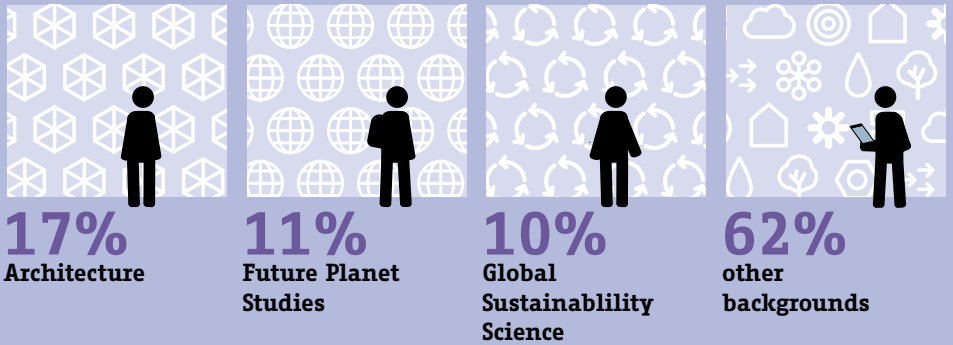
Entrepreneurial minds that turn ideas into startups

The entrepreneurial ambitions of our students took many forms this year. From taking part in ClimateLaunchpad – organized together with EIT Climate-KIC – to being selected for the AMS Startup Booster, to creating a winning design for WURs Urban Greenhouse Challenge.

3rd prize for teAMSpirit

WUR challenged students worldwide to develop a business plan for an iconic and circular urban 'greenhouse' to be implemented in a metropolitan area in China. And 'teAMSpirit', a multidisciplinary group of MSc MADE, WUR and TU Delft students won third prize with their design 'the Turtle'.

One of their plan's unique selling points: in the urban greenhouse all seasons are simulated in four separate greenhouse pods. This creates four controllable environments for investigating seasonal crop-sequences.

"Food systems – a vital element for a healthy society – are still very disconnected from the current default habitat of humans: the city. We see great value in integrating these two to ensure sustainable and healthy future living environments across the world."

teAMSpirit, *MSc MADE, WUR and TU Delft students*

AMS Academy for Professional Education

AMS Academy is a learning environment for professionals, researchers and entrepreneurs. Within the AMS Academy, we are developing new concepts for professional education. The fundamentals of every program are academic knowledge and how to implement it. Participants are challenged to collaborate in teams on real-life cases. They work on skills that help them take ownership of change, apply new knowledge and create new solutions in a co-creating setting. Always with an entrepreneurial mindset.

"To create impact, you need to have the knowledge, the skills and the mindset to lead change. AMS Academy for professional education aims to create a learning environment that bridges exactly that."

Femke Haccou, *Program Developer Professional Education, AMS Institute*

Winter School Lisbon: PhD program Smart BEEjS

In co-creation with the Urban Living Lab team a winter school was developed for the PhD program of Smart BEEjS. For one full week the students were challenged to design an urban living lab set-up for real-life cases. During a dynamic program with lectures, exercises, energizers and field trips they learned how to make such a set-up for their research. This edition worked as a prototype to further develop a summer school for a mix of professionals and researchers.

Urban Living Lab Summer School: Online edition

During this week professionals and researchers teamed up to learn how to set up an Urban Living Lab.

All participants came from different backgrounds, disciplines and nationalities. In a very intense, dynamic and interactive week the teams were challenged to create a design for a living lab focusing on real-life cases in Amsterdam: Energy Lab Zuidoost and the Bridges and Quay Walls program.

"I learned the benefits of working in an environment with professionals from various background with different perspectives, and how to take an alternative approach to my usual one."

Karen Williams, *Researcher, Amsterdam University of Applied Sciences*

"I liked the wide variety of international participants and the open minds they brought."

Mellany Doldersum, *Project Manager, City of Amsterdam*

Research & Innovation

It is revolutions in new technologies, science and design methods that help us conceive solutions for the challenges our cities face. Our research portfolio revolves around six urban challenges to create an innovative, sustainable and just city.

Our accumulated project portfolio consists of 140 research projects. All are defined and executed by interdisciplinary consortia of knowledge institutes and public and private partners, and in close collaboration with the City of Amsterdam. By involving all relevant stakeholders, we aim to contribute to the development and implementation of sustainable solutions that guarantee livability and accessibility of the Amsterdam Metropolitan Area (AMA).

Smart Urban Mobility

The City of Amsterdam's ambitions

An accessible, liveable and less polluted city: that is what the City of Amsterdam would like to achieve for its citizens, visitors and businesses, today and for future generations.

The Smart Mobility program 2019-2025 focuses on three ambitions:

1 Amsterdam aims to be the world's number-one smart mobility city;
2 Cleaner and smarter transport for all Amsterdammers, visitors and goods;
3 The City's traffic center collects data digitally – and centrally – in order to manage, analyze and predict mobility flows in real time.

AMS Institute's ambitions

The continuing growth and ambitions of the City of Amsterdam and the needs of its citizens lead to increasing transport of people and goods. Which in turn puts pressure on urban space and urban infrastructure, and impacts livability and quality of life. Our Smart Urban Mobility program therefore focuses on the following themes:

• Digital: Experiment with digital mobility management tools;
• Spatial: Optimize and rethink available infrastructure and public space;
• Sustainable: Reduce emissions and create a healthier way of moving around the city;
• Social: Give more users better access to mobility and reduce mobility poverty.

Full-scale Roboat ready for autonomous tests on Amsterdam's canals

What if autonomous boats could relieve Amsterdam's city center of heavy traffic over its vulnerable quays and bridges while making the canals a testbed for innovation? Roboat – a research project by MIT and AMS Institute – will provide self-driving solutions on water for different use cases.

In the past three years full autonomy was successfully implemented on the 1:4 and 1:2 scale boats. Now in its fourth year of research, Roboat introduced the first full-scale prototype. It's now ready to start piloting real-life use cases, to be applied in the fields of waste logistics and transporting people.

Project lead: AMS PI Carlo Ratti (MIT)
Partners: MIT, Waternet, City of Amsterdam
Total budget: €25M
Duration: 5 years

"In 2020 the tech team located in the Netherlands expanded with two new members: a mechatronics and software engineer. MSc MADE students explored the business case of waste management for Roboat, and four TU Delft students joined us for their graduation assignments. New collaborations also flourished with sponsors like Murata, Torqeedo, and VETUS."

Ynse Deinema, *Program Developer Smart Urban Mobility, AMS Institute*

Keep track of the Roboat developments:

City Analytics empowers city officials and crowd managers:

CityFlows: How to improve the livability of crowded urban spaces?

The CityFlows EIT Urban Mobility project tests and evaluates various innovative crowd-monitoring techniques in real-life settings through living lab projects in three European metropoles: Amsterdam, Milan and Barcelona. The goal of the consortium is to launch a Crowd Management Decision-Support System (CM-DSS) to improve the safety and comfort of busy pedestrian spaces.

In November a project milestone was reached with the launch of the City Analytics startup. The technology used by City Analytics was developed in the CityFlows project to provide real-time information about pedestrian flows in urban space. The startup, founded by among others Dorine Duives and MSc MADE Alumni Matt Bearden, is a vehicle for turning the CityFlows CM-DSS into a license-based Software-as-a-Service (SaaS) package.

Project lead: Dorine Duives (TU Delft)
Partners: TU Delft, City of Amsterdam, Altran (Capgemini), UPC, City of Barcelona, ENEA, City of Milan
Total budget: €1.4M
Duration: 2 years (extended till Dec 2021 due to COVID-19)

"With the launch of City Analytics, the crowd monitoring technology developed through CityFlows is ready to scale and is helping to boost the quality of pedestrian spaces across Europe and internationally. This is more urgent than ever, especially as cities are looking for tools that can help them keep the COVID-19 emergency under control in the upcoming months and build resilient public spaces in the future."

Matt Bearden, *MSc MADE Alumnus, City Analytics co-founder & CEO*

Innovation center for Digital Mobility management (IDM)

This year marked the start of developing an innovation center for data-driven mobility solutions in close collaboration with the City of Amsterdam. At IDM, multi-modal mobility data is made available for research and collaboration.

IDM invites multidisciplinary stakeholders – from researchers to City officials and mobility providers – to dive into Amsterdam's mobility data, gain insights on the city's mobility flows and jointly conduct research and develop new solutions to improve these flows. Newly developed tools and instruments can be tested and evaluated at this collaborative innovation center until they're ready for actual operation in Amsterdam's traffic center.

Project leads: AMS Institute, City of Amsterdam
Total budget: TBD
Duration: Minimum 4 years

"By combining and analyzing readily available mobility data at IDM, new tools can be developed to improve the traffic control center's ability to monitor and adjust traffic flows in the city. This not only applies to car traffic, but also to public transport, bicycles and pedestrians."

Tom Kuipers, *Program Developer Smart Urban Mobility, AMS Institute*

Circularity in Urban Regions

The City of Amsterdam's ambitions

By 2030 the City of Amsterdam aims to reduce the use of primary raw materials by 50% and is committed to becoming fully circular by 2050. Here the focus lies on resources that drive urban activities, such as building materials, water, food and energy.

AMS Institute's ambitions

The Circularity in Urban Regions program aims to accelerate the circular transition of Amsterdam and the AMA. We do so primarily by developing integrated solutions that prolong the shelf life of products, buildings and infrastructures, and that close cycles of materials, food, water and energy. These solutions preserve and recover as much value as possible in the urban environment. As such, we contribute to climate change mitigation by reducing the need for raw materials and the emissions related to their sourcing and processing.

We prioritize circular solutions that lead to an inclusive society, because they create a wide range of local jobs and enhance the self-determination of our cities' communities, making cities less reliant on the whims of global production chains. We develop these solutions by establishing new collaborations between governments, scientists, businesses and civil society.

COMPRO: Composite building material from wastewater resources

When we flush our toilets, cellulose-rich toilet paper also goes down the drain. In the Netherlands, this adds up to 175 million kg of toilet paper every year. As resources are ultimately finite, there is a growing urge to recycle waste streams in an urban context. So, what if we could build bridges from all this flushed toilet paper?

The COMPRO project builds on results and insights found by WASCOM – in which two major organic waste streams are upcycled to produce high-value building material for the city. These waste-streams are cellulose fibers from retrieved toilet paper and a 'biological glue' called Kaumera produced by bacteria in the Nereda® wastewater treatment process. Together these can be used to yield a fully bio-based and circular composite material – one that can be put to valuable use in the construction sector.

Project lead: AMS PI Mark van Loosdrecht (TU Delft)
Partners: BAM Infraconsult, NPSP, ChainCraft, TU Delft
Total budget: €850K
Duration: 3 years

"Waste water, vegetable waste and garden waste are examples of organic waste streams. All these waste types also occur in natural ecosystems, but in nature organic waste streams are efficiently re-used and recycled. Natural concepts and biological processes can therefore help us recycle and re-use organic waste streams in an urban setting."

Peter Mooij, *Research Fellow Circularity in Urban Regions, AMS Institute*

Watch this video on COMPRO:

Testing first Circular Kitchen prototypes

Kitchens are replaced more often than other components such as roofs and facades, because a kitchen's functional lifespan – how long it meets the user's (aesthetic) requirements – and technical lifespan – how long it functions as intended – are generally much shorter. What if you could install a kitchen that is easy to renew and lasts a lifetime?

The 'Circular Kitchen' applies a plug-and-play concept, separating the kitchen into parts based on expected technical and functional lifespan. To illustrate: after 20 years, instead of buying a whole new kitchen, you can simply replace outdated modules or parts that require functional replacement. These replaced modules are collected, reused or recycled. This saves raw materials, reduces waste streams and halves the CO_2 emissions generated per kitchen. In 2020 we started testing the first Circular Kitchen prototypes in people's houses.

Project lead: Vincent Gruis (TU Delft)
Partners: TU Delft, Bribus, Atag, Dirkzwager Groep, Eigen Haard, Remeha, Waterweg Wonen, Akzo Nobel, Feenstra
Total budget: €2.23M
Duration: 2 years

Metropolitan Food Systems

The City of Amsterdam's ambitions

1. Reduce food waste by half by 2030;
2. Stimulate growing and production of food in Amsterdam as well as in agricultural areas around the city;
3. Enhance the share of healthy and sustainable food in food consumption;
4. Stimulate a sustainable food circle;
5. Promote knowledge exchange with regard to food.

AMS Institute's ambitions

Our Metropolitan Food Systems program introduces innovation to the urban food system to make healthy, safe and sustainable food accessible and enjoyable for everyone. We accelerate innovations in the food system with knowledge and the development of new technologies in:

1. Sustainable and circular food production;
2. Access to safe & healthy food for everyone;
3. Enjoyable food experience.

Innovations can be based on fundamental, applied or implementation research.

Space for Food: Space technology to improve circularity in cities

Municipal waste water has great potential for nutrients and water re-use. The Space for Food project applies space technology in an urban context to recover and transform these nutrients from waste water for food production.

For this project, waste water is collected from the municipality and a local brewery Homeland, situated at MALL. We use this waste water for the cultivation of purple bacteria in a raceway reactor at pilot scale.

At this stage, space technology is tested as a means to extract nutrients which are then transformed into a slow-release plant fertilizer, and clean water. This fertilizer is to be tried and tested at a local vertical farm set-up by GROWx – reinforcing the closed-loop system.

Project lead: Wei-Shan Chen (WUR)
Partners: Waternet, MELiSSA Space Tech, SEMiLLA IPSTAR, GROWx, Universiteit Antwerpen, Nijhuis
Total budget: €83K
Duration: 8 months exploration

"A big part of innovation in space technology revolves around finding smart, efficient and circular ways to establish a life support system for the astronauts going on the trip. What if we view 'cities as spaceships' in terms of urban environments being closed-loop systems?"

Alexander Laarman, *Program Developer Business Development, AMS Institute*

More information:
ams-institute.org/spaceforfood

Cultural Culinary Heritage: Sustainable exotic food production in the city

Over 180 nationalities live in Amsterdam and they all bring their own culinary cultural heritage to the city. What do all these people eat? Where do the products come from? In many cases, exotic foods are imported from native regions, and unfortunately, they are not always produced in a sustainable way.

This project explores the culinary heritage of different cultures in Amsterdam Zuidoost to identify opportunities for local and sustainable production of traditional exotic vegetables, fruit and herbs.

In order to search for a form of urban agriculture that matches the culinary heritage and desires of the residents of Amsterdam Zuidoost, a living lab is being set up, where new cultivation systems to grow exotic foods locally can be tested and further developed.

Project leads: Eveline van Leeuwen (WUR), Jan Eelco Jansma (WUR)
Partners: City of Amsterdam, WUR
Total budget: €106K
Duration: 6 months

"The Gaasperplas area in Amsterdam is currently being redeveloped. Could this become 'the place to be' for urban agriculture? Together with WUR and the City of Amsterdam, we're exploring if a local food production area for Amsterdam Zuidoost could be realized there."

Alexander Laarman, *Program Developer Business Development, AMS Institute*

Watch our Pakhuis de Zwijger Livecast on this project:

Climate Resilient Cities

The City of Amsterdam's ambitions

The City of Amsterdam aims to become climate-neutral by 2050. More specifically, in 2050, CO_2 emissions must be 95% lower compared to emissions in 1990. In addition to these mitigation goals, the city is implementing a climate adaptation strategy to make it resilient to unavoidable climate effects, especially heat, drought, extreme rainfall and flooding.
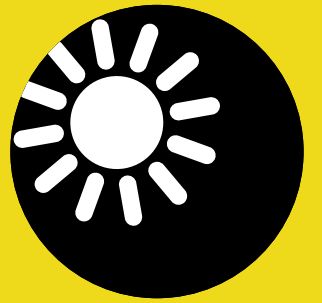
AMS Institute's ambitions

The Climate Resilient Cities program helps the City create an evidence-based climate adaptation approach. It uses designs and interventions that are either nature-based, such as greening, or technological, such as roads with water storing constructions underneath. Experimentation with and research on new designs, technology and ideas takes place in real-life living lab situations in Amsterdam and in cooperation with companies and contractors. The ultimate goal is always to find solutions with impact that qualify for further implementation in the city.

Amsterdam's Bridges and Quay Walls

As part of its duty to keep the city safe, accessible and 'future-proof', the City of Amsterdam has developed a 'Bridges and Quay Walls' program. For about 200 km of quays and 850 bridges in Amsterdam many aspects that determine their structural safety are largely unknown.

Together with the City, we aim to mitigate potentially unsafe conditions through appropriate technical solutions. In 2020 we continued to take steps that provide a better view of the structural aspects, including modelling the sub-surface conditions of the quay walls to make them future-proof. A total of 5 living labs as well as a quay wall failure test will be set up throughout the city.

Project leads: Mart-Jan Hemel (TU Delft), Pantelis Karamitopoulos (TU Delft)
Partners: TU Delft, City of Amsterdam
Total budget: €190K
Duration: 2 years

"While the historic quay walls in Amsterdam are becoming older and weaker, the usage of these 'hydraulic structures' continues to rise. Engineers will have to come up with creative and practical solutions to tackle this problem."

Mart-Jan Hemel, *Research Fellow Civil Engineering & Geosciences, AMS Institute*

"The scale and impact of this work resulted in a lot of traction; from Pakhuis de Zwijger events where lively discussions were held with a wide range of stakeholders to MSc MADE students sharing their expertise with the City of Amsterdam on how to integrate climate adaptability into the design of the quay walls."

Henk Wolfert, *Program Manager Research & Valorization, AMS Institute*

What innovations are we exploring?
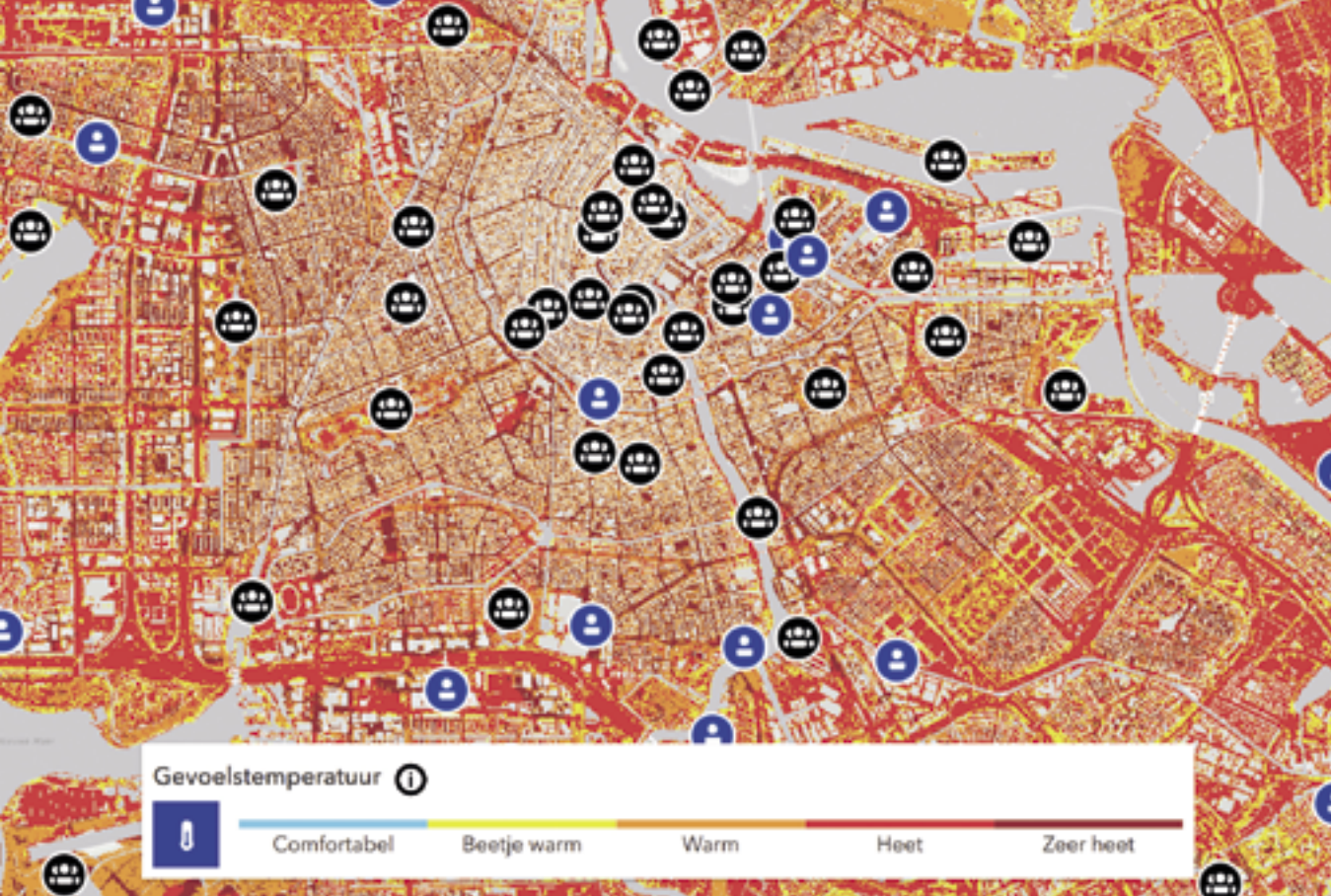
'Find Your Cool' map

Lockdown measures to prevent the corona virus from spreading aggravated the effects of summer heat in cities. People were told to stay close to their homes. But homes in cities often lack a garden where you can find a cooler spot at the hottest time of day. We developed an app (in Dutch: Koele Plekken Checker) to facilitate citizens to find cooler spots in the Amsterdam's public space, and that provide ample space to stick to social distancing regulations.

In this dynamic online map, that was optimized for use on mobile devices, we combined real-time information on the perceived temperatures with information on the expected crowdedness of popular places based on visitor numbers in recent weeks. The real-time temperature information was based on algorithms developed in AAMS, one of our previous projects. Information on crowdedness came from the 'busy places map' made by the City's corona crisis team.

Project leads: Arie de Niet (Witteveen & Bos), Caspar Egas (AMS Institute)
Partners: CLEVER°FRANKE, Witteveen+Bos, City of Amsterdam
Total budget: €30K
Duration: 2 months

"The impact of heat stress on, for example, the vitality and productivity of citizens is often underestimated. Understanding the urban climate and the predictability of a city's weather profile is therefore becoming increasingly important."

Gerben Mol, *Program Developer Climate Resilient Cities, AMS Institute*

Read the full article:

Urban Energy

The City of Amsterdam's ambitions

The City of Amsterdam has the ambition to become 'climate-neutral', i.e. reduce CO_2 emissions by 55% by 2030, and by 95% by 2050 – with 1990 as a benchmark. This requires major transformations of the current energy system. The City has therefore set out four theme-specific ambitions:

1. The built environment: The City wants to eliminate the use of natural gas by 2040.
2. Traffic and transport: In 2030, all traffic on Amsterdam's roads and water should be emission-free.
3. Electricity: The City's production of sustainable electricity should be maximized. For example, by 2030, 80% of the electricity that households use should be generated from solar and wind energy.
4. The port and industry: By 2050, the port of Amsterdam will be a fully sustainable energy and fuel cluster with green hydrogen, biofuels and synthetic fuels. The City aims to phase out fossil fuels by 2050.

AMS Institute's ambitions

What is the best way to ensure a sustainable, affordable and reliable energy system for the Amsterdam region? That's the main question our Urban Energy program aims to answer. In our energy projects, we explore how best to deal with increased variability in consumption, storage and production on multiple scales. Our goal is to help design smart infrastructures that contribute to accelerating Amsterdam's urban energy transition.

Smart BEEjS: Building Efficiency and Energy Justice for Sustainable Living

The Smart-BEEjS Innovative Training Network utilizes the work of 15 PhD researchers across Europe, exploring Positive Energy Districts (PEDs) from different perspectives and in different localities. It complements the EU's Strategic Energy Technology Plan which aims to establish "100 positive energy districts by 2025 (with 2015 as baseline) and 80% of electricity consumption to be managed by consumers in 4 out of 5 households". Through a system-thinking approach, Smart-BEEjS researchers develop strategies, methodologies, policies and practical tools that can be recommended to cities, businesses or communities in order to identify their pathway of transition towards a PED.

Project lead: The Nottingham Trent University
Partners: WUR, Technische Universität Wien, Instituto Tecnológico de Canarias, RWI-Leibniz Institute for Economic Research, Instituto Universitário de Lisboa, Université Basel, Eurac Research
Total budget: €4M
Duration: 5 years

"We need rigorous science to develop new capabilities to accelerate the energy transition. Smart BEEjS forms an ideal framework to connect science with practical innovations."

Michel Handgraaf, *Research Fellow, AMS Institute & Associate Professor, WUR*

"Success in a feasible energy transition means integration between the electricity, gas and heat. Models will be needed to find the optimum."

Martijn Bongaerts, *Sr innovation manager, Alliander*

Magneto

The Magneto project explores the feasibility of magneto-caloric power conversion (MPC) technology and its potential business cases in the urban context, focusing on Amsterdam. It examines the potential of lower temperature waste heat for power production by consulting industrial companies to identify possible use cases. These cases provide inputs for design specifications and to manufacture tailored prototypes. Methods applied for a socio-technological analysis of the MPC technology include desk research, interviews, expert consultation and an online workshop aimed at answering: what are potential use cases for MPC in Amsterdam?

Project lead: TU Delft
Partner: Magneto BV
Total budget: €300K
Duration: 1.5 years

RESS

The aim of this Regional Energy Self Sufficiency project is to support the realization of energy self-sufficient regions in the Netherlands. It is one of the first studies of the integrated use of electricity, gas, heat and renewable sources. In 2020, local stakeholders assessed the models developed for integral energy grid optimization in terms of their practical use and the project delivered a multi-stakeholder assessment of Amsterdams' 'deelRES'. RESS sets out the region's energy objectives for large-scale sustainable generation of wind and solar energy and how the region wants to achieve these.

Project lead: Kees Vuik (TU Delft)
Partner: Alliander
Total budget: €431K
Duration: 5 years

"Magnetocaloric energy conversion is an exciting process to convert power to heat and vice versa. We are developing new materials to make this process work. In Amsterdam we will explore the feasibility of the technology in a real-life environment."

Kornelis Blok, *Chairman Urban Energy Institute, TU Delft*

Responsible Urban Digitization

The City of Amsterdam's ambitions

1   Free digital city: The ambition is to consciously deal with the opportunities and threats of digital technologies, to ensure protection of civil rights and fair access to and fair distribution of the proceeds of digital technologies. Companies must adhere to the rules in the field of data and technology;

2   Inclusive digital city: Technology must help all citizens to participate in city activities and become digitally resilient. Digitization should provide access to all kinds of information and education;

3   Creative digital city: Digitization is used to contribute to solving social challenges, to put (ethical) issues around technology on the agenda and to make them public. Another aim is cooperation with other (inter)national cities.
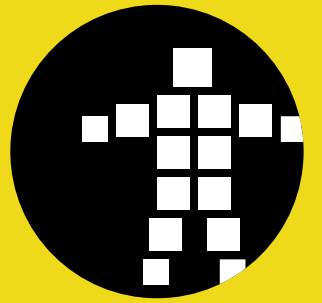
AMS Institute's ambitions

In our Responsible Urban Digitization program, we specifically aim to safeguard and embed critical democratic and societal values like autonomy, privacy, transparency, and inclusiveness of innovations. Our research-by-design approach aims to develop the knowledge on how to integrate these values in the design of technologies, which will be essential for the city to be and remain free, inclusive and creative for its citizens.

Responsible Sensing Lab (RSL)

Technologies like smart sensors can help solve urban challenges. Functionalities of these smart devices range from calculating and measuring (i.e. sensors) to steering processes in the city (i.e. actuators) such as traffic lights, charging stations, adaptable street lights, barriers that go up and down, and adaptive digital signs. These devices help to optimize mobility flows in Amsterdam's urban environments, rationalize garbage removal, and much more.

But what public values are involved when collecting data? Together with the City of Amsterdam we started by setting up our Responsible Sensing Lab. Here we explore how to integrate social values in the design of sensing systems in public space.

"Responsible Sensing Lab is a place where experimentation and technologies come together to (re)design these innovative solutions that make public spaces cleaner, smarter and easier – while at the same time guaranteeing our social and democratic values."

Thijs Turèl, *Program Manager Responsible Urban Digitization, AMS Institute*
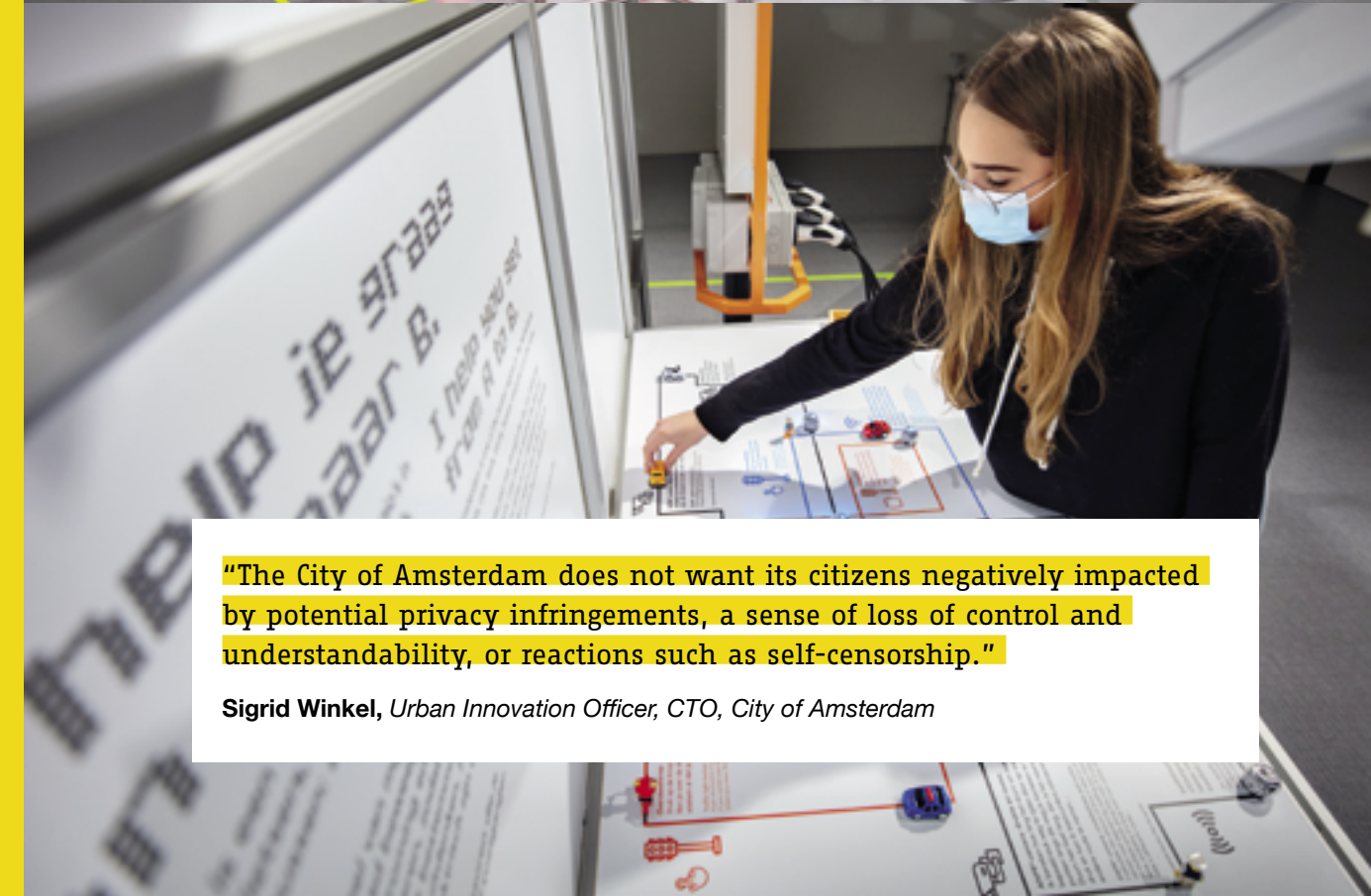
"The City of Amsterdam does not want its citizens negatively impacted by potential privacy infringements, a sense of loss of control and understandability, or reactions such as self-censorship."

Sigrid Winkel, *Urban Innovation Officer, CTO, City of Amsterdam*

ShutterUp! Transparant Charging Station, and mmWAVE sensor

Three new projects were added to the portfolio of Responsible Sensing Lab in 2020:

The **ShutterUp!** project originated from the notion that people do not know *if* and *when* cameras in the public space are recording - or not. We wondered: would people like to live in a city where all city cameras clearly show or state when they're not in use? What if, just like the laptop shutters many people have placed over their webcam, this could be a way to make clear to citizens when a camera is not recording them?

The number of electric vehicles on the streets is increasing, but the current power network is limited. We are working on a charging station that determines which cars have priority. But who or what determines this and what is fair? The **Transparent Charging Station** shows electric car owners what the considerations are in distributing the power.

Crowd monitoring in busy public spaces is key to ensure, among others, the comfort and safety of Amsterdammers. The corona crisis has made measuring crowds an even more urgent issue. Could we design a privacy-friendly alternative to CCTV in the city? The **mmWave sensor** sees moving objects (such as people) as a collection of points in space. This way we keep an eye on the crowds while maintaining the privacy of the Amsterdammer.

"Our recent research has pointed out that 'official' actors primarily see transparency as a means to ensure adoption, while citizens see transparency as a starting point for voicing their concerns and influencing the purpose and use of smart technology. We – as designers of these systems – need to aim to design these systems for engagement as well as pushback by society."

Gerd Kortuem, *Professor & AMS PI, TU Delft*

Entre-
preneurship

AMS Institute is strongly committed to helping the next generation of ambitious urban and sustainable entrepreneurs turn their ideas into reality: from an open invitation to develop solutions for the challenges the City of Amsterdam faces, to guiding and challenging entrepreneurial spirits to develop their start-up ideas. Accelerating entrepreneurship, while improving our urban environments – talk about a win-win!

The AMS Startup Booster

At AMS Institute we see potential innovative ideas emerge from the MADE curriculum and our own research activities. We also welcome ideas from external startups in search of the right eco-system and a place to grow and develop their business models. To help develop and establish these new startup ideas we have developed a new entrepreneurship program, the AMS Startup Booster. In this pre-incubation program, we aim to help the next generation of ambitious urban and sustainable start-ups take the next steps and turn their ideas into reality.

The AMS Startup Booster kicked off in October with eight teams, three of which originated from or are affiliated with the MSc MADE:

City Analytics

This start-up, led by TU Delft researcher Dorine Duives and MADE Alumnus Matt Bearden, stems from the CityFlows project on crowd monitoring. City Analytics has developed a software-as-a-service package to monitor pedestrian flows in outdoor spaces. The platform allows city officials and crowd managers to visualize and monitor crowds in real-time and gain insights in the efficiency of crowd management measures.

Container Collectief

For her thesis, Lotte Geeraedts worked on a concept of a participatory design firm. She is now developing her startup on this concept in the Booster together with three other MADE students/alumni – Renee Swinkels, Tes Miedema and Florinde Vessies. Container Collectief is a traveling hybrid design agency. In a 6-week co-creation process, they design sustainable solutions in collaboration with a neighborhood while consulting their network for expertise and knowledge.

Mublio

Two friends (including one MADE alumnus) who have been working together as contractors decided to join the Booster Program to commercialize their concept of tailor-made solutions to create more space in houses. With digital design and manufacturing, they provide beautifully designed, space-saving interiors that create more m^2 of living space.

Check out all the boosted startups:
ams-institute.org/ startupbooster
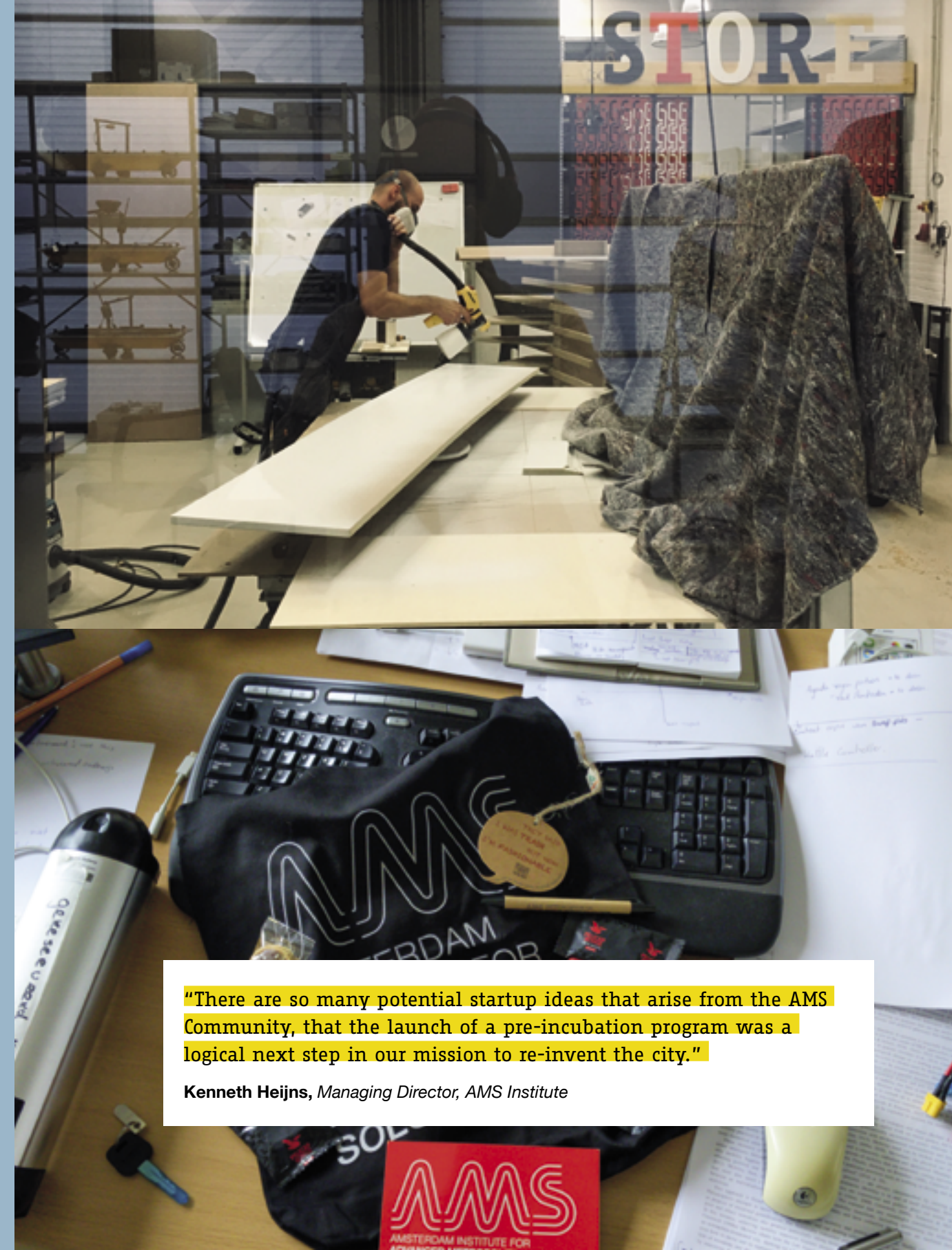
"There are so many potential startup ideas that arise from the AMS Community, that the launch of a pre-incubation program was a logical next step in our mission to re-invent the city."

Kenneth Heijns, *Managing Director, AMS Institute*

"EIT Urban Mobility Accelerator is a great European platform to get your start-up idea to a next level, with the support of a consortium of leading European mobility partners."

SWUGO, *ClimateLaunchpad, National finalist 2020 and AMS Startup Booster participant*

The ClimateLaunchpad for new business ideas

A new generation of climate entrepreneurs, eager to make a difference, participated in the ClimateLaunchpad during the summer of 2020. The eight participating teams pitched their business ideas to a jury of experts in the National Finals in August. One of the participating startups – MycoFiltro – made it to the Global finals to compete with startups from over 55 countries.

EIT Urban Mobility Accelerator Program

The EIT Urban Mobility Accelerator program stimulates new business creation to accelerate positive change on mobility to make urban spaces more livable. AMS Institute and the City of Amsterdam, together with other EIT partners, are responsible for the acceleration program for startups from the Benelux, the UK and northern France. The focus is on startups working to reduce congestion and increase efficiency in the transport system. In 2020 two mobility-related startups participating in the AMS Startup Booster applied to join the EIT Urban Mobility Accelerator. SWUGO was the startup selected to join the program. They aim to make electrified bicycles accessible to everyone.

Young Urban Engineers

Young Urban Engineers (YUE) is a new consultancy, founded by MSc MADE students Annie Berendsen, Hanna Winters and Titus Venverloo. With its focus on multidisciplinary challenges in the urban environment the consultancy aims to play a connecting role between companies, MSc MADE students and the City of Amsterdam. With a fresh perspective YUE integrates different academic disciplines to create no-nonsense innovative solutions.

"The Urban Greenhouse Challenge by WUR is an experience we wanted more students to be able to have. Not only for the students' learning experience, but also for the added value of a fresh perspective for the business and policy world. This is why we started Young Urban Engineers."

Hanna Winters, Annie Berendsen and Titus Venverloo, *MSc MADE students & Founders YUE*

Learn more about YUE:

Sensing the city from a data-driven perspective

Cities are extremely data-rich environments. Technologies like artificial intelligence, robotics, big data, and sensors are increasingly used by the City of Amsterdam. We believe data is a valuable catalyst to gain new insights into our urban environments. AMS Institute aims to enhance the findability, accessibility, interoperability, and reuse of the city's digital assets. Therefore, our goal is to work with cross-domain experts to develop and study novel methods and tools for social urban data processing that are fair, accurate, and accountable. Ultimately, to create solutions that enable better urban planning and decision making to transform metropolitan areas in a transparent and evidence-based way.

Urban Data Science

Our Urban Data Science team develops the in-house competences and infrastructure required to conduct data-driven experiments and studies on urban challenges. They also manage the resulting digital assets, such as data and software. More specifically, AMS Institute designs and develops novel computational methods and tools for the acquisition, integration, visualization, and exploratory analysis of time-varying, dynamic and large urban datasets. This work contributes to an increased understanding of the metropolitan challenges we address. The team also actively supports AMS partners with off-the-shelf technological and methodological solutions and contributes to AMS research and education-related topics.

Data Visualization Lab

Humans are visual creatures and, as such, process visual information much faster than they process text, audio and other modalities. Human beings are also able to detect patterns and anomalies with the blink of an eye. Data visualization makes use of these strong visual capabilities by representing data graphically.

Our Data Visualization Lab therefore develops visualizations and sense-making for social urban data. In turn, data becomes more accessible, understandable and actionable. The Data Visualization team also seeks collaborations with others: for instance, exploring projection mapping in data visualization with the design agency CLEVER°FRANKE and the Chief Technology Office (CTO) of the Municipality of Amsterdam.

Examples of urban challenges addressed by the Urban Data Science team in 2020 include:

The Social Distancing Dashboard

COVID-19 has really turned our lives and worlds upside down. After initial lockdowns in the Netherlands in March and April, society had the difficult task of maintaining social distance in practice. A challenging task in many cities, due to the way public space (or lack of it) has been designed. The Social Distancing Dashboard helps to raise awareness about constraints arising from the design of public space and contributes to decision making for COVID-19 related interventions in urban planning.

By integrating high-resolution open data about the geometry of footpaths, the structure of the street network, the distribution of economic activities along streets, and estimates of pedestrian flows, we can understand how the form and dynamics of cities relate to exposure risks. Importantly, the dashboard can be adapted to the local characteristics of different cities worldwide.

The Social Distancing Dashboard is a project led by scientists from TU Delft, in collaboration with AMS Institute and MIT Senseable City Lab.

"The map visualizes the challenges for residents to live in the 1.5 meter society and for governments to design it. We can use this map to compare the red and orange highlights with the actual situation on the streets. The data helps us come up with interventions, new ways to organize public space and work in a transparent way together with citizens and businesses."

Ger Baron, *Chief Technology Officer, City of Amsterdam*

"Using an integrated approach, the Social Distancing Dashboard blends data, design knowledge, and local context. This helps city officials prioritize the use of open spaces, allowing for safe human movement on the streets. It also raises awareness among city residents – especially those in at-risk groups – who want to navigate the city streets as safely as possible."

Achilleas Psyllidis, *Assistant Professor of Location Intelligence & Spatial Analysis, TU Delft*

February 11
07:30

March 17
07:30

May 12
07:30
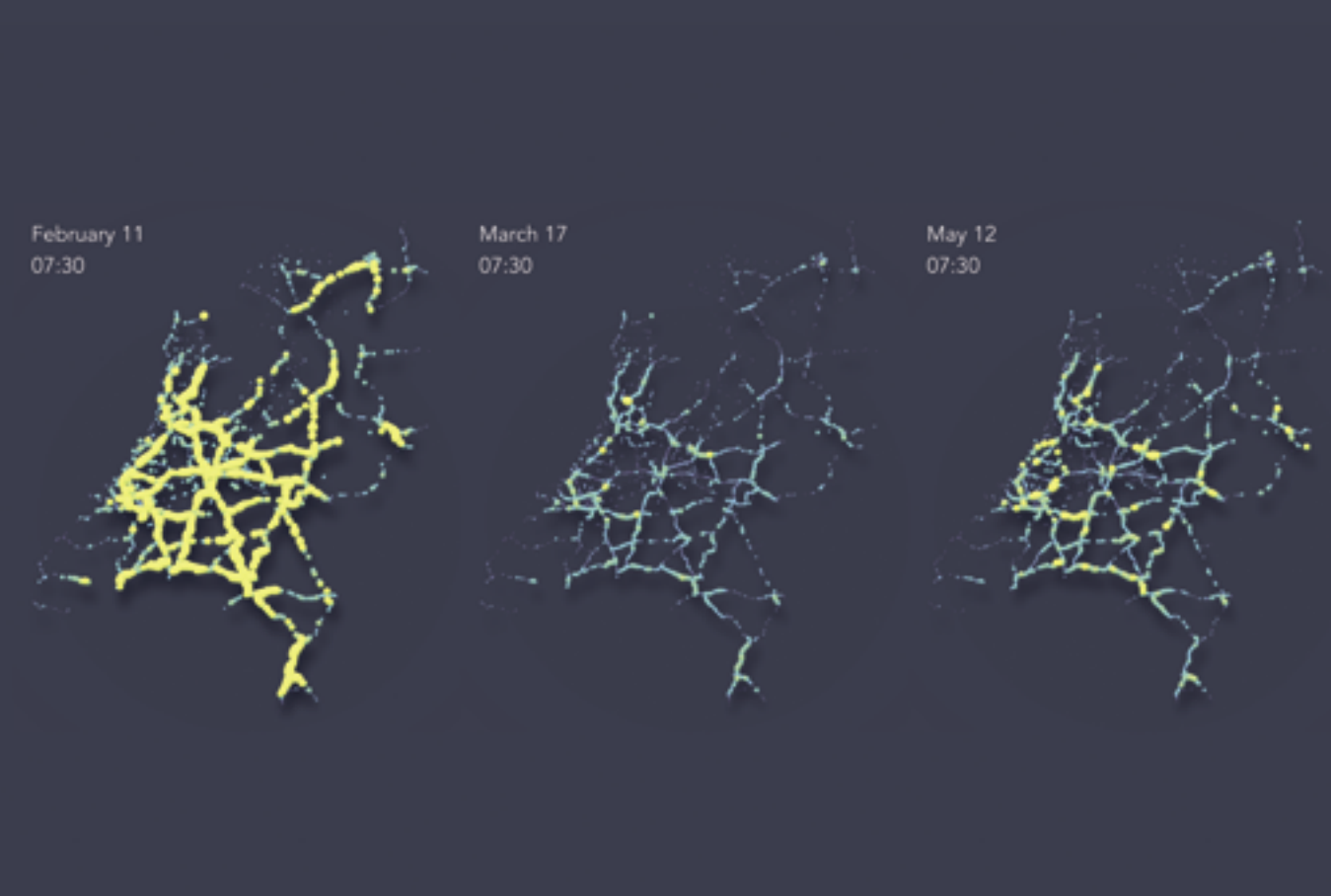
"The total length of the heatwave in August this year was striking. Also, the nighttime temperatures were considerably high – even when the heatwave ended these temperatures dropped slowly."

Gert-Jan Steeneveld,
Senior Researcher, WUR
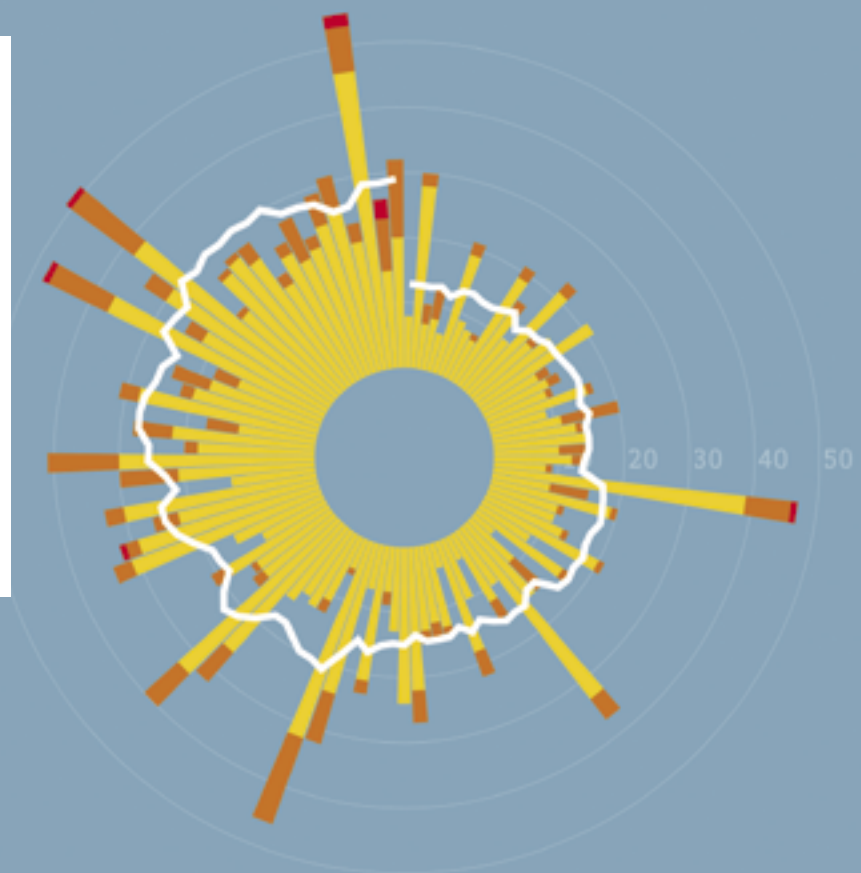
Traffic intensity and the 'intelligent' lockdown

In March 2020, the Dutch government introduced measures to slow down the spread of COVID-19. As expected, this resulted in a decrease in traffic on highways. But what does this look like? To answer this question, our Data Visualization Lab took a dive into the open data of the National Data Warehouse for Traffic Information (NDW). The result clearly illustrates the impact of lockdown measures.

100 years of Dutch summers

Temperature records show that our summers are getting warmer and heat waves are becoming more frequent. At the same time, due to urbanization, the number of city dwellers having to deal with the consequences of increasing heat is also growing.

According to the Royal Netherlands Meteorological Institute (KNMI), the kind of heat waves we saw in 2020 will become more frequent: from once every twenty years a century ago, to every two to three years now. This triggered our data visualization team to create the visualization '100 years of Dutch summers', that shows the impact of our changing climate.

"Each colored ball of the visualization on the top left represents a sensor, and the color indicates how many cars per hour have passed these sensors on the highway. Dark blue indicates low traffic intensity, whereas yellow means the roads are busy. Because many sensors are close to each other, and all those dots are together, the visualization resembles a caterpillar."

Erik Boertjes, *Data Visualization Engineer, AMS Institute*

Board Report

The board of AMS Institute was founded on August 26, 2014 and is registered with the Amsterdam Chamber of Commerce (KVK 61346020). It consists of four representatives – two from each of our founding partners: Delft University of Technology and Wageningen University & Research.

In 2020, the composition of the AMS Board was as follows:

R. Mazier	Chair
H.P.S. Althuis	Member
J.G.A.J. van der Vorst	Member
D.E. van Gameren	Member

The board was supported by the executive secretary **Monique Gulickx**.

The board met nine times, including twice with the executive boards of Wageningen University & Research and Delft University of Technology, to discuss and steer the general development and long-term strategy of AMS Institute. During these meetings, the board addressed a broad range of topics, including:

- The 2019 Annual Report, the 2020 Budget and Annual Plan and the AMS Institute Strategy 2020-2024, following the independent 5-year review (2019).
- Adoption of policy measures in light of the COVID-19 situation.
- Appointment of Professor Eveline van Leeuwen as AMS Institute's Scientific Director.
- Collaboration agreements with, among others, Amsterdam City Maintenance, Program Bridges and Quay Walls, Waternet, Innovation center for Digital Mobility management.
- Research and innovation flagship-project developments, entrepreneurship programs including the 'AMS Startup Booster' and educational offerings.
- Approval of new projects and programs and the extension of existing ones, including 'Roboat', 'Sky High', 'COMPRO', 'CityFlows', 'TRiLOGy', 'GrowX2.0', 'Smart BEEjS', 'D-CoDE', 'Urban Mobility Accelerator', 'Magneto', 'MELiSSA', 'Cultural Culinary Heritage', 'Sea level rise and adaptation'.

The overall Research & Innovation portfolio reached a grand total of 140 projects with a total value of approximately €96.4M.

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Glossary

AAMS
Amsterdam Atmospheric Monitoring Supersite

AM
Amstelland en Multi (gebiedsontwikkelaar)

AMA
Amsterdam Metropolitan Area

BEEjS
Building Efficiency and Energy Justice for Sustainable Living

BKO
Bajes Kwartier Ontwikkeling

CCTV
Closed-circuit television

CM-DSS
Crowd Management Decision-Support System

COMPRO
Converting **Com**posite into building **pro**ducts

CTO
Chief Technology Office of the City of Amsterdam

EIT
European Institute of Innovation and Technology

ENEA
Italian National Agency for New Technologies, Energy, and Sustainable Economic Development

IDM
Innovation center for Digital Mobility management

KNMI
Koninklijk Nederlands Metrologisch Instituut (The Royal Netherlands Meteorological Institute)

MSc MADE
Metropolitan Analysis, Design & Engineering

MALL
Marineterrein Amsterdam Living Lab

MIT
Massachusetts Institute of Technology

MOOCs
Massive Open Online Courses

MPC
Magnetocaloric Power Conversion

NDW
National Data Warehouse

NEMO
New Metropolis Science Museum

NPSP
Natural Powered Speed Products

NWA
Nationale Wetenschapsagenda

PEDs
Positive Energy Districts

PI
Principal Investigator

RES
Regional Energy Strategy

RF
Research Fellow

RSL
Responsible Sensing Lab

RWI
Rheinisch-Westfälisches Institut

SAAS
Software-as-a-Service

TU Delft
Delft University of Technology

ULL
Urban Living Lab

UPC
Universitat Politècnica de Catalunya – BarcelonaTech

VSNU
Vereniging van Universiteiten

WASCOM
Converting **Was**tewater into **Com**posites

WUR
Wageningen University & Research

SLOTERDIJK

STAATSLIEDENBUURT

WesterY

Bosleeuw

WEST

JORDAAN

Mercure

Sportpark
Spieringhorn

Amsterdam
Teleport Hotel

Van de Buurt

Bagels & Beans

Noorderkerk

Havian

Kebaya

Elendy

New Kit

Erasmusgracht

Yam Yam

OLVG Locatie West

DE
BAARSJES

Hotel La Emde

De Nieuwe Liefde

Bijbels Museum

Leonardo Hotel Amsterdam
Rembrandtpark

Hotel Not Hotel

Kinkerstraat

OVERTOOMSE
VELD

Rembrandtpark

Borgerstraat

Jacob van Lennepkade

The Milky Way

Wilhelminastraat

Hotel Europa 92

Rijksmuseum

Overtoom

Orgelpark

Vondelstraat

Bastion

Belfort

Conscious hotel
the fire station

Vondelpark

Vondelpark Open-
Air Theater

Van Gogh Museum

Vondelpark

Van Breestraat

Valeriusstraat

OUD-ZUID

Hotel Washington

Rob Bistrobar

Jan van Goyenkade

Hilton Amsterdam

the College Hotel

TasteAmsterdam

Haarlemmermeerstation

Tijlaanstraat

Apollobuurt

Xaviera's Happy House

Retort

Pad Thai

Eemstraat

Stadionbuurt

ZUID

Zuider Amstelkanaal

Harbour Club Café

Gerrit Rietveld
Academie

Zuider Amstelkanaal

CitizenM

As

Park de
Meeilanden

Rai Theater

Ringweg-Zuid

Ringweg-Zuid

ZUIDAS

Gustav Mahlerlaan

Gustav Mahlerlaan

Lab 012

Crowne Plaza
Amsterdam-South

Holiday In

VU University
Medical Center

Vrije Universiteit

Initium

Novotel

HenriKlave