



Intelligent Citizens

Towards a Resilient & Illuminated Smart City 2.0

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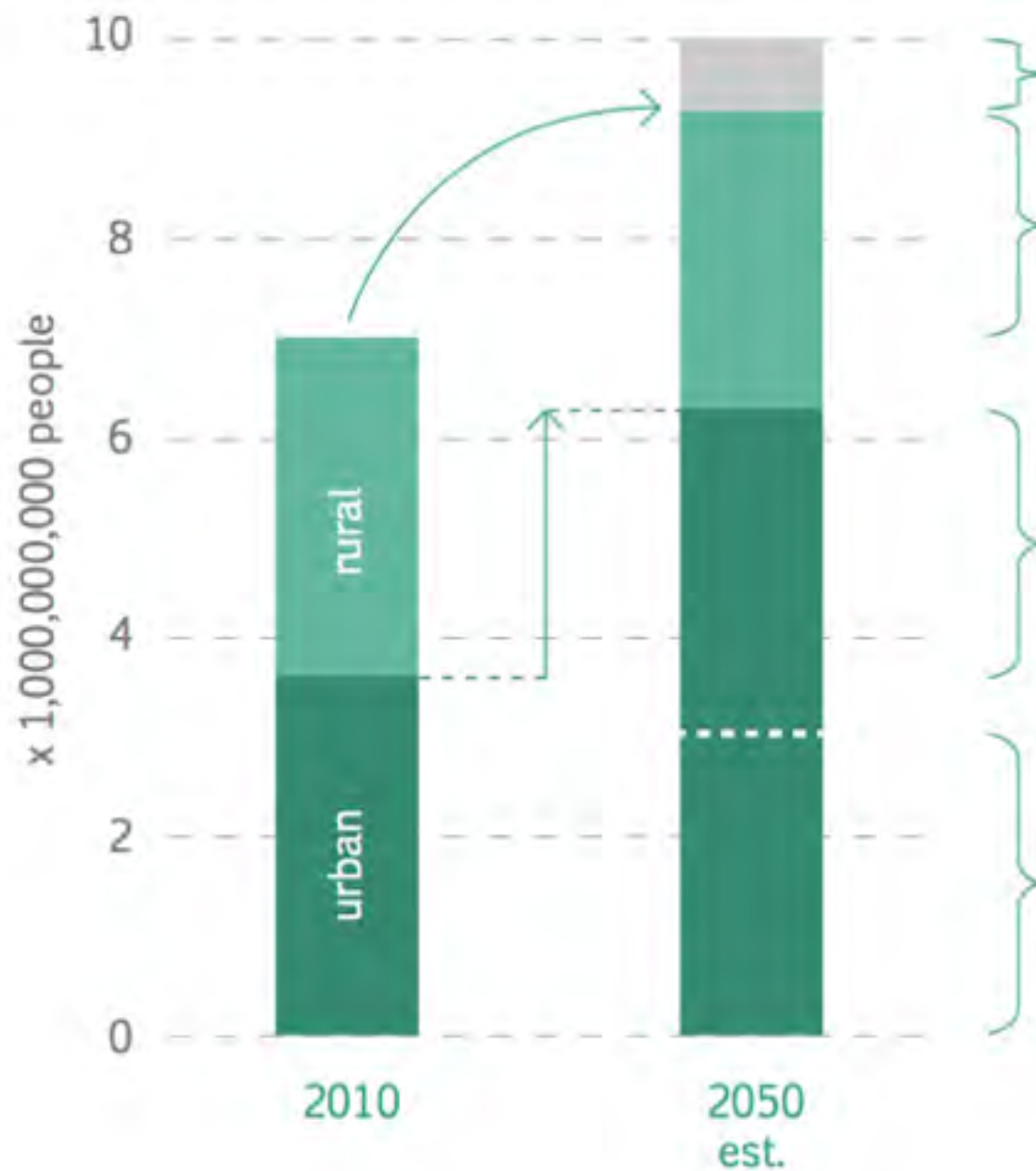
Scientific Director Institute for Advanced Metropolitan Solutions (AMS)



Beijing, China, 500PX, by Daniel Cheong

“ If we expect the extraordinary achievements of human culture to survive, we have to drastically change our self-destructive patterns. ”

URBANIZATION IN CRISIS



without family planning and birth control

+40% in 40 years

is equal to



near doubling of urban dwellers

3,000,000,000 people live in informal settlements

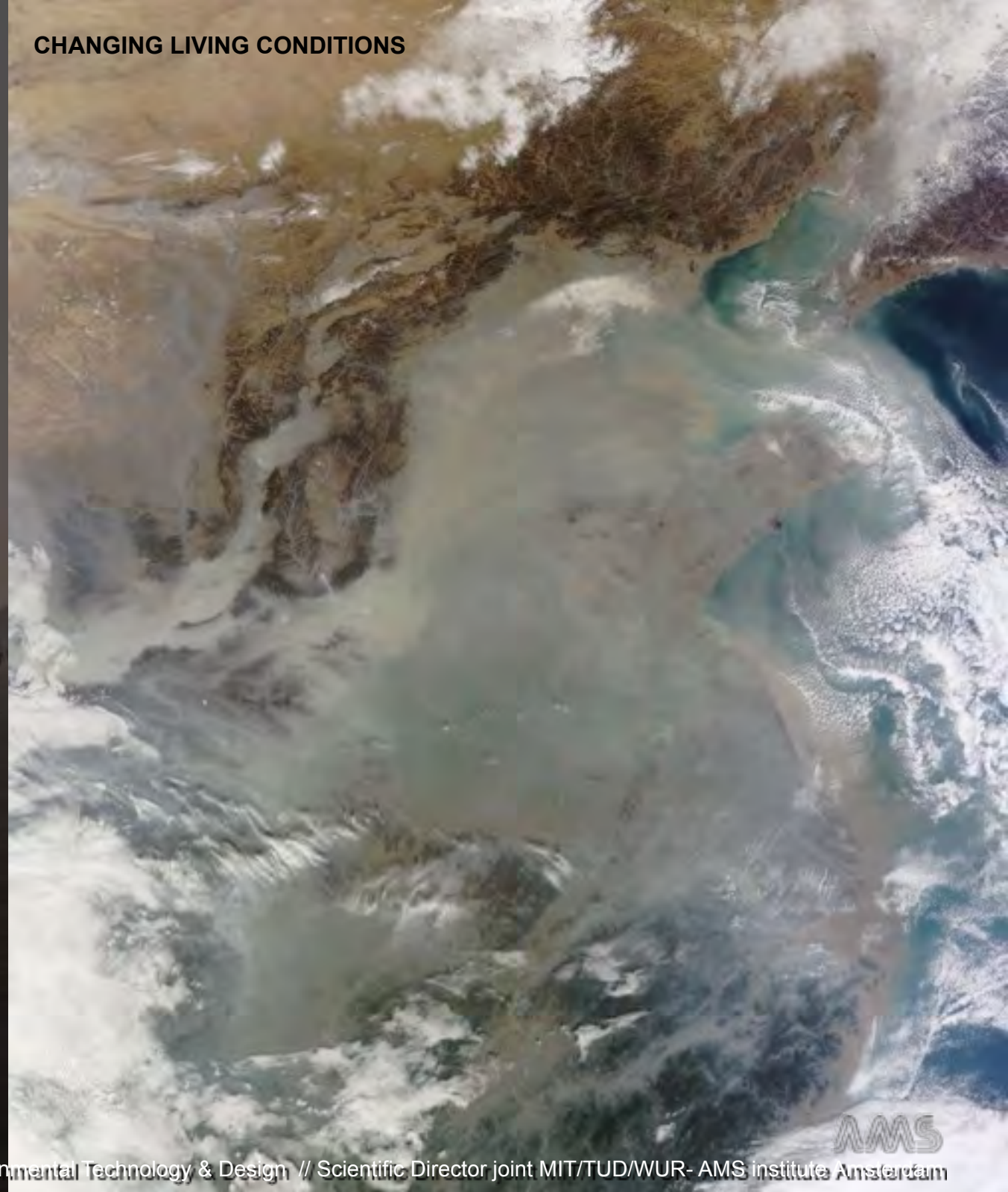


95% of growth in developing countries

[29] World bank 2009
[30] UN 2012

A CHANGING CLIMATE...

CHANGING LIVING CONDITIONS





HIGH QUALITY OF URBAN LIFE , SUSTAINABILITY & RESILIENCE ?

Ecological Footprint of Hong Kong = 2200x its spatial size...

Urban centric ‘positions’ in hopes of initiating a leapfrogging effect with respect to:

- Sustainability → ‘the Sustainable City’
- Improved equity & government transparency → ‘the Just City’
- Quality of life → ‘the Healthy City’
- Increased levels of technological innovation and urban dynamics → ‘the Creative City’
- Happiness → ‘the Happy City’
- Resilience → ‘the Resilient City’
- Efficient infrastructure & resource use → ‘the Smart City’

Prosperous Cities : “smart, sustainable & just” cities

... what means ‘Prosperity’ anno 2016?

hard to answer due to large differences between living conditions in the world ...

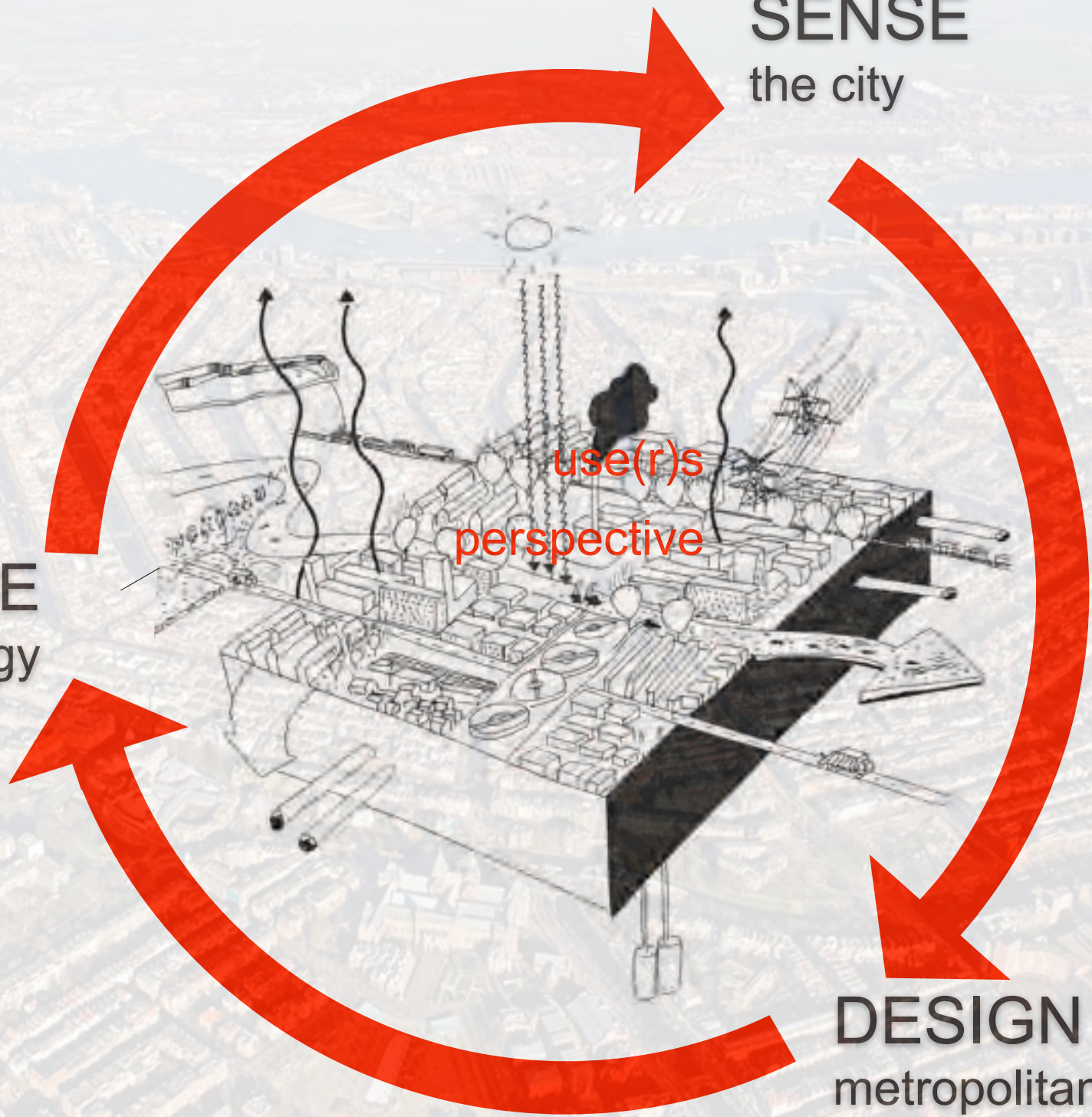
... imperative is that the definition of ‘prosperity’ now, ...
depends on the needs of future generations

UN-Habitat “**City Prosperity Index (2012)**”, with five dimensions of prosperity :

- productivity & innovation,
- infrastructure (development),
- quality of life,
- equity and social inclusion,
- environmental sustainability

source: UN Human Settlements Program (UN-HABITAT) , “State of the World’s Cities Report 2012/2013”

SENSE
the city



INTEGRATE
technology

DESIGN
metropolitan solutions



RISE OF THE SMART CITIES



"SMARTER" CITIES

Through its Smarter City Challenge program, IBM has given free IT consulting to over 100 municipalities and 2000 cities around the globe in hopes of attracting investment in their 'smart city in a box' solutions. For what its worth, it's paid off handsomely as IBM's annual income from smart city consulting fees is about \$3 billion, representing about 25 percent of the company's annual revenue.

Top, left: ads doubling as functional objects, part of IBM's Smarter Cities advertising campaign.



WHAT IS A **SMART CITY**?

While no exact definition exists, the most holistic definition of the smart city imaginary distinguishes **6 distinct aspects** :



SMART ECONOMY

Linking to a spirit of innovation, entrepreneurialism, flexibility of the labor market, integration in the international market and the ability to transform.



SMART MOBILITY

Referred to local and supra-local accessibility, availability of ICTs, modern, sustainable and safe transport systems.



SMART LIVING

Involving the quality of life, imagined and measured in terms of availability of cultural and educational services, tourist attractions, social cohesion, healthy environment, personal safety and housing.



SMART GOVERNANCE

Related to participation of various stakeholders at various levels in the decision-making processes, transparency of governance systems, the availability of public services and quality of political strategies.



SMART ENVIRONMENT

Understood in terms of attractiveness of natural conditions, lack of pollution and sustainable management of resources.



SMART PEOPLE

Linked to the level of qualification of human and social capital, flexibility, creativity, tolerance, cosmopolitanism and participation in public life.



TECHNOLOGY

- The ongoing evolution of IP and the Internet as an underlying framework for services (i.e. Internet of Things)
- Telepresence and videoconferencing
- Open application programming interfaces (APIs)
- New connectivity technologies, including high-speed fixed, wireless and mobile broadband
- Proliferation of smartphones and tablets
- Positioning technologies such as GPS
- Enhanced cameras and image processing
- Machine-to-machine and sensor networks
- Radio-frequency identification (RFID) sensors and near-field communications (NFC)
- Augmented reality (AR)

POLICY & BUSINESS FRAMEWORKS

- Open data infrastructures
- Push for increased data transparency
- The crowdsourcing and open source movement
- The proliferation of cloud computing services and software-as-service models where businesses and individuals lease instead of own software and/or hardware.
- The mash-up model that enables data owners to make data available to third parties
- The development of a wide range of frameworks such as public-private partnerships and distributed governance.



GIVE US YOUR
DATA AND WE'LL GIVE YOU A
TECHNO-UTOPIA

THE IDEA THAT YOU
PUT SENSORS OUT,
MEASURE EVERYTHING,
AND ON THE BASIS
MAKE DECISIONS IS
BIASED BECAUSE
DATA IS CRAFTED.





CENTRO DE OPERAÇÕES
PREFEITURA DO RIO



SONGDO IS NOT A REAL CITY PER SAY,
BUT RATHER THE FIRST ITERATION OF AN
EXTREMELY EXPENSIVE, TOP-DOWN DESIGNED
PRODUCT THAT IS MEANT TO FOSTER AN
IDEAL CORPORATE ENVIRONMENT
AND BUSINESS EXPERIENCE

Songdo (near Seoul), CISCO Systems version of a 'Smart City'




Humanity was once dispersed and dislocated on a planet that used to be so mysterious and unfamiliar, but through ingenuity and technological prowess we have created a globalized society, integrated by *ubiquitous* infrastructures, that now finds itself on the precipice of concurrent crises. Cities have become the stage of modernity as the realities of resource scarcity, climate change, stiff global competition and technologically-led austerity are forcing them (us) to adapt to ever changing, economic, environmental and socio-political conditions. IT companies, politicians, and technologists claim they have the exact remedy to urban ills: the Smart City.

For them, smart sensors and sophisticated algorithms can be used to optimize urban space and make our cities more efficient, environmentally sustainable, economically attractive and socially inclusive. Seeing as information and communications technologies have disrupted so many other industries in the last 20 years, can it actually be used to solve age-old urban problems and take us into the future? Does the Smart City illuminate the intricate complexities of urban life, the reciprocities between cities and their hinterlands, and empower individuals and communities? Or are there elements of urbanity and the human condition that lie beyond the purview of data collection alone?

ISBN 978-94-6186-417-8



 TU Delft

UBIQUITY & THE ILLUMINATED CITY

TIMMEREN

HENRIQUEZ

REYNOLDS

UBIQUITY

&

THE ILLUMINATED CITY

ARJAN VAN TIMMEREN LAURENCE HENRIQUEZ
ALEXANDRA REYNOLDS

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“ The most pressing urban problems are not technological but social in nature, and have tended to be exacerbated, not solved, by corporate-led privatization and city branding strategies. ”

DIGITAL DIVIDES AND ELITE ENCLAVES

IN 2012,
(SMART) SINGAPORE BEAT THE UNITED STATES
TO HOLD ITS TITLE AS THE MOST ECONOMICALLY
UNEQUAL SOCIETY OF ALL OECD COUNTRIES.





**BY MIDCENTURY 2 BILLION PEOPLE
IN DEVELOPING COUNTRIES
WILL BE LIVING IN
INFORMAL SETTLEMENTS**



the “Right to the City” (Henri Lefebvre)
and: the “Right to Infrastructure”



“To be an engineer ...

is not enough to be an engineer”

José Ortega y Gasset

THE STACK

Physical

Technical

Biological

A-Biological

Earth

Cloud

City


Network

Address

Interface

User





Cities have continued to decentralize
while Utilities have been centralizing !
but this is changing!

The concept of smartness

“

A city can be smart only if it is able to integrate and sort data gathered from each type of sensor. That would increase efficiency, equity, sustainability and quality of life

”

Batty et al, 2012



People to machine (P2M)



“

In general, a Smart City is seen as a city which enables citizens and enterprises to apply new ICTs to economise time, improve individual mobility, facilitate access to information and services, save energy and resources, and participate in urban decision-making processes.

”

Kunzmann, 2014



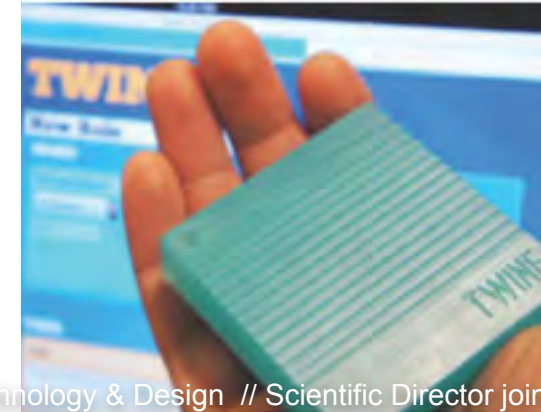
Dubai 'The Strip' (Daniel Cheong, 2014)



INTERNET OF EVERYTHING

There has been an explosion of crowdfunded projects related to the Internet of Things and smart devices in the past few years. Projects range from surveillance systems to energy monitors to virtual pets whose well being is dependent on the user exercising.

AMS
Amsterdam



RECENT **SMART** INTEGRATED CONCEPTS

» The world's first solar bike path has been built in by SolaRoad in the Dutch town of Krommenie.



« The Oyster card is the key to London's smart public transport system. The data collected from the cards is used to create more intelligent traffic management systems.



« Part of the Citybike Wien fleet, Vienna's public bike rental system.



» Automated pods provide a new form of transit for visitors to Heathrow International Airport in London. The same system has also been implemented in Masdar City.



At 2010-10-04 07:00:00 there were 215 bikes in use.





IT IS
**CONSTANT
INNOVATION**
THAT STANDS OUT AS
THE KEY STIMULUS FOR
LONGEVITY IN
ECONOMIC
COMPETITIVENESS

Smart cities might not completely live up to the claims of corporate marketers, but their function as a **testing ground** for experimental technologies offers a possible vision of what our future cities might look like: **tech-enabled, hyper-efficient urban spaces** that harness sensing technology to manifest **the most seamless and automatic urban experience** possible.

FROM IPv4 TO IPv6

The Alphabet of Ubiquity

IP : INTERNET PROTOCOL

As the **Internet of Things** expands ever further, so too are the numbers of devices that are capable of connecting to the internet. Each of these connected devices has an assigned IP address to identify its network and location.

1980

First major protocol in use is **IPV4** encompassing **4.3 billion** addresses

```
~$ ipv4
32-bit address
4.3 • 109 unique addresses

81.68.63.14
└─┬─┘
  binary number from 0-255
```

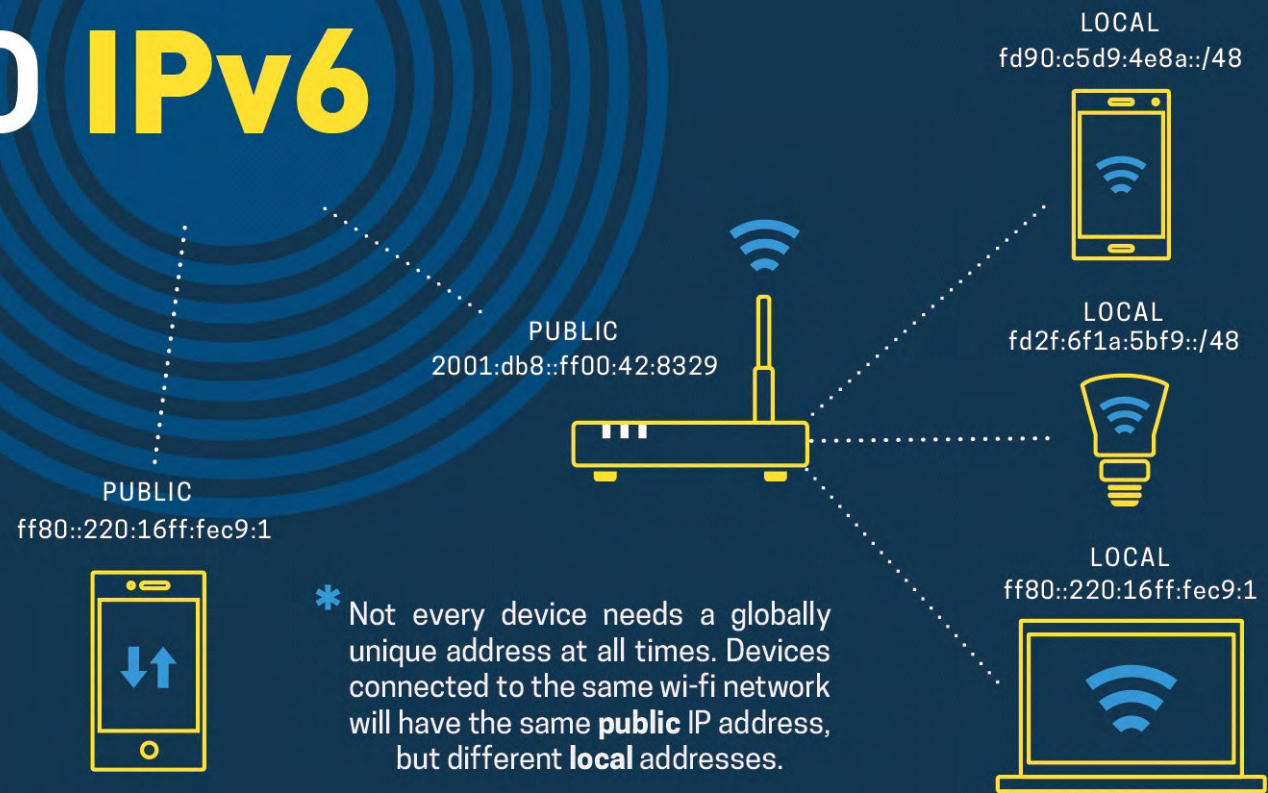
2011

Free IPv4 address pool is **EXHAUSTED**

The world transitions to its much larger successor:

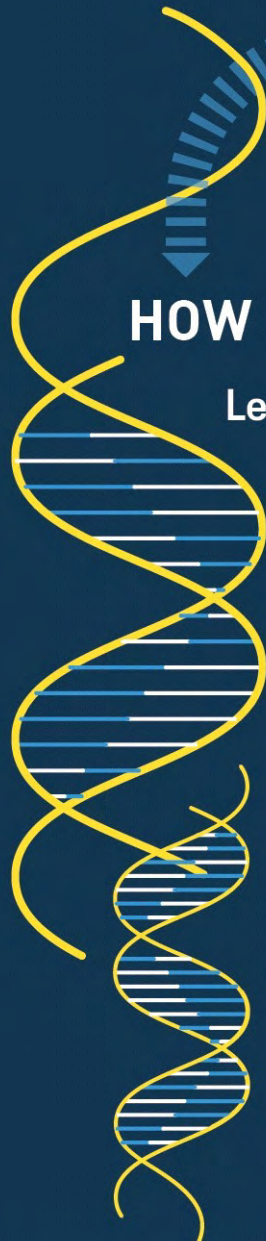
IPv6

* Not every device needs a globally unique address at all times. Devices connected to the same wi-fi network will have the same **public** IP address, but different **local** addresses.



HOW MANY ADDRESSES IS 3.4×10^{38} REALLY?

Let's put things into perspective.



3×10^9
3 BILLION
The number of **DNA base pairs** in a single human cell¹.

3.72×10^{13}
37.2 TRILLION
The number of **cells** in the human body².

7.2×10^9
7.2 BILLION
The number of **humans** on this planet³.

8.04×10^{32}
80.4 NONILLION
Total number of **DNA base pairs** of all living humans on the planet.

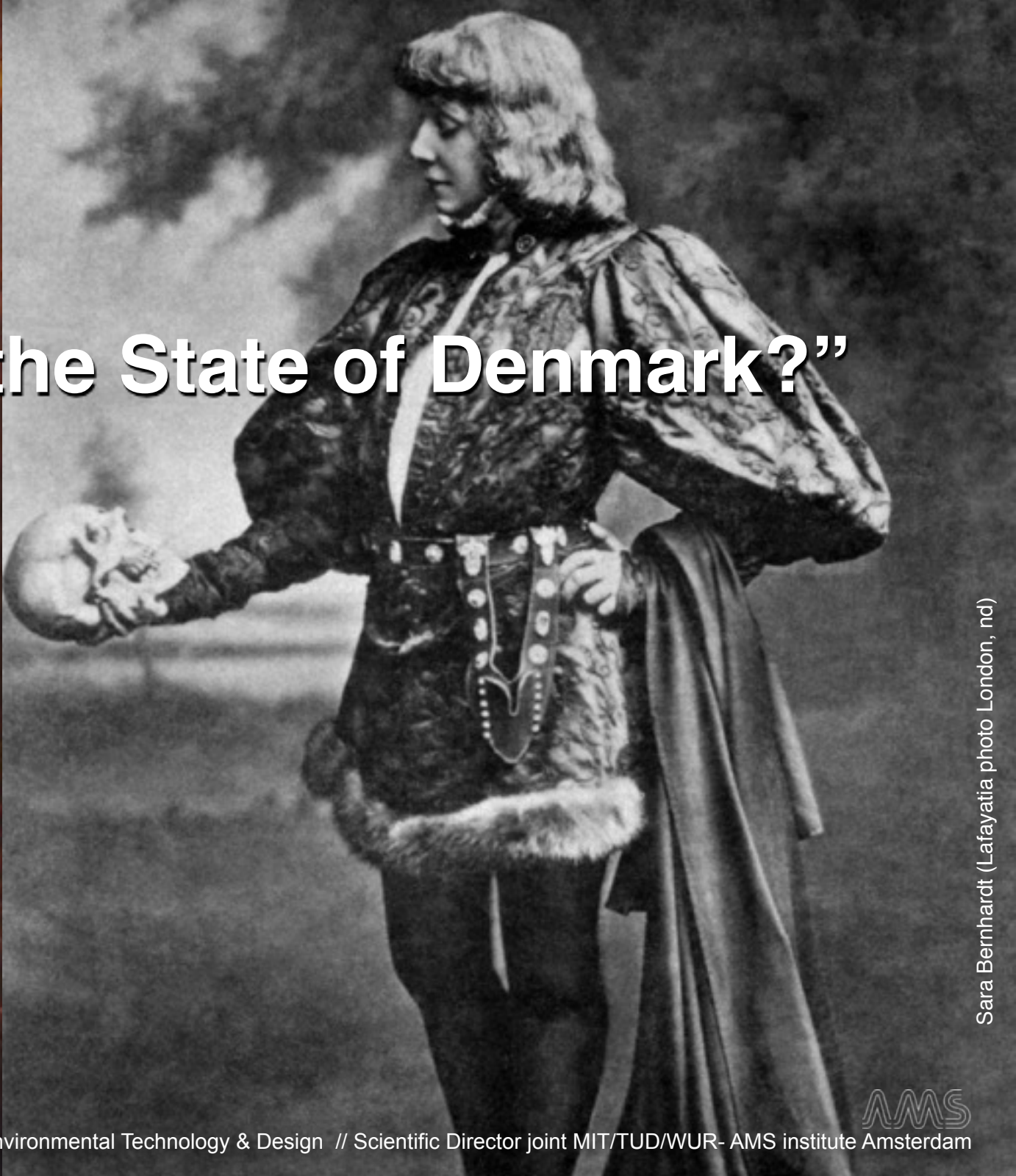
423,000
The number of **IPv6 addresses** that could be assigned to **every DNA base pair** in **every living human** on Earth.

1. Human Genome Project.
<http://www.genome.gov/11006943>
2. Bianconi, E., Piovesan, A., Facchin, F. et al. (2013). An estimation of the number of cells in the human body. *Annals of Human Biology*. November 1st.
3. Population Reference Bureau.
http://www.prb.org/pdf14/2014-world-population-data-sheet_eng.pdf



Eugène Delacroix (1839) Hamlet and Horatio in the Graveyard

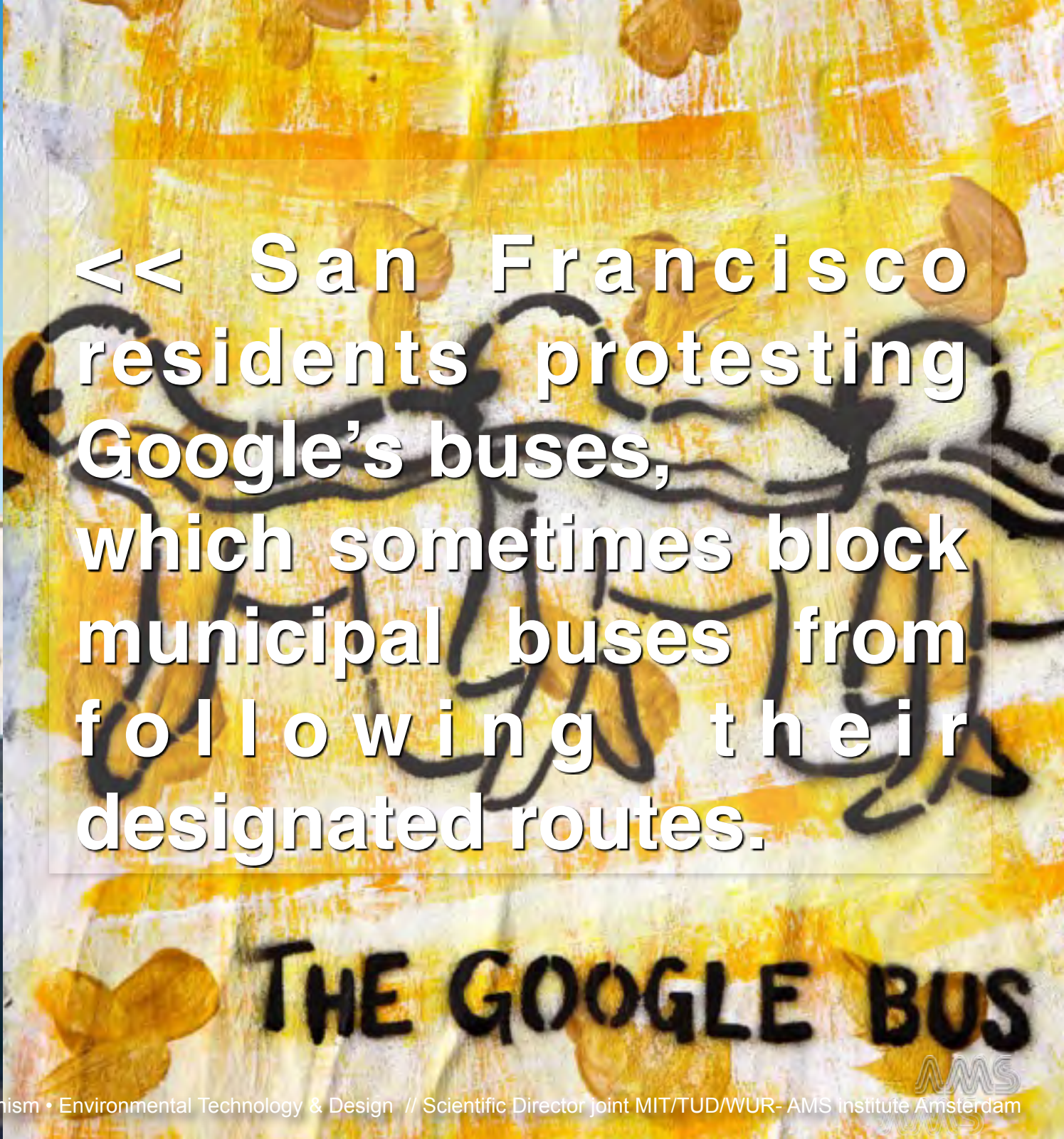
“Is something rotten in the State of Denmark?”



Sara Bernhardt (Lafayette photo London, nd)



<< San Francisco residents protesting Google's buses, which sometimes block municipal buses from following their designated routes.







Cloud Computing

Dynamic Infrastructure

HOW STANDARDS PROLIFERATE: (SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

SITUATION:
THERE ARE
14 COMPETING
STANDARDS.

14?! RIDICULOUS!
WE NEED TO DEVELOP
ONE UNIVERSAL STANDARD
THAT COVERS EVERYONE'S
USE CASES.

YEAH!



SOON:

SITUATION:
THERE ARE
15 COMPETING
STANDARDS.



LIBERTÉ, PRÉDICTIVITÉ, UNIFORMITÉ

“ Smart cities may be the apotheosis of Homo Ubikis, where we become so reliant on ubikquity that our capacity to reason could not function without it. ”



ACCELERATION
TOWARDS CLOUD
FEUDALISMS



... and all with the tacit click or poke
of an arcane user agreement form.

TOWARDS ... SMART CITY 2.0





AMS-Institute, Amsterdam





ACADEMIC, PRIVATE AND PUBLIC PARTNERS

DELFT UNIVERSITY
OF TECHNOLOGY

WAGENINGEN UNIVERSITY
AND RESEARCH

MASSACHUSETTS INSTITUTE
OF TECHNOLOGY



- ACCENTURE
- ALLIANDER
- CISCO
- ESA
- IBM
- SHELL
- WATERNET
- AEB
- PORT OF AMSTERDAM
- DELTA RES
- ...
- ...

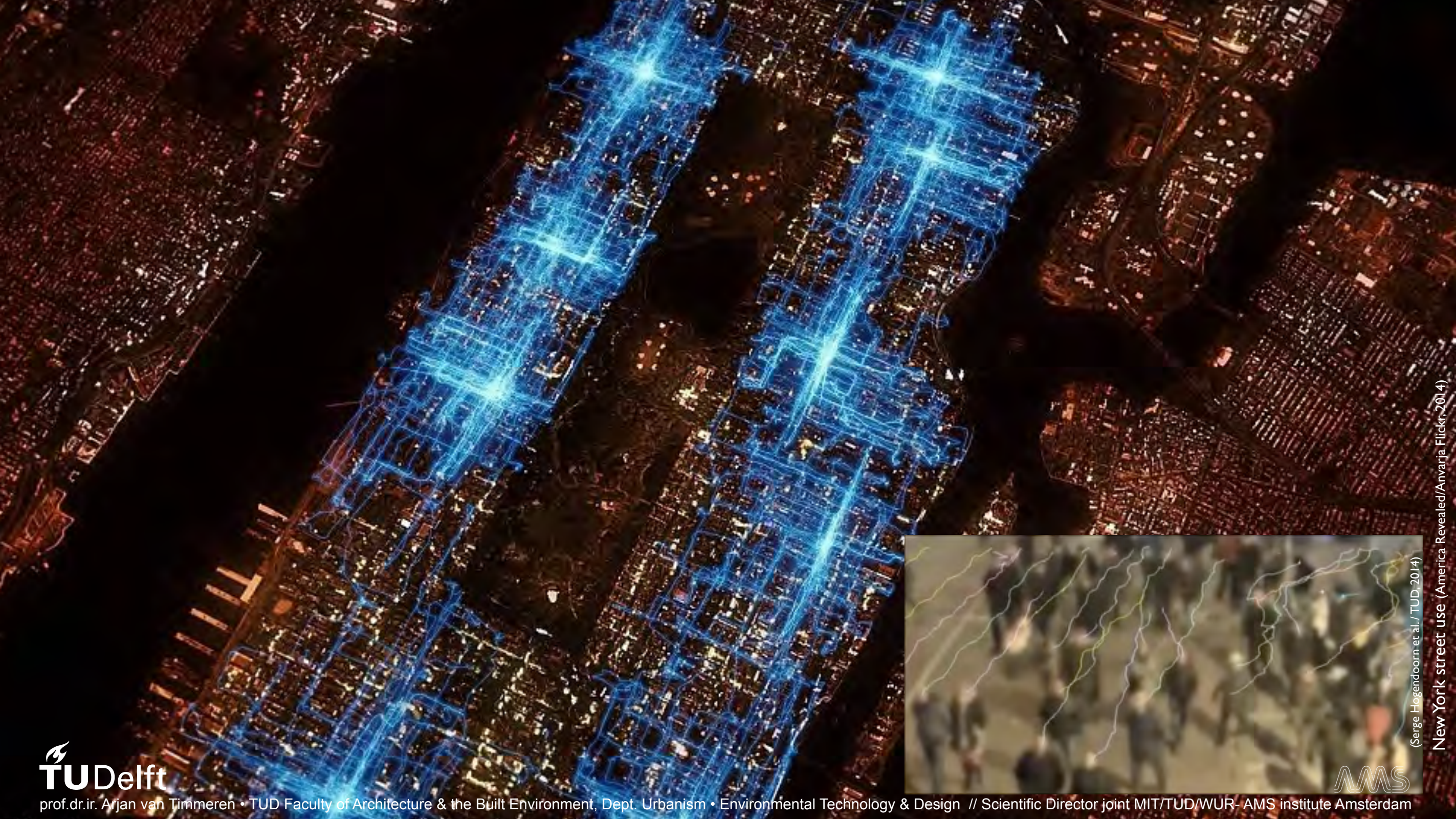
AMSTERDAM SMART CITY | CITY OF BOSTON | KPN | TNO | WAAG SOCIETY | CITIZEN PLATFORMS



the city of Amsterdam as
a Living Laboratory...



SOCIAL GLASS



Social Urban Data

Sensor & Mobile Phone Data

Social Web Data

Census Records, Demographics, Spatial Statistics, Economic Data, Real-Estate Data etc.

Physical Sensor Data, Mobile Phone Logs (CDRs), Transport Data, Energy Data etc.

Geo-localized Social Media Data from web platforms (e.g. Twitter, Instagram, Sina Weiboo 4SQ etc.)

High data quality
High levels of accuracy, completeness, and validity
Generally truthful
Semantic-by-design

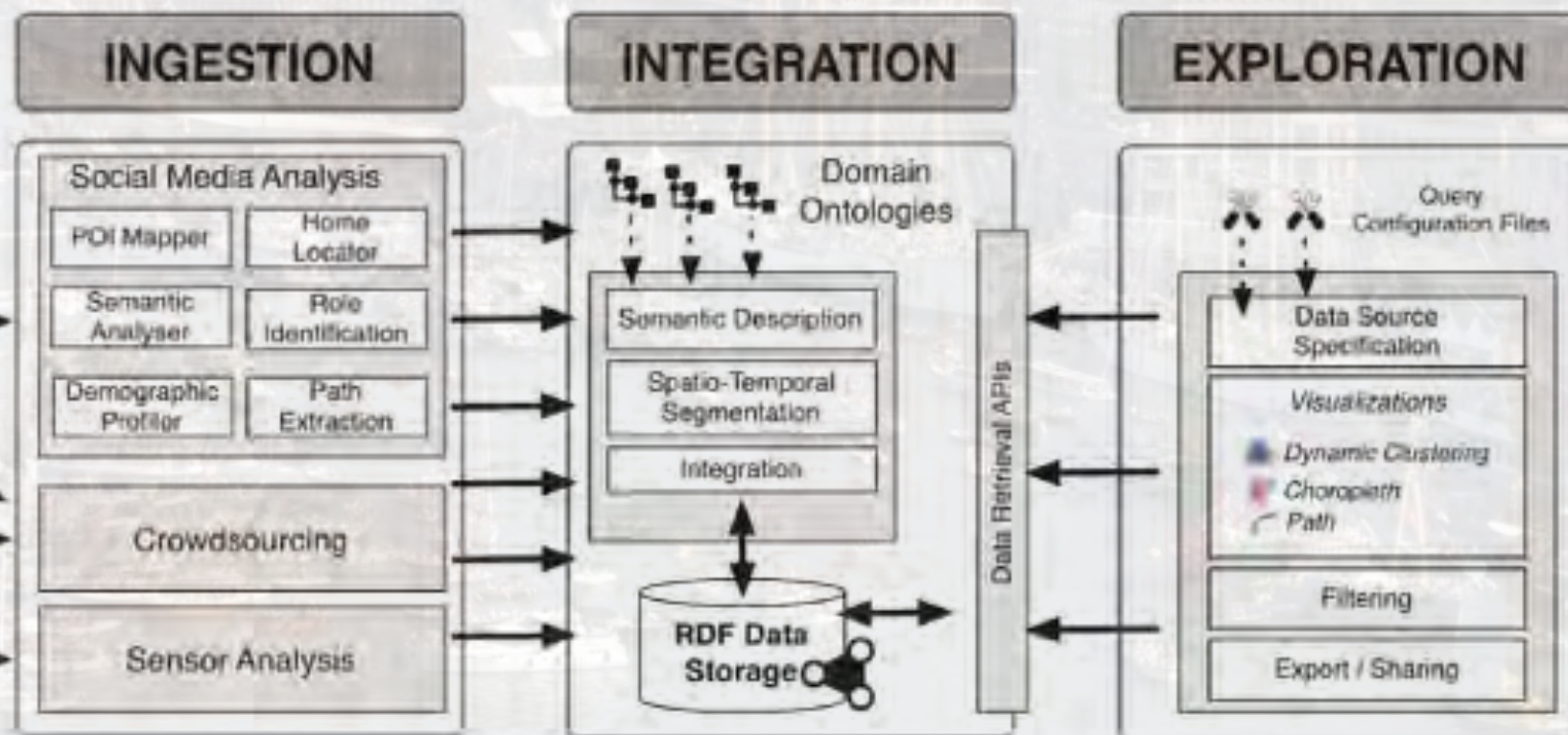
High levels of accuracy
High spatio-temporal resolution
High technology penetration
Generally truthful
Scalable & dynamic

High speed & refresh rate
Created by people
Enriched with annotations about places and human activities
Scalable

Low refresh rate
Costly & laborious collection methods
Non-scalable
Limited or no temporal variability (static, semi-static)

Mostly proprietary
Very expensive to acquire (CDRs)
Very expensive to deploy at the city-scale
No semantics

Mismatch between the platform's scope and the application domain
"Noisy"
Biased (tech, social)
Generally untrustworthy



SOCIALGLASS



Largest public sailing event in the World

5 Days, >1.5M Visitors, >300K/Day

Mix of Commuters / Tourists / Visitors

**ORGANIZERS'
GOAL:
Real-time crowd
monitoring**

Main Route: ~ 6Km

**What measures can I apply to
manage the crowd?**

**What is the effect of such
measures?**



How many people are in my
area?

What kind of people are
these?

Where do they come from?

Which routes do they use?

How long do they stay in my
area and for what purpose?

What are travel times on
these routes?

Research Goal: Analysis and validation of mobility patterns as observed from social data

8 Camera



Count heads @Location

High Precision,
No Semantics
Low Spatial Density
High Time Density

100 GPS



Track Route

Random Distribution,
Precise Semantics
(*Demographic, Usage Role*)
Low Density

20 WiFi



Count Devices @Location

Fixed Position
No Semantics
Low Spat. Density
High Time Density

Social Media



Count Users, Track Routes

Biased Distribution
Inferred Semantics
(*Demographic, Usage Role, Topic, Sentiment*)
Higher Spat. Density, Lower Time Density



Crowd control van de toekomst: elektronica houdt drukte Sail bij

22-08-15 12:30 uur - Bron: Het Parool



Drukke op de Veemkade tijdens Sail. © anp

Tijdens deze editie van Sail wordt geëxperimenteerd met crowd control van de toekomst, met in plaats van alleen verkeersregelaars en matrixborden allerlei nieuwe snuffjes.

Als draden uit een bolletje wol trekken ze over de lens. Op telcamera's zijn de voetgangers door het Sailgebied niet herkenbaar, maar binnen het onscherpe beeld wordt haarfijn hun zwalkende beweging over de kades

Dashboard to unravel SAIL 2015 visitor flows and potential critical situations based on real-time data collection and innovative data fusion techniques





Twitter

27.082

Aantal gebruikers

Total users

137.502

Aantal Berichten

Total posts

Aantal 'Drukte' woorden

Total 'Busy' words



Instagram

33.244

Aantal gebruikers

Total users

88.741

Aantal Berichten

Total posts

Aantal 'Drukte' woorden

Total 'Busy' words



Research Goal:
Analysis and validation of mobility patterns as observed from social data

Sentiment analysis

Gevoelsanalyse

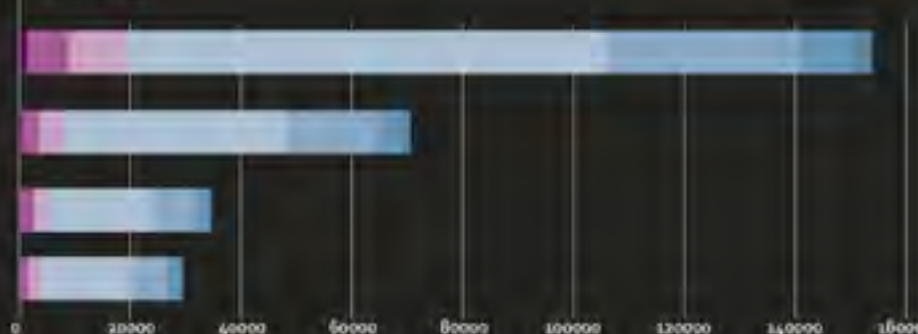


Aantal berichten
Number of comments

Negative

Positive

Twitter



Bewoners
Residents

37%*
Gebruikers
Users



De Twitteractiviteiten van bewoners zijn meer verspreid over de stad, terwijl de foto's op Instagram meer op het centrum geconcentreerd zijn.

Residents' activity is uniformly distributed across the city, while photographic posts are focused on the city center.



27%*
Gebruikers
Users

Binnenlandse bezoekers
Local Visitors

16%*
Gebruikers
Users



Lokale bezoekers focussen hun activiteiten op minder locaties rond het centrum, maar het patroon is intenser, vooral op Twitter.

Local visitors focus their activities on fewer locations around the city center, but it is more intense, especially on Twitter.



40%*
Gebruikers
Users

Buitenlandse bezoekers
Foreign Visitors

47%*
Gebruikers
Users



Toeristen focussen meer op de binnenstad, maar kennen een scherper onderscheid tussen het maken van foto's van de binnenstad (Instagram) dan het er over praten (Twitter).

Tourists focus more on the city center, but are more keen on taking pictures of the city (Instagram) than talking about it (Twitter).



33%*
Gebruikers
Users



BEAUTIFUL ALGORITHMS

In the past, GPS mapping algorithms have generally been restricted to calculating the shortest, cheapest, or fastest routes.

Researchers at Yahoo Labs in Barcelona are revisiting this idea. After studying correlations in Flickr's database of photos and their tags, they developed an algorithm to calculate the happiest, most beautiful, and most quiet routes through London and Boston. They had 84 users between the two cities evaluate the paths their algorithm generated, and lo and behold, the users agreed that the algorithm did exactly what it set out to do.

(Yahoo Labs Barcelona, 2014)



shortest route



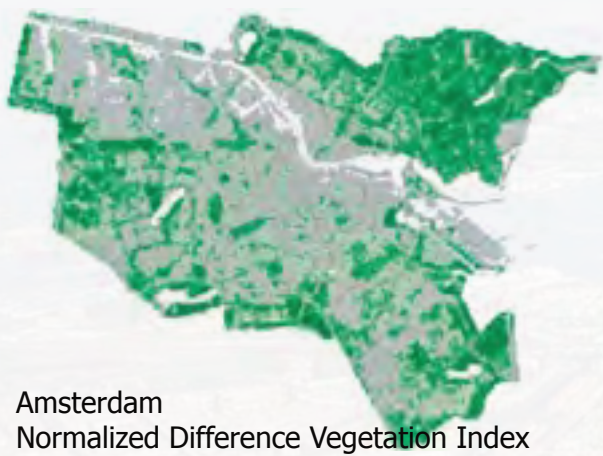
happiest route

most beautiful route

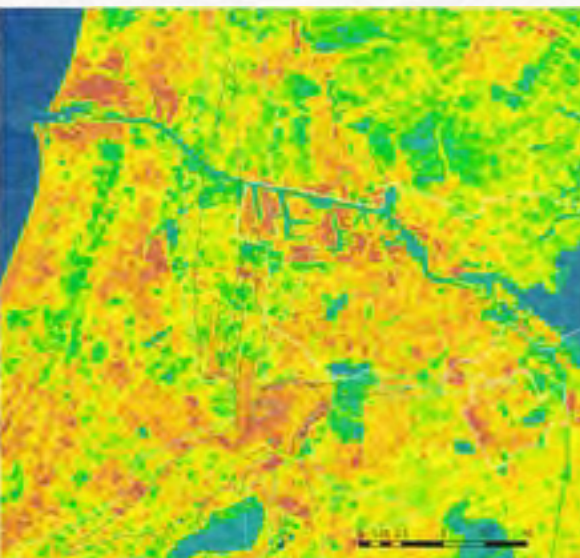


most quiet route





Amsterdam
Normalized Difference Vegetation Index

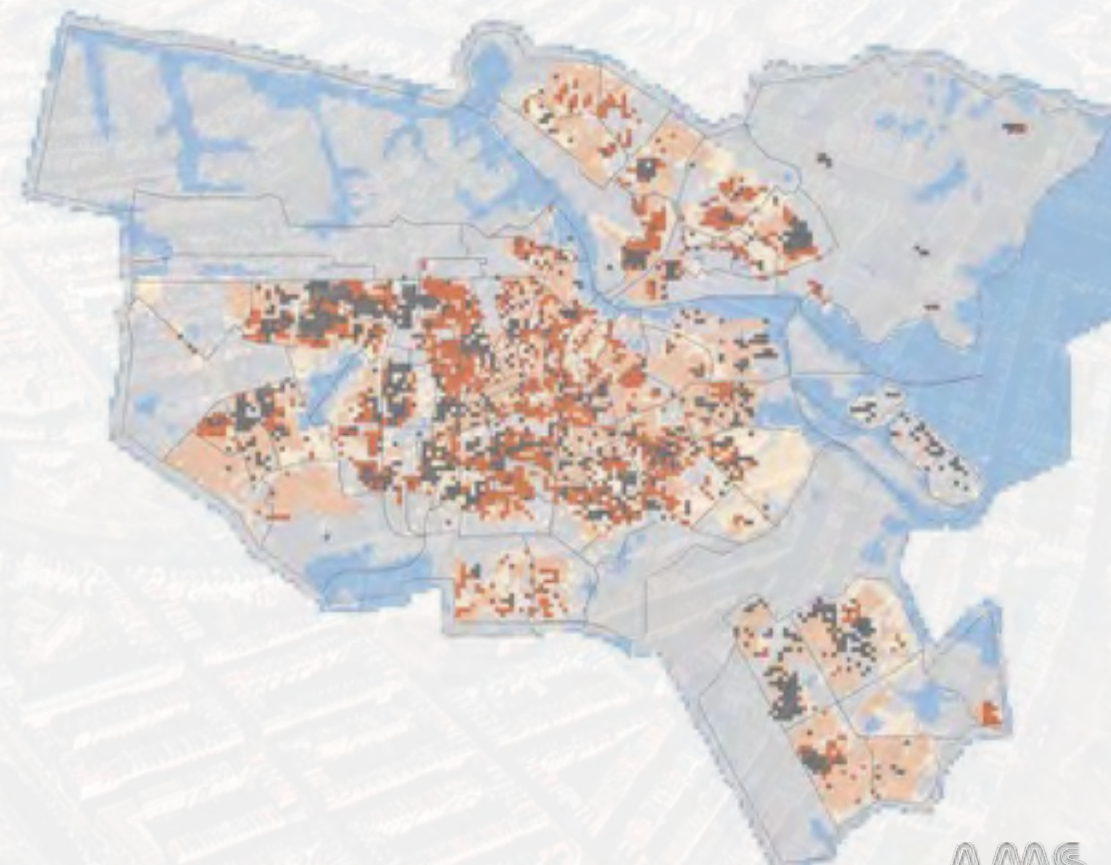
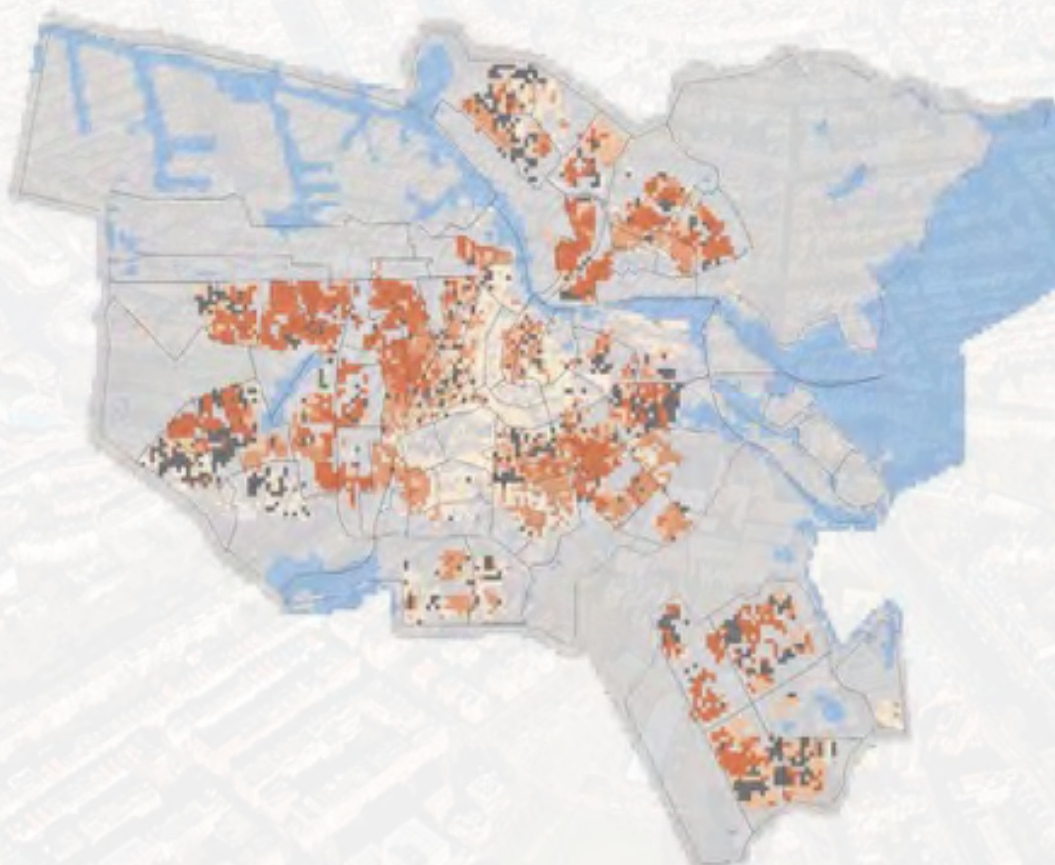


Typology Vulnerability of Inhabitants: elderly

	UHI surface temperature	Quality of Life index	Average energy label of buildings	75+/ha
most vulnerable	8 C°	modest positive	D	18.3
more vulnerable	8 C°	modest	D	5.0
vulnerable	8 C°	modest positive	G	6.5
little vulnerable	8 C°	modest positive	E	4.6
little vulnerable	7 C°	positive	G	4.5
other	-	-	-	< 1.5
water	-6 C°	-	-	0

Typology Vulnerability of Inhabitants: infants

	UHI surface temperature	Quality of Life index	Average energy label of buildings	Infants/ha
most vulnerable	8 C°	negative	G	3.7
more vulnerable	8 C°	modest negative	G	1.7
little vulnerable	8 C°	modest positive	G	1.4
little vulnerable	8 C°	modest positive	-	0.3
other	-	-	-	<0.2
water	-	-	-	-





Proximity Filtering

You can filter other datasets to only include records from that dataset that are within (or in proximity to, or not in or near) one or more shapes in this dataset.

Include only records inside of or within 1000 feet of this dataset.

Apply as filter to:

- SF Crime Incident...

Disable **LOCKED** DISABLING Proximity Filtering will UNLOCK this dataset and its filters.



SF Crime Incidents - Jun 25 - ...

Count

Color scale legend: 0 to 100

SF Public and Private School...



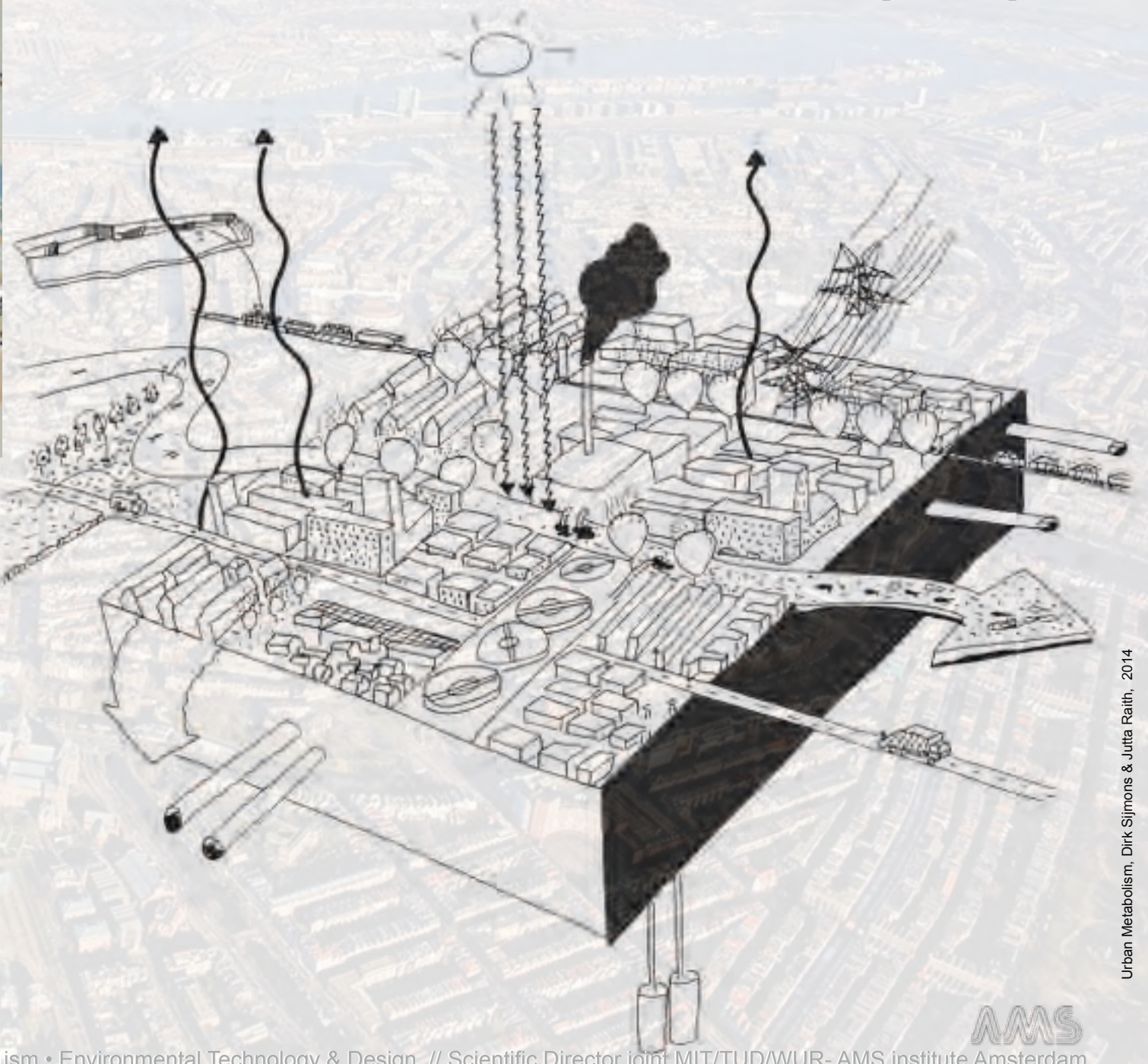
URBAN METABOLISM (UM)



Amsterdam Smart Grid, EB, Watermet, Gem, A'dam ea, 2013 /



Energie atlas, Stremke, Spiller, Agema, Jonkhoff, van der Hoek et al. 2014



Urban Metabolism, Dirk Sijmons & Jutta Raith, 2014

An aerial photograph of Central Park in New York City, showing the dense green and yellow foliage of the park in the foreground and the dense, multi-story buildings of Manhattan in the background under a cloudy sky.

METROPOLITAN METABOLISM
X
REAL TIME FEEDBACK LOOPS

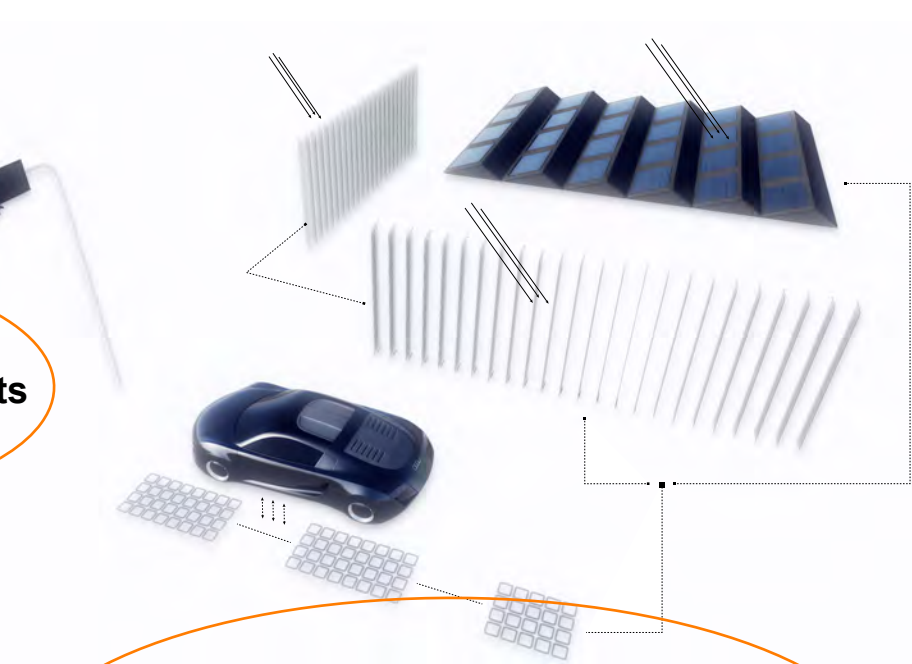
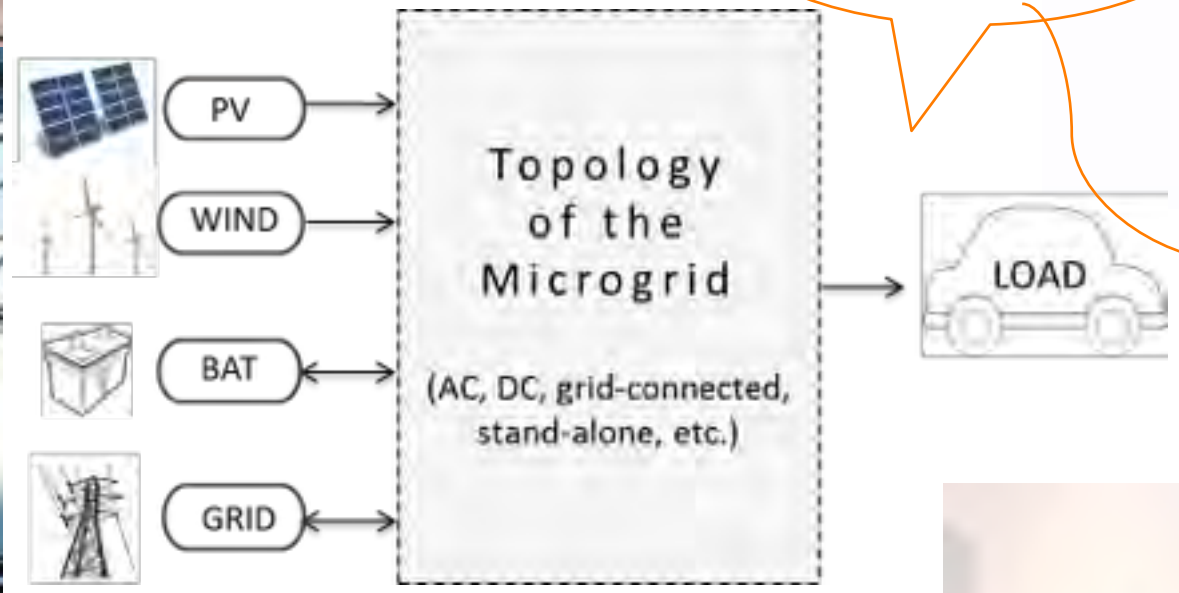
= (URBAN) PULSE



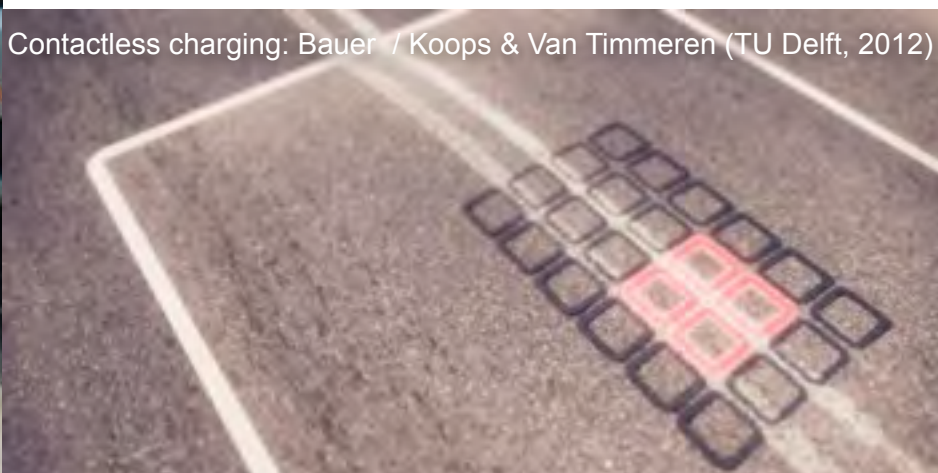
- Data (wind speed, solar irradiance)
- Components specifications,
- Optimum Operation

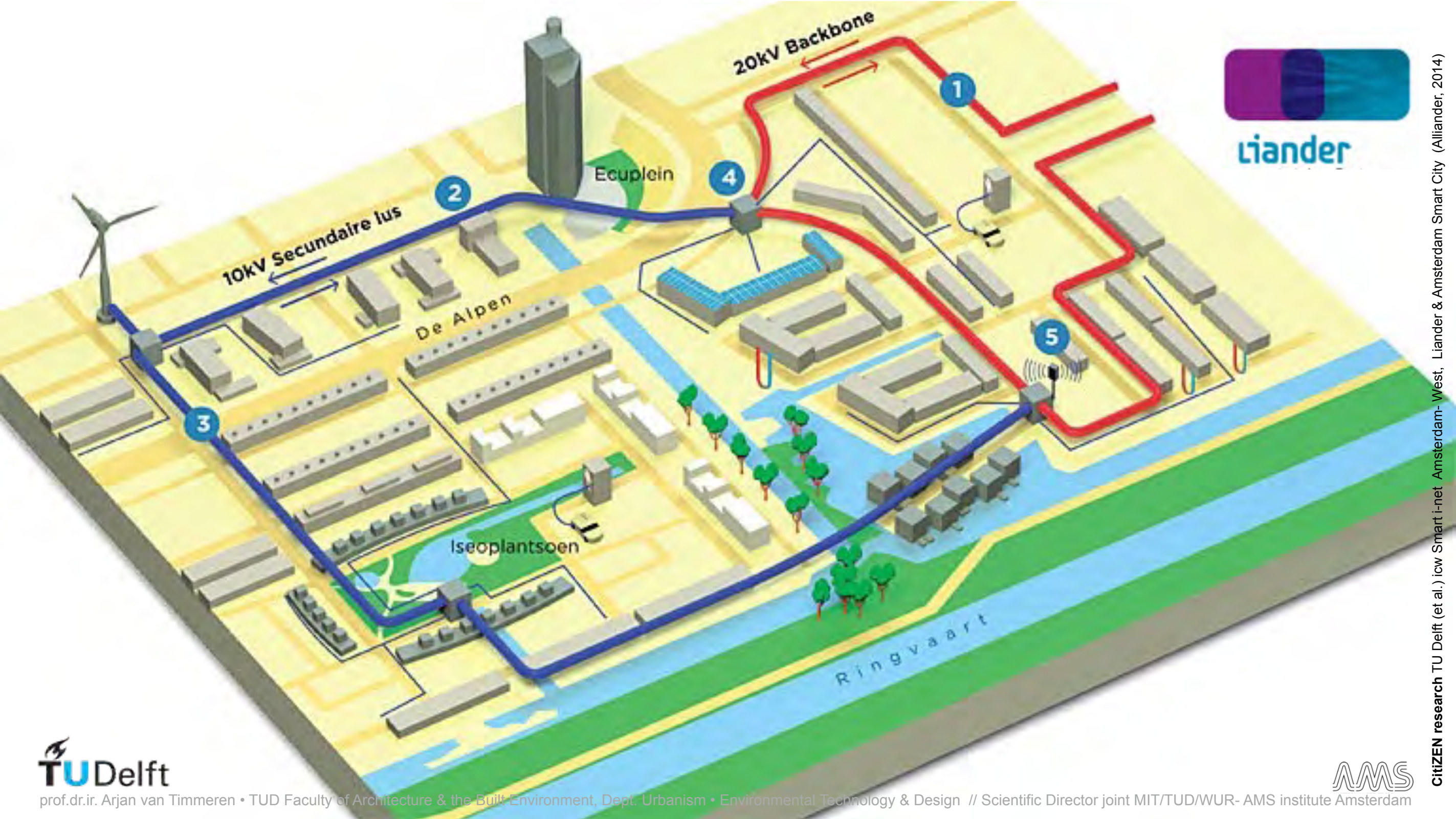
- Optimum Topology
- Sizing of components
- Power Management

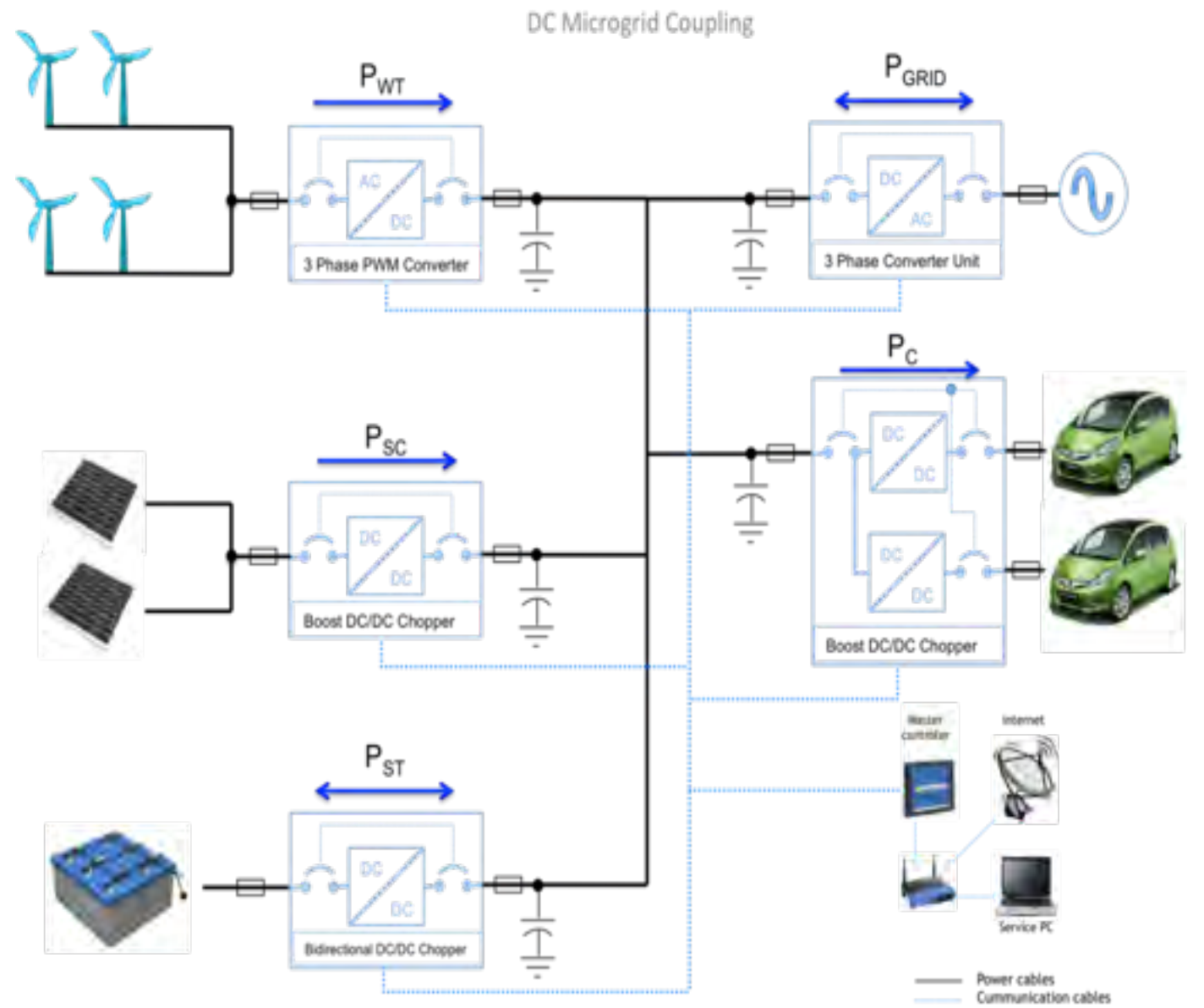
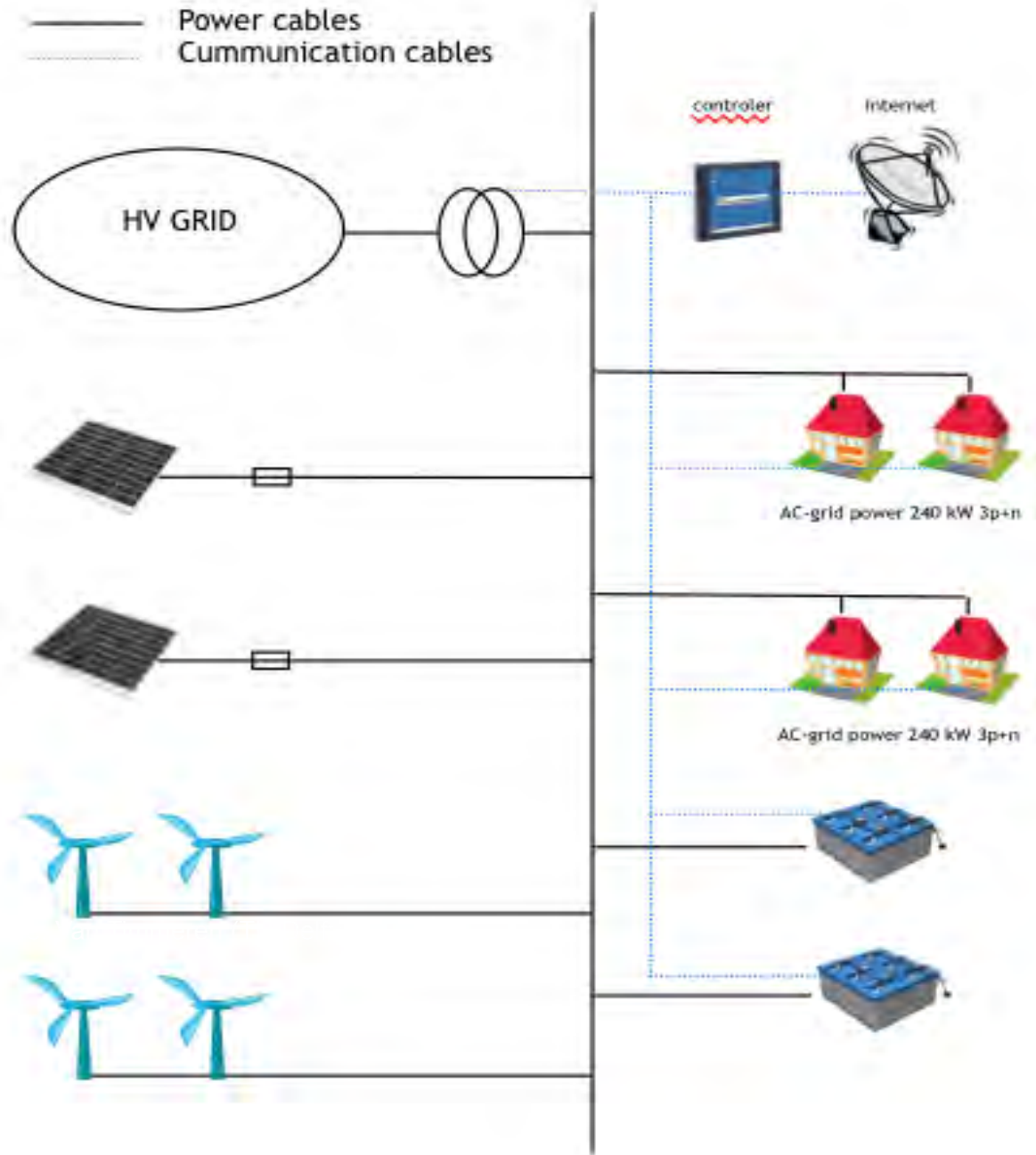
- Driving Pattern in the Netherlands
 - Power consumption of Electric Vehicles
 - Power requirements of CPT System
 - Combine all the above
- Demand curve**

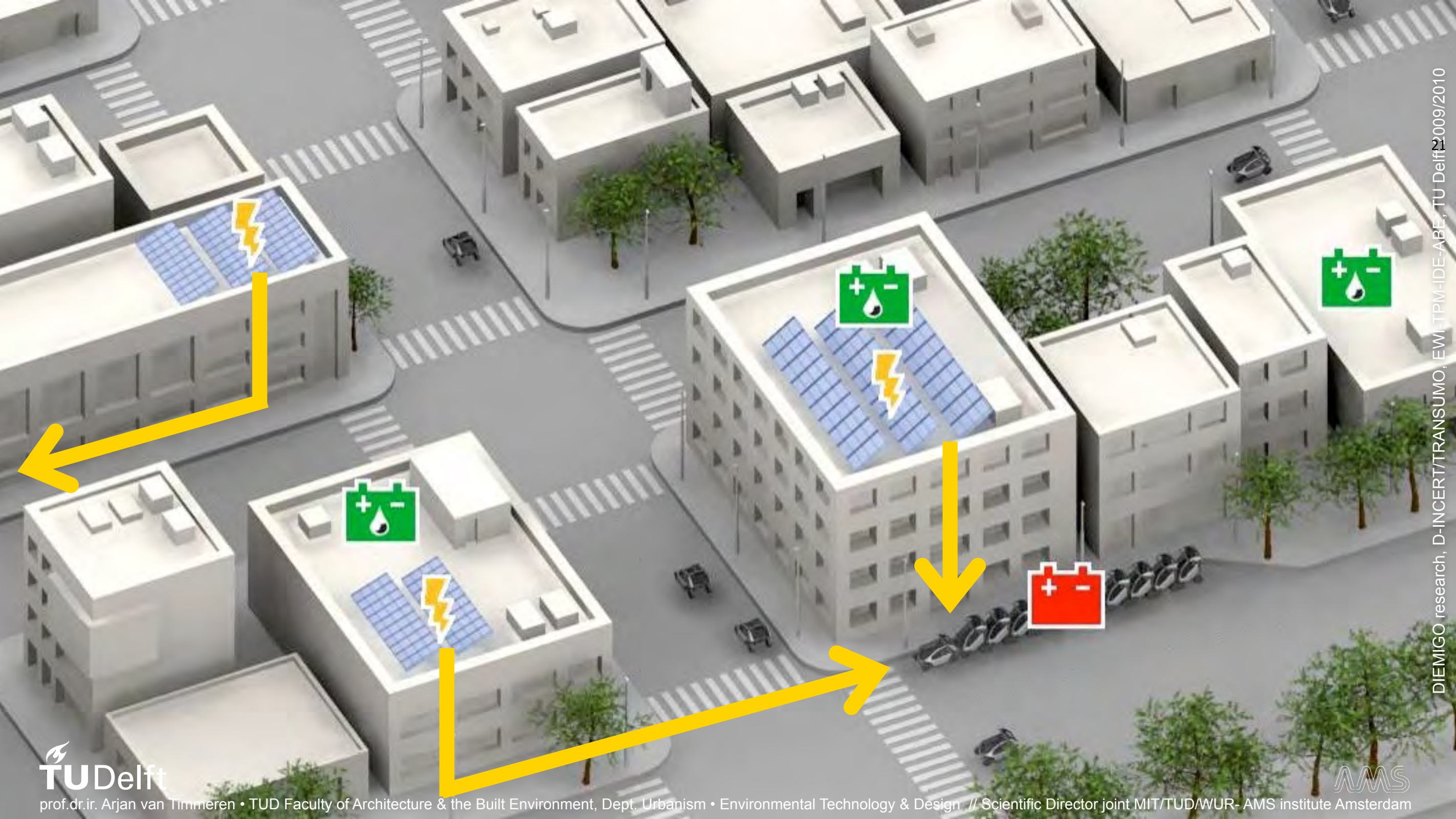


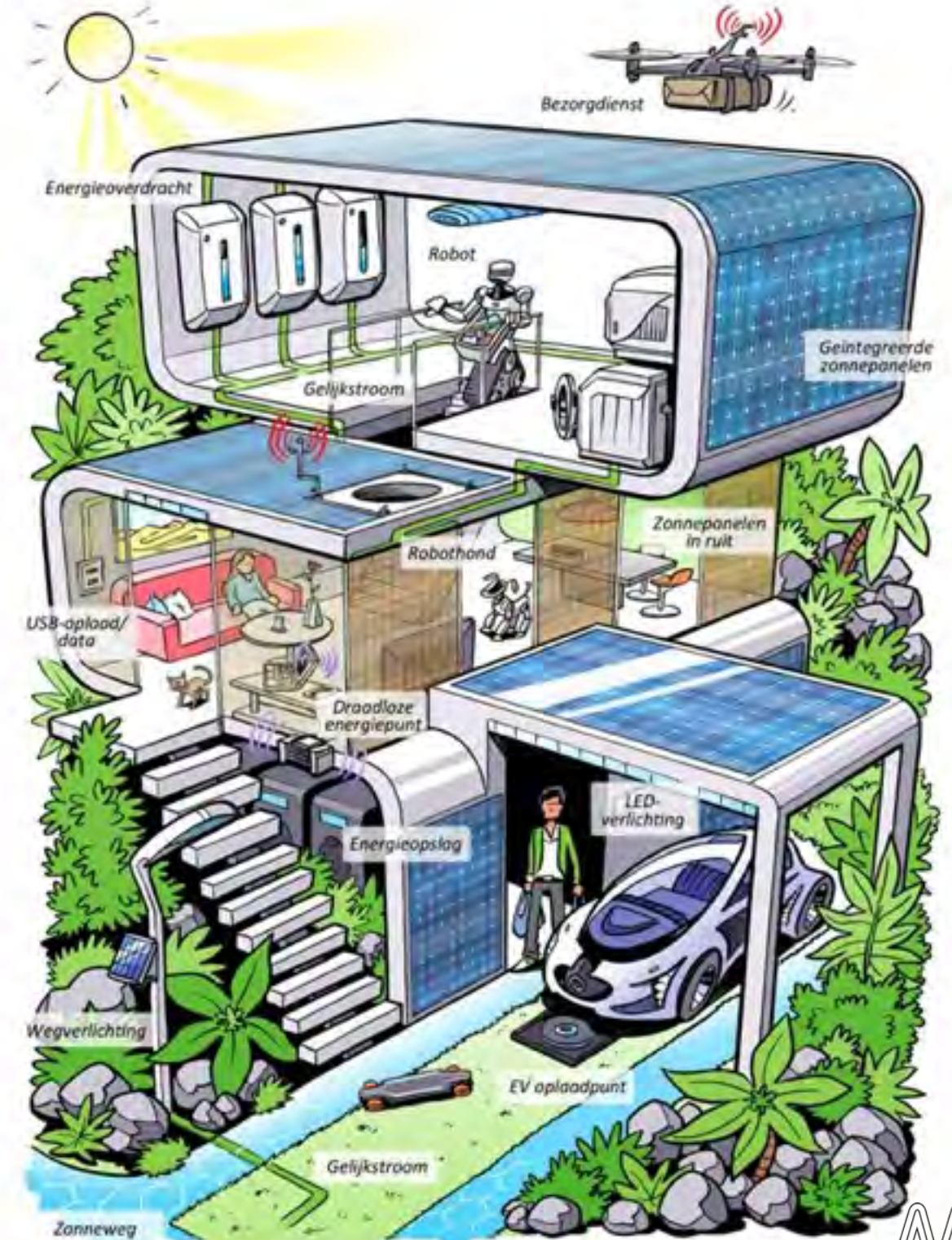
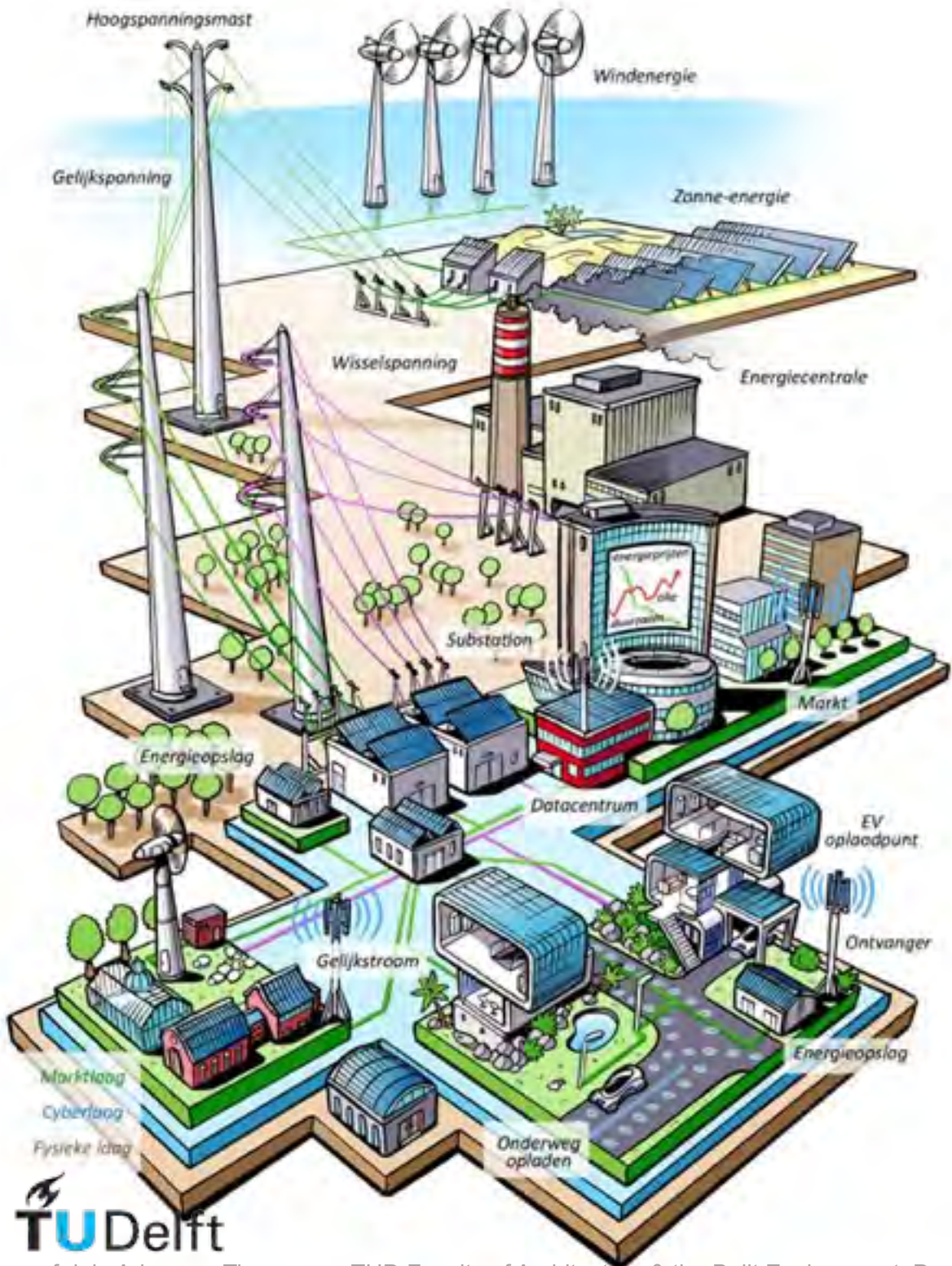
Contactless charging: Bauer / Koops & Van Timmeren (TU Delft, 2012)













Design concept of a V2H system for the SusLab Concept House Prototype consisting of:

1. An apartment (block) garage with user-dedicated charging park spots, solar powered remotely controlled electric garage door, and a showroom look,
2. RFID controlled EV charge manager with data communication with EV chargers and apartment grids,
3. Car key rings with RFID chip for user identification,
4. A smartphone application for user control and system information,
5. And a web-based application with user control, system information and comparison with other users.







1 PLASTIC WASTE

2 SHRED

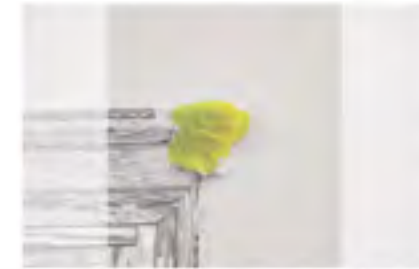
3 EXTRUDE

4 3D-PRINT

THE
NEW
RAW



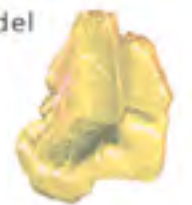
molding



3d scanning



3d model



DUS.

aeb





(partial) map of the internet in 2005 (Matt Britt, 2014)



yeast, with a similar network geometry (Arjan van Timmeren 2006)

“ Civilization advances by extending the number of important operations which we can perform without thinking about them. ”

Alfred Whitehead

NETWORKED ENVIRONMENTS



Congregation Market square, Pittsburg (Michael Henninger, 2014)

Networked Environments



Congregation Market square, Pittsburg (Michael Henninger, 2014)

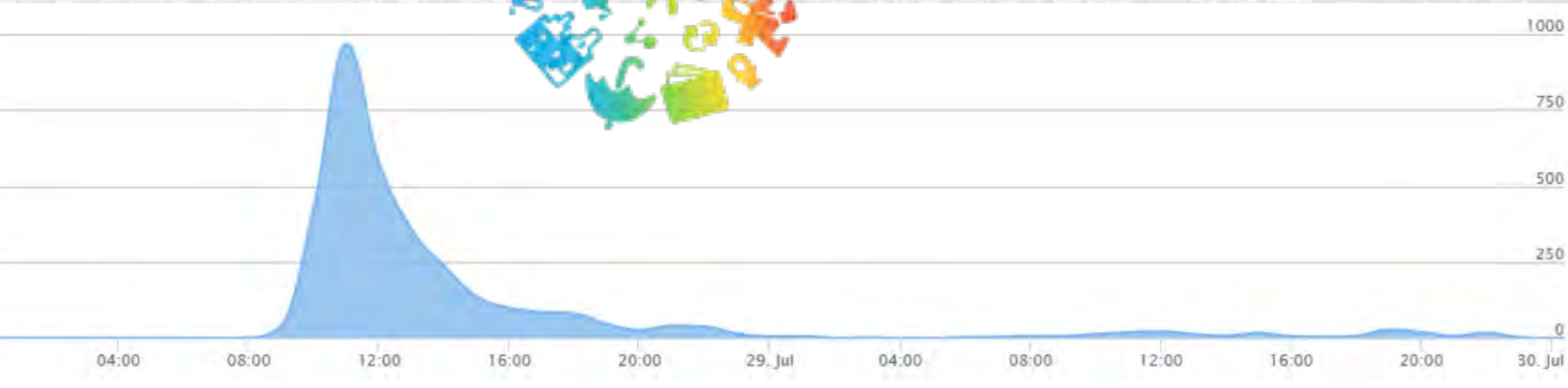
RAIN SENSE

Sensing urban weather for rainproof Amsterdam

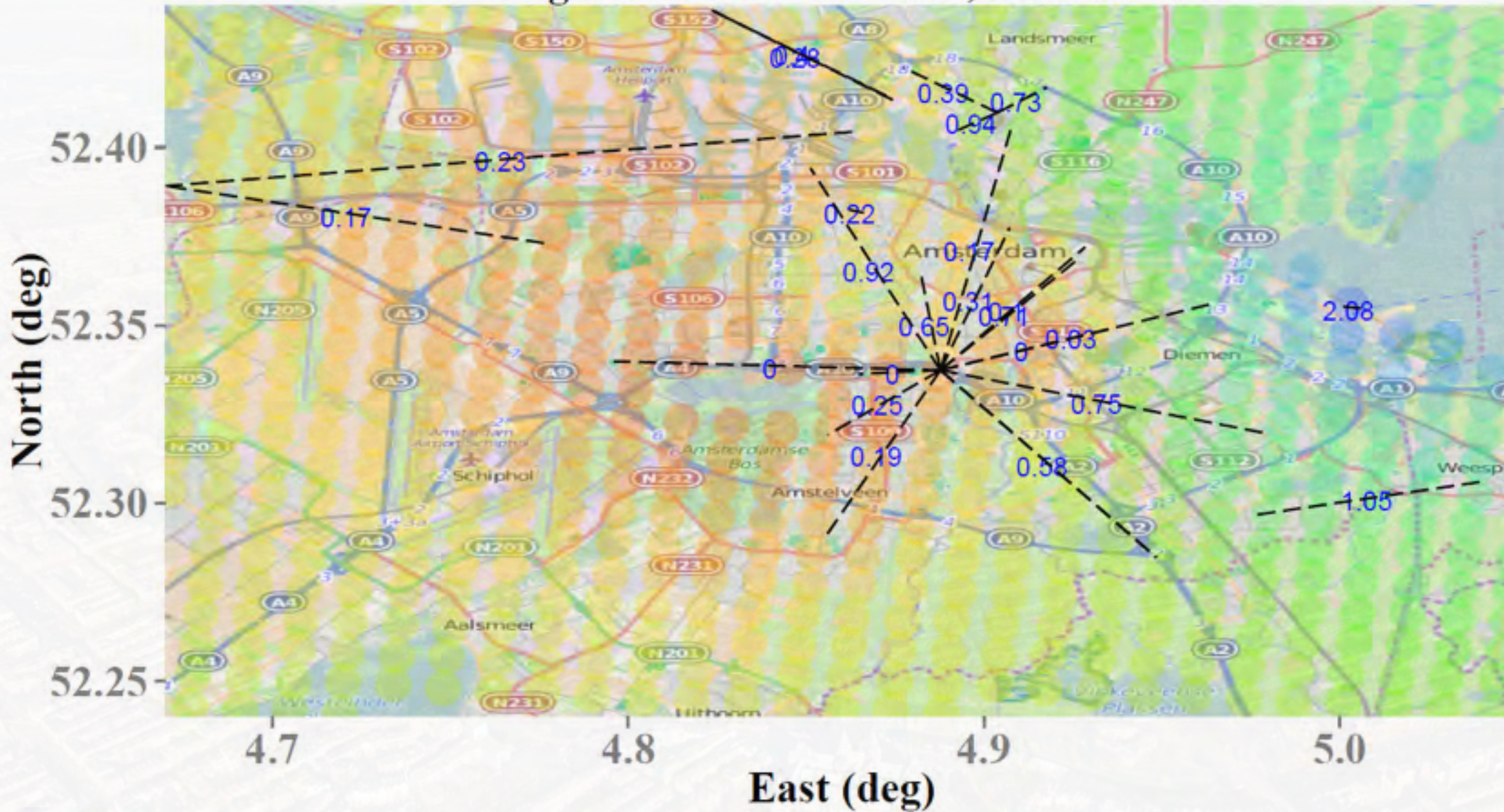
MarieClaire ten Veldhuis

Delft University of Technology





Regenkaart: 20-07-2015, interval 16



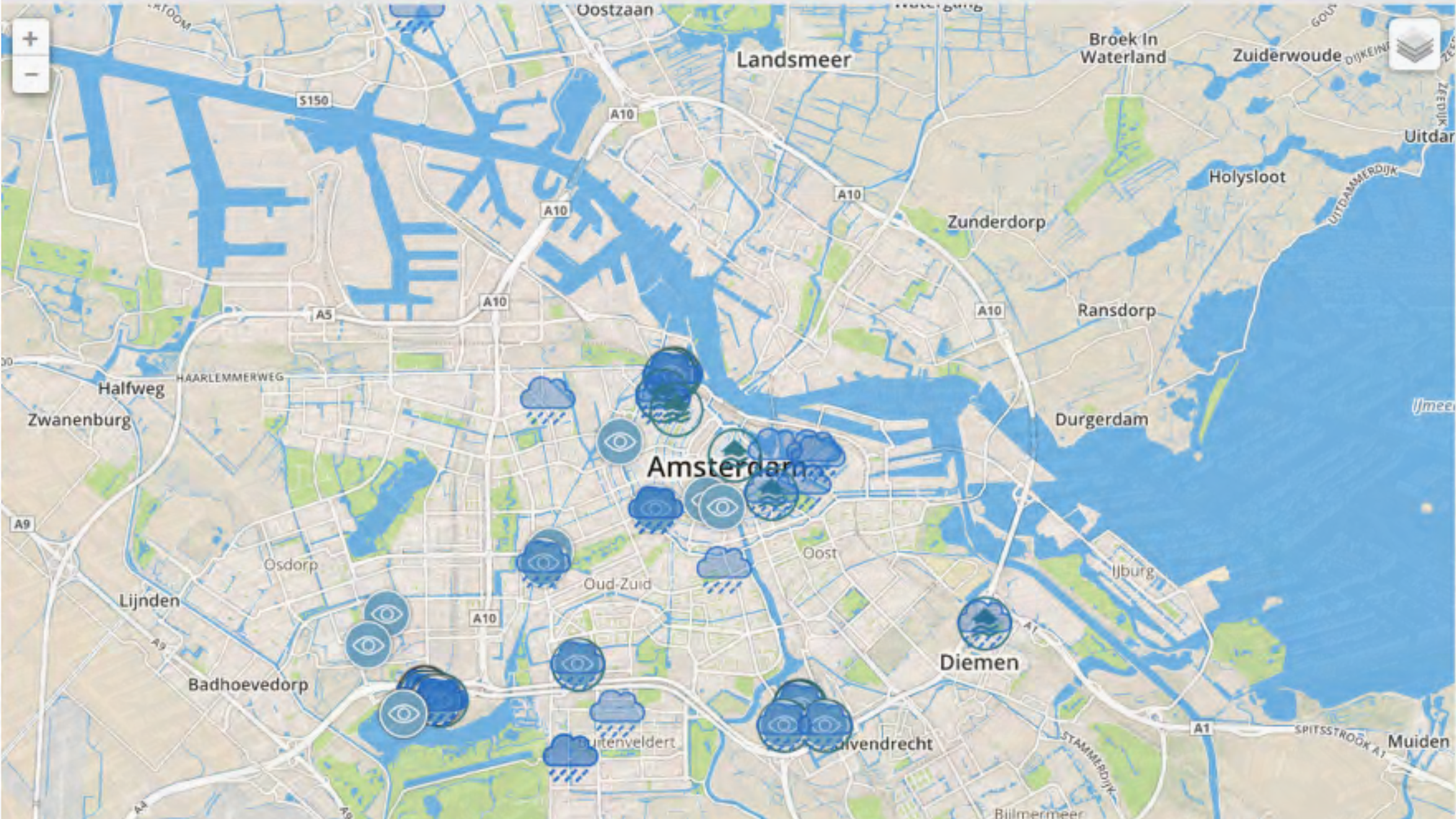
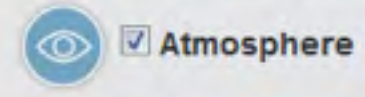
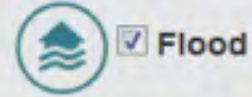
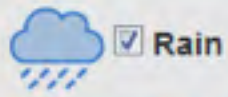
Rainfall map derived from GSM antenna links.

15 min rainfall intensities over Amsterdam, 20 July 2015



Courtesy: L. de Vos, A. Overeem, R. Uijlenhoet, Wageningen University

Select range: 23/10/2015 12:00 AM - 23/10/2015 11:59 PM



Social Weather App inputs summer experiment Amsterdam: Reported rainfall and flooding



TECHNO-AUSTERITY

How much do you tip a robot bar tender?



Smart City 2.0: Illuminated Cities

- Citizen-focused, community-defined, and open-source cities that harness technology to enhance democracy and distributed governance, support individual and collective autonomy, community participation in urban planning, and enshrine the citizen's right to privacy and protection from data commodification...



Tietgen Dormitory, Copenhagen (Lundgaard, & Tranberg Architects 2014)

Smart City 2.0: Illuminated Cities

- Citizen-focused, community-defined, and open-source cities that harness technology to enhance democracy and distributed governance, support individual and collective autonomy, community participation in urban planning, and enshrine the citizen's right to privacy and protection from data commodification.

- They harness information technology to illuminate truths of urban life that are not absolute or self-evident in sensor collected data but generated and understood the continuous physical interaction of human beings in urban space and reveal the unseen relations between urban communities and the wider natural systems that support them

<http://etd.bk.tudelft.nl>
www.ams-institute.org



תודה
Dankie Gracias
Спасибо شكراً
Merci Takk
Köszönjük Terima kasih
Grazie Dziękujemy Děkojame
Ďakujeme Vielen Dank Paldies
Kiitos Tänname teid 谢谢
Thank You Tak
感謝您 Obrigado Teşekkür Ederiz
Σας ευχαριστούμε 감사합니다
Bedankt Дěkujeme vám
ありがとうございます
Tack

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Scientific Director

Joint initiative MIT-TUD-WUR

Amsterdam based Institute for:

Advanced Metropolitan Solutions (AMS)

