



CIRCULAR CITIES: HELLO JOBS, GOODBYE WASTE

Econetwork Speaker Series

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Charlotte, NC, 2018.02.01

OUTLINE

- About Metabolic
- Urgency: Global Challenges
- The Circular Economy
- Lessons from our Work

Metabolic is a consulting and venture building company that uses systems thinking to tackle global sustainability challenges.

We work towards our mission in three main ways:

1. INSIGHTS:

We provide influential organisations and individuals with the knowledge and tools to understand the global metabolism and support improved decision-making.

2. IMPLEMENTATION:

We develop transformative ventures and technologies, and support existing networks that can address sustainability challenges at scale.

3. ACTIVATION:

We are inspiring a new generation of changemakers by breaking down complex information and by providing actionable resources.



THOMAS MASON
SUSTAINABILITY
CONSULTANT

TONY SEVOLD
RESEARCH
COORDINATOR,
METABOLIC
FOUNDATION

NADINE GALLE
SUSTAINABILITY
CONSULTANT

GERARD BOOR
SOFTWARE ENGINEER

CHRIS MONAGHAN
CO-FOUNDER AND
INNOVATION DIRECTOR

**OSCAR SABAG
MUÑOZ**
SUSTAINABILITY
CONSULTANT



**CHANDAR VAN DER
ZANDE**
PROJECT MANAGER

EVA GLADEK
FOUNDER AND CEO

CASSIE BJÖRCK
GRAPHIC &
INFORMATION DESIGNER

**LEONARDO
VERKOOIJEN**
SUSTAINABILITY
CONSULTANT

**DORINDE DE
TEMPE**
OFFICE &
ADMINISTRATION
MANAGER

PHILIP GLADEK
CEO, SPECTRAL



ADAM STONES
COMMUNICATIONS
DIRECTOR

TOM WESTRA
SALES & MARKETING
DIRECTOR, SPECTRAL
UTILITIES

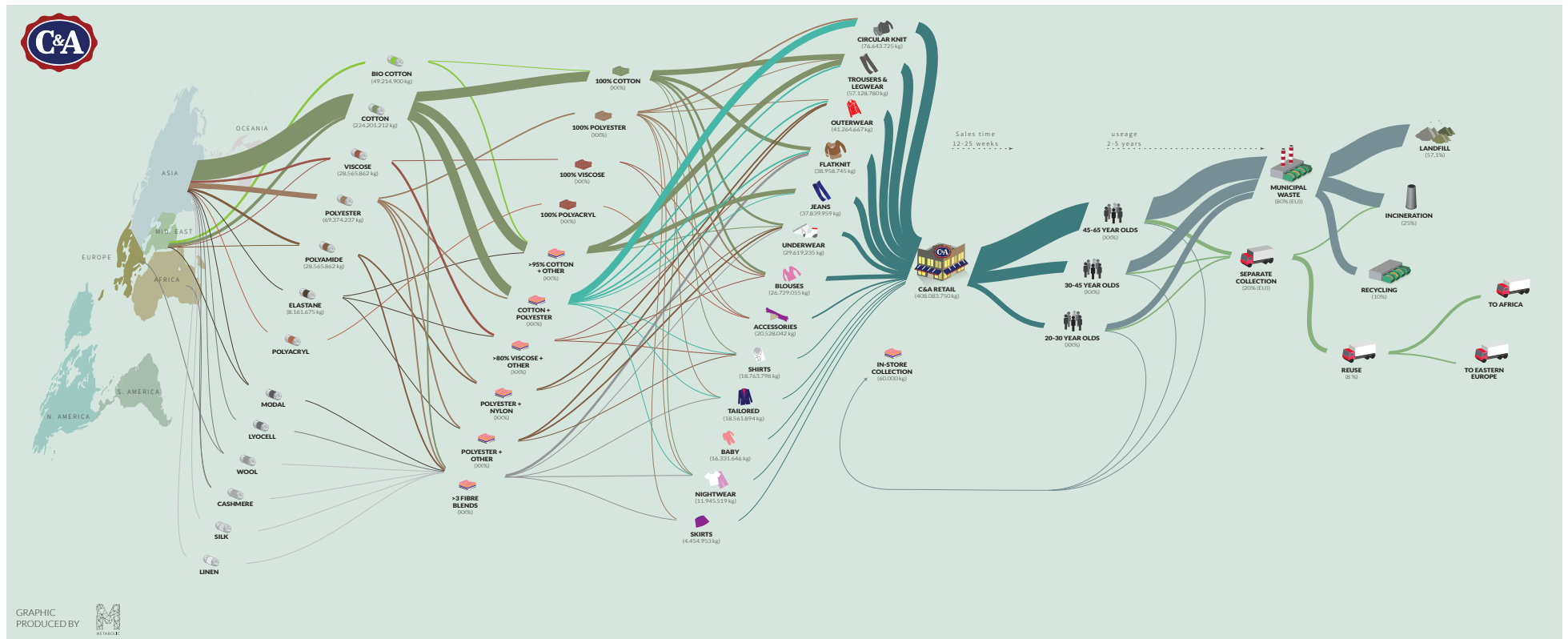
ERIN KENNEDY
SUSTAINABILITY
CONSULTANT

GERARD ROEMERS
SUSTAINABILITY
CONSULTANT

CHRISTIE METTES
PROJECT COORDINATOR,
METABOLIC
FOUNDATION

**FLOOR VAN
BOVENE**
PROJECT MANAGER

INSIGHTS



We help businesses, governments, and non-profits thrive in the circular economy through our knowledge and tools.

IMPLEMENTATION



We develop transformative innovations and ventures to shift the way we live and work to a sustainable state.

ACTIVATION

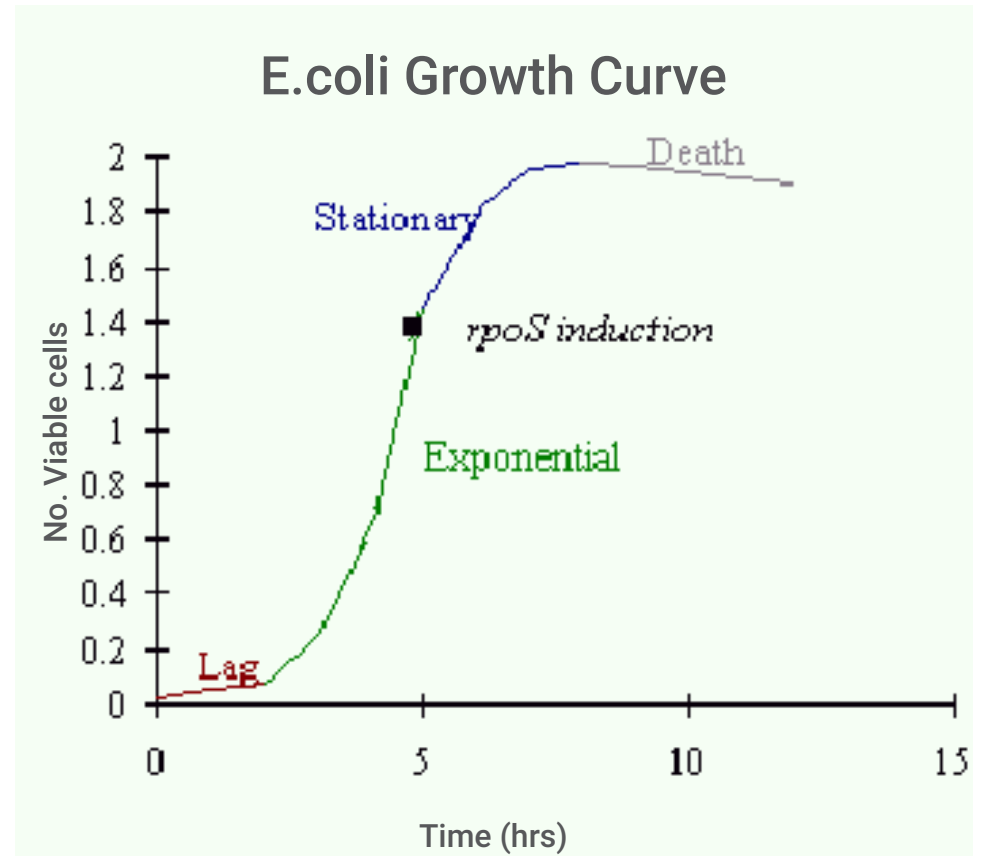


We inspire through education and actionable ideas, and our Foundation helps us reach underserved communities.

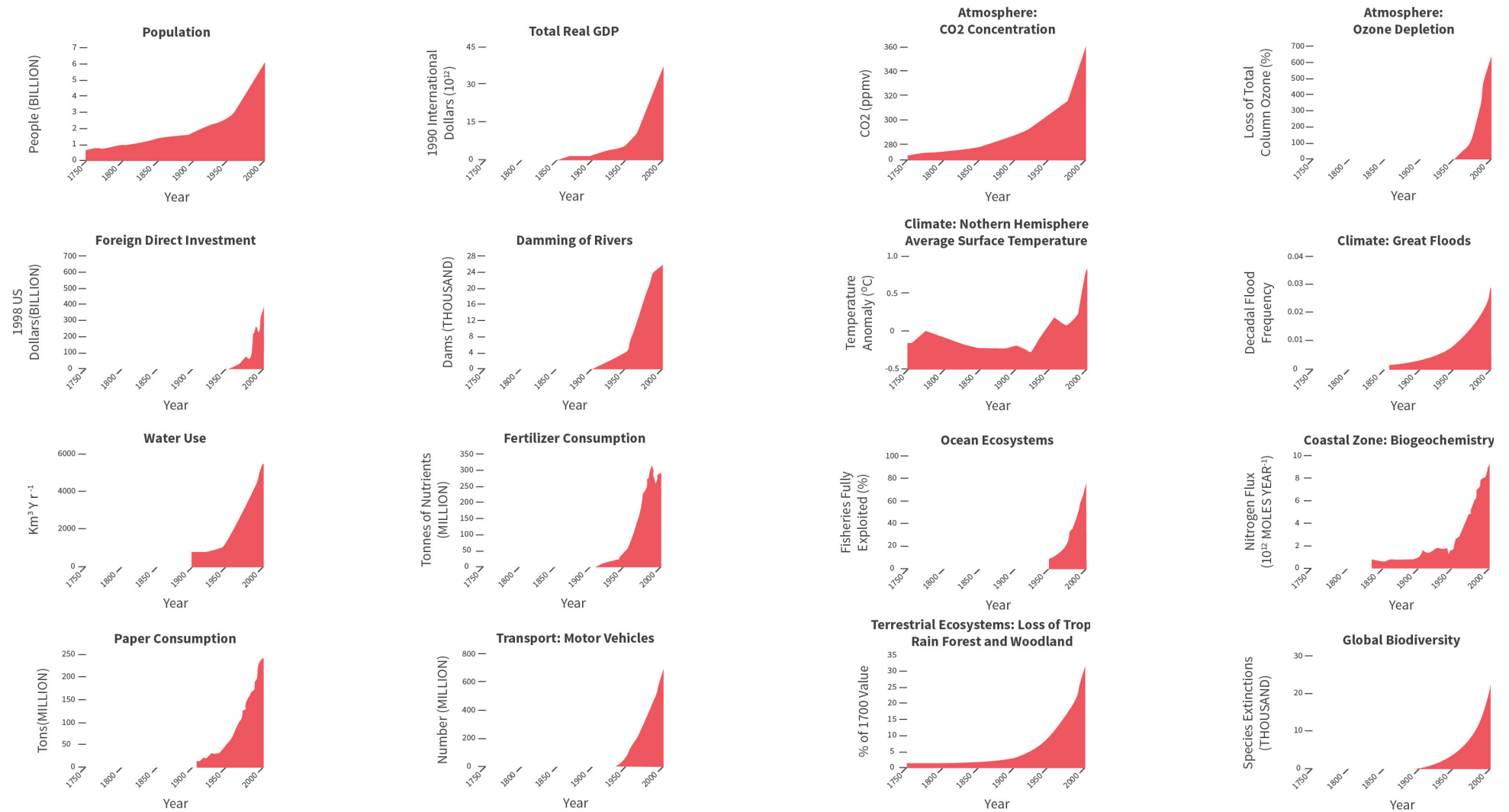


URGENCY: GLOBAL CHALLENGES

FATAL FEEDBACK LOOPS



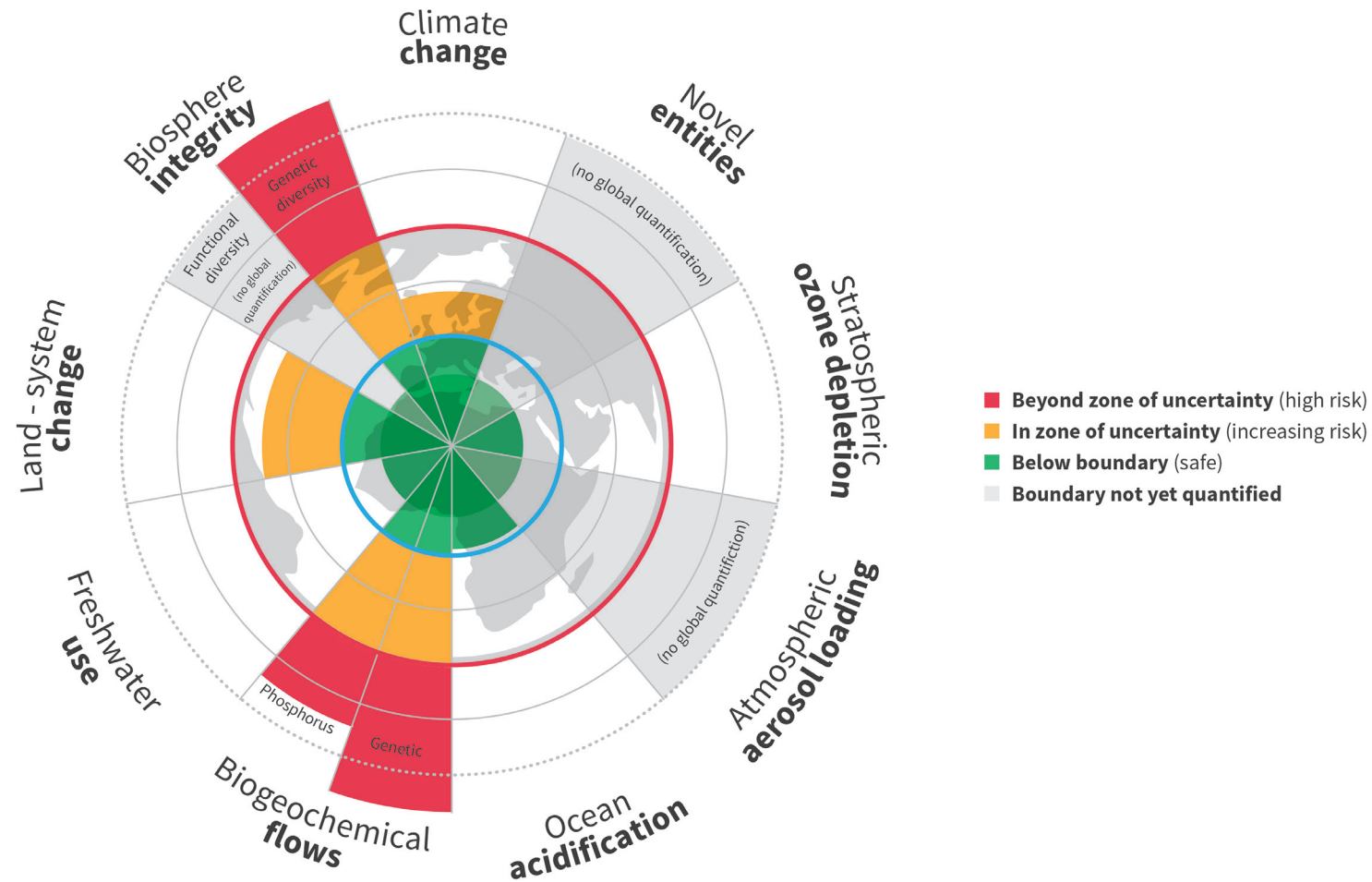
EXPONENTIAL TIMES



SUSTAINABILITY CHALLENGES



PLANETARY BOUNDARIES

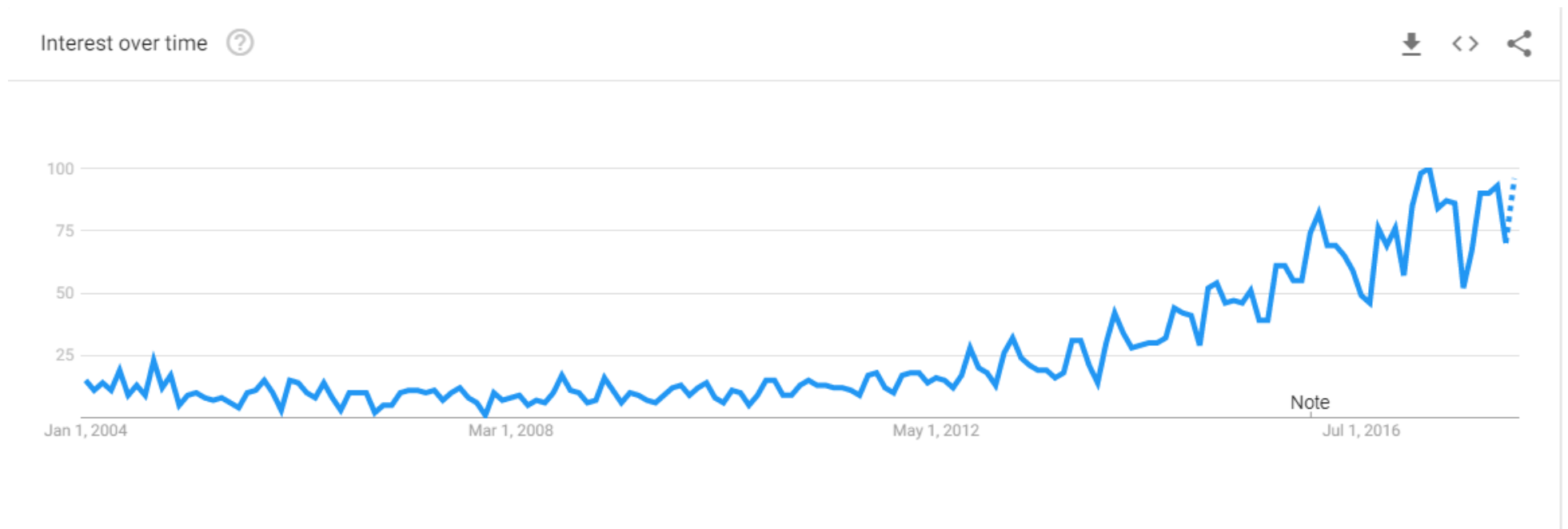


Planetary Boundaries. Source: Rockstrom et. al, Stockholm Resilience Centre



SO HOW DO WE MOVE FORWARD?

THE CIRCULAR ECONOMY





I AM A...

I'M LOOKING FOR...

OUR WORK

Open Labs:

THE CIRCULAR CITY
7-25 NOVEMBER 2016

Circular economy

Encouraging the development of new circular economy solutions in Scotland



CIRCULAR AMSTERDAM

A vision and action agenda for the city and metropolitan area



Circular

UPCYCLE FORUM

LE FORUM DES SOLUTIONS
DE L'ÉCONOMIE CIRCULAIRE
À IMPACT POSITIF

13 Avril 2016 | Paris

INSCRIVEZ-VOUS

THE PERSPECTIVE OF THE CIRCULAR CITY

10
RECOMMENDATIONS
FOR THE
CIRCULAR CITY



RESERVEZ VOUS

Patrick OLLIER
Président de la Métropole du Grand Paris

Xavier LEMOINE
Conseiller métropolitain délégué à
l'économie circulaire

Anne HIDALGO
Maire de Paris

Antoinette GUHL
Adjointe à la Maire de Paris
chargée de l'économie sociale et solidaire,
de l'innovation sociale et de l'économie circulaire

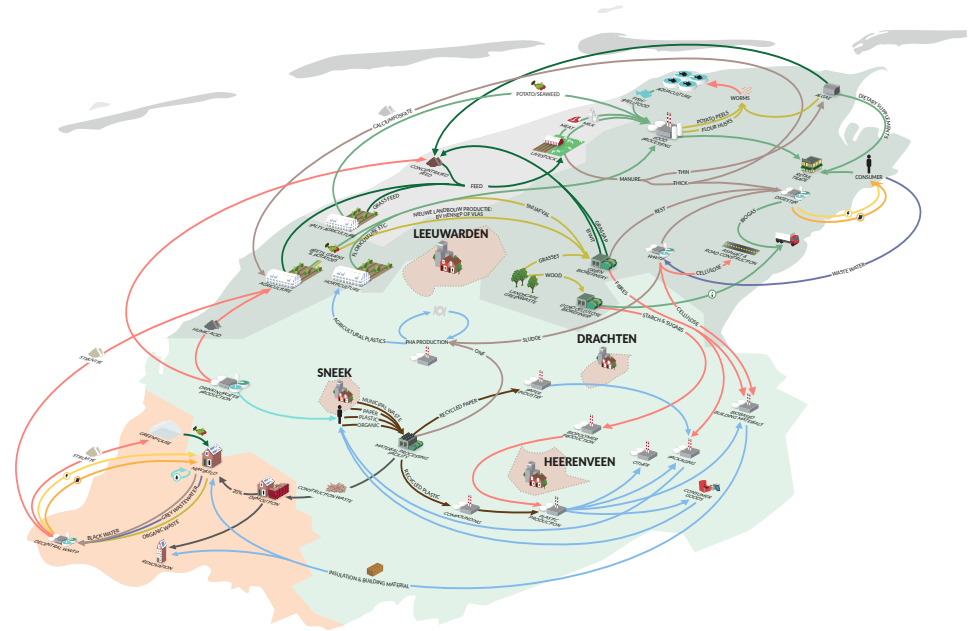
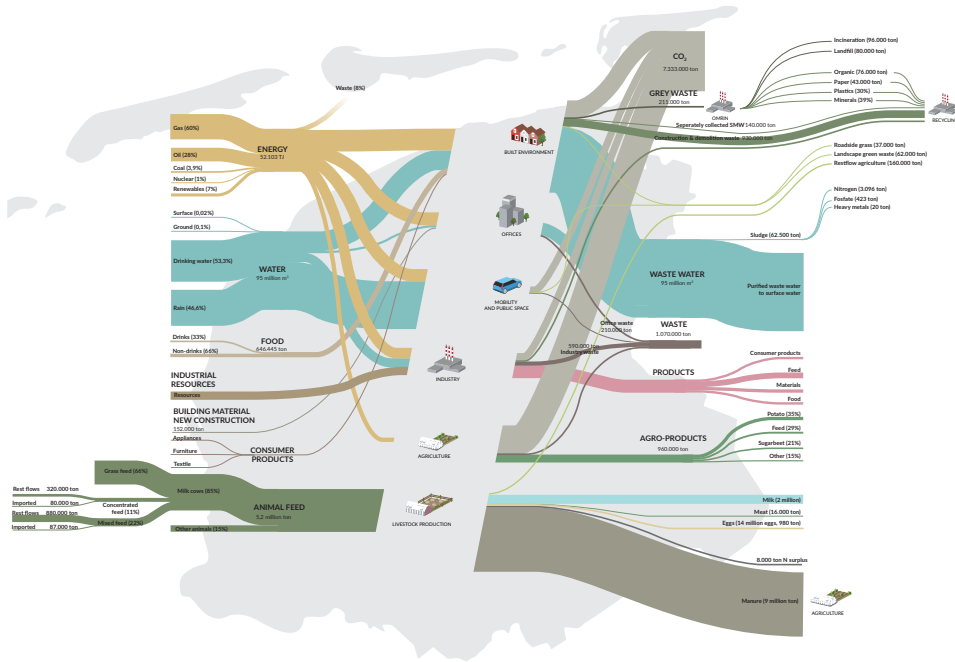
Grand Paris Circulaire
l'événement métropolitain de l'économie circulaire

le Jeudi 5 Octobre 2017
Au Palais des Congrès d'Issy
25 Avenue Victor Cresson, 92130 Issy-les-Moulineaux

grandpariscirculaire@metropolegrandparis.fr

BUILDING A CIRCULAR ECONOMY

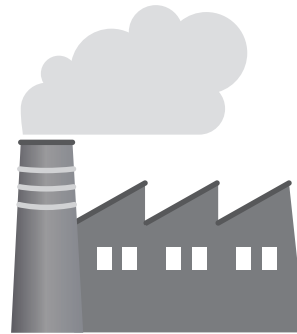
Since 2012, Metabolic has completed over 250 projects for companies, cities, and governments, with a large focus on the Circular Economy.



THE LINEAR ECONOMY



TAKE



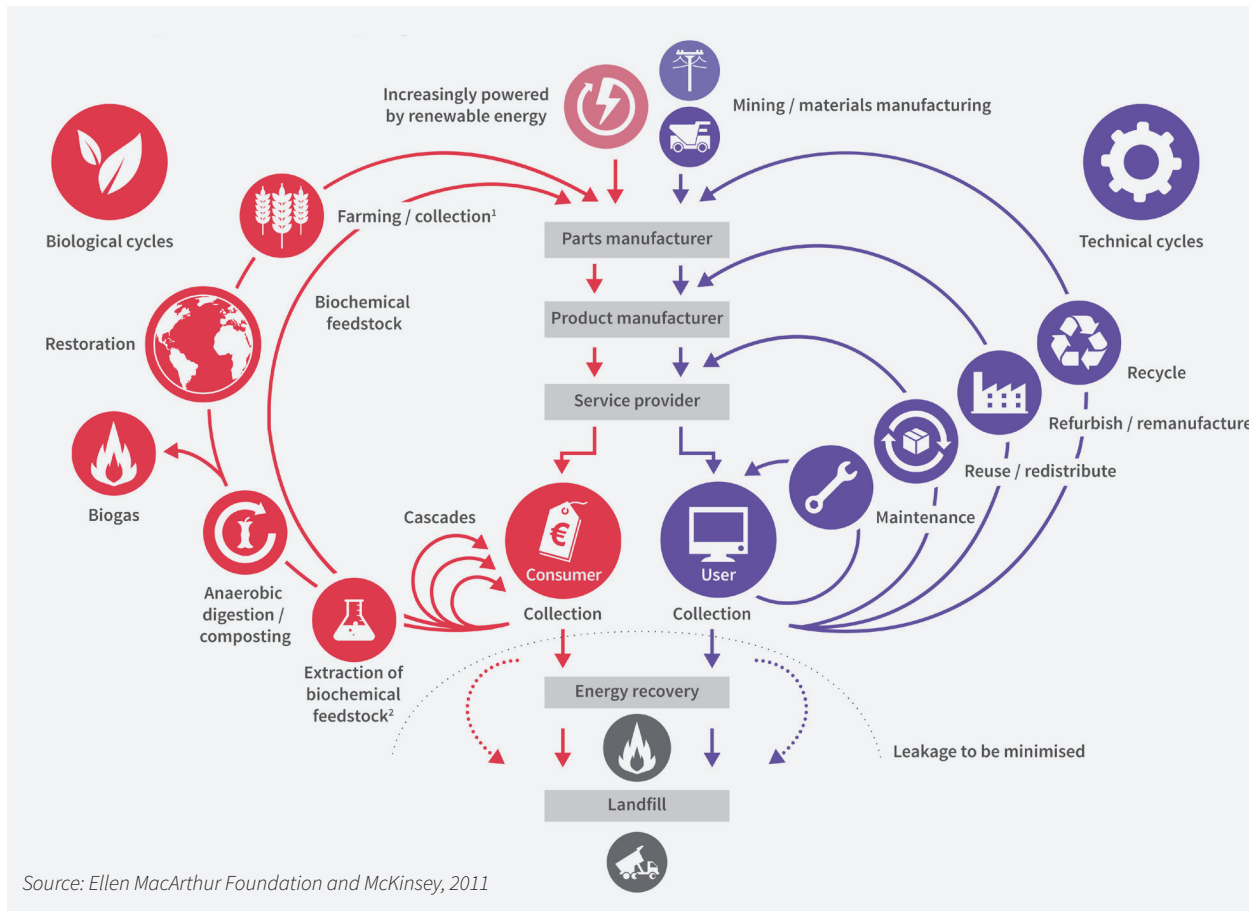
MAKE



DISPOSE

THE CIRCULAR ECONOMY

“Based on detailed product level modelling, the report estimates that the circular economy represents a net material cost saving opportunity of USD 340 to 380 billion p.a. at EU level for a ‘transition scenario’ and USD 520 to 630 billion p.a. for an ‘advanced scenario’”





THE VALUE OF MATERIALS



iPhone 5

CIRCULAR ECONOMY BUSINESS MODELS

Power of the inner circle:

- Pay per use and leasing
 - Repair
 - Waste reduction
 - Sharing platforms
-

The power of circling longer:

- Performance based contracting
 - Takeback guarantees
 - Through-sales
 - Refurbishment
-

Power of cascaded use:

- Upcycling
 - Recycling
 - Supply chain collaboration
-

The power of pure inputs:

- Monomaterials
- Certified materials
- Circular procurement and sourcing

EXAMPLE: PRODUCTS AS SERVICES



Xerox Pay-Per-Copy – 1959
Printing As A service (subscription)



Zipcar – 2000
Car As A Service (subscription + pay per use)

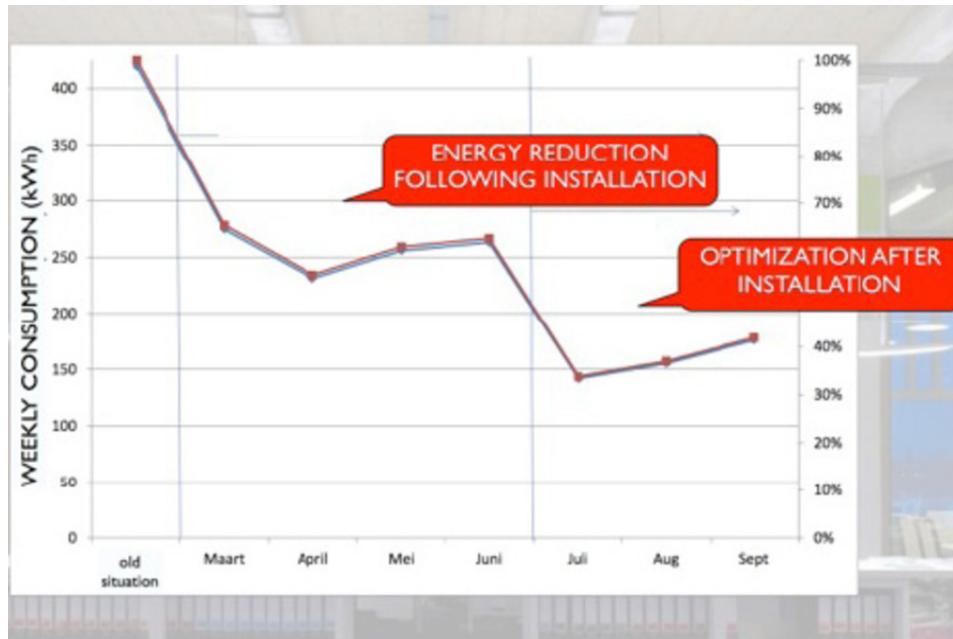


Philips Pay-Per-Lux – 2014
From selling light bulbs to selling light (for businesses)



ToolPool – 2013
Stores lending tool for free while selling supplies

EXAMPLE: PHILIPS PAY PER LUX



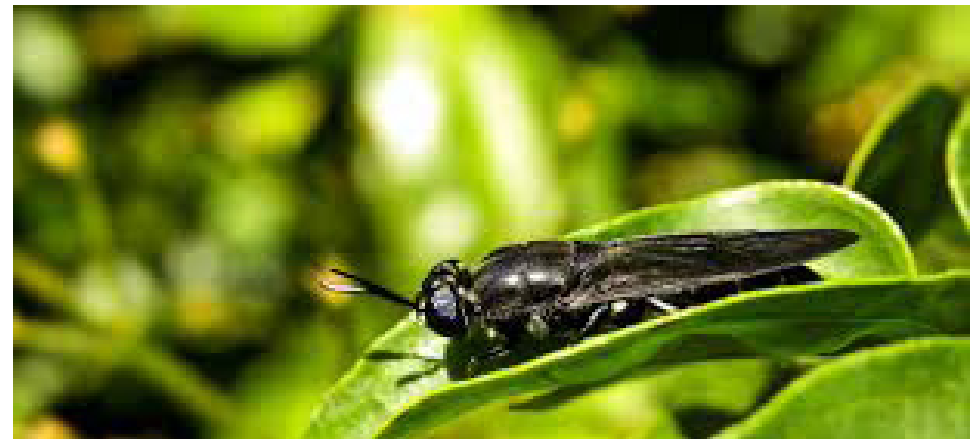
EXAMPLE: INSTOCK RESTAURANT



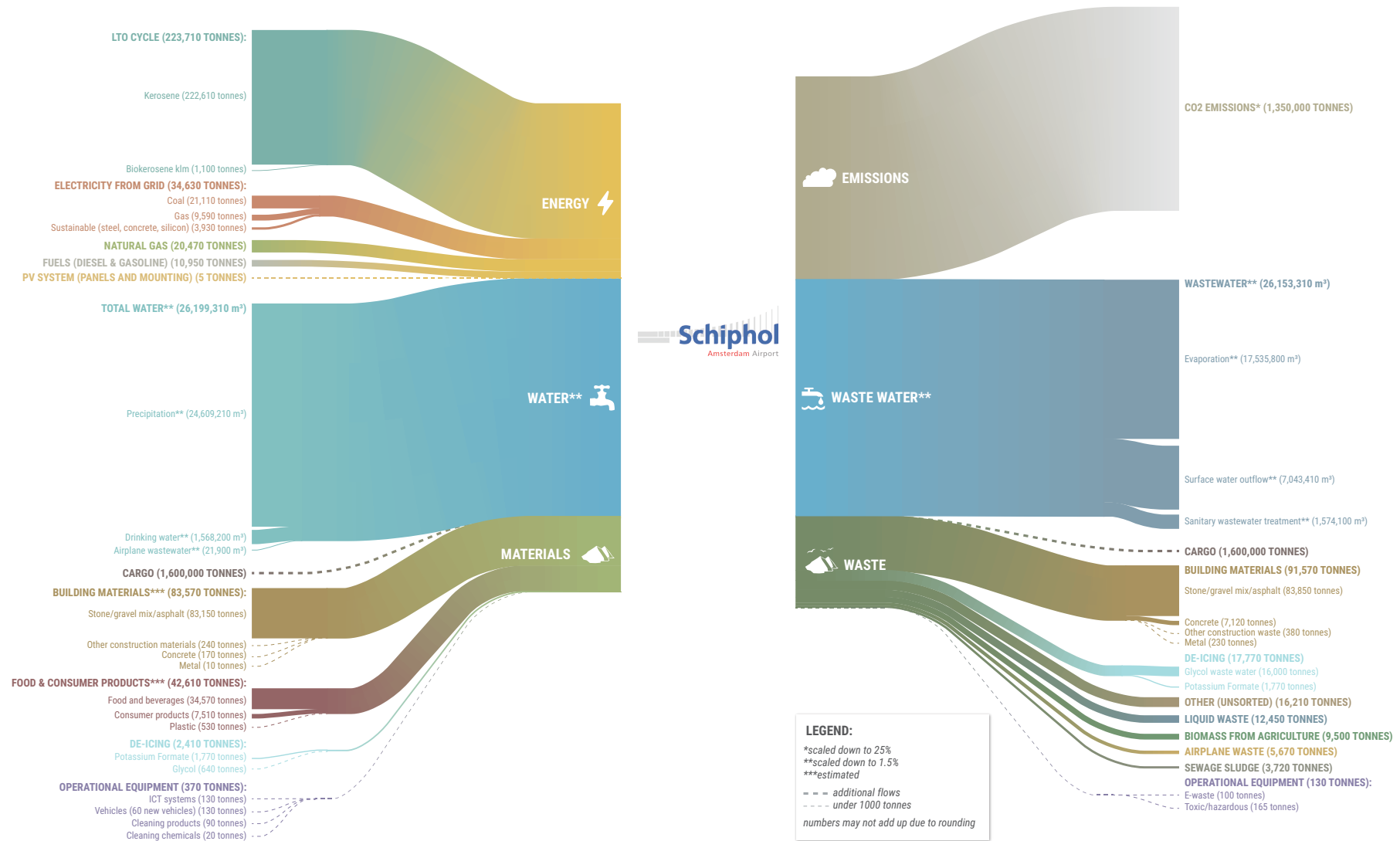
EXAMPLE: BLACK BEAR CARBON



EXAMPLE: PROTIX BIOSYSTEMS



AMSTERDAM AIRPORT SCHIPHOL



Offshore windparks deliver electricity to Schiphol and the surrounding communities.

Deliveries are done by Schiphol's drone fleet, which distribute the cargo from airplanes and the 3D-printed products in the Amsterdam Metropolitan Region.

Hydrogen fuel is produced with sustainable energy sources.

Biodigesters are implemented to transform organic waste into biogas for local use.

Collaborations with local farmers and social food ventures strengthen Schiphol's relationships within the region while delivering high-quality, yet low-impact food.

Strong collaborations between companies at Schiphol and local communities create symbiosis through which all parties thrive. Material loops are closed in the region, making Schiphol a zero-waste airport.

Buildings at Schiphol are modularly designed and retrofitted, functioning as a building material hub for the Amsterdam Metropolitan Region.

100% of all energy consumed is sustainable, renewable and locally-produced.

Schiphol is the 3D-printing hub of the Netherlands. Companies rent printing time at the facilities at Schiphol and make use of the vast distribution network to transport final products to their destination.

Hyperloop carries people and cargo faster than airplanes through pod-like vehicles in reduced-pressure tubes.

A well-functioning public transport system supports high-speed train travel to replace short-haul flights, providing a quick and affordable alternative to flying.

Schiphol transforms to a connectivity hub beyond transportation by offering high-definition virtual reality and hologram-enhanced meeting rooms to (partially) replace in-person business meetings.

Anti-glare solar panels on the roofs and fields.

All cars, taxi's and busses are fully electric.

Schiphol is the Silicon Valley of the aviation industry. The terminal is a showcase of innovative solutions and entrepreneurship, making a visit to Schiphol an inspiring experience, while exposing millions of passengers to inventive initiatives.

Greenroofs reduce heating, carbon monoxide impact, noise, smog, stormwater runoff, and transform dead space into garden space. Plant selection guarantees no nuisance caused by an increase in wildlife.

Green flights: Older planes fly on bio-kerosene for the remainder of their lifetime, before they are disassembled for parts and/or recycled.

Yellow flights: Airplanes fly using solar panels placed on the wings in combination with strong batteries. Airplanes no longer require refueling, but rather change their batteries at Schiphol, where they are charged with renewable electricity.

Blue flights: Airplanes fly on hydrogen produced via electrolysis using electricity from solar and wind. Emissions still occur in the form of CO₂ and H₂O, but this has steered aviation away from using fossil fuels.

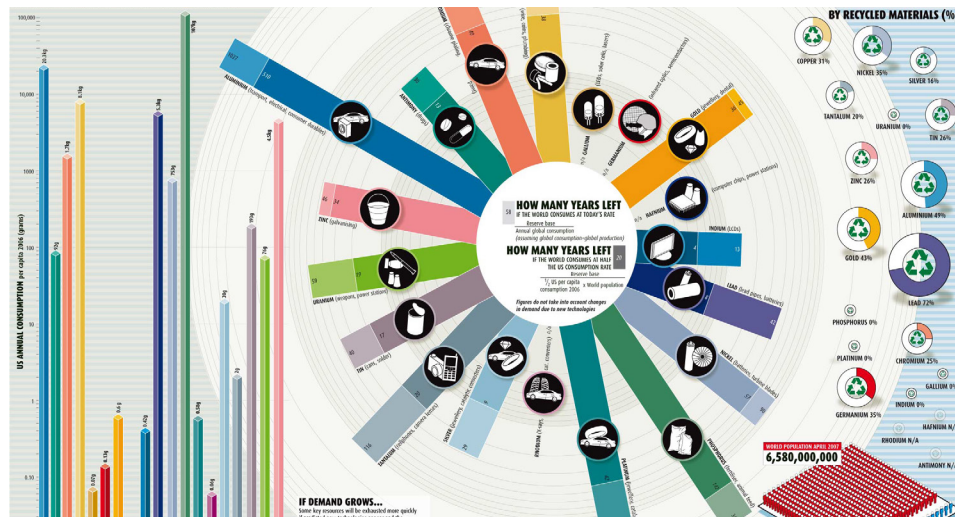
Innovation has developed vertical take-off and landing aircraft, which saves time, reduces fuel, decreases noise pollution and increases safety.

Circular runway allows planes to fly in or out regardless of wind direction, limiting noise pollution.

IS THIS CIRCULAR?



Marcopper mining disaster. Source: ProtectEcuador.org



How long will it last?: Critical resource demand. Source: Graedel et. al, Yale University



CIRCULAR ECONOMY CHARACTERISTICS



All materials are cycled infinitely



All energy is based on renewable sources



Biodiversity is structurally supported



Culture & society is supported



Health & well-being is supported



Not only financial value is generated



System is adaptive and resilient

Source: Gladek et al., 2014. Circular Buiksloterham.

NOT FORGETTING GOALS BEYOND MATERIALS

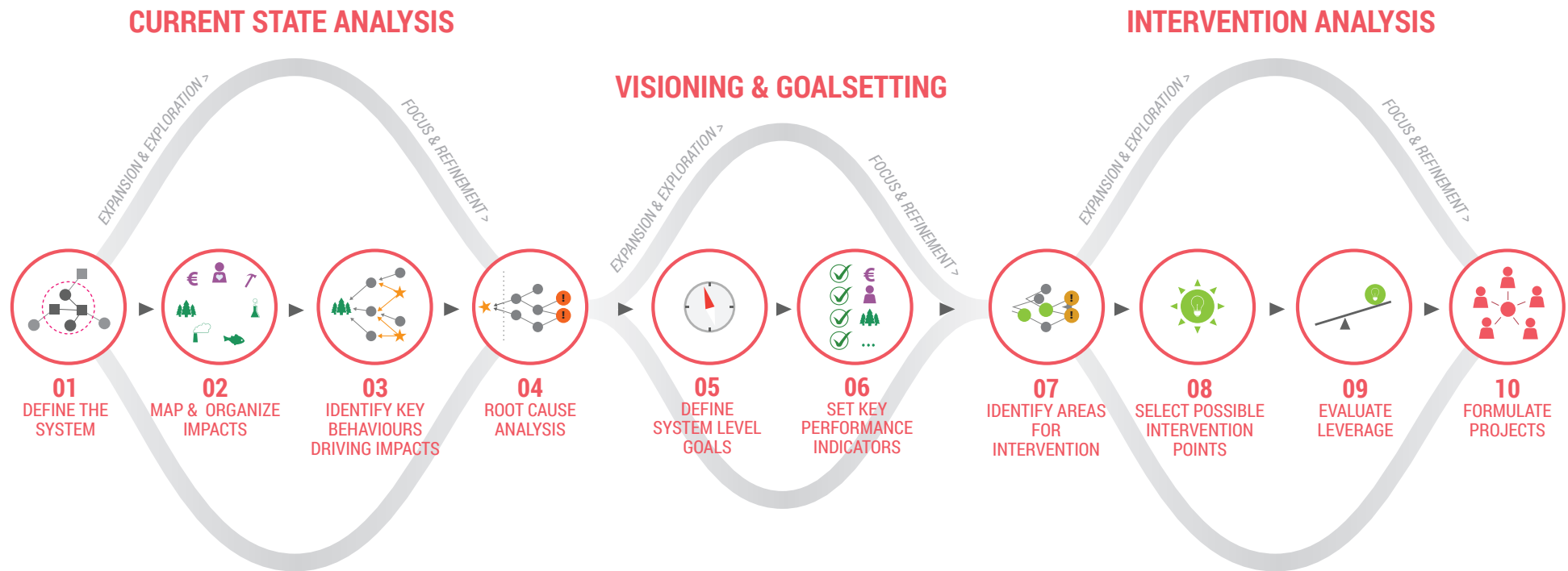


SO A CIRCULAR ECONOMY IS...

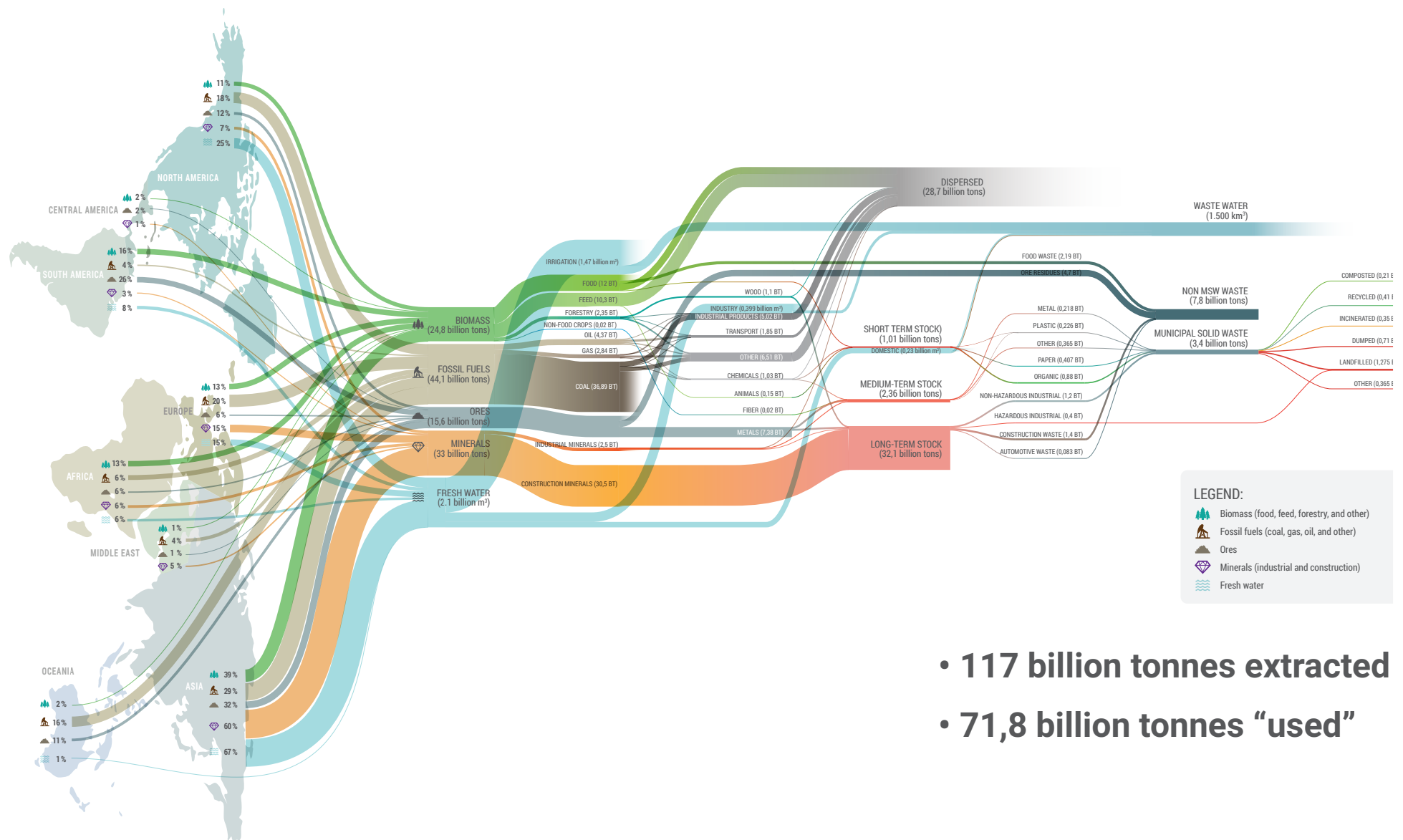
A NEW ECONOMIC MODEL for addressing human needs and fairly distributing resources without undermining the functioning of the biosphere or crossing any planetary boundaries.

**WE NEED TO TRANSFORM
THE ECONOMY.
WHERE DO WE START?**

OUR SYSTEMS TRANSFORMATION METHOD



THE GLOBAL MATERIAL FLOW: 2010



• 117 billion tonnes extracted

• 71,8 billion tonnes "used"

KEY INTERVENTION AREAS



agriculture



cities & the built environment



wastewater



mobility & transport



electronics



chemicals



construction & demolition waste

THE BUILT ENVIRONMENT IS A KEY INTERVENTION POINT

Cities...

- occupy 3% of global land area
- produce 80% of global GDP
- are responsible for 90% of innovation
- produce 50% of global waste
- consume 75% of natural resources
- account for 60 - 80% of global GHG emissions

Source: Gladek et al., 2014. Circular Buiksloterham



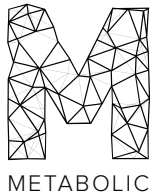
IMAGINING CIRCULAR CITIES



The background is a solid red color with a network of thin, white, intersecting lines that create a complex, abstract geometric pattern of various-sized triangles and polygons.

CIRCULAR DEVELOPMENT: CASE STUDIES

EXAMPLE IN PRACTICE: DE CEUVEL



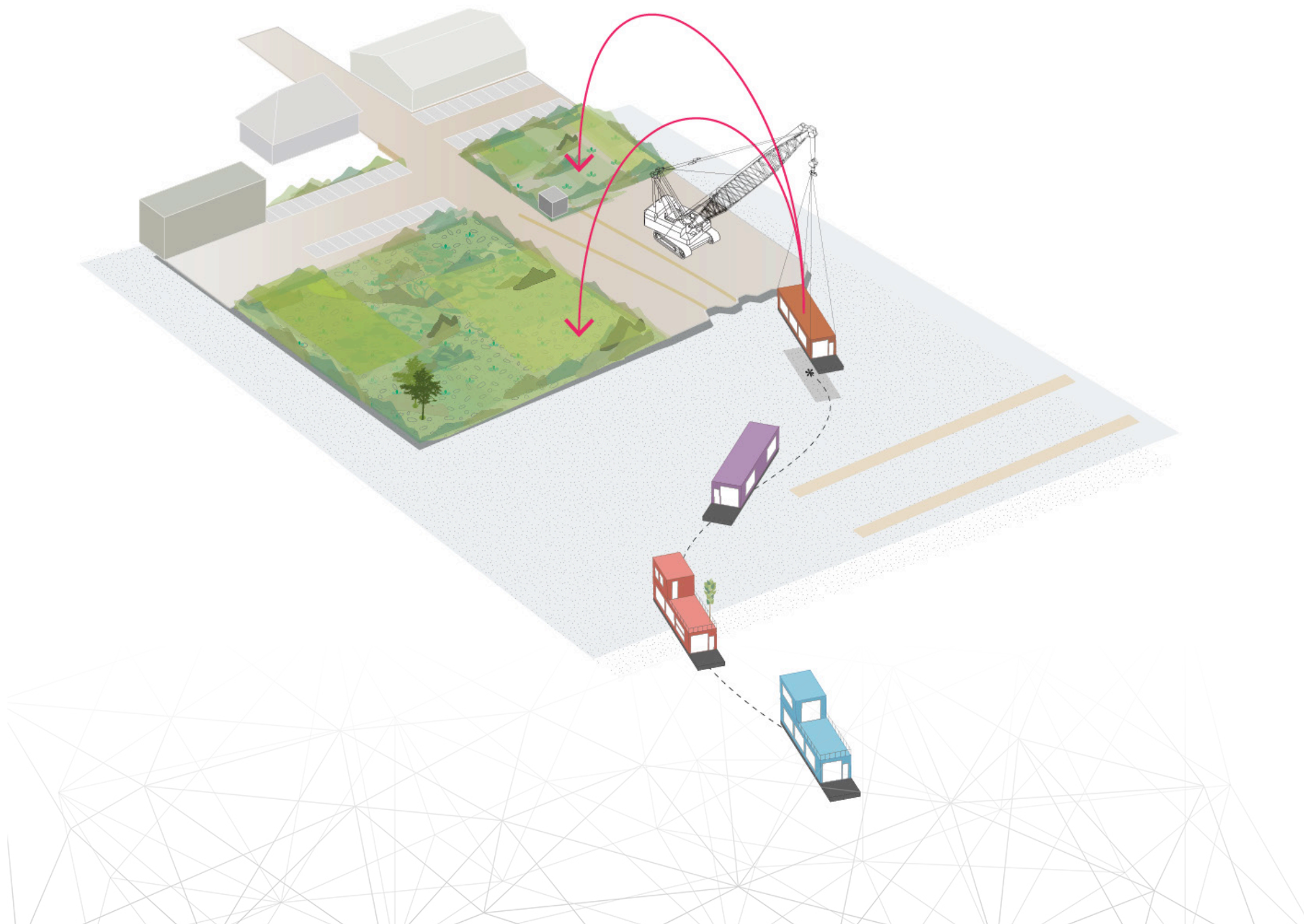
space&matter

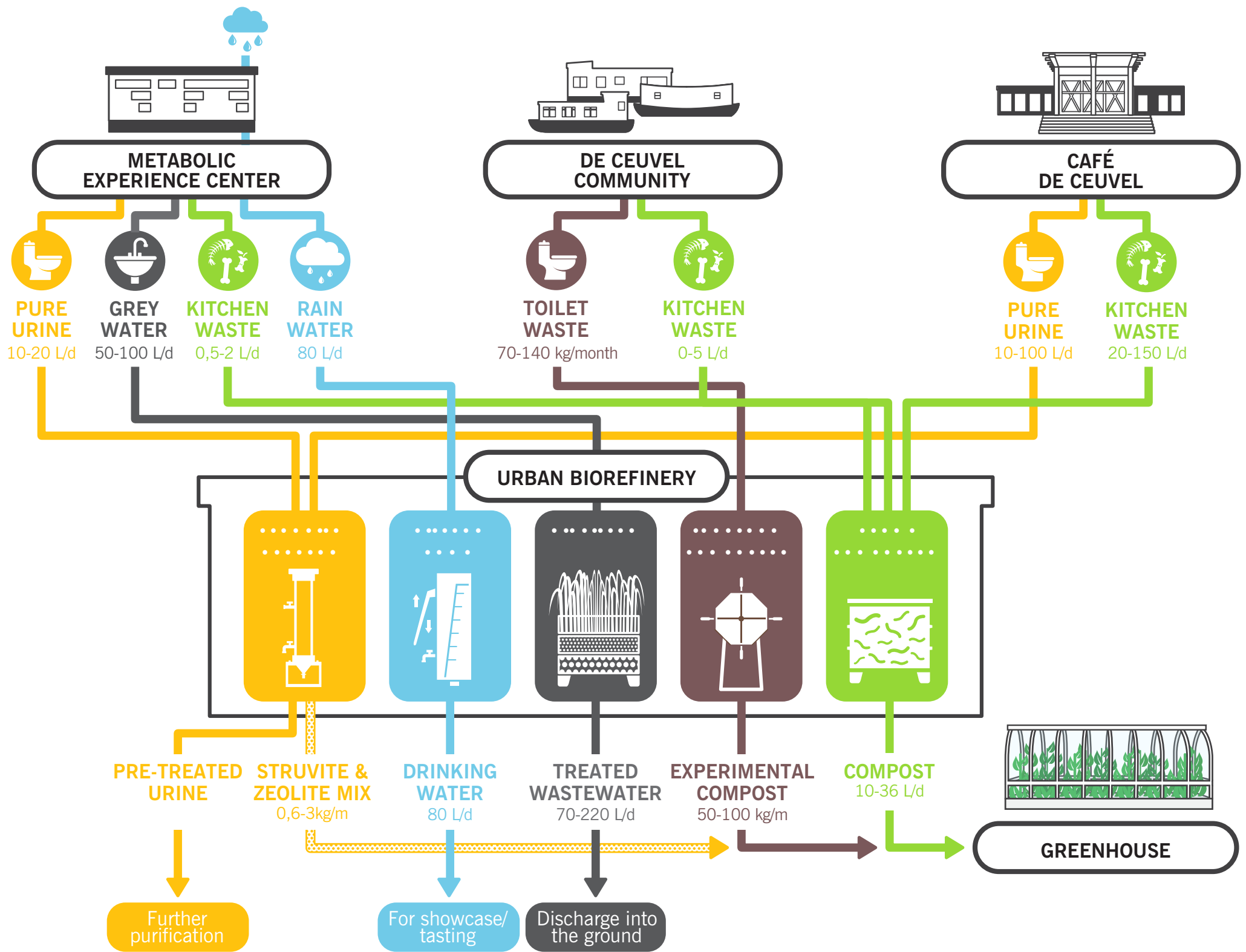




DE CEUVEL: BACKGROUND

- Polluted piece of industrial land
- 5000m² / 1.2 acres
- Tender put out by municipality
- 10 year land lease - temporary development
- Plan submitted for creative eco-office park
- Total budget 0.5 million euro
- High ambitions of circularity





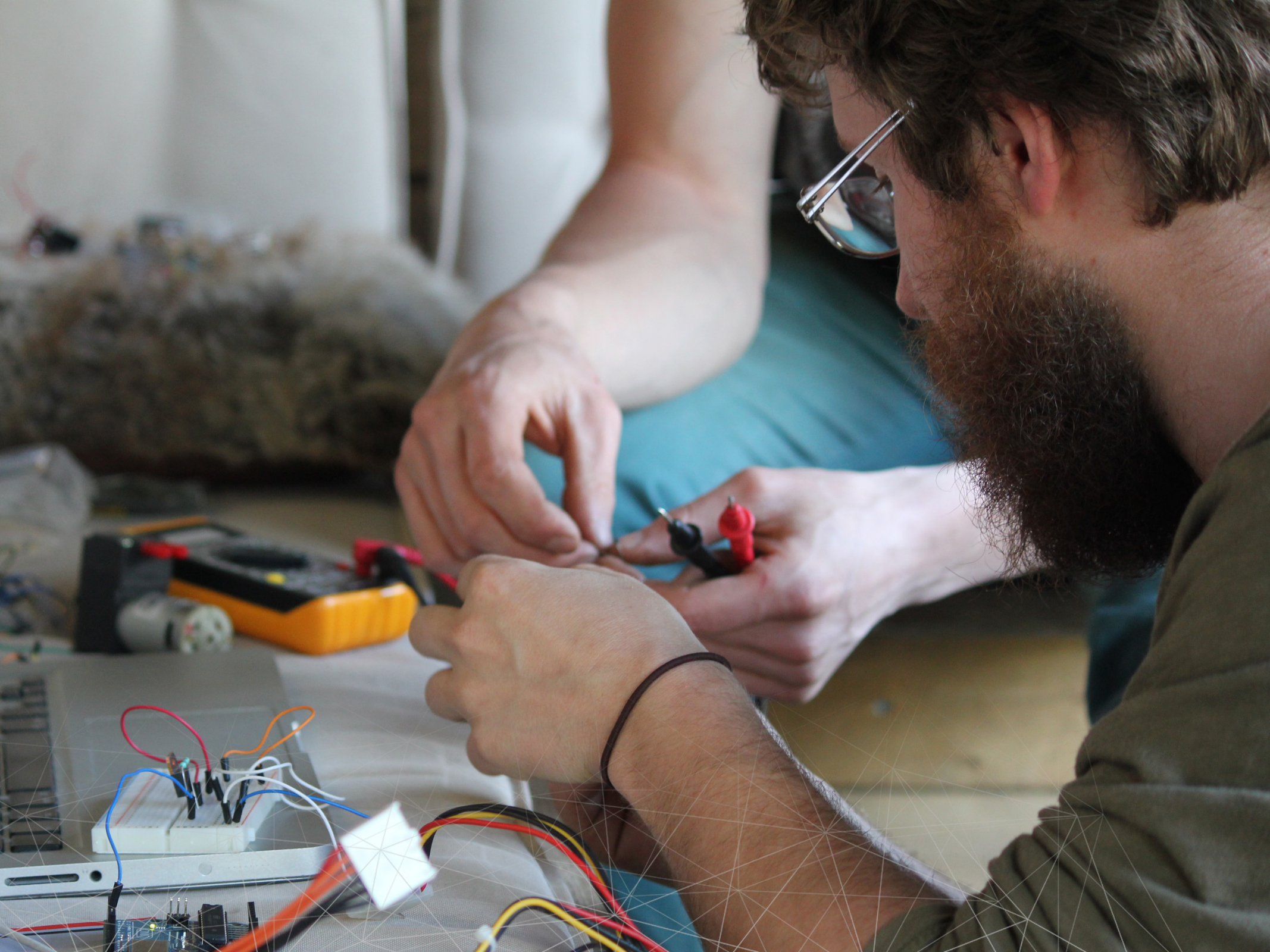
DE CEUVEL: PERFORMANCE GOALS

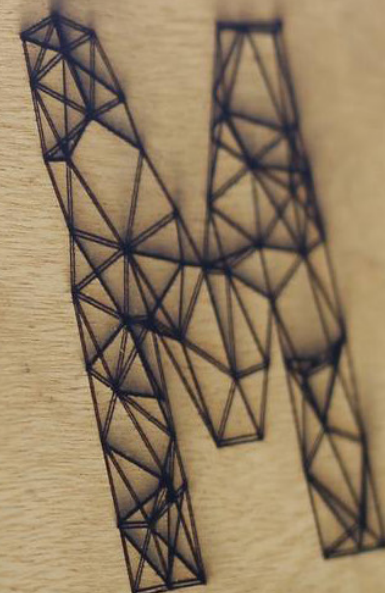
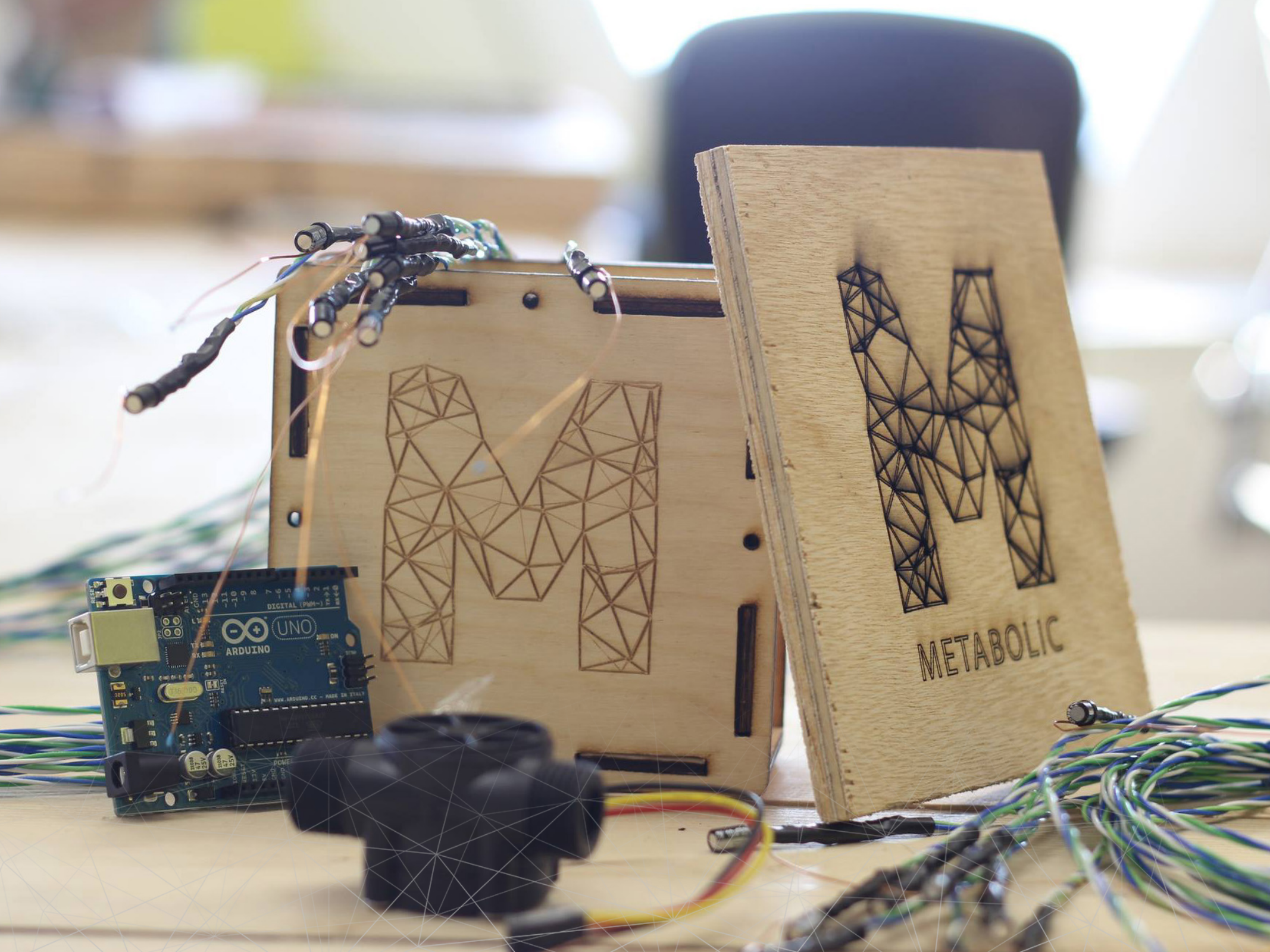
- 100% renewable energy
- 70% local nutrient recovery
- 100% water self sufficiency
- 10% food production
- monitoring & feedback systems
- community program
- financially feasible



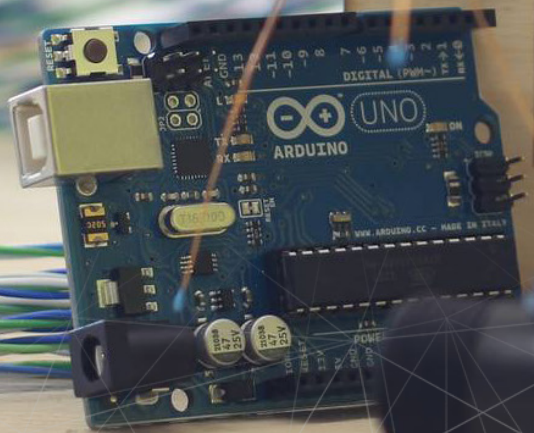








METABOLIC





Hey User.

Here's how things are going.



1.23 kg
+0.72 kg



4.56 K
- 1.01 K



7.89 L
- 0.12 L



0.12 V
- 0.23 V



3.45 L
- 1.20 L



6.78 V
+ 1.03 V



9.01 K
+ 5.03 K



2.34 kg
- 4.23 kg

Click on an icon to view more detailed information.

Did you know?

Your power usage for this past week could power



4,57% of Amsterdam
for a whole day.

More about power

Power is a most powerful thing.



"This is a description of an article that does not actually exist. But, since you are clearly taking the time to actually read this filler text, I will entertain you with a fun little palindrome: 'Are we not pure? 'No sir!' Panama's moody Noriega brags. 'It is garbapel' Irony dooms a man; a prisoner up to new era.'"

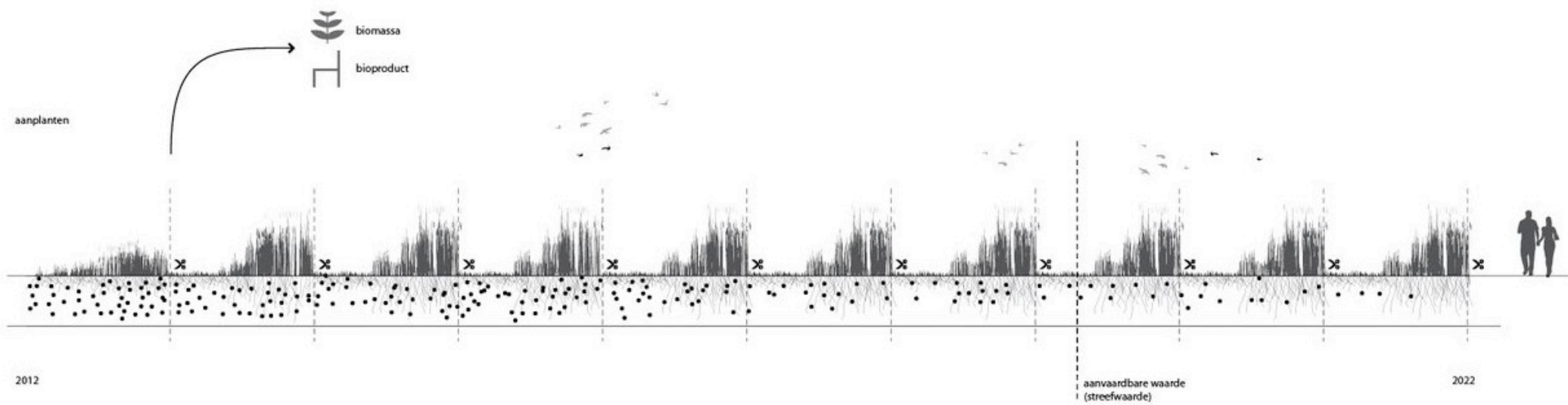
Read the full article on
[ThisIsNotReal.nl](#)



JOULIETTE

AT DE CEUVEL





Brede Waterpest



Fonteinkruid



Ruwe Smele



Katwilg







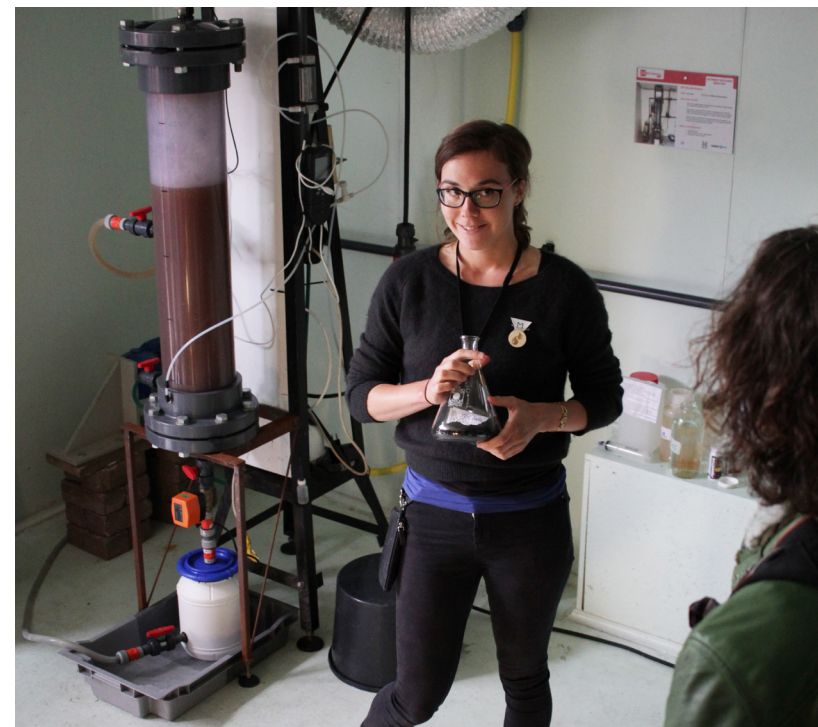
Solar panels produce local, renewable energy



A low cost, solar
energy-driven soil
clean-up technique



- Gray water from kitchen and bathrooms are filtered through biofilters
- On-site filtration





Circulaire landbouw



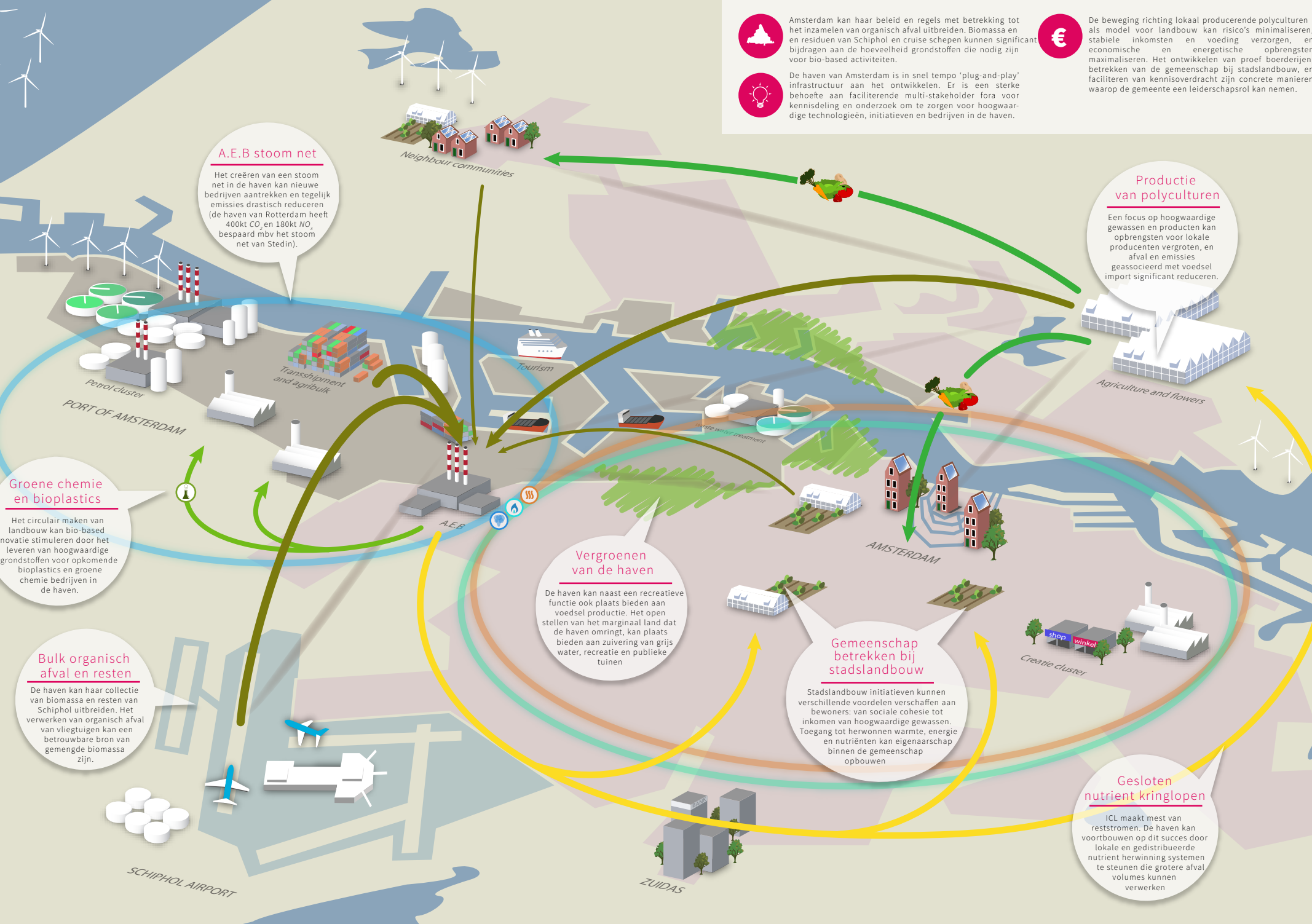
Amsterdam kan haar beleid en regels met betrekking tot het inzamelen van organisch afval uitbreiden. Biomassa en en residuen van Schiphol en cruise schepen kunnen significant bijdragen aan de hoeveelheid grondstoffen die nodig zijn voor bio-based activiteiten.



De haven van Amsterdam is in snel tempo 'plug-and-play' infrastructuur aan het ontwikkelen. Er is een sterke behoefte aan faciliterende multi-stakeholder fora voor kennisdeling en onderzoek om te zorgen voor hoogwaardige technologieën, initiatieven en bedrijven in de haven.



De beweging richting lokaal producerende polyculturen als model voor landbouw kan risico's minimaliseren, stabiele inkomsten en voeding verzorgen, en economische en energetische opbrengsten maximaliseren. Het ontwikkelen van proef boerderijen, betrekken van de gemeenschap bij stadslandbouw, en faciliteren van kennisoverdracht zijn concrete manieren waarop de gemeente een leiderschapsrol kan nemen.



The background is a solid red color with a complex, abstract pattern of thin white lines. These lines intersect at various angles to form a network of irregular, interconnected triangles and polygons of different sizes, creating a mesh-like or crystalline structure.

SCALING UP: CIRCULAR BUIKSLOTERHAM

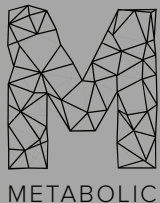
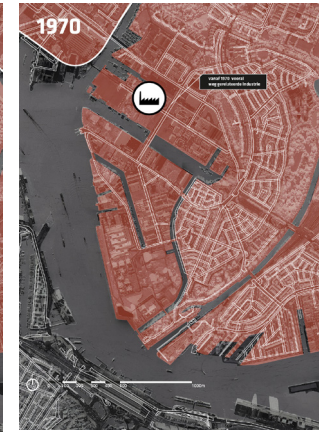


BUIKSLOTERHAM

- Polder in the northern part of the city, constructed from deposited dredge materials.
- Former industrial area: petrochemical industry, waste incineration, etc.
- An area in transition: 6500 future inhabitants; 8000 future workers in the area.

BUIKSLO- TERHAM

- » CIRCULAR
- » SMART
- » BIOBASED
- » 20-YEAR VISION



CLIENTS:



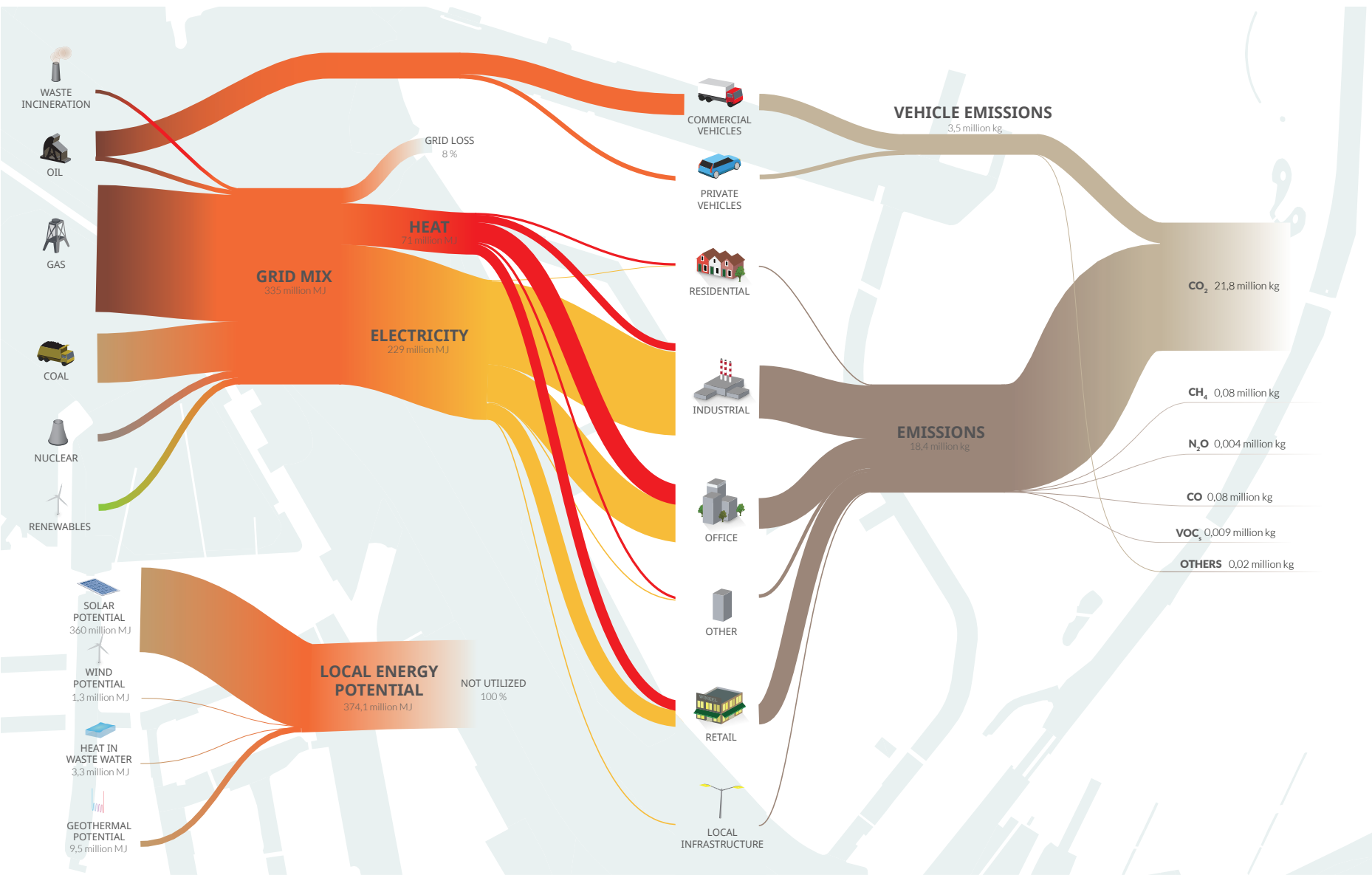
TEAM:



Stuudioinedots



BUIKSLOTERHAM: ENERGY AND EMISSIONS



An architectural rendering of a sustainable neighborhood. The scene features modern, multi-story buildings with large windows and balconies. One building has a bicycle icon and the word "NOORD" on its facade. The area is lush with trees, including a large tree in the foreground with a butterfly. People are shown walking, sitting, and playing in a central courtyard area. The overall atmosphere is bright and sunny, with a warm, orange-toned filter.

VISION & GOALS

- **Energy:** Buiksloterham is energy self-sufficient with a fully renewable energy supply
- **Materials & products:** Buiksloterham is a zero waste neighbourhood that with a near 100% circular material
- **Water:** Buiksloterham is rainproof and has near 100% resource recovery from wastewater
- Goals on smart infrastructure, economy, society

MANIFEST

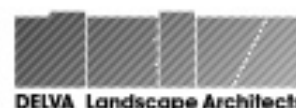
CIRCULAIR

BUIKSLOTERHAM

“Verbonden door de ambitie om te bouwen aan een duurzame toekomst voor de stad”



Studiosincedots



amsterdam economic board



Westpoort Warmte



BELEEF
BUIKSLOTERHAM

PAKHUIS DE ZWIJGER*

**DURVEN HET AAN EN SPREKEN ZICH UIT IN EEN
MANIFEST VOOR DE CIRCULAIRE ONTWIKKELING
VAN BUIKSLOTERHAM**

Schoon Schip

AMSTERDAM

A sustainable neighbourhood of 30 floating households in Amsterdam that is pushing the boundaries of community governance, technology integration, architecture, and construction.



Cities occupy only 3% of the world's land but consume 75% of its resources. In the heart of Buiksloterham, a neighborhood in Amsterdam, a new housing project called Schoonschip is setting new standards for sustainable urban development.

A COMPREHENSIVE SUSTAINABILITY PLAN

The goal of Schoonschip is to create an urban ecosystem embedded into the fabric of the city. It will harvest ambient water and energy for use on site, cycle nutrients locally, and create the environment that is supportive of biodiversity and human health and wellbeing. To reach this, the design process for Schoonschip is guided by a comprehensive sustainability plan with goals in nine key areas and means to achieve them through an integrated design process.

ECOSYSTEMS & BIO-DIVERSITY

Beneficial impact on existing ecosystems, regenerating them where possible both during construction and the whole project life cycle

MATERIALS

100% low-impact and circular material management

HEALTH & WELL-BEING

Providing high level of comfort while maintaining modern standards of living

ECONOMIC & FINANCIAL

Financially feasible

SOCIAL & GOVERNANCE

A close-knit community that develops and regulates shared technologies and is involved in site design, construction and maintenance

CIRCULAR & SMART

Implementation of management and monitoring strategies to ensure optimal treatment of resources for infinite life cycles

WATER

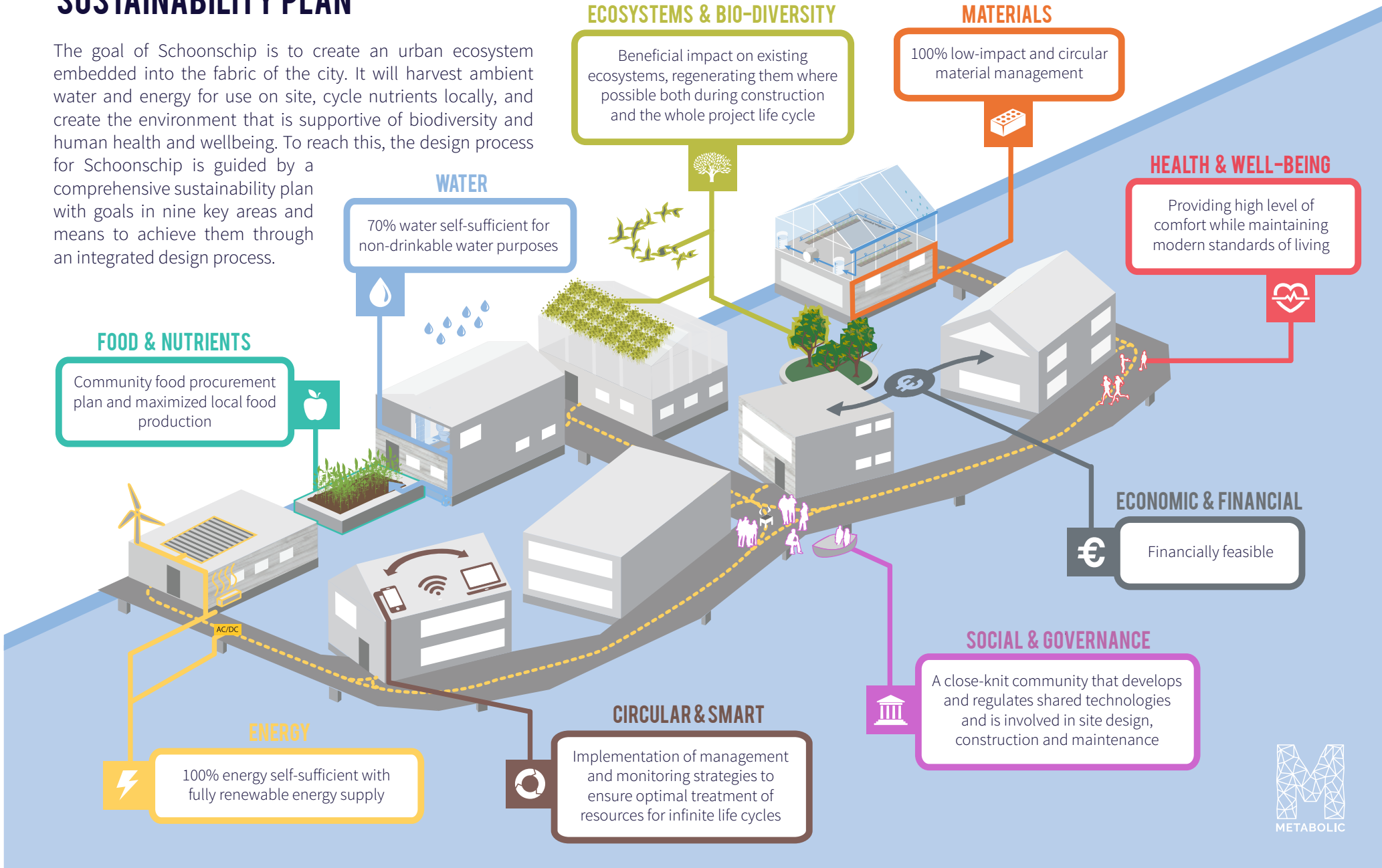
70% water self-sufficient for non-drinkable water purposes

FOOD & NUTRIENTS

Community food procurement plan and maximized local food production

ENERGY

100% energy self-sufficient with fully renewable energy supply



ENERGY

100% energy self-sufficient with fully renewable energy supply

- Local renewable energy supply (solar thermal, solar PV and small scale wind)
- Passive house standard (insulation and airtightness, building orientation, window openings, facade orientation)
- High efficiency technologies (lighting systems, hot fill water appliances, multi-temperature phase boilers)
- Urban plan optimized for daylight, thermal comfort and building heat demand

WATER

70% locally water self-sufficient for non-drinkable water purposes

- Rainwater collection for non-drinkable water use (i.e., toilets, showers and household appliances)
- Semi-centralized storage and purification systems
- Energy efficient technologies (low-flush or vacuum toilets, water recycling showers, low flow water aerating taps)

MATERIALS

100% low-impact and circular material management

- Living buildings that manage all of their own resources internally
- Circular buildings that are designed for complete disassembly and reuse of building components at the end of life
- Design for flexibility by using modular systems and easy to access infrastructure
- 100% recycling of recyclable materials and constructions
- Low-impact, low-VOC, and non-toxic materials
- Sustainably sourced materials from certified or eco-verified sources

ECOSYSTEMS & BIO-DIVERSITY

Beneficial impact on existing ecosystems, regenerating them where possible both during construction and the whole project life cycle

- Introduction of green roofs, green facades and green spaces (floating gardens)
- Preserving habitats and migratory corridors
- Introducing habitat elements and plants
- Regenerative soil and water treatment
- Reduced construction impact through selecting efficient, low-impact processes and building techniques

CIRCULAR & SMART

Implementation of management and monitoring strategies to ensure optimal treatment of resources for infinite life cycles

- Data monitoring to provide feedback to users on energy and water use
- Data sharing and product sharing platform
- Seasonal and short cycle load balancing through on-site battery systems
- Materials passport for buildings

ECONOMIC & FINANCIAL

Financially feasible

- Partnerships and sponsorships to cover the costs of technologies and installations
- Internal market mechanisms for resources sharing among community members

HEALTH & WELL-BEING

Providing high level of comfort while maintaining modern standards of living

- Aesthetically pleasing
- Healthy and safe environment

SOCIAL & GOVERNANCE

A close-knit community that develops and regulates governing mechanisms for all shared and installed technologies and solutions and is involved in site design, construction and maintenance

- Providing education and learning opportunities for the community
- A cooperative that will manage the energy systems on site, as well as shared water and waste technologies, and other shared facilities
- Partnerships between diverse players in the energy and built environment fields, research institutes and utilities

FOOD & NUTRIENTS

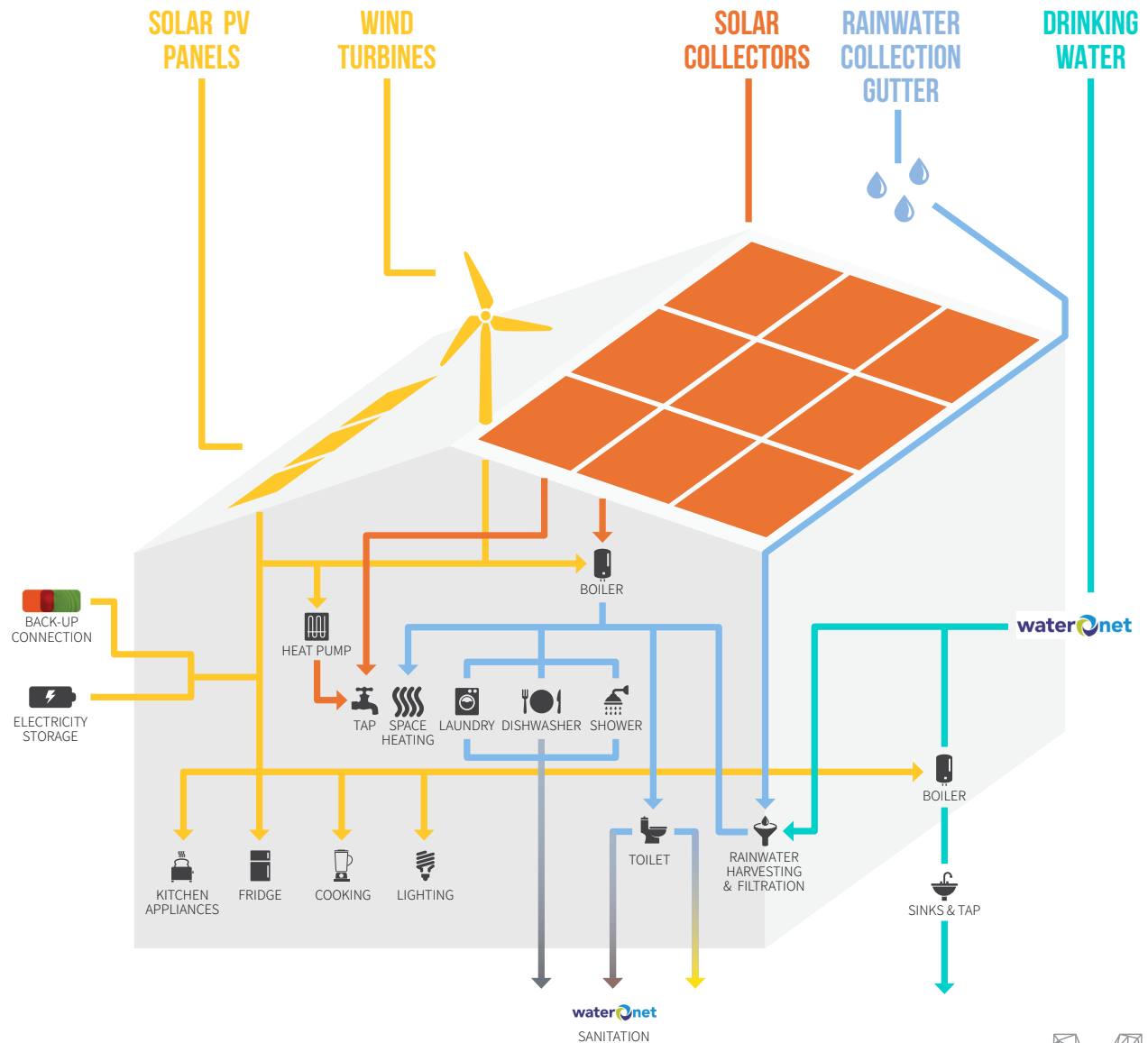
Community food procurement plan and maximized local food production

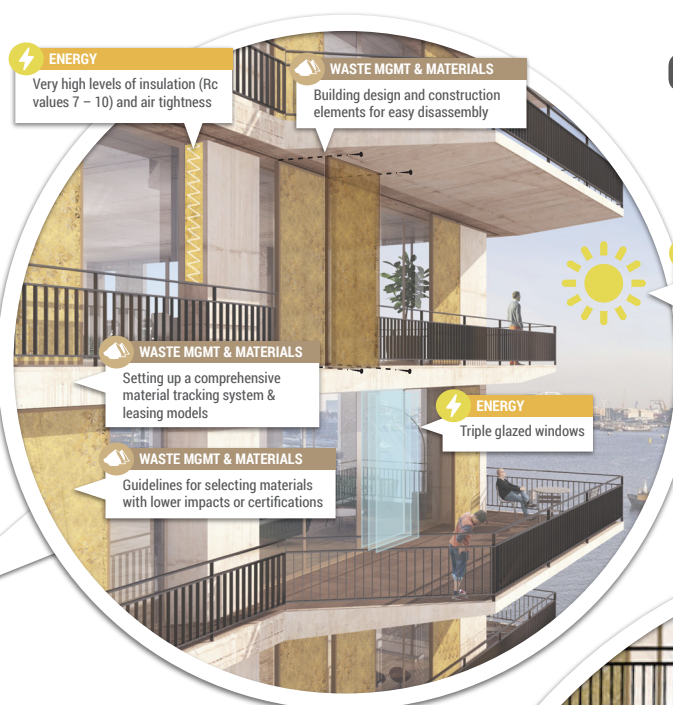
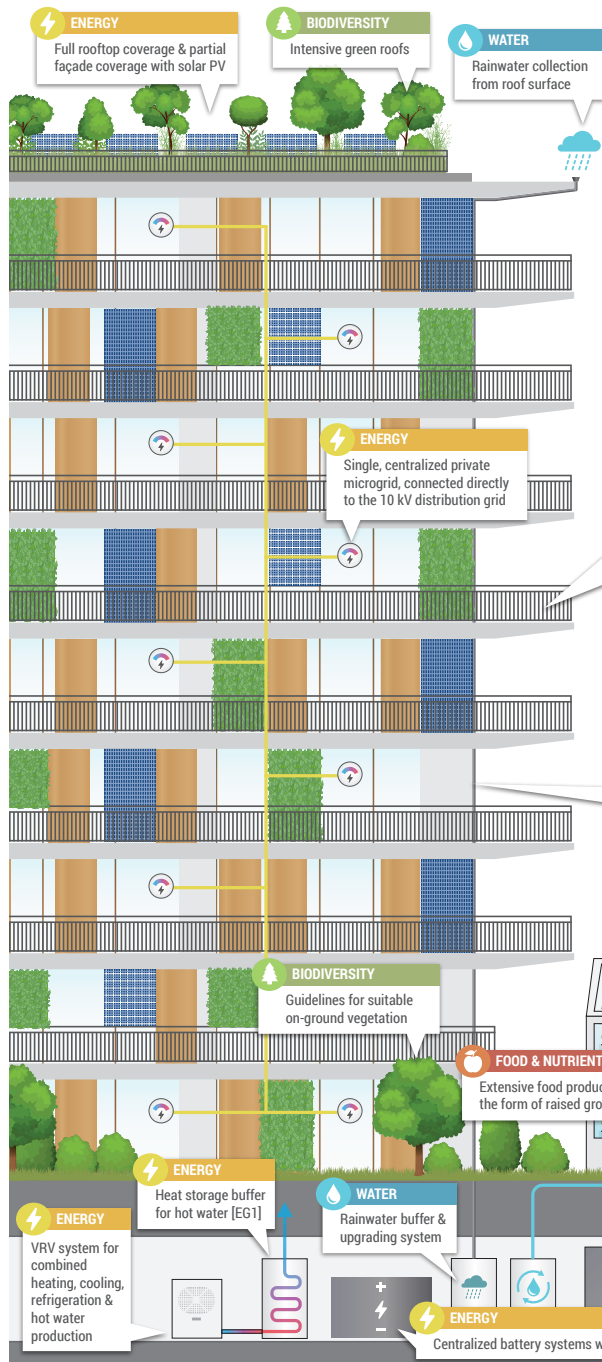
- Local food production
- Nutrient recovery from wastewater (urine-diverting toilets)
- Composting and local reuse of organic wastes

SCHOONSHIP'S RESOURCE FLOW STRATEGY

The urban plan of the site has been optimized for daylight, thermal comfort, and building heat demand. All the members of the community have committed to producing energy through installing integrated technologies on their own plots, and each household has been given pre-calculated targets for their energy demand and consumption (for space heating, electricity, and hot water), with the goal of achieving passive house standards for most buildings on site through integrated technology solutions.

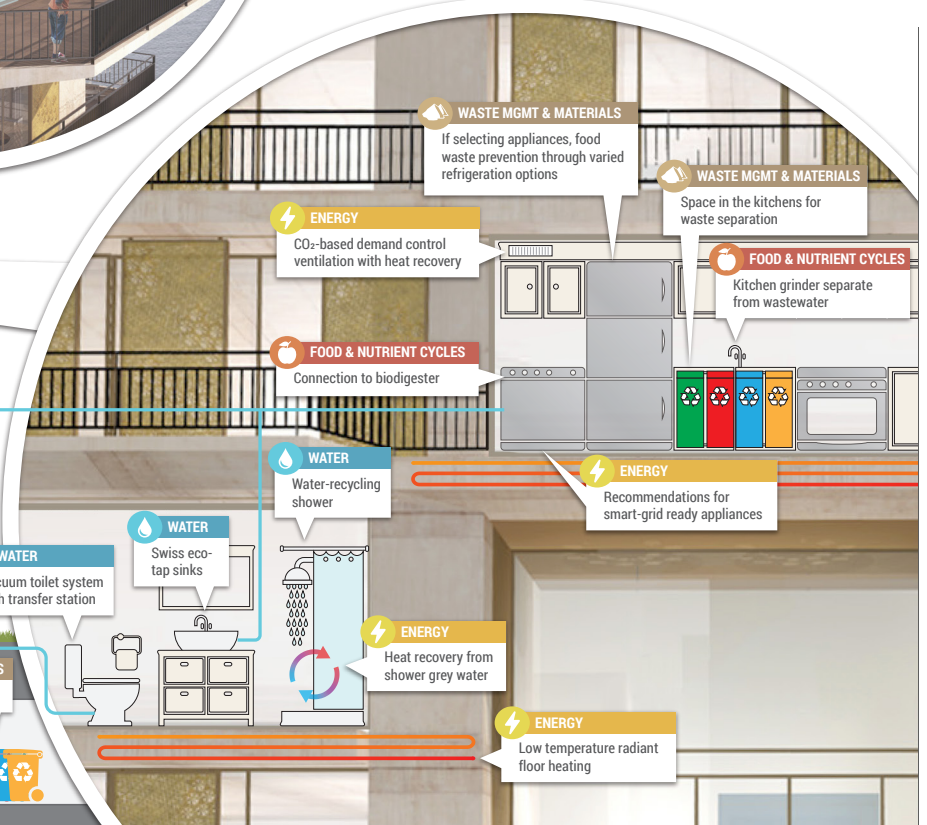
- Local electricity generation from renewable energy sources (a combination of solar PV and thermal, small-scale wind and heat exchangers)
- Electricity and heat demand have further been reduced through the use of water-recycling showers and optimized appliance and lighting plans
- Rainwater collection and nutrient management
- Smart home systems
- Energy cascading through an AC/DC micro smart grid
- Heat cascading and heat recovery ventilation
- Highest efficiency technologies





CIRCULARITY INTERVENTIONS

High investment package



**“AMSTERDAM HEEFT
ALS EERSTE STAD TER
WERELD EEN INSTRUMENT
ONTWIKKELD WAARMEE
OPDRACHTGEVERS
CIRCULAIR BOUWEN
KUNNEN VASTLEGGEN”**



Gemeente
Amsterdam

Roadmap Circulaire Gronduitgifte

Een introductie in circulaire bouwprojecten



SGS

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