METABOLIC

UNLOCKING VALUE IN A CIRCULAR ECONOMY

Identifying business opportunities using a systems perspective

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Outline

- Introduction to Metabolic
- Urgency: Global Challenges
- Systems Failure
- The Circular Economy
- Our Process for Identifying CE Opportunities

Towards a circular economy

1. REDUCE

Generating less **waste**
(reduce packaging and leftovers)

2. RECYCLABLE

Ensuring all packaging materials that we put on the market are fully **recyclable**

3. RECYCLED

Use **recycled materials** instead of virgin ones (such as ***P****ost* ***C****onsumed* ***R****ecycled* plastics)

4. RE-THINK

Drastically re-think business models to make the **system circular**

Unilever

Towards a circular economy

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Unilever

INTRODUCTION

About Metabolic

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:

INSIGHTS

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

IMPLEMENTATION

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

ACTIVATION

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

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SUSTAINABILITY CONSULTANT

THOMAS MASON
SUSTAINABILITY CONSULTANT

CHANDAR VAN DER ZANDE
PROJECT MANAGER

ERIN KENNEDY
SENIOR CONSULTANT

GERARD ROEMERS
SENIOR CONSULTANT

EVA GLADEK
FOUNDER AND CEO

MARTA SIERRA GARCIA
GRAPHIC AND UX DESIGNER

JAN STREECK
SUSTAINABILITY CONSULTANT

CASSIE BJÖRCK
CREATIVE DIRECTOR

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PROJECT COORDINATOR, METABOLIC FOUNDATION

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THOMAS THORIN
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OFFICE & ADMINISTRATION MANAGER

ALISTAIR LE RUEZ
ASSOCIATE

PIETER VAN EXTER
SUSTAINABILITY CONSULTANT

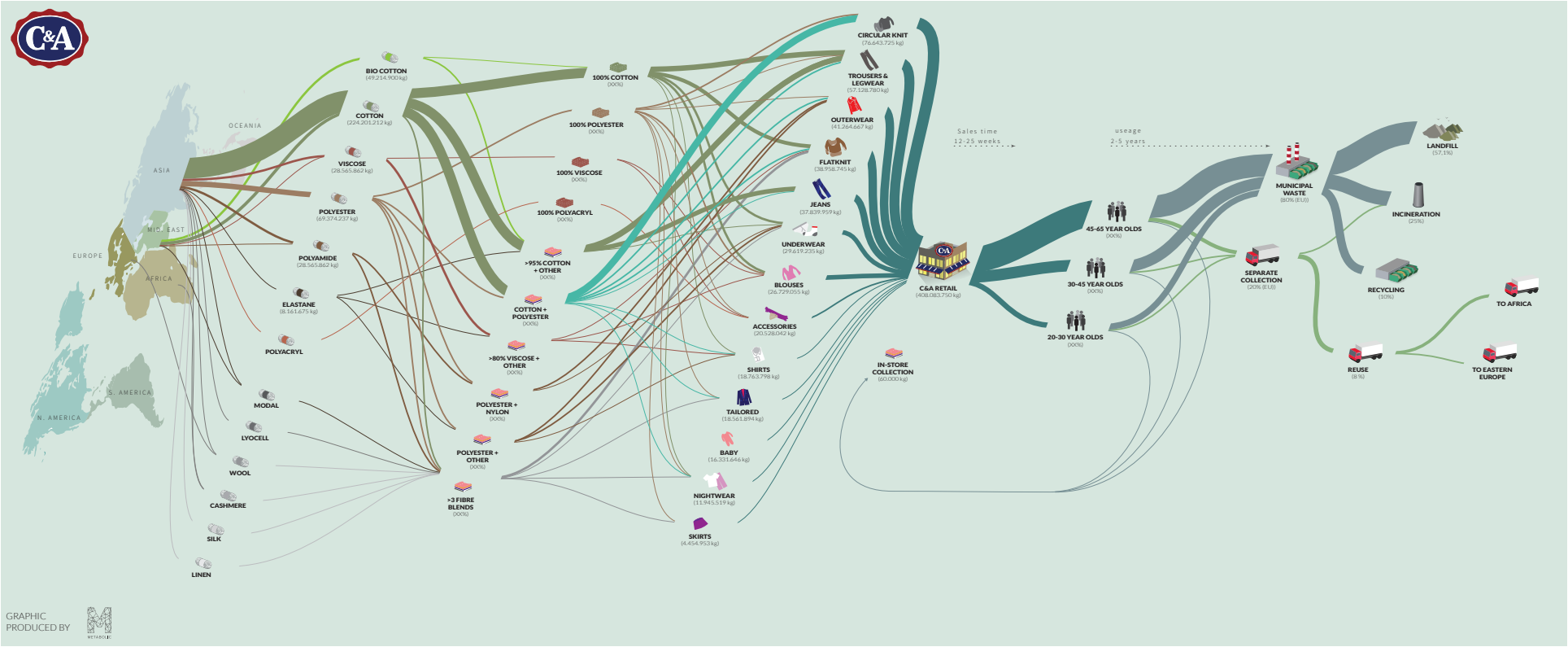
NADINE GALLE
SUSTAINABILITY CONSULTANT

FLOOR VAN BOVENE
PROJECT MANAGER

CHRIS MONAGHAN
CO-FOUNDER AND INNOVATION DIRECTOR

KATE BLACK
COMMUNICATIONS DIRECTOR

Insights

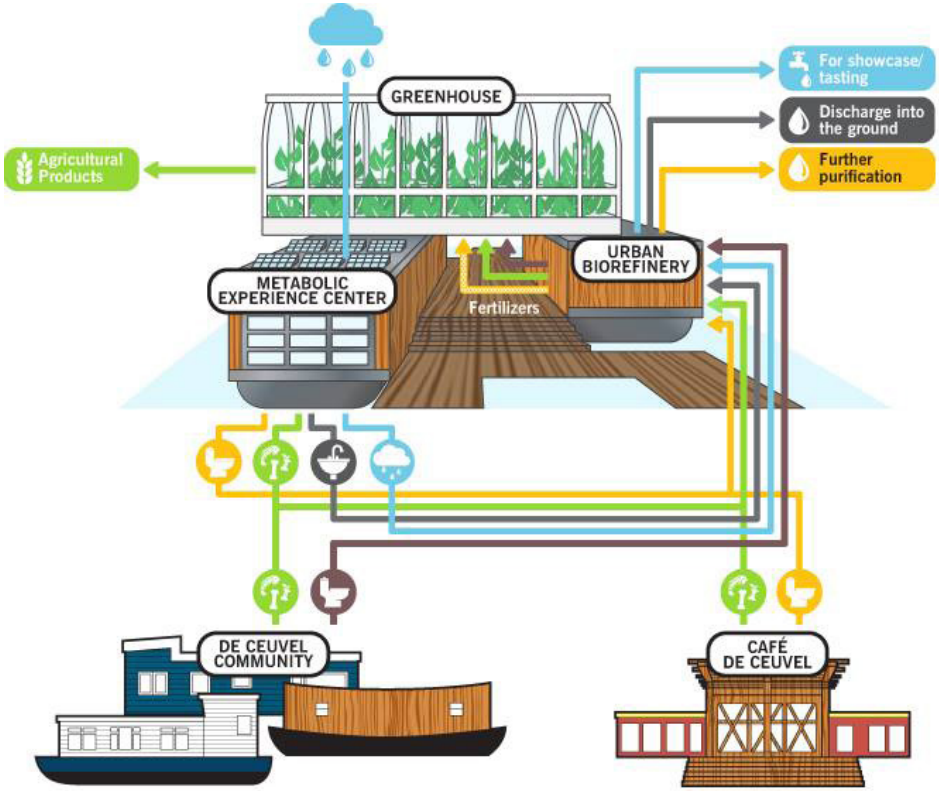


We help businesses, governments, and non-profits thrive in the circular economy through our knowledge and tools.

Implementation

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

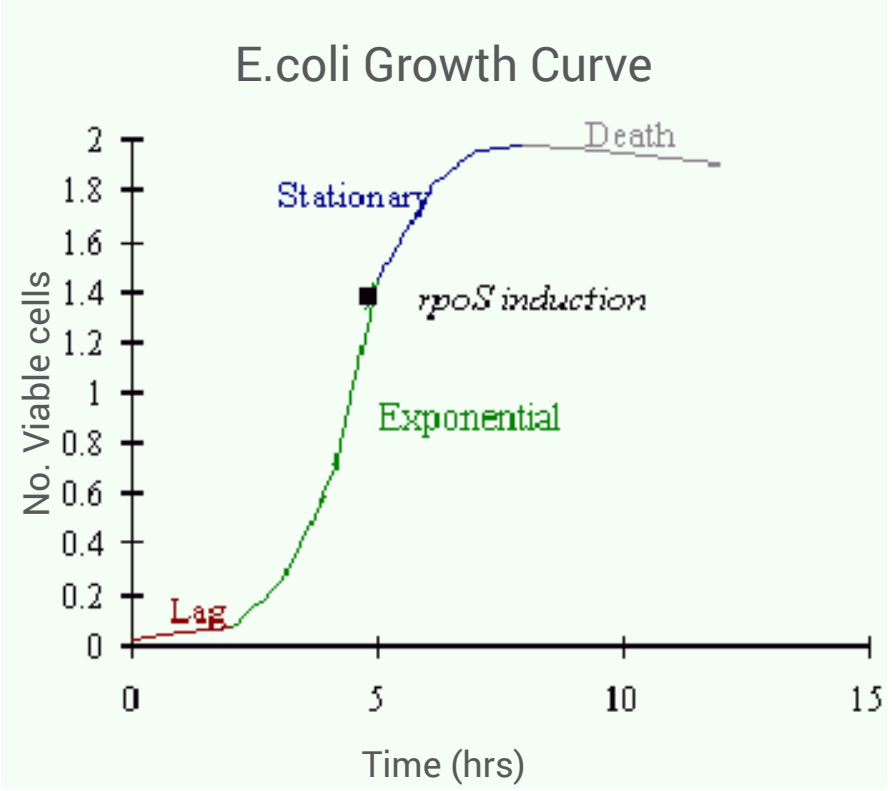
Activation



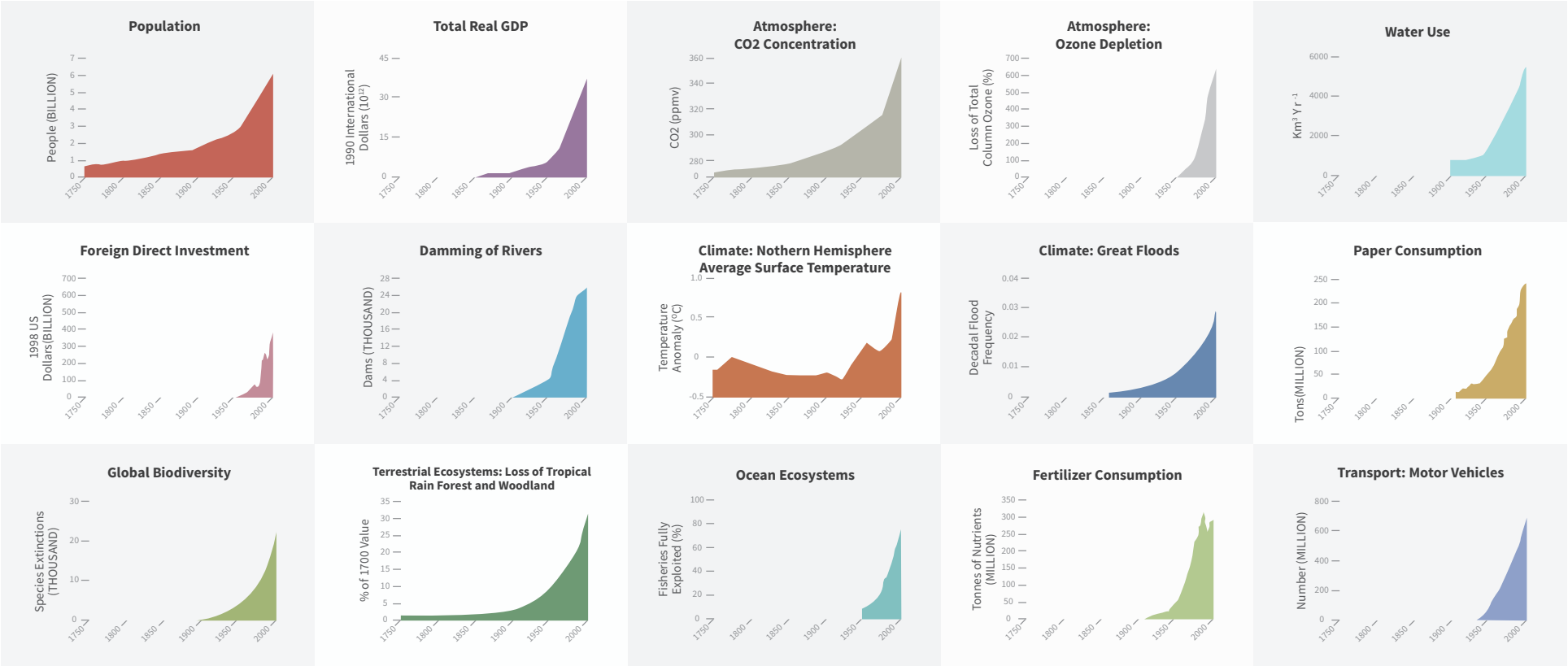
We inspire through education and actionable ideas, and our Foundation helps us reach underserved communities.

WHY I CHOSE THIS PATH

Fatal feedback loops



Exponential times

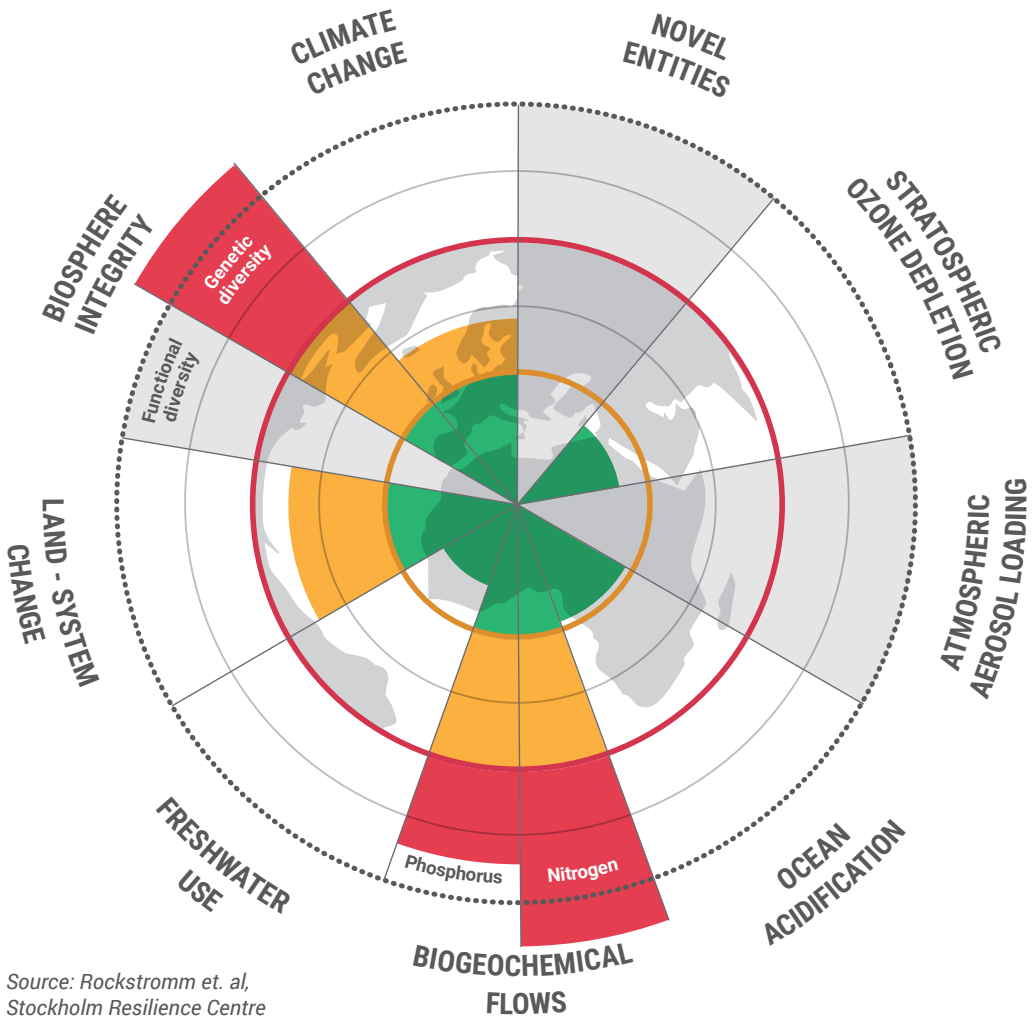


Sustainability challenges






Planetary boundaries



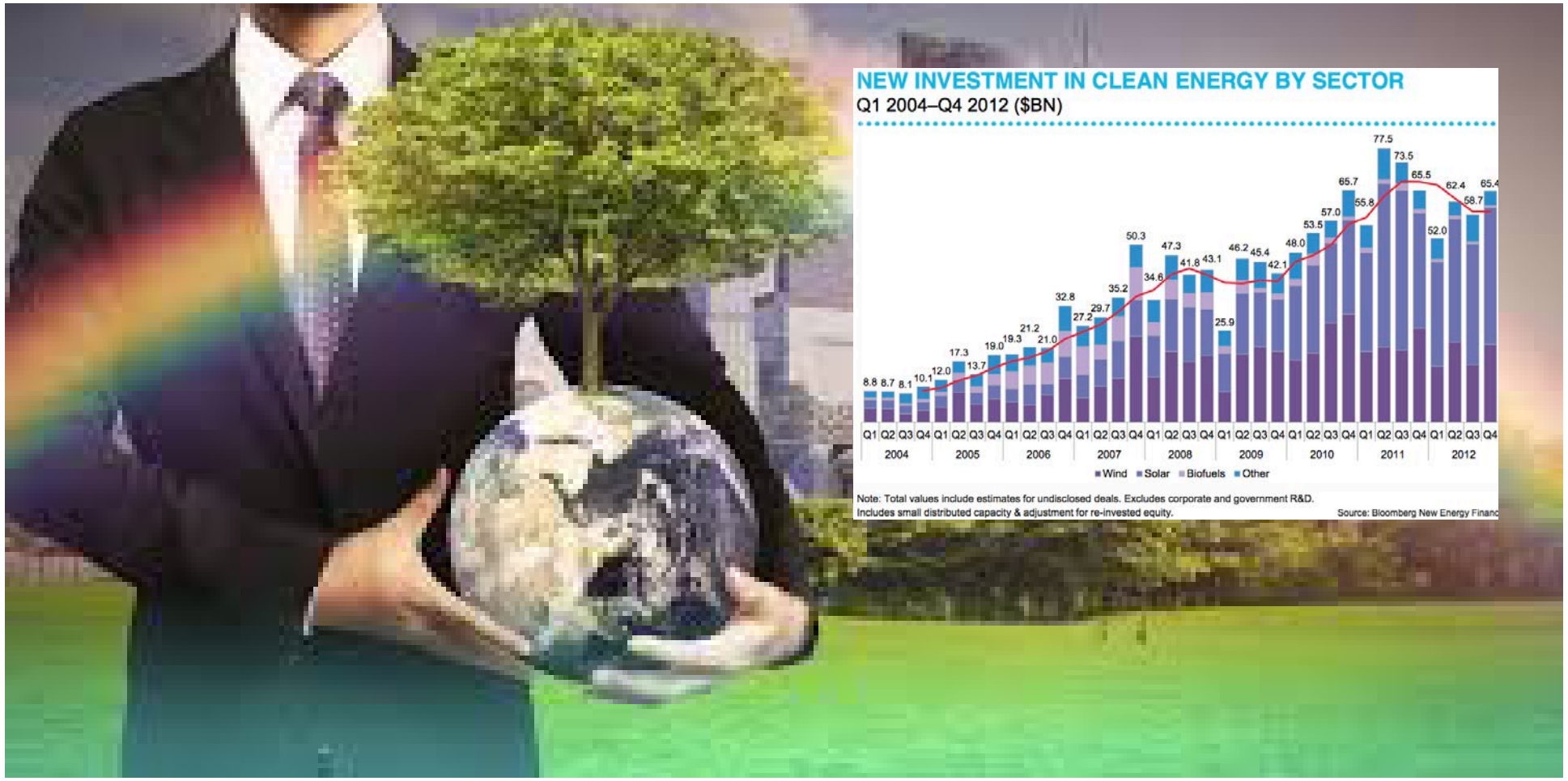
Source: Rockstromm et. al, Stockholm Resilience Centre

- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

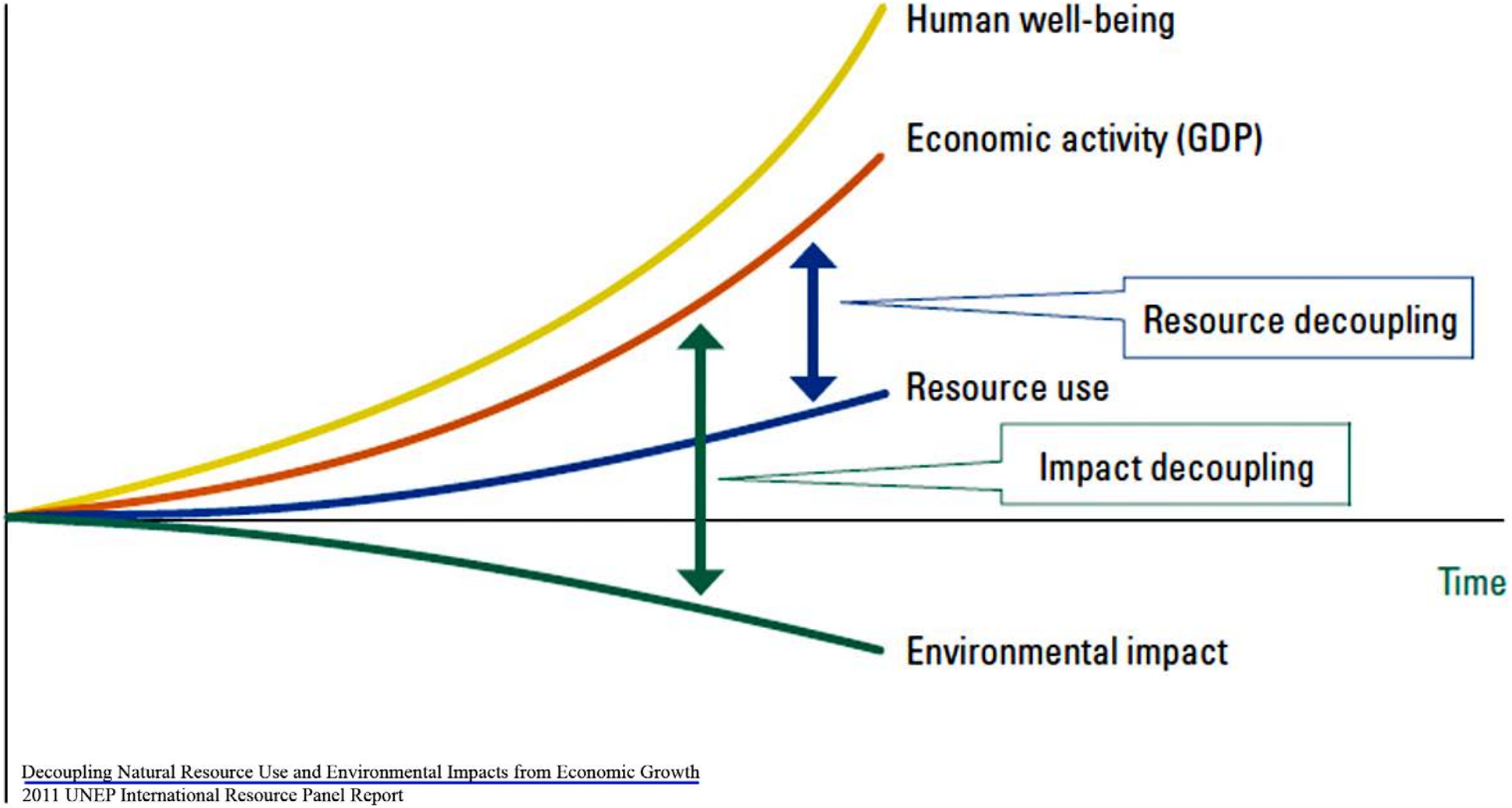
SO HOW ARE WE DOING?

Ecolabel proliferation

High levels of investment

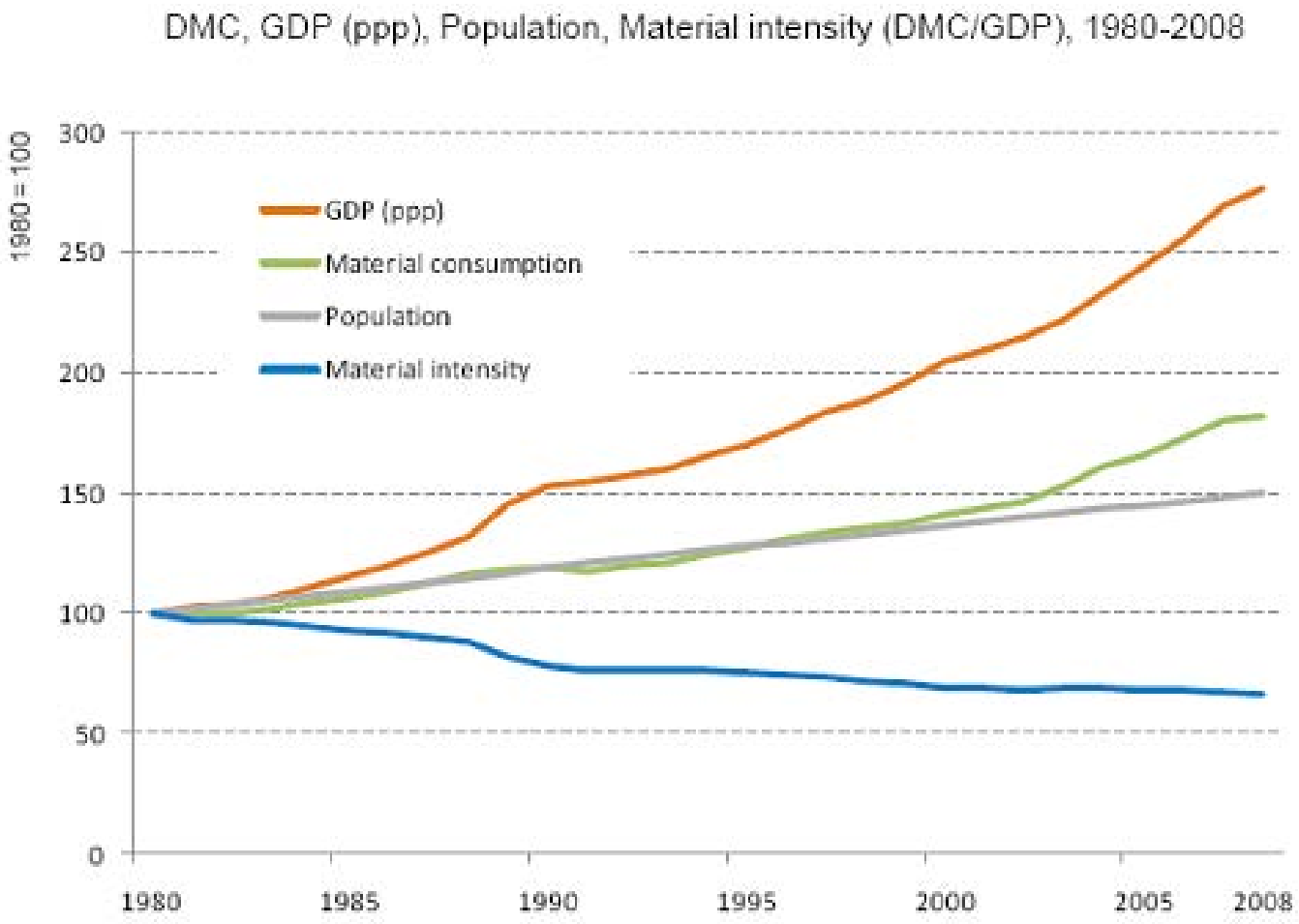


The theory: Eco-economic decoupling



Decoupling Natural Resource Use and Environmental Impacts from Economic Growth
2011 UNEP International Resource Panel Report

But... Not quite working



Giljum, S., - Dittrich, M.: *Green Economics Around the World?*, WRF 2011, September 12 - 21, 2011, Davos.

SO WHAT'S THE PROBLEM?

Pitfalls of not using systems thinking

01 Efficiency rather than Effectiveness

02 Burden Shifting

03 Rebound Effects

04 Short-Term Perspectives

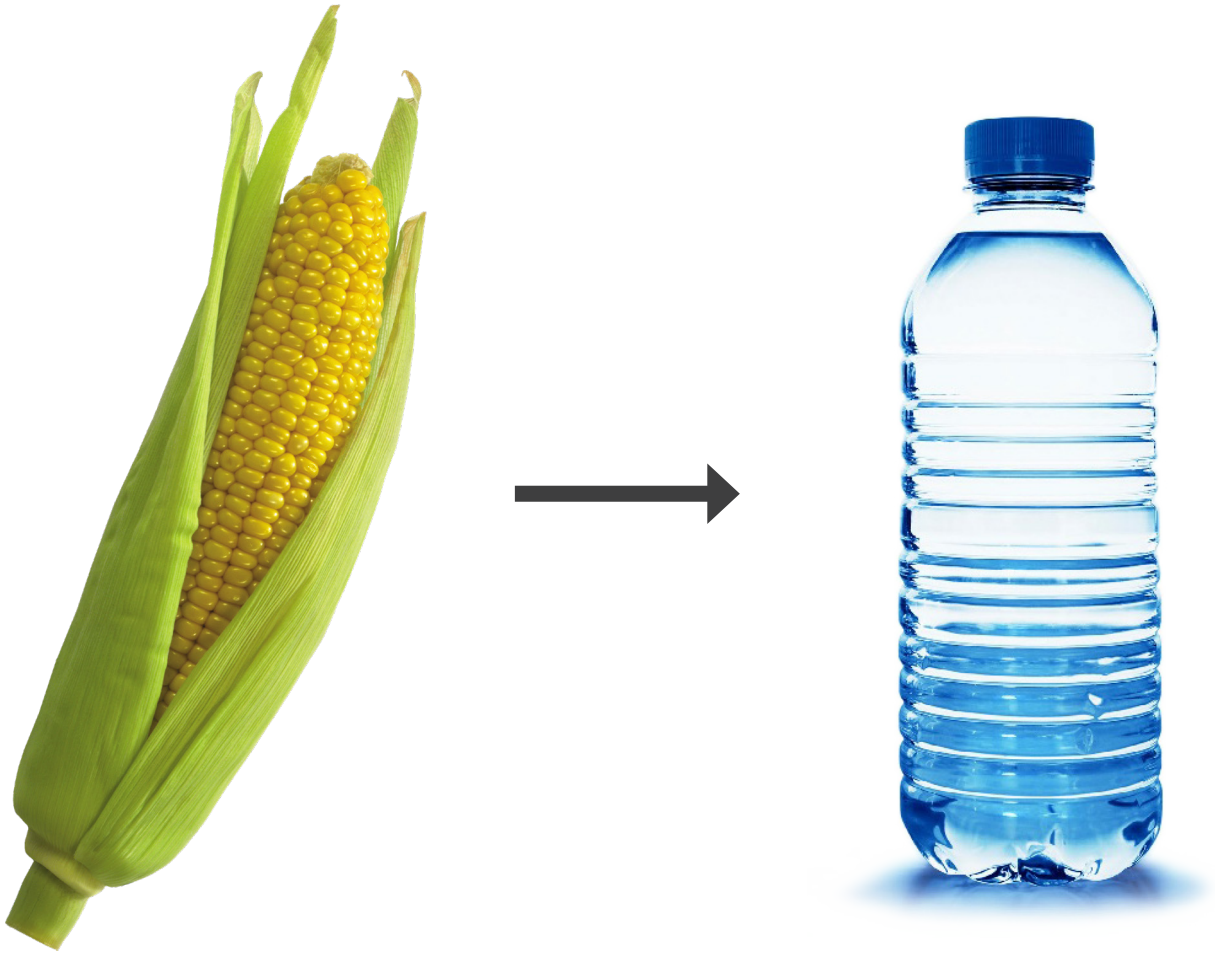
05 Relative Rather Than Absolute Impact

01 Efficiency rather than effectiveness

- Start from “Why?”
- Does this product need to exist?
- Doing the right things vs. Doing things right

02 Burden shifting: lighting technology

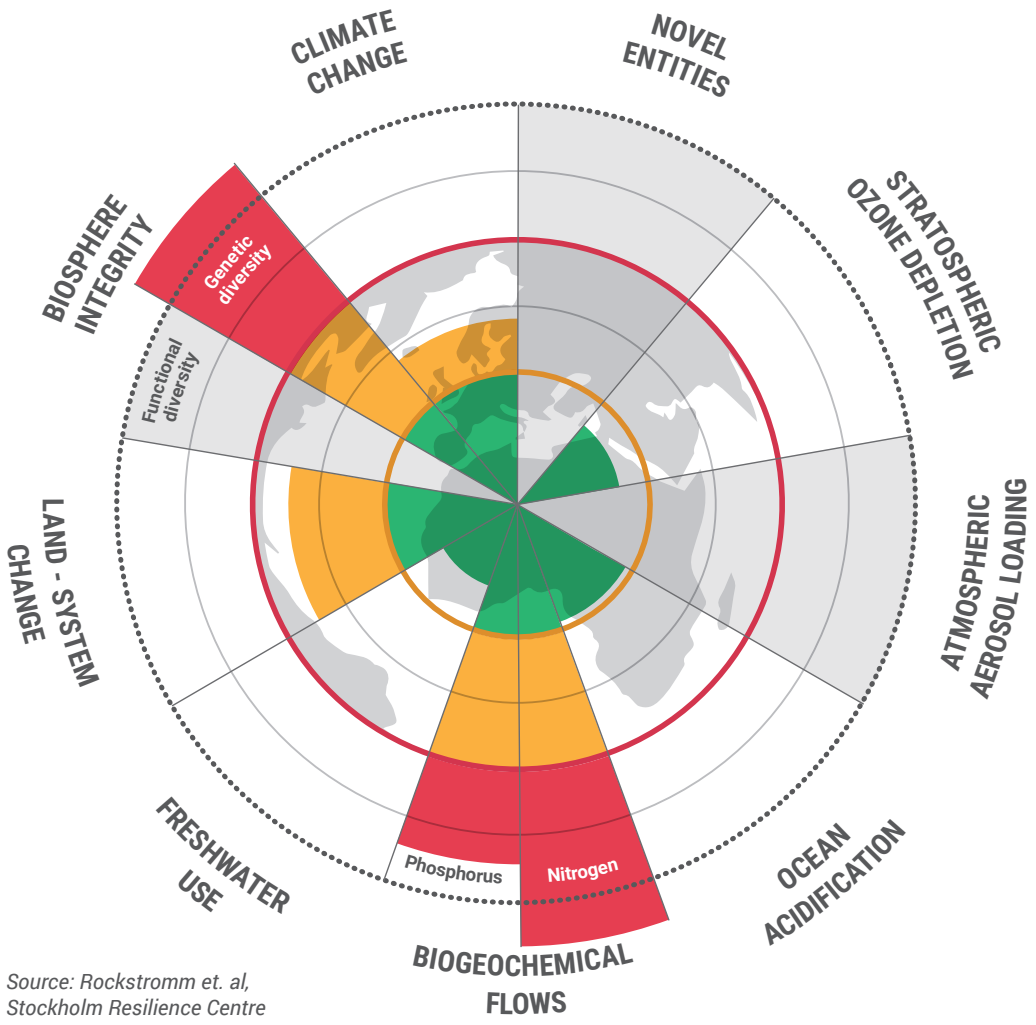
03 Rebound effects: bioplastics



04 Short term perspectives

Design for multiple life cycles of value

05 Relative rather than absolute impact



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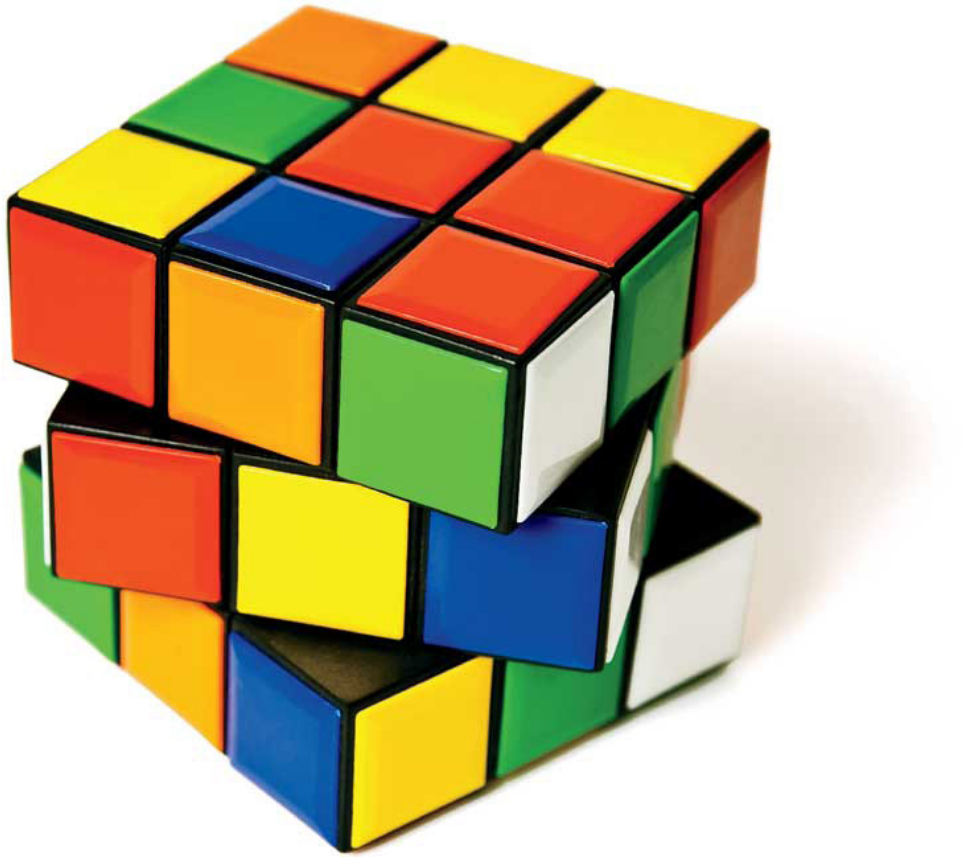
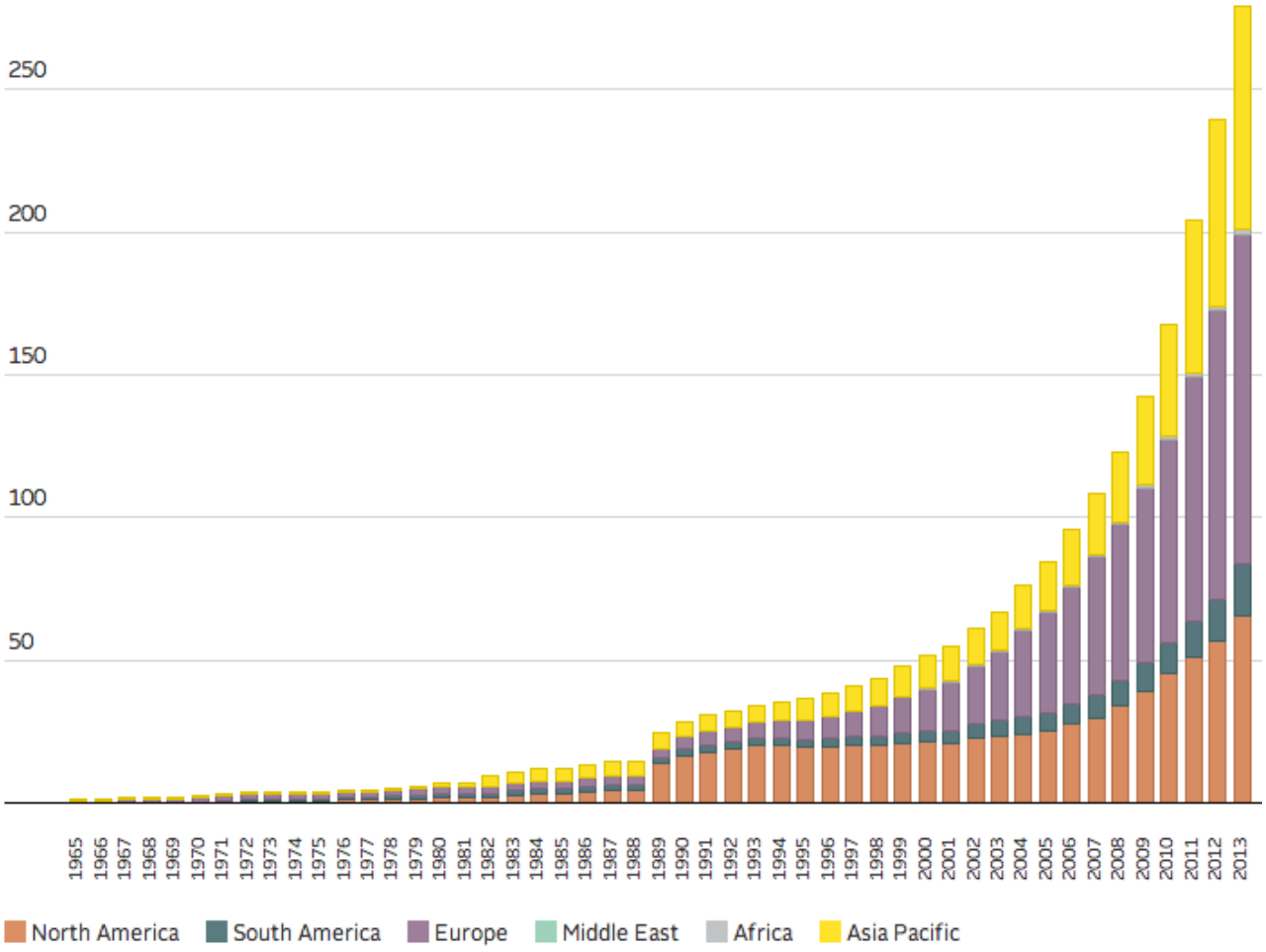


There is no such thing as a sustainable product.

There can only be sustainable product-service *systems*.

Exponential solutions

Global Renewable Energy Consumption

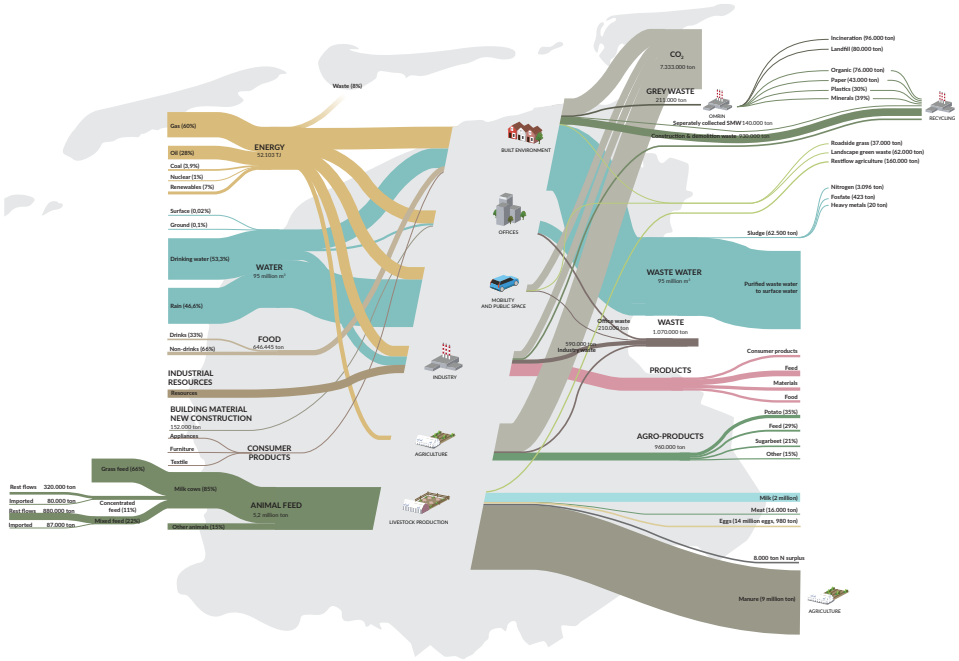


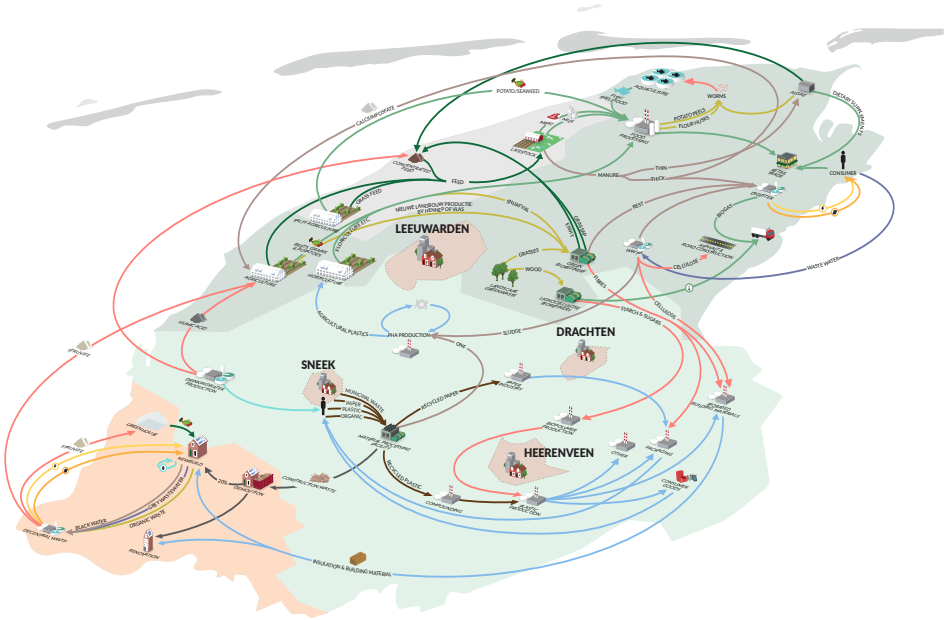
- 40 years ahead of expected forecasts in many countries, like the United States.
- Over half of new power capacity installed in 2015 was renewable
- Already in 2017, renewables hit 25% percent of global power supply

THE CIRCULAR ECONOMY

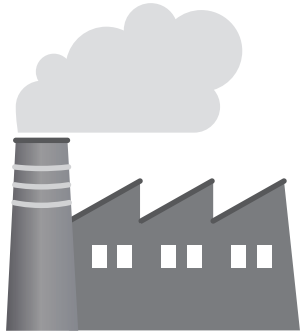
BUILDING A CIRCULAR ECONOMY

Since 2012, Metabolic has completed over 350 projects for companies, cities, and governments, with a large focus on the Circular Economy.



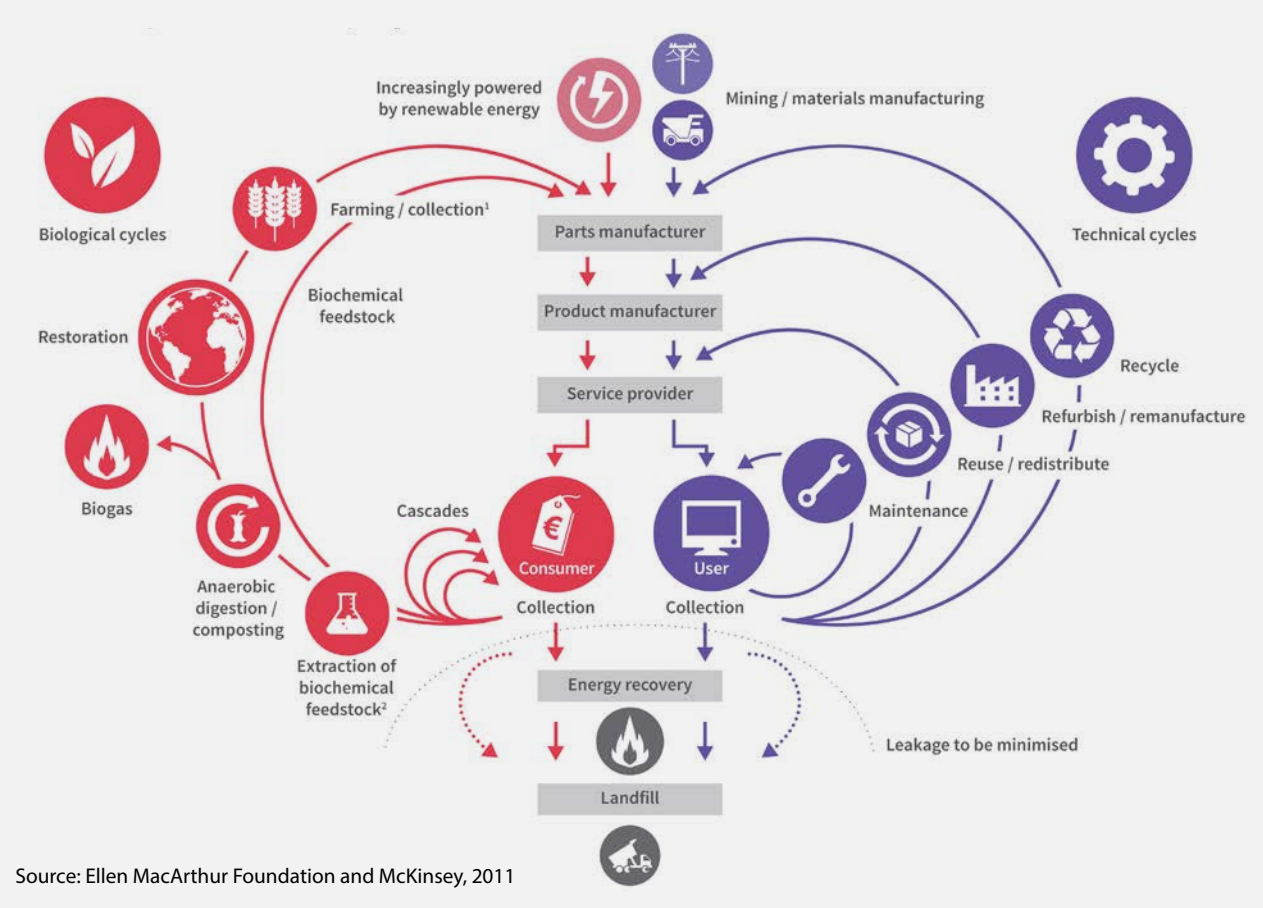


THE LINEAR ECONOMY



TAKE → MAKE → DISPOSE

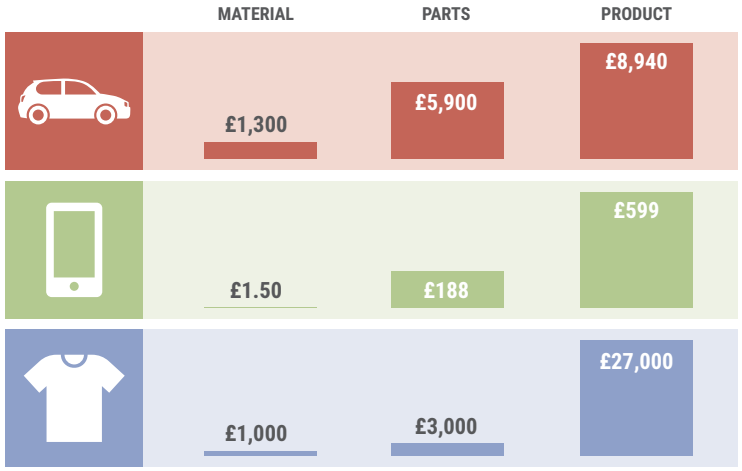
THE CIRCULAR ECONOMY



Source: Ellen MacArthur Foundation and McKinsey, 2011

"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'"

CIRCULAR ECONOMY BUSINESS MODELS



Finished products are worth much more than the raw materials inside them.

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

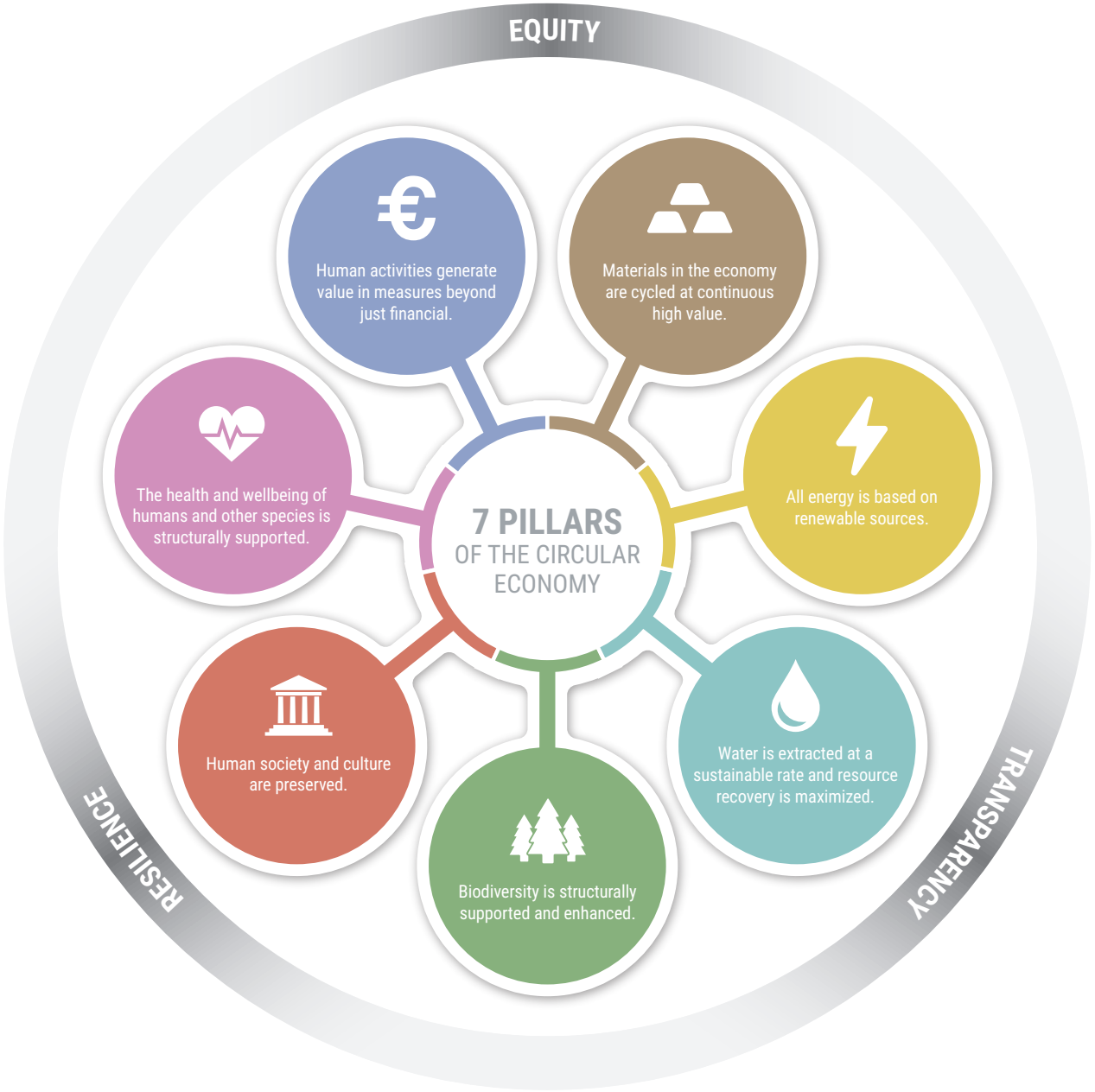
The power of pure inputs:

- Monomaterials
- Certified materials
- Circular procurement and sourcing

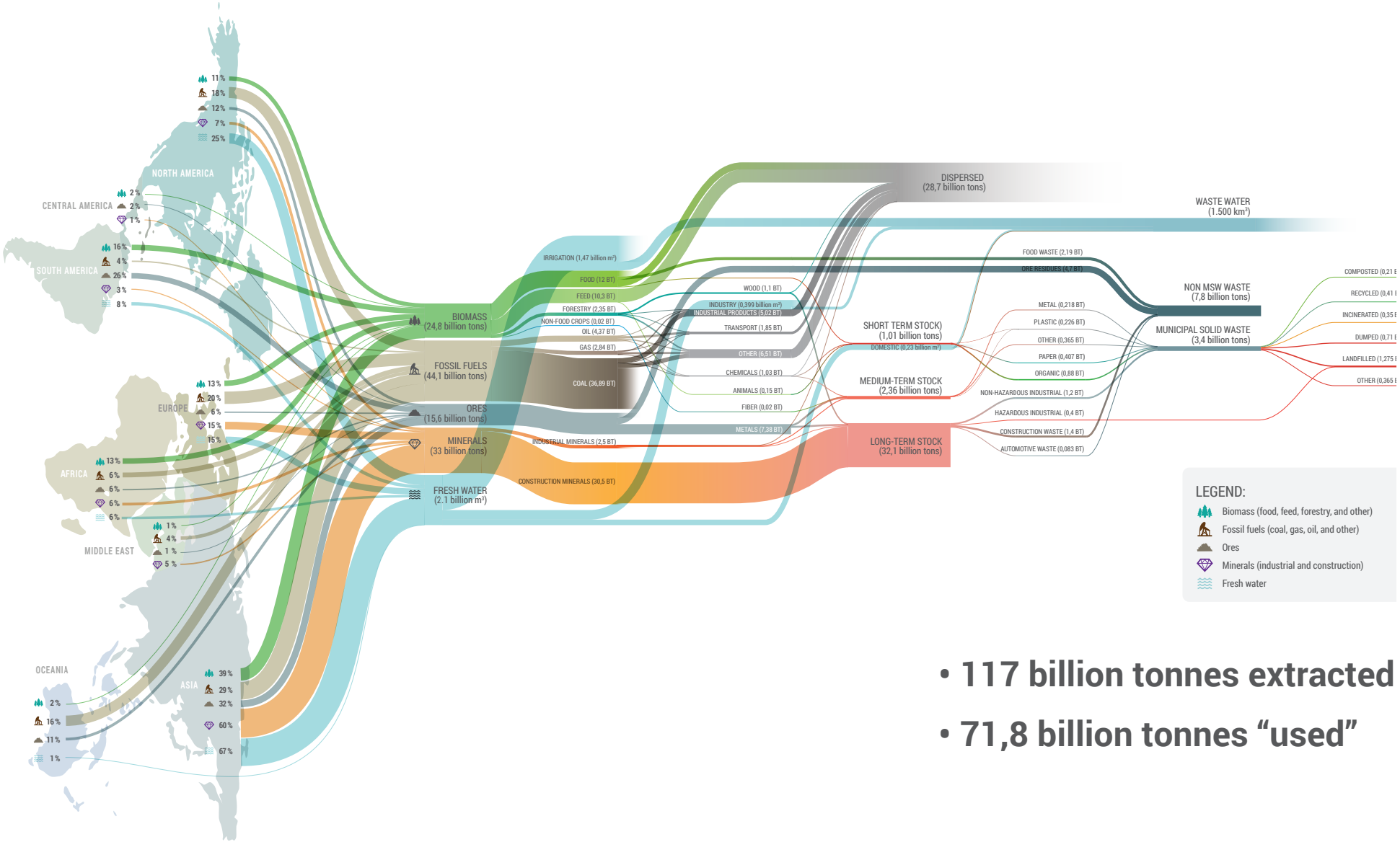
THE VALUE OF MATERIALS

iPhone 5

IS THIS CIRCULAR?


EQUITY
Human activities generate value in measures beyond just financial.
Materials in the economy are cycled at continuous high value.
All energy is based on renewable sources.
Water is extracted at a sustainable rate and resource recovery is maximized.
Biodiversity is structurally supported and enhanced.
Human society and culture are preserved.
The health and wellbeing of humans and other species is structurally supported.
7 PILLARS
OF THE CIRCULAR ECONOMY
TRANSPARENCY
RESILIENCE

THE GLOBAL MATERIAL FLOW: 2010



- 117 billion tonnes extracted
- 71,8 billion tonnes “used”

KEY INTERVENTION AREAS FOR ACHIEVING A CIRCULAR ECONOMY


agriculture


cities & the built environment


wastewater


mobility & transport

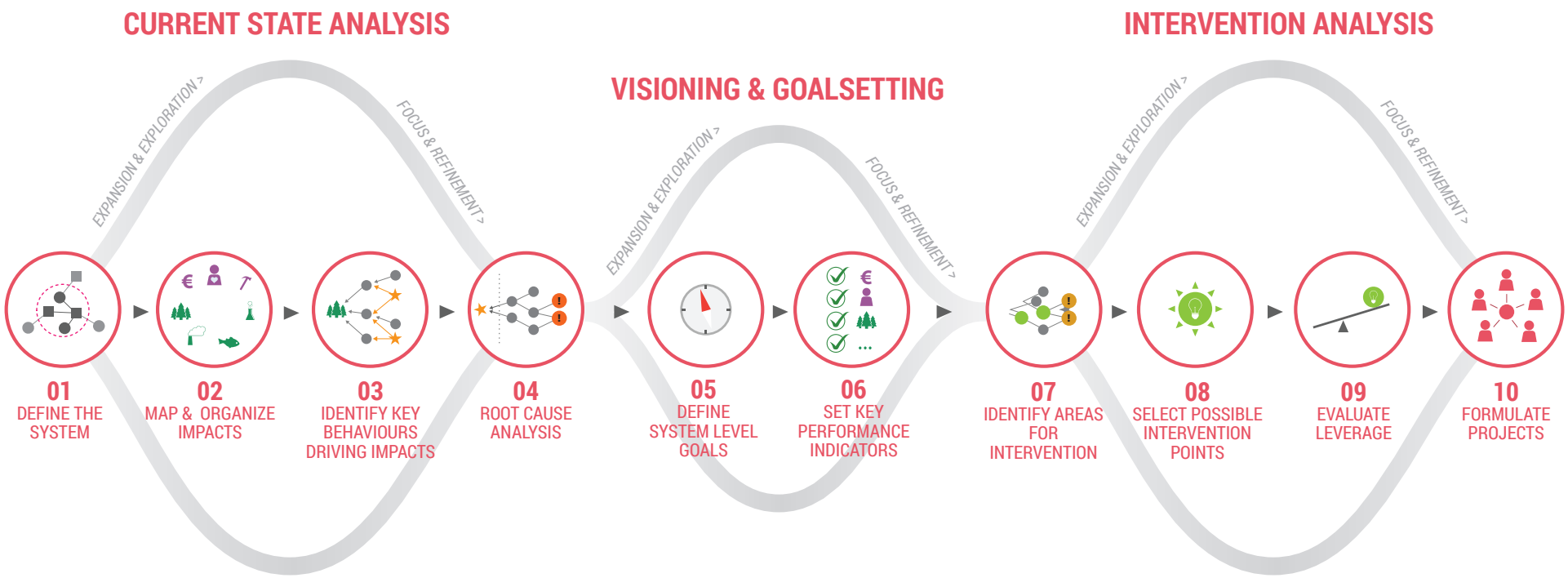

electronics


chemicals


construction & demolition waste

A SYSTEMATIC AND DATA-DRIVEN APPROACH TO FINDING CIRCULAR OPPORTUNITIES

Systems approach to finding circular opportunities




DURALOCK
DURACELL
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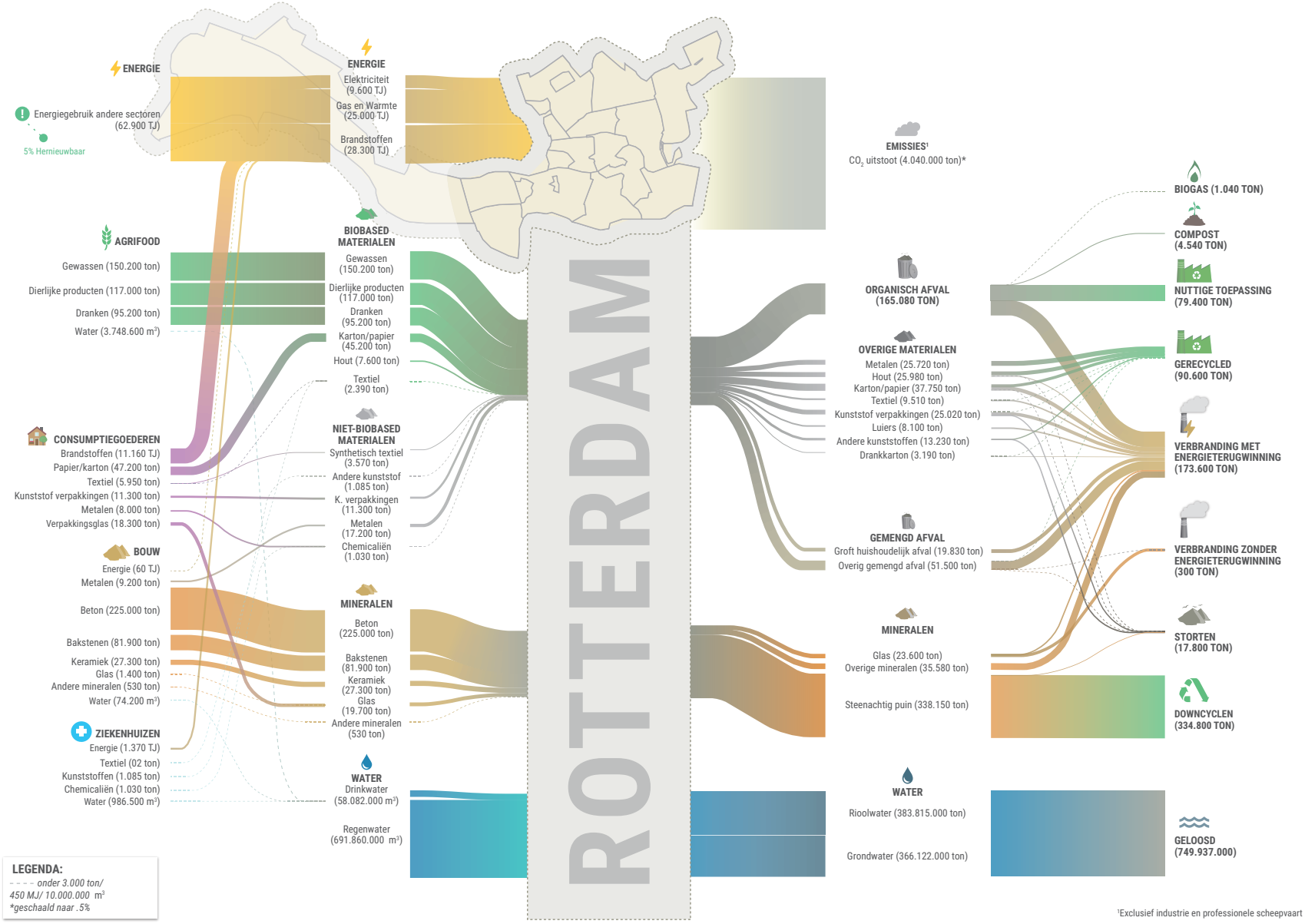
DURACELL

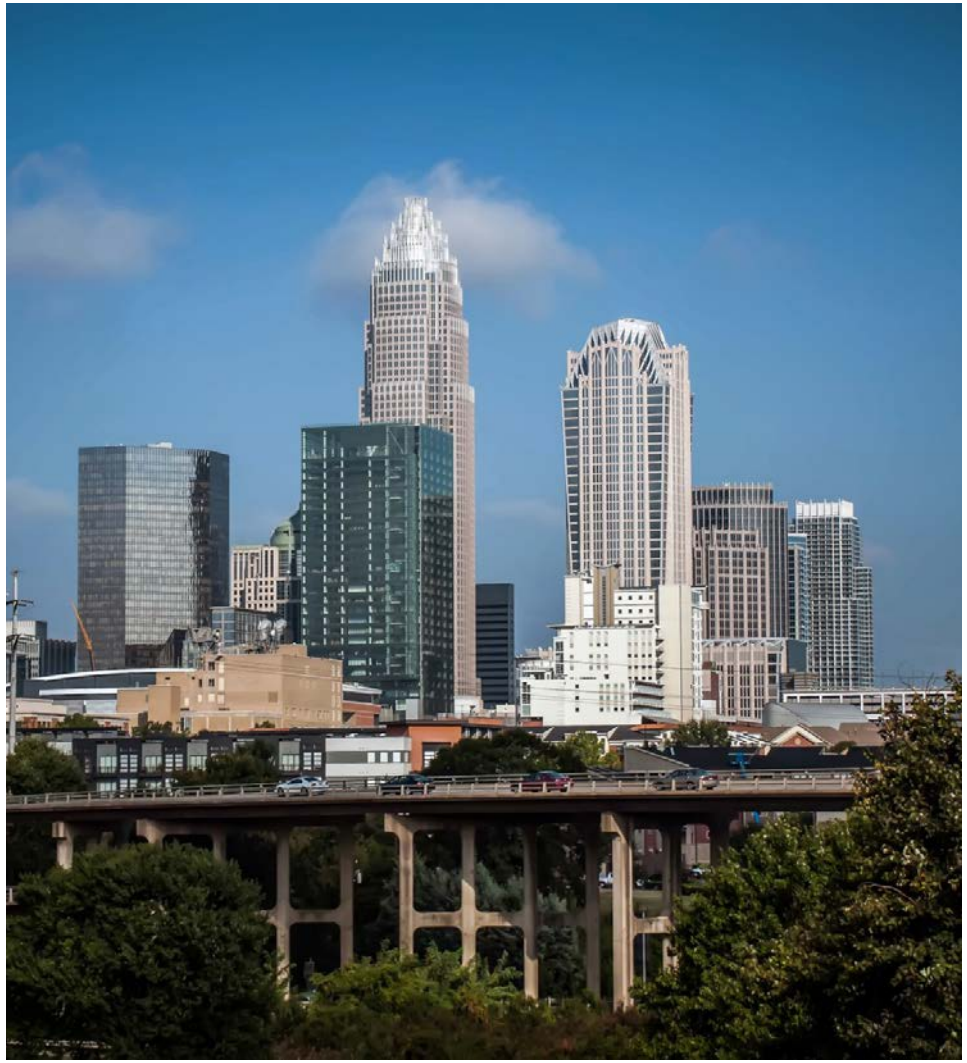
CURRENT STATE ANALYSIS



¹Exclusief industrie en professionele scheepvaart

IMPACT ANALYSIS

CHARLOTTE'S STRENGTHS

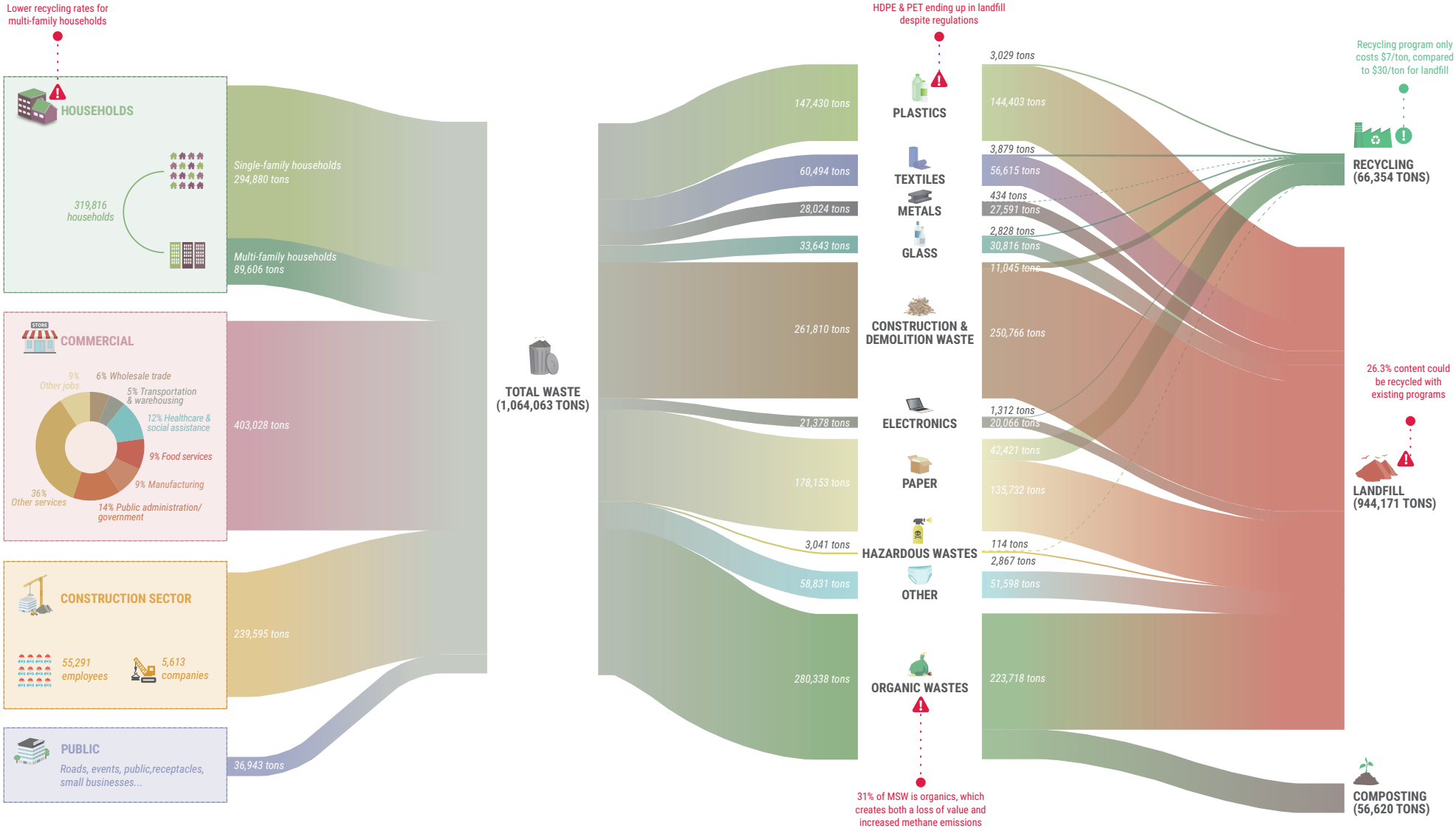


- Globalized economy: 14% of GMP in 2014 provided through export (110,000 jobs in Charlotte supported by export) and 6.8% employment at global firms
- Well connected: 45 million passenger p.a. in Charlotte Douglas International Airport, placing it 24th globally
- Strong connection to rest of North America, Europe, and Asia
- 27,000 miles of rail connects Charlotte with 23 states

CHARLOTTE'S WEAKNESSES

- Prosperity of the city is not accessible to everyone
- Lowest social mobility among the 50 biggest cities in the US *(Deruy & Boschma, 2016)*
- More than 800,000 people living in poverty *(DATA USA, 2018)*
- Shrinking middle class *(Mecklenburg County Community, 2018)*

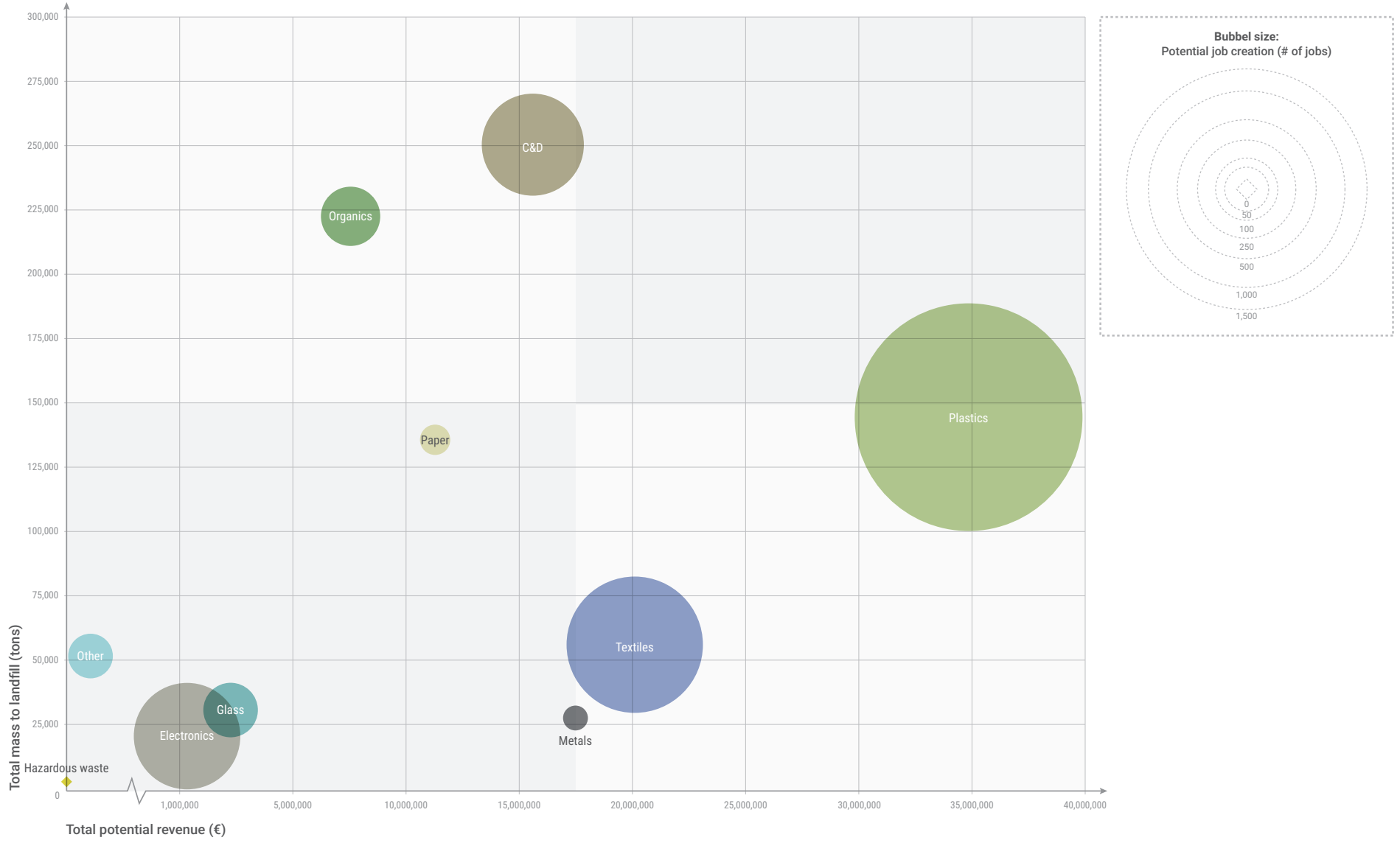
CIRCULAR CHARLOTTE



METABOLIC

UNLOCKING VALUE IN A CIRCULAR ECONOMY

CIRCULAR JOB CREATION



IF ALL PLASTICS LANDFILLED IN CHARLOTTE ARE RECYCLED, THIS SAVES 936,329 BARRELS OF OIL PER YEAR & CREATES REVENUES & JOBS

144,403 TONS

PLASTICS LANDFILLED

or

936,329

BARRELS OF OIL AVOIDED

+

35 MILLION

REVENUES POSSIBLE

+

1,343

JOBS CREATED

SHAPING A VISION AND DEFINING KPIs

VISION FOR A CIRCULAR CHARLOTTE

A CIRCULAR CITY

AN INNOVATIVE CITY OF THE FUTURE

A RESILIENT AND HEALTHY CITY

A CITY WITH OPPORTUNITIES FOR ALL

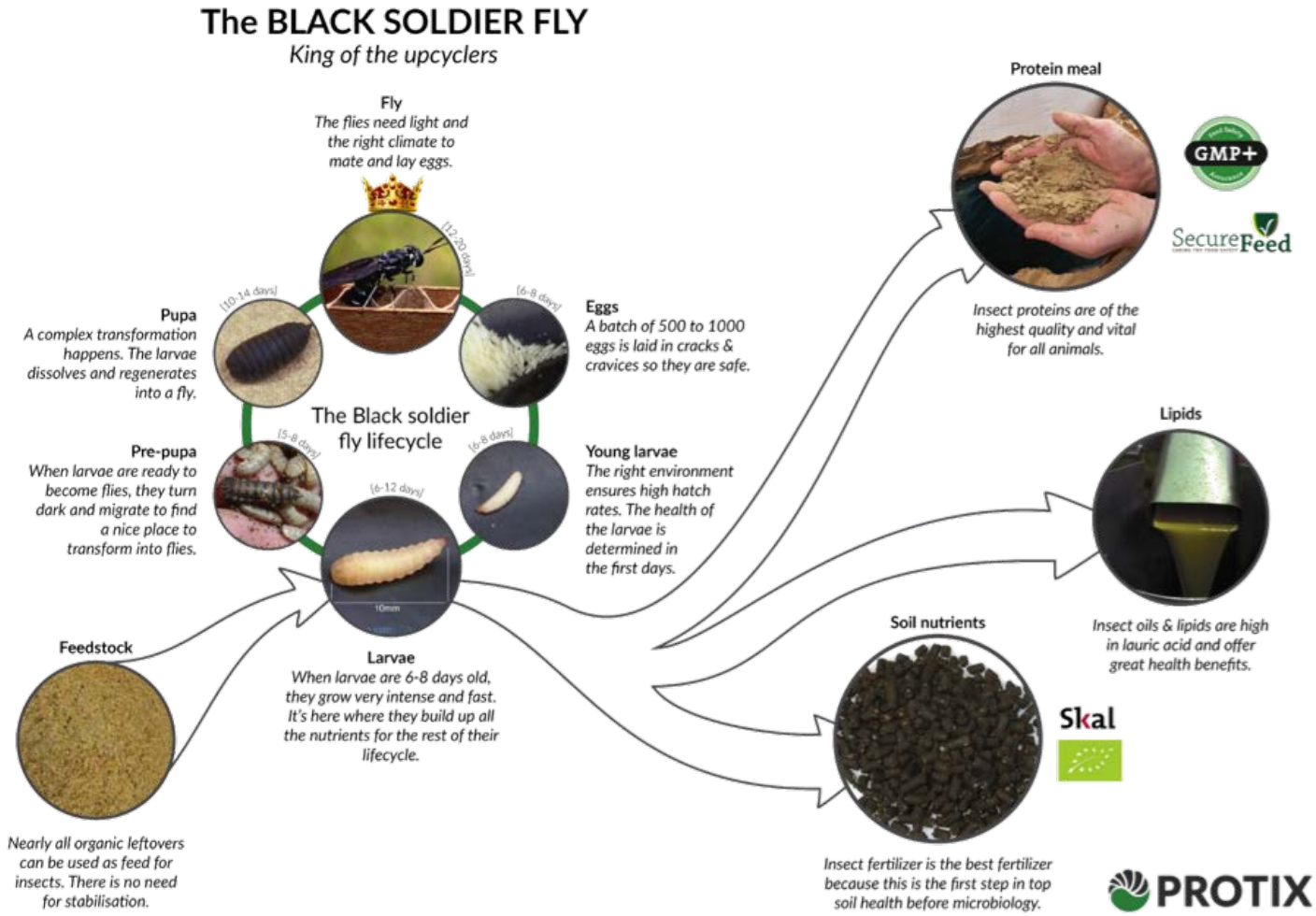
DEFINING STRATEGY AND INTERVENTIONS

IDENTIFYING INTERVENTIONS

No.	Impact Addressed	Impact Size	Intervention Name	Type	Feasibility	Impact Reduction Potential % (Low)	Impact Reduction Potential % (High)	Average Possible Impact Savings (tonnes)	Local Job Creation	Local Job Destruction
A1	Water voor gewassen - import (m3)	4162942	Incentives for low-impact urban agriculture	Supply	Medium	20%	80%	2081471	High	Netural
A2	Mixed Organic Waste (tonnes)	85062	Door-to-Door Biowaste Collection	Synergize	Medium	20%	75%	40404.45	High	Neutral
A3	Mixed Organic Waste (tonnes)	85062	Pay-As-You-Throw scheme	Synergize	High	60%	80%	59543.4	Low	Neutral
A4	Mixed Organic Waste (tonnes)	85062	Waste-to-Chemical Processing	Synergize	Medium	80%	95%	74429.25	High	Low
A5	Voedselverspilling - algemeen (tonnes)	24500	Subsidy for food waste avoidance projects	Reduce	High	10%	20%	3675	Medium	Neutral
A6	Slib bij bedrijven (tonnes)	22900	Waste-to-Chemical Processing	Synergize	Medium	50%	90%	16030	Medium	Low
A7	Mest (tonnes)	27806	Vermi-composting	Synergize	Low	70%	80%	20854.5	Medium	Neutral
A8	Mest (tonnes)	27806	Bio-digestion	Synergize	Low	80%	90%	23635.1	Medium	Neutral
A9	Dierlijk & Planten Afval bij bedrijven (tonnes)	56500	Waste-to-Chemical Processing	Synergize	Medium	80%	90%	48025	High	Medium
A10	Voedselverspilling bij consumenten (tonnes)	18000	Shopping, Cooking, Storage Education	Reduce	High	10%	30%	3600	Low	Neutral
A11	GHG-dieren - import & local (tonnes)	139341	Public procurement of low-impact food	Supply	High	2%	5%	4876.935	Low	Neutral
A12	Mixed Organic Waste (tonnes)	85062	R&D investment in bioprocessing tech	Synergize	Medium	N/A	N/A	N/A	High	Neutral
A13	Voedselverspilling bij retail (tonnes)	1700	Adoption of apps, e.g., FoodCloud	Reduce	Medium	10%	20%	255	Low	Neutral
A14	Voedselverspilling bij horeca (tonnes)	4800	Adoption of apps, e.g.: Winnow, TooGoodToGo	Reduce	High	3%	8%	264	Neutral	Neutral
A15	Voedselverspilling bij retail (tonnes)	1700	Ban on Retail Food Waste	Reduce	Low	10%	30%	340	Medium	Neutral
A16	Voedselverspilling bij retail (tonnes)	1700	Adoption apps, e.g., NoFoodWasted	Reduce	High	18%	25%	365.5	Neutral	Neutral
A17	Voedselverspilling bij horeca (tonnes)	4800	Family-bag policy	Reduce	High	10%	20%	720	Neutral	Neutral
A18	GFT Afval (tonnes)	48904	Incentives for GFT separation in offices	Synergize	High	5%	10%	3667.8	Neutral	Neutral
A19	Mest (tonnes)	27806	Biorefining	Synergize	Low	20%	40%	8341.8	Medium	Neutral
A23	Mixed Organic Waste (tonnes)	85062	Organic Mono-Material Collection	Synergize	Low	5%	15%	8506.2	High	Neutral
A20	GHG-dieren - import & local (tonnes)	139341	Campaign on sustainable, healthy diets	Reduce	High	5%	20%	17417.625	Neutral	Neutral
A21	GHG-dieren - import & local (tonnes)	139341	Incentives for animal product replacements	Supply	Medium	10%	30%	27868.2	Low	Neutral
A22	Voedselverspilling bij consumenten (tonnes)	18000	Better Food Labeling	Reduce	Medium	10%	30%	3600	Neutral	Neutral
A24	Mixed Organic Waste (tonnes)	85062	Monitoring of organic waste generation	Manage	Low	N/A	N/A	N/A	Low	Neutral

EXAMPLE: REDUCING FOOD WASTE

EXAMPLE: PROTIX



WASTE OR RESOURCE?

/ Piñatex® is an innovative natural textile made from pineapple leaf fibre.

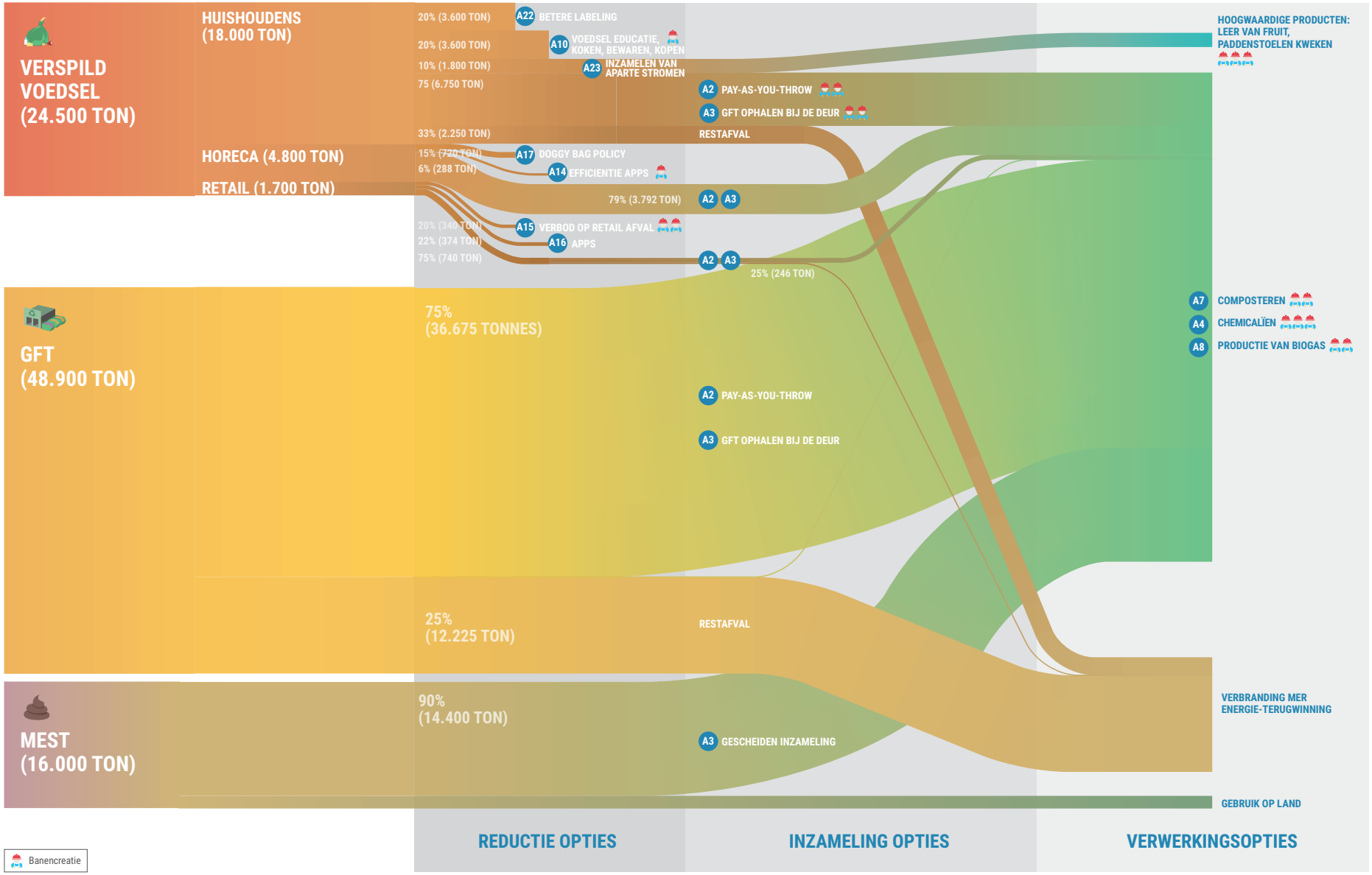
The leaves are the byproduct of existing agriculture, and their use creates an additional income stream for farming communities.

Piñatex® is a natural, sustainably-sourced, cruelty free material.

→ **Low environmental impact, high social responsibility.**

↓ **A better choice for a better future.**


up to 700.000 tons
of citrus waste


VERSPILD VOEDSEL (24.500 TON)
HUISHOUDENS (18.000 TON)
HORECA (4.800 TON)
RETAIL (1.700 TON)
GFT (48.900 TON)
MEST (16.000 TON)
20% (3.600 TON)
A22 BETERE LABELING
20% (3.600 TON)
A10 VOEDSEL EDUCATIE, KOKEN, BEWAREN, KOPEN
10% (1.800 TON)
A23 INZAMELEN VAN APARTE STROMEN
75 (6.750 TON)
A2 PAY-AS-YOU-THROW
A3 GFT OPHALEN BIJ DE DEUR
33% (2.250 TON)
RESTAFVAL
15% (720 TON)
A17 DOGGY BAG POLICY
6% (288 TON)
A14 EFFICIENTIE APPS
79% (3.792 TON)
A2 A3
20% (340 TON)
A15 VERBOD OP RETAIL AFVAL
22% (374 TON)
A16 APPS
75% (740 TON)
A2 A3
25% (246 TON)
75% (36.675 TONNES)
A2 PAY-AS-YOU-THROW
A3 GFT OPHALEN BIJ DE DEUR
25% (12.225 TON)
RESTAFVAL
90% (14.400 TON)
A3 GESCHEIDEN INZAMELING
HOOGWAARDIGE PRODUCTEN: LEER VAN FRUIT, PADDENSTOELEN KWEKEN
A7 COMPOSTEREN
A4 CHEMICALIËN
A8 PRODUCTIE VAN BIOGAS
VERBRANDING MER ENERGIE-TERUGWINNING
GEBRUIK OP LAND
REDUCTIE OPTIES
INZAMELING OPTIES
VERWERKINGSOPTIES
Banencreatie

CIRCULAR CHARLOTTE: BUSINESS CASES

Selection of five promising business cases to investigate in detail:

- Closed loop textiles
- Upcycling food waste into feed
- Materials innovation lab
- Tokenized reverse logistics for plastics
- Concrete recycling chain

CLOSED-LOOP TEXTILES CHAIN

OPPORTUNITY	VALUE
Total waste diverted from landfill (lbs/year)	210,000 lbs/year
Potential profits from case ($/year)	$201,800
Total jobs created (#)	9
CO_2e emissions saved (tons)	1,226
Water use avoided (gallons)	345,341
Land use prevented (acres)	79

- Textiles are historically important for Charlotte and innovation in this sector fits the local context
- Charlotte still ranks 2nd in U.S. for employment in textiles sector
- 57,000 tons of textiles ending up in the landfill per year
- Limited closed-loop textiles project (uniforms, linens) can be a starting point for a fully circular chain
- Local companies like Unifi and Recover Brands show the right pieces are in place in Charlotte

UPCYCLING FOOD WASTE INTO FEED

OPPORTUNITY	VALUE
Total waste diverted from landfill (lbs/year)	100 million
Potential profits from case ($/year)	1,200,000
Total jobs created (#)	233-333
CO_2e emissions saved (tons)	97,000
Water use avoided (gallons)	41,000
Land use prevented (acres)	3,200

- 150,000 tons of food waste to landfill per year in Charlotte
- Companies like Crown Town and Earth Farm collecting organic waste, but still on a small scale
- Cost of collection is high while value of compost is low
- Upcycling this waste into feed can create a high-value product at a commercial scale and link to local initiatives around aquaponics production
- Legislative barriers still stand in the way

MATERIALS INNOVATION LAB

OPPORTUNITY	VALUE
Total waste diverted from landfill (lbs/year)	2.57 million lbs/year
Potential profits from case ($/year)	N/A
Total jobs created (#)	14-21 jobs/year
CO_2e emissions saved (tons)	23,000 tons over ten-year period
Water use avoided (gallons)	Dependent on products produced
Land use prevented (acres)	Dependent on products produced

- 31% of waste to landfill is organic
- Currently there is a lot of interest in innovation in biobased products made from specific waste streams
- Many interesting new innovations in waste-based products exist
- Supporting a materials innovation lab can encourage local innovation and entrepreneurship
- Provides an invaluable experience for local students and entrepreneurs that adds additional value to

TOKENIZED REVERSE LOGISTICS SYSTEM

OPPORTUNITY	VALUE *
Total waste diverted from landfill (lbs/year)	ST: 3.6 mln lbs, LT: 88.2 mln lbs
Potential profits from case ($/year)	ST: N/A, LT: min. 3 mln per year
Total jobs created (#)	ST: 35, LT: 130
CO_2e emissions saved (tons)	ST: 10,310, LT: 237,003
Water use avoided (gallons)	ST: 675 mln gallons, LT: 18 bln gallons
Land use prevented (acres)	ST: 1,317 acres, LT: 34,404 acres

*ST is short-term, LT is long term

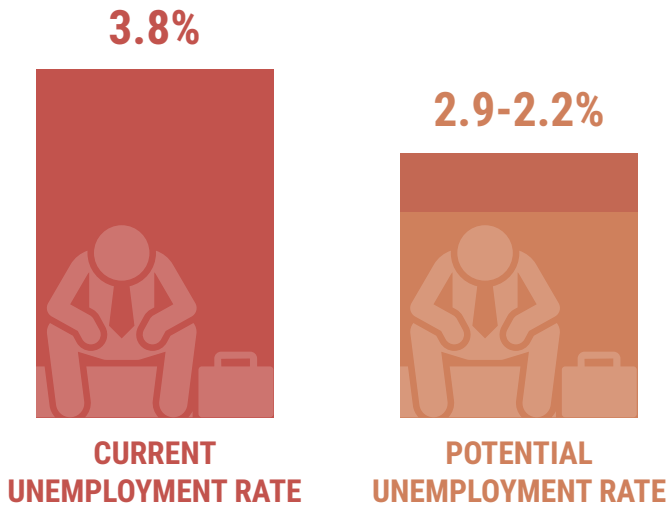
- One of the largest barriers is getting people to recycle
- Tokenized system gamifies recycling and provides incentives to households
- Clean and source-separated recyclables --> Vouchers for local business (also encourage shopping locally)
- Once critical mass is reached, case can be very profitable
- Break-even point is around 10% participation with a 10% rate of recycling of materials by those households

CONCRETE RECYCLING CHAIN

OPPORTUNITY	VALUE
Total waste diverted from landfill (lbs/year)	100 million lbs
Potential profits from case ($/year)	$2 million after first year
Total jobs created (#)	5
CO_2e emissions saved (tons)	41,186
Water use avoided (gallons)	183 million
Land use prevented (acres)	Unknown

- Charlotte is a fast-growing city with 12,000 new apartments being built
- 50,000 tons of concrete ends up in the landfill per year, ~6% of total
- Up to 20% of aggregate and 20% of cement can be replaced by recycled aggregate and glass in new cement
- In total, all of Charlotte's concrete could become 16% recycled
- Local concrete recyclers already have the equipment for recycling aggregate, but this is currently being

BUSINESS CASES: KEY TAKEAWAYS



- In total, ~100,000 - 150,000 tons of waste to landfill can be prevented with the five business cases
- An estimated 290-492 jobs can be created with these cases
- CO_2 emissions can be reduced by 379,000 tons/year
- Each business case improves 13-19 of the 29 Key Performance Indicators (KPIs)
- $22 - $34 million USD per year in revenue

PART
1

REFINING STRATEGIES AND SELECTING BUSINESS CASES

PART
2

ROADMAPPING THE IMPLEMENTATION OF STRATEGIES

PART
3

CREATING A HOLISTIC ROADMAP AND IDENTIFYING SYNERGIES

CLOSING THOUGHTS

- We need a holistic vision of a sustainable, circular, regenerative future - not one based on single issues like climate change (even though they are also important).
- A systems approach can help us find the pathways towards the most profitable and circular solutions.

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