DATA FOR CIRCULARITY

INTERNATIONAL CONFERENCE

A collaboration of Rijkswaterstaat and Delft University of Technology

Ministerie van Infrastructuur en Waterstaat

TU Delft

CINDERELA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 776751

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Introduction

Tjerk ter Veen – Ministry of Infrastructure and Water Management

9:00 - 9:20 | 25th May 2022

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE

Introduction

Vivianne Heijnen - Secretary of State for Infrastructure and Water Management

9:00 - 9:20 | 25th May 2022


Dear participants,

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE

Schedule – 25th May

9:00 - 9:20	Introduction
9:20 - 11:30	Measuring the Circular Economy (including Coffee Break)
11:30 - 12:30	Keynote Speech
12:30 - 13:30	Lunch
13:30 - 15:30	Recommendations Preparation Session
15:30 - 15:45	Conference Close
15:45 - Late	Drinks and Snacks

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Schedule – Measuring the Circular Economy

Chair: Tjerk ter Veen

09:20 - 09:45	Tanya Tsui, Delft University of Technology (NL)
09:45 - 10:10	René Reich, KU Leuven (BE)
10:10 - 10:35	Arnout Sabbe, Delft University of Technology (NL)
10:35 - 11:00	Elmer Rietveld, TNO (NL)
11:00 - 11:30	Coffee Break

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Measuring the Circular Economy

Chair: Tjerk ter Veen

9:20 - 11:30 | 25th May 2022

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Where Will Circular Hubs be in the Future?

Tanya Tsui – Delft University of Technology

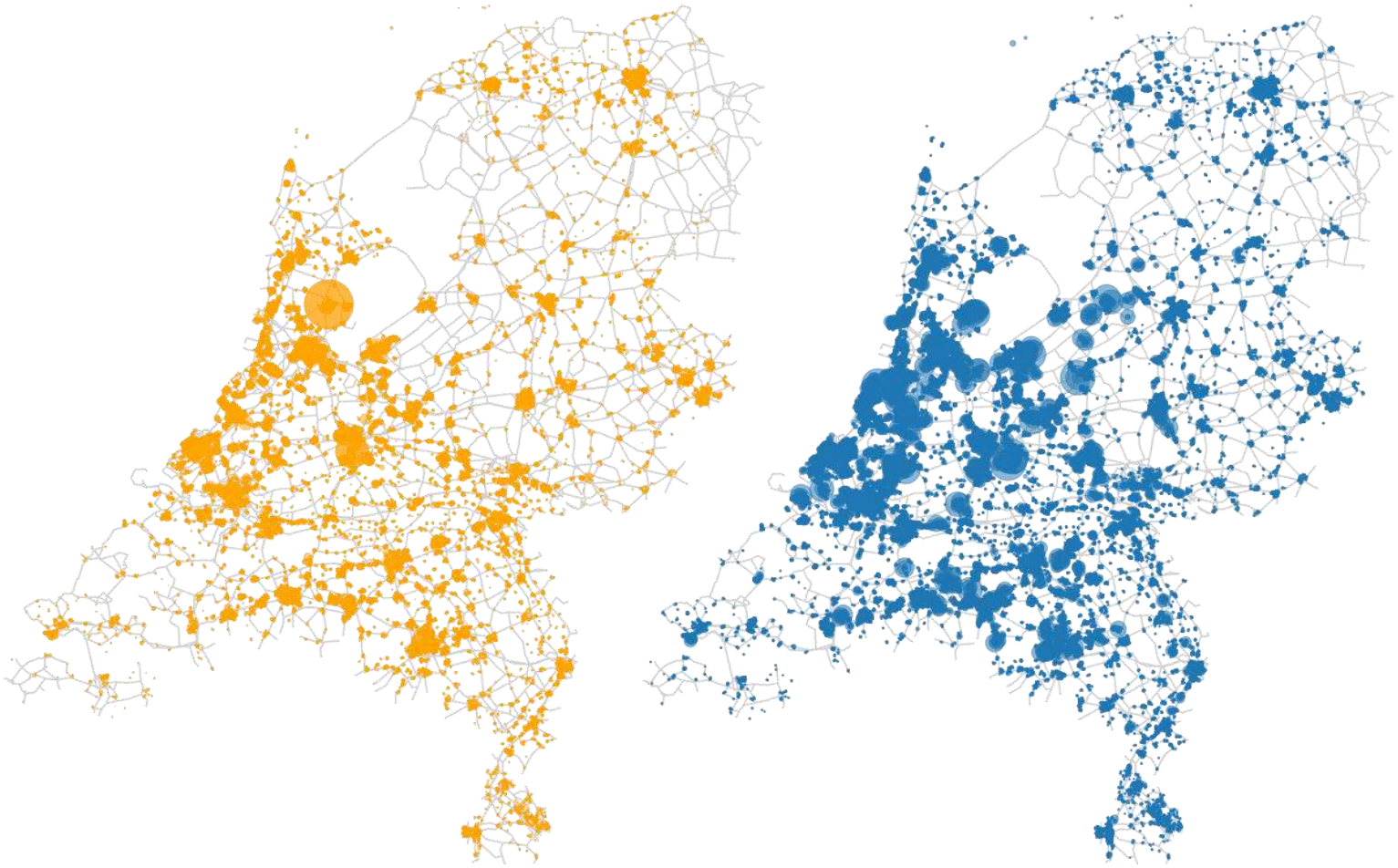
Where will circular hubs be in the future?

Spatial analysis methods to forecast future locations of circular hubs for the building industry in the Netherlands

Tanya Tsui, PhD candidate at TU Delft Faculty of Architecture and the Built Environment
Supervisors: Arjan van Timmeren, David Peck, and Alexander Wandl
Data for Circularity Conference 25th May 2022

Contents

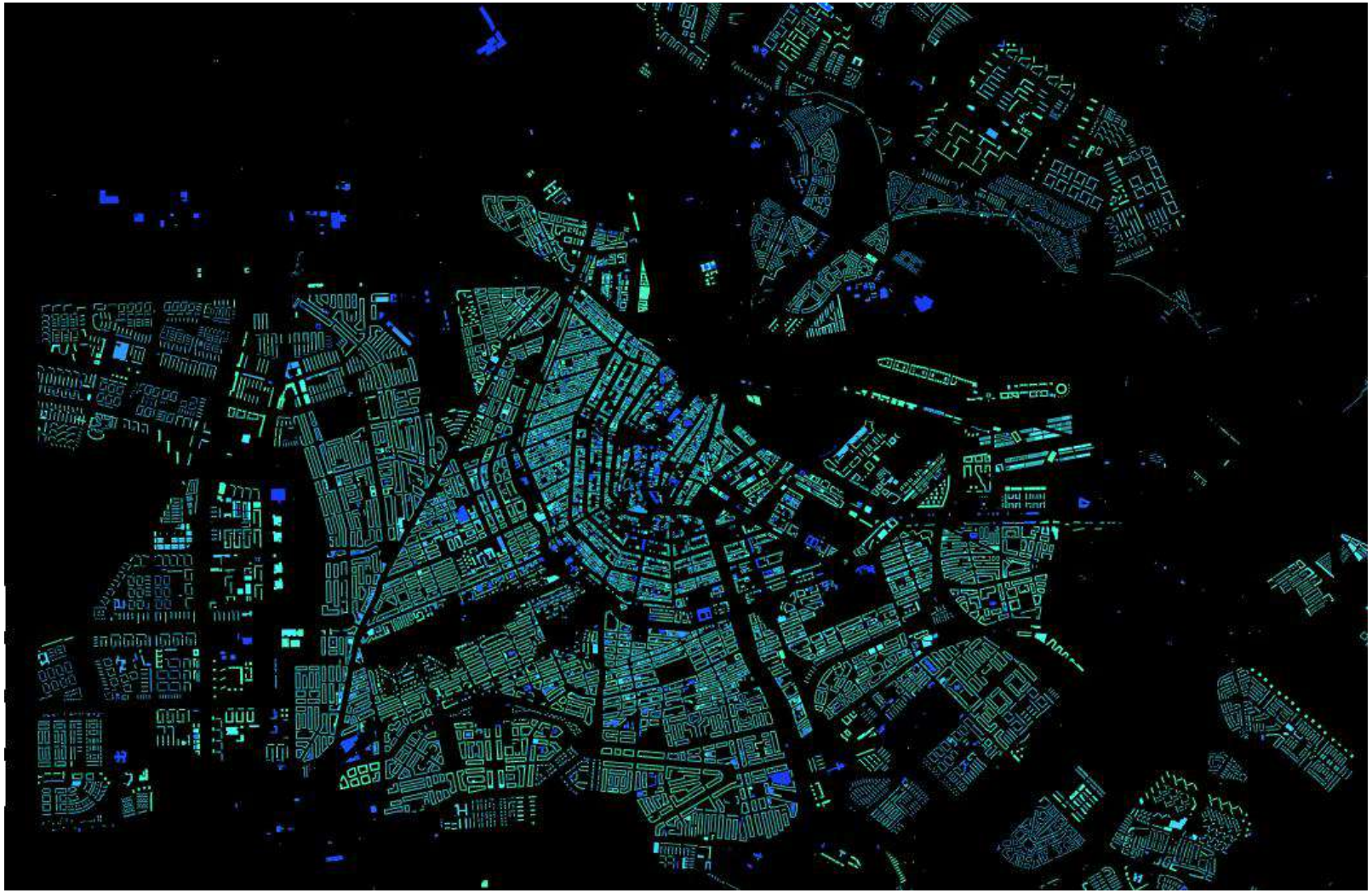
- **WHY** do this research?
- **WHAT** are circular hubs?
- **WHAT** data will we use?
- **HOW** will we forecast locations of circular hubs in the future?



WHY do this research?

Applying the science of **where** to the study of circular cities

- CE activities (recycling, reuse, storage) require space
- Transitioning to CE has spatial consequences
- We are researching **what** CE activity might look like, **how** circular cities should be governed…
- … But we also need to know **where** CE activities are taking place, and where they will be in the future.



Research questions

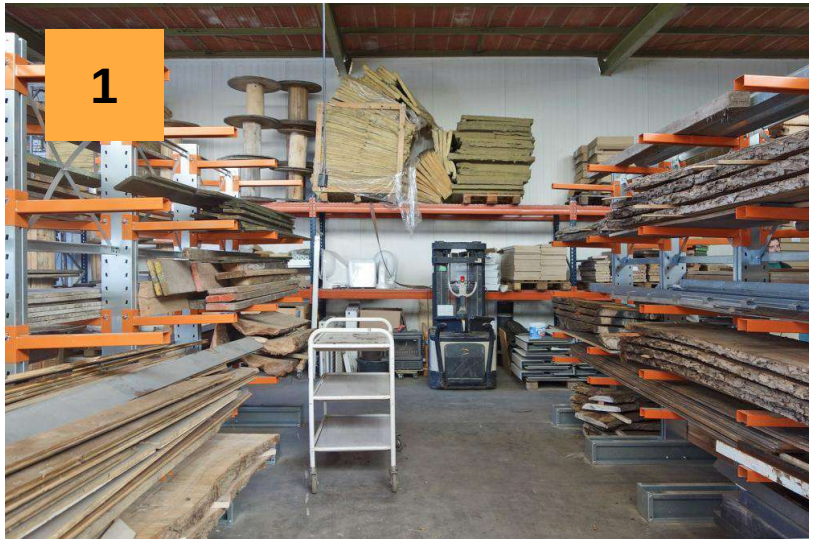
Where will circular hubs be in the future, for the building industry in the Netherlands?

- What are the **types** of circular hubs in the building industry?
- What are the **spatial parameters** that affect the location of circular hubs?
- What are the **spatial analysis methods** that can be used to predict future locations of circular hubs?

WHAT are circular hubs?

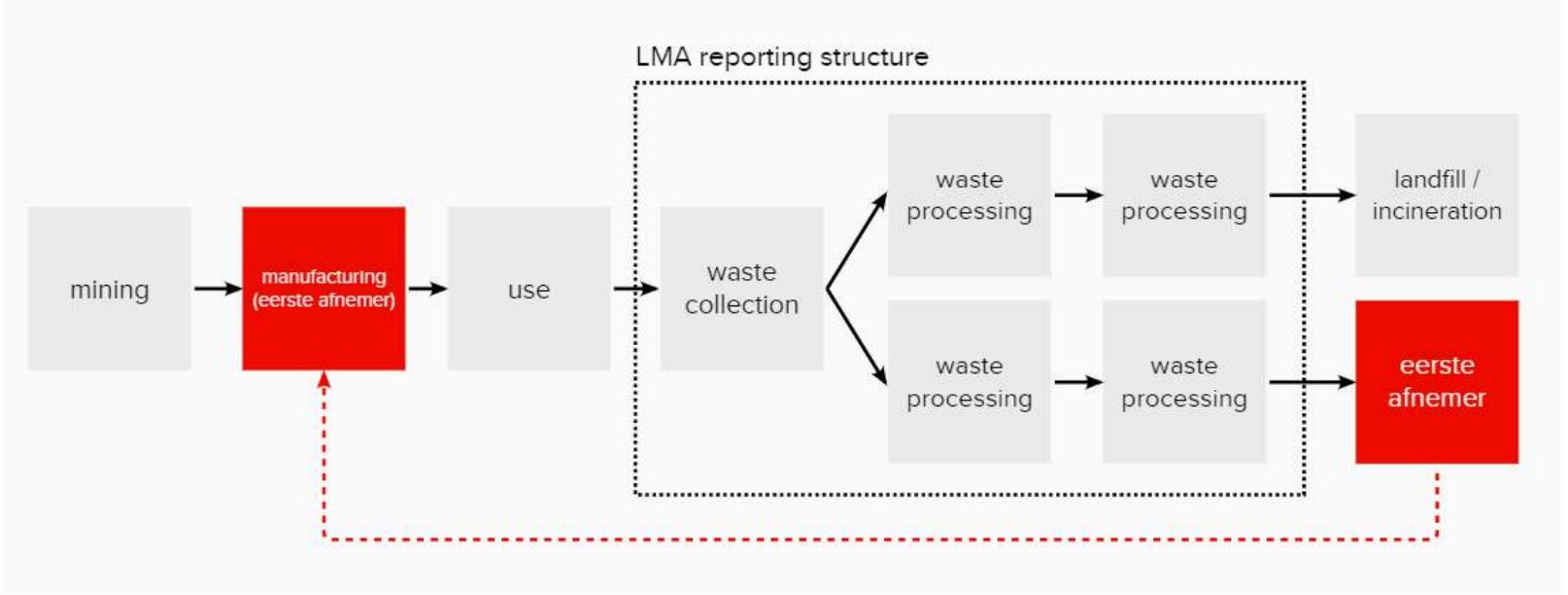
“Circular hubs” in the building industry:

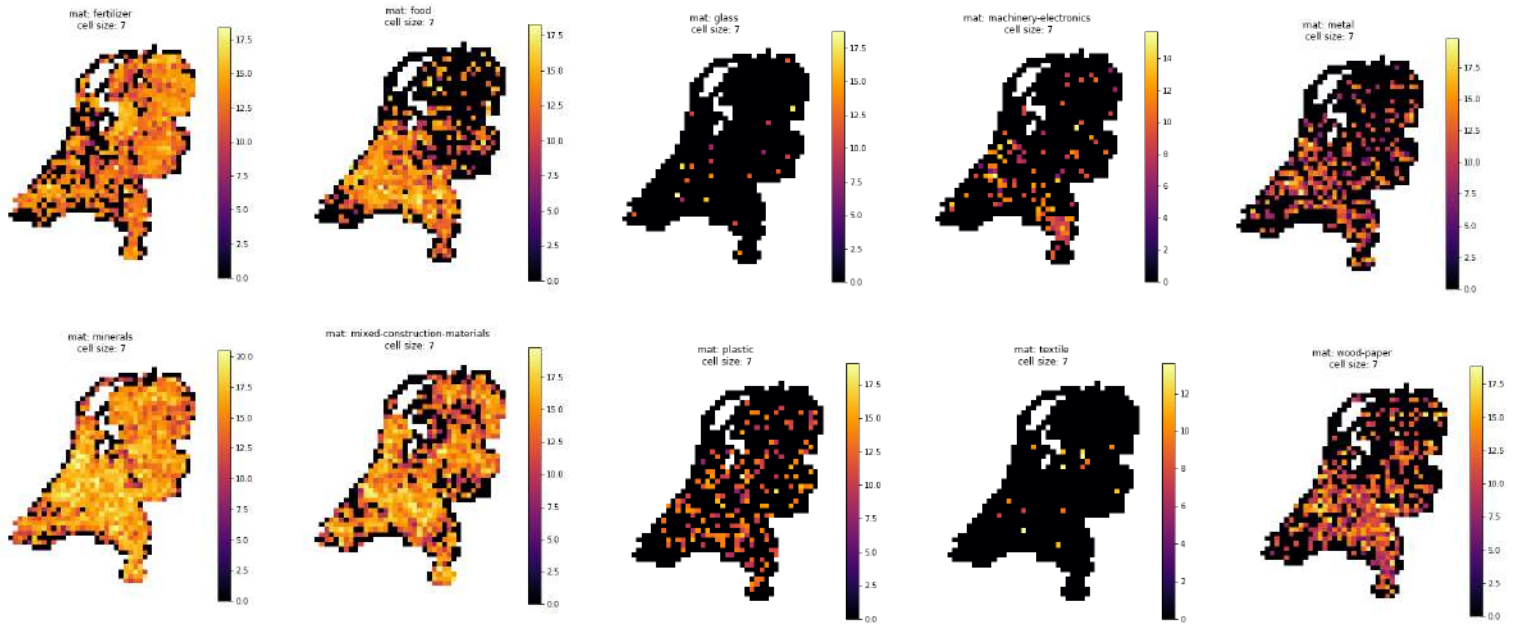
1. Building material bank / reseller
2. (De-)construction logistics hub
3. Building product manufacturer from waste flows



WHAT data will I use?

- **LMA** data - locations of construction waste producers, processors, and re-users
- **PBL** data - prediction of future material supply and demand in the construction industry
- **OSM** data - street network, buildings
- **CBS** census data - population density, income, skills





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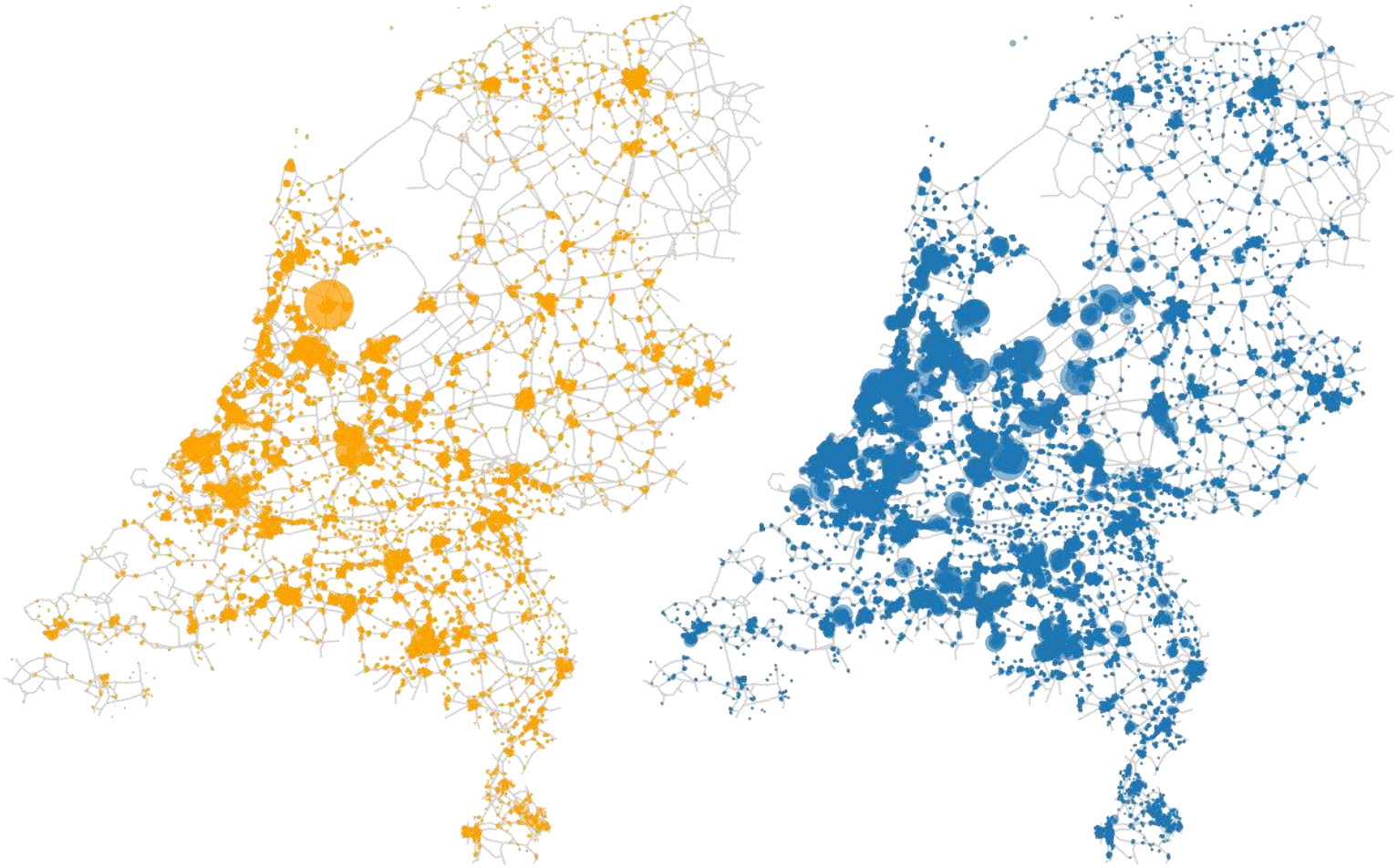

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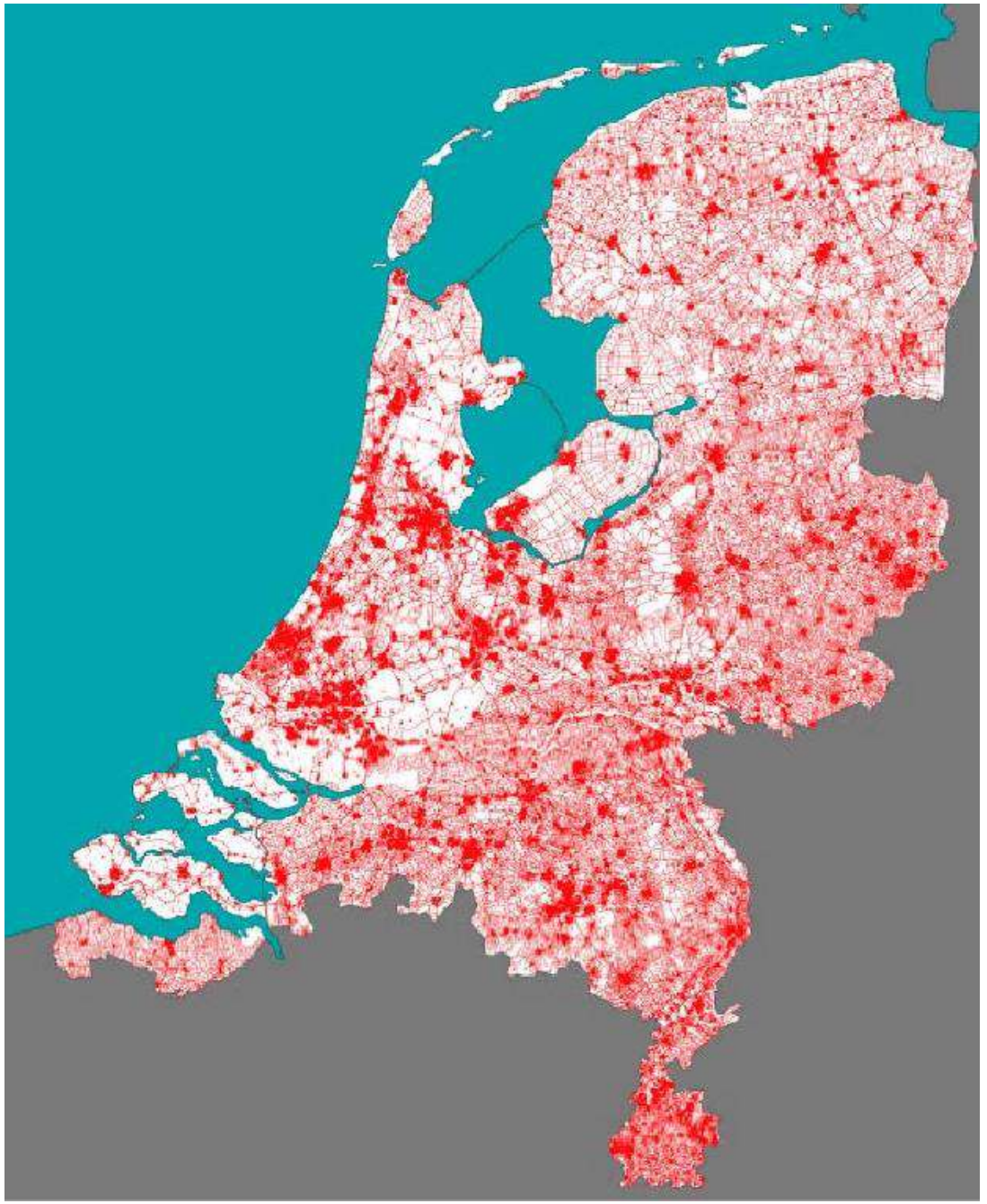

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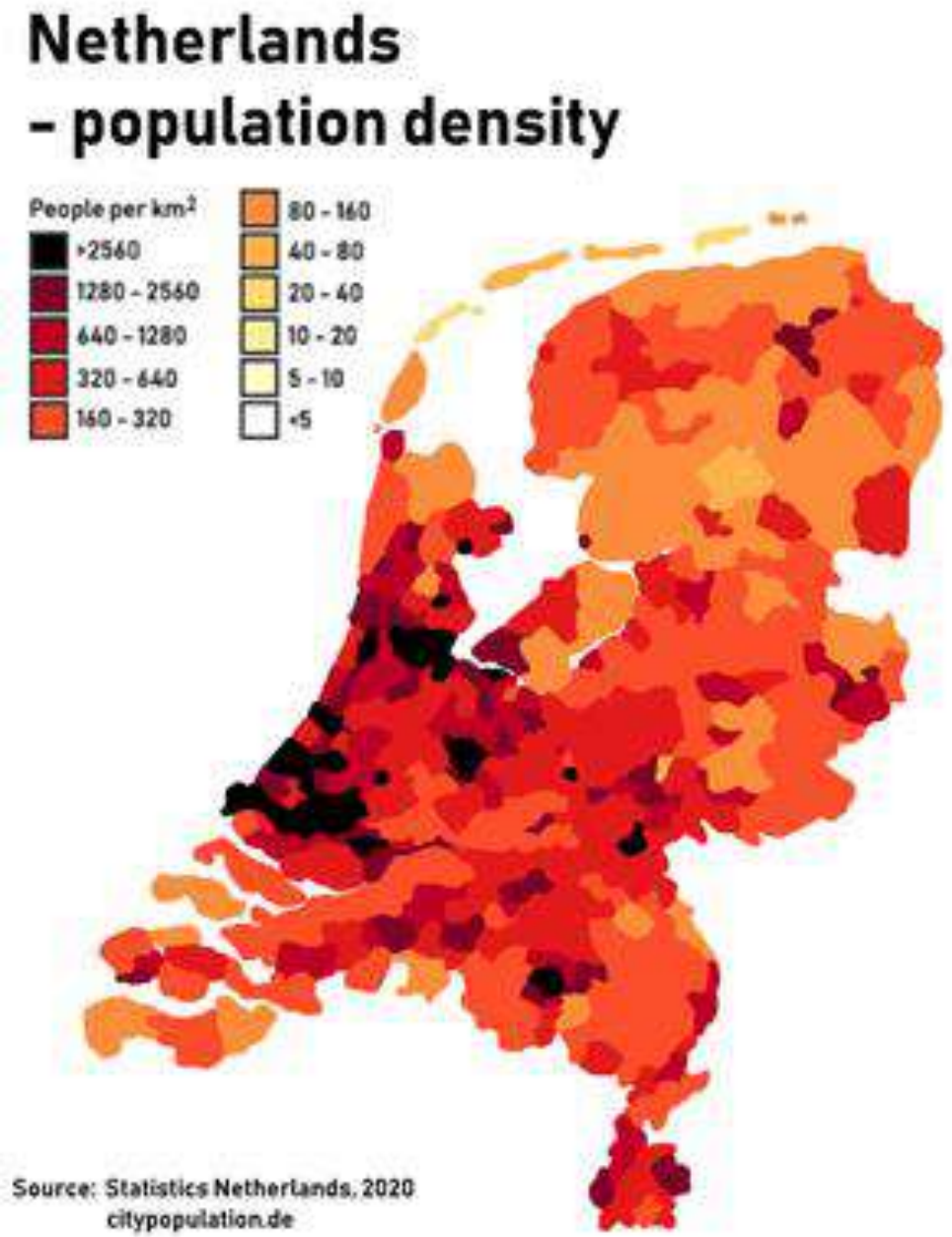
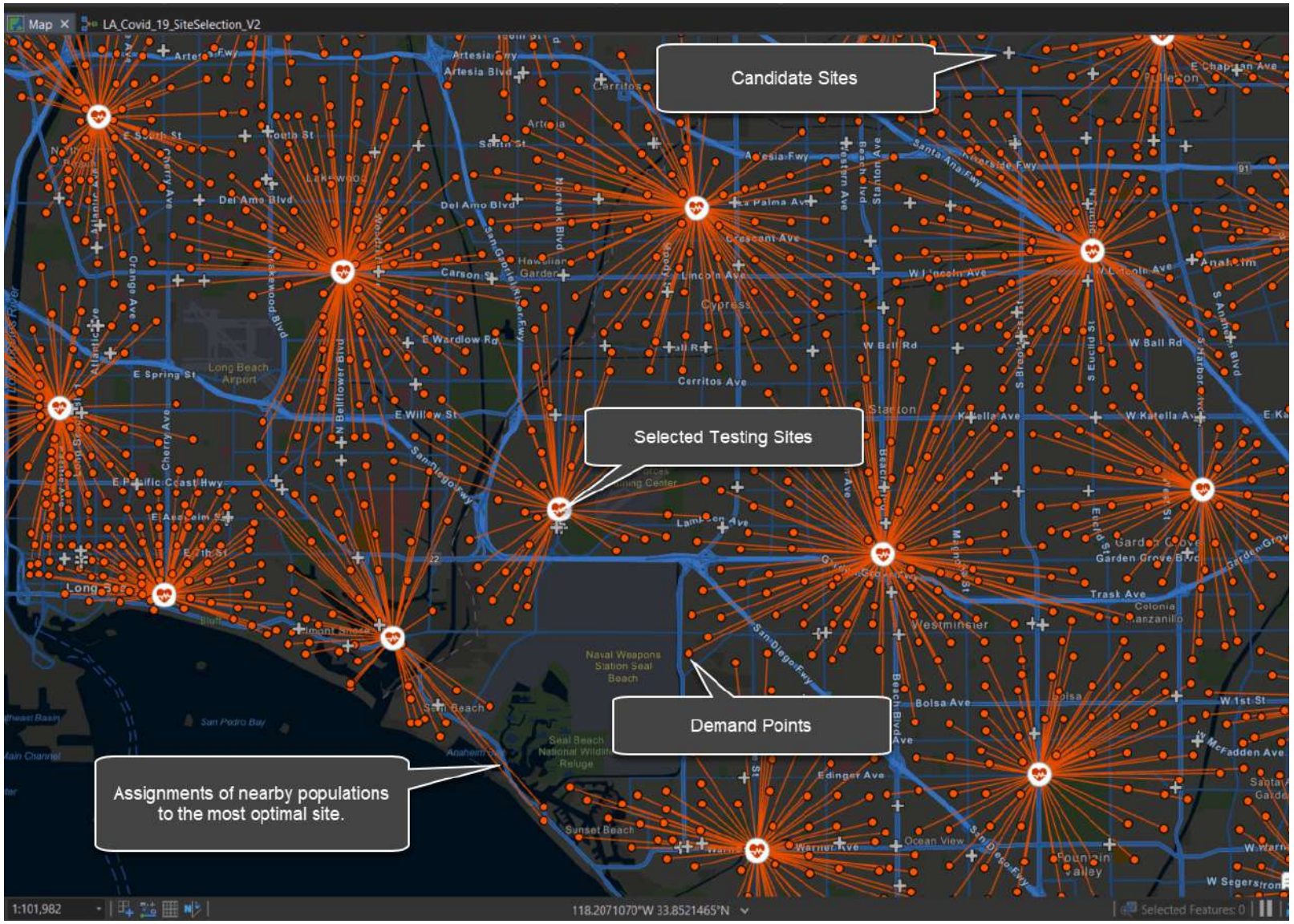


HOW will I forecast the circular hub locations in the future?

Perspectives of spatial analysis methods:

- **Operations** - facility location analysis
- **Urban morphology** - street network analysis
- **Business** - site selection analysis



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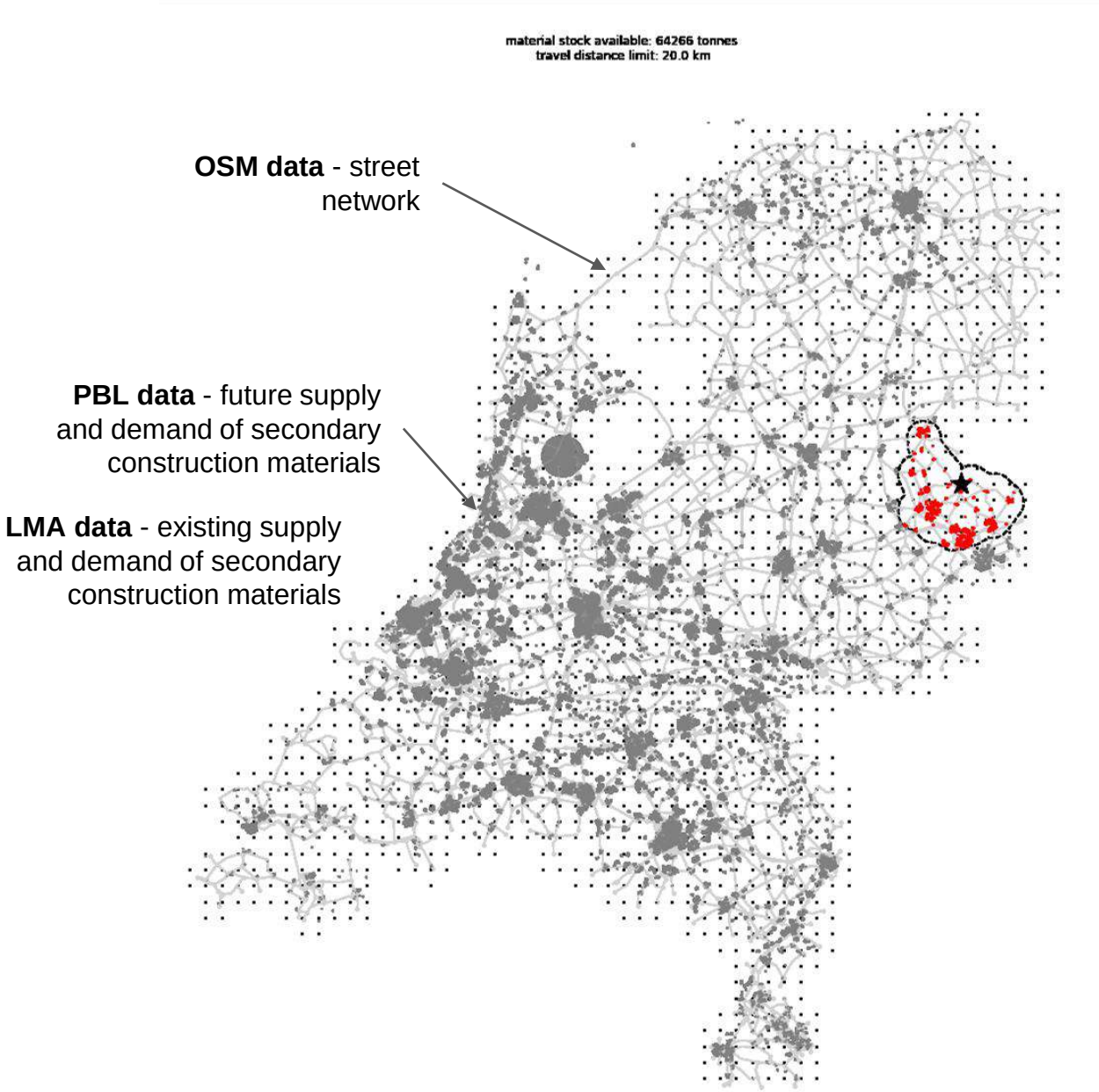

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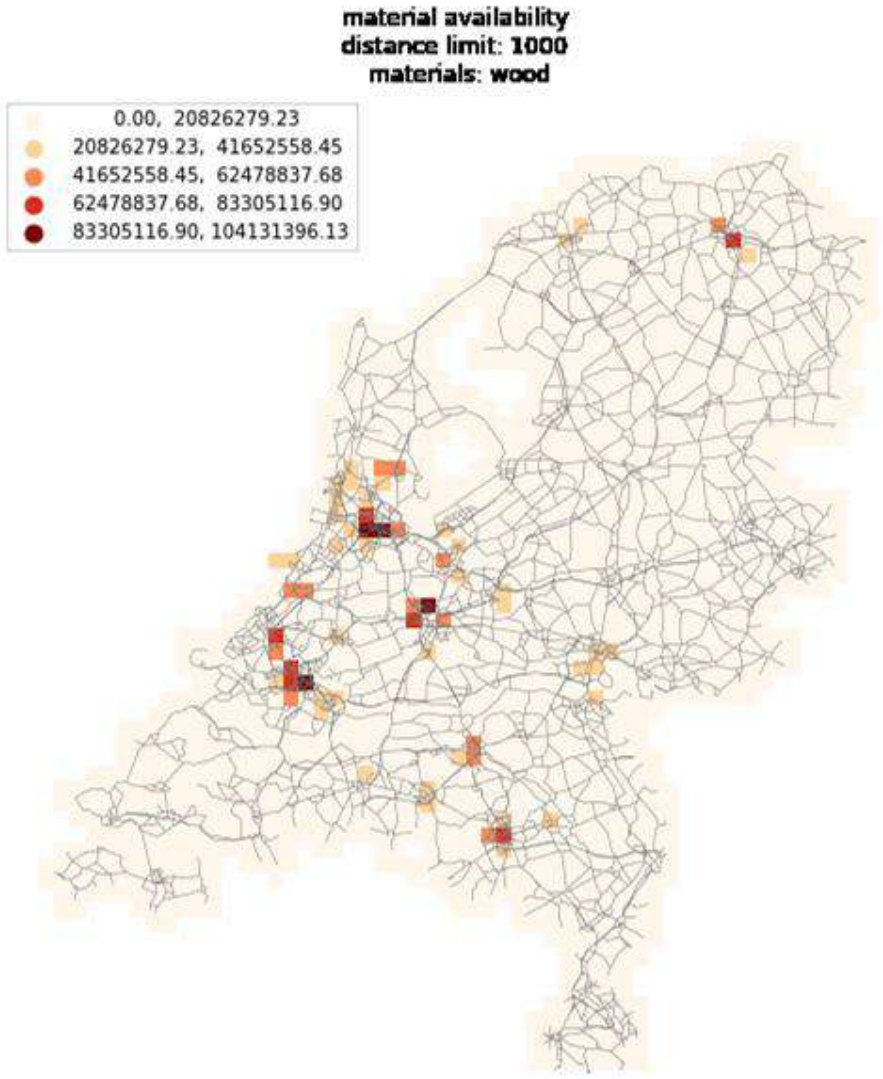

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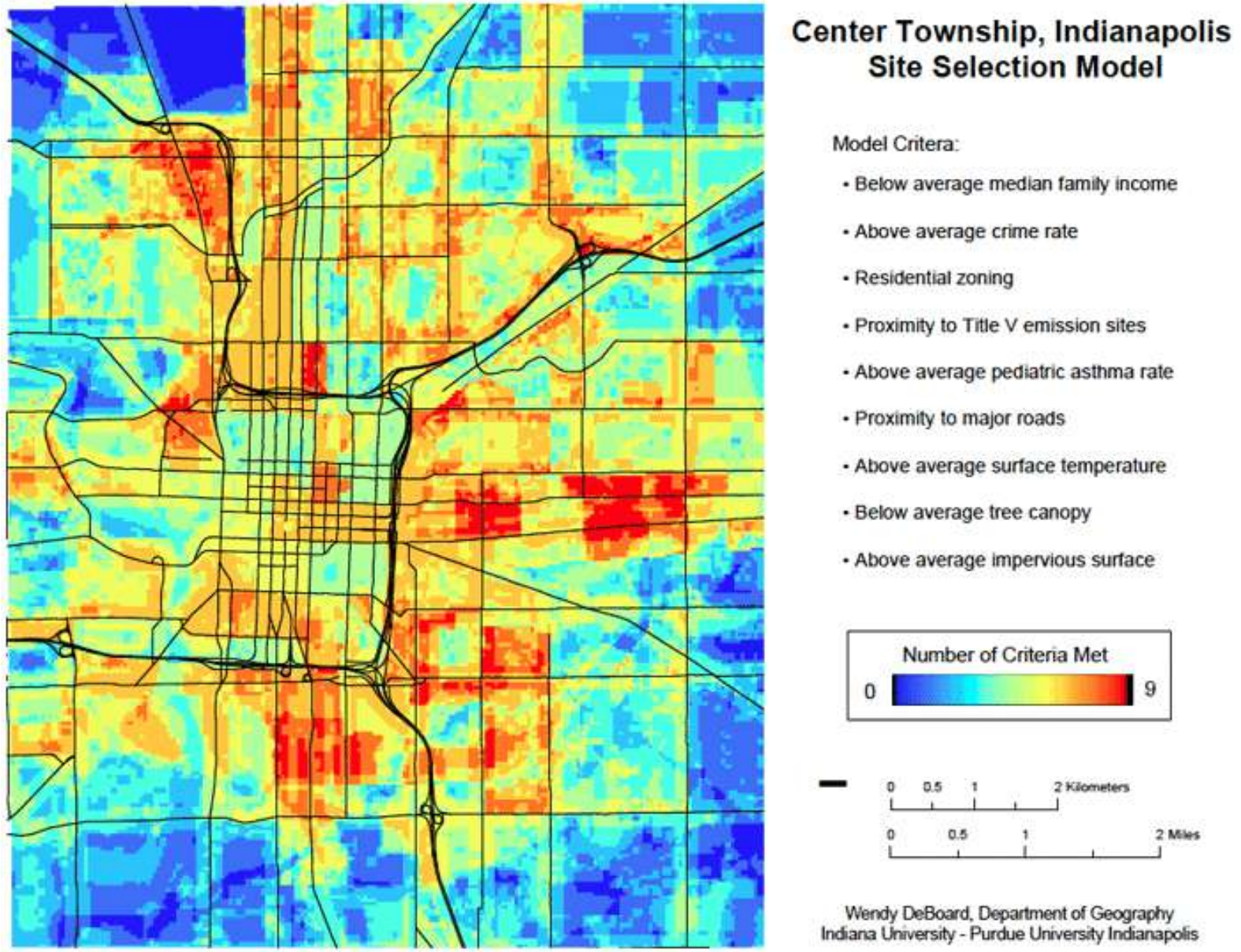

What now?

- Interviewing circular companies - what do you take into account when selecting a facility location?
- Suggestions / contacts welcome!

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INTERNATIONAL CONFERENCE

A Holistic Method to Monitor a Circular Economy

René Reich – KU Leuven (BE)

KU LEUVEN

A holistic method to monitor a circular economy

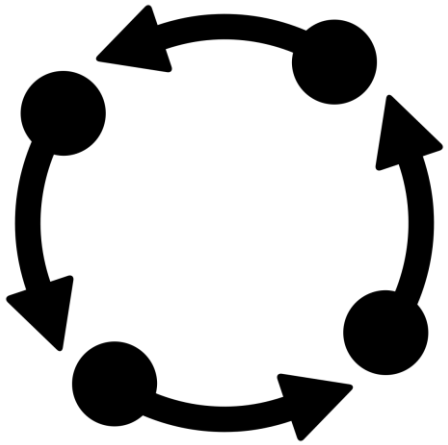
René H. Reich, Veerle Vermeyen, Luc Alaerts, Karel Van Acker
Sustainability Assessment of Materials and Circular Economy

Data for Circularity int. conference
25 May 2022, TU Delft

What can you expect…

1. Problem statement: From Business Administration to Economics
2. Approach: Need and need satisfiers
3. Methodology: Need satisfier systems (NSS) and how to assess them
4. Results: Case study Housing in Flanders
5. Conclusions
6. Questions and discussion

Business Administration and Economics



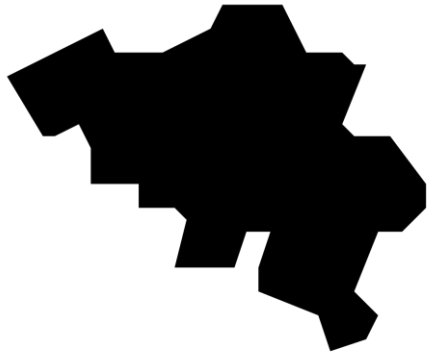
Business Administration:

Indication on performance of…

…products

…business models

…companies



Economics:

Circular economy as tool of environmental economics

How circular is the economy?

What are needs and satisfiers?

Needs:

- universal
- satiable
- intervowen
- irreplaceable

Need satisfiers:

- fulfill one or more needs
- a need can be satisfied by one or more satisfier
- depending on culture, time, circumstance and the individual
- their materialization is quantifiable and analyzable

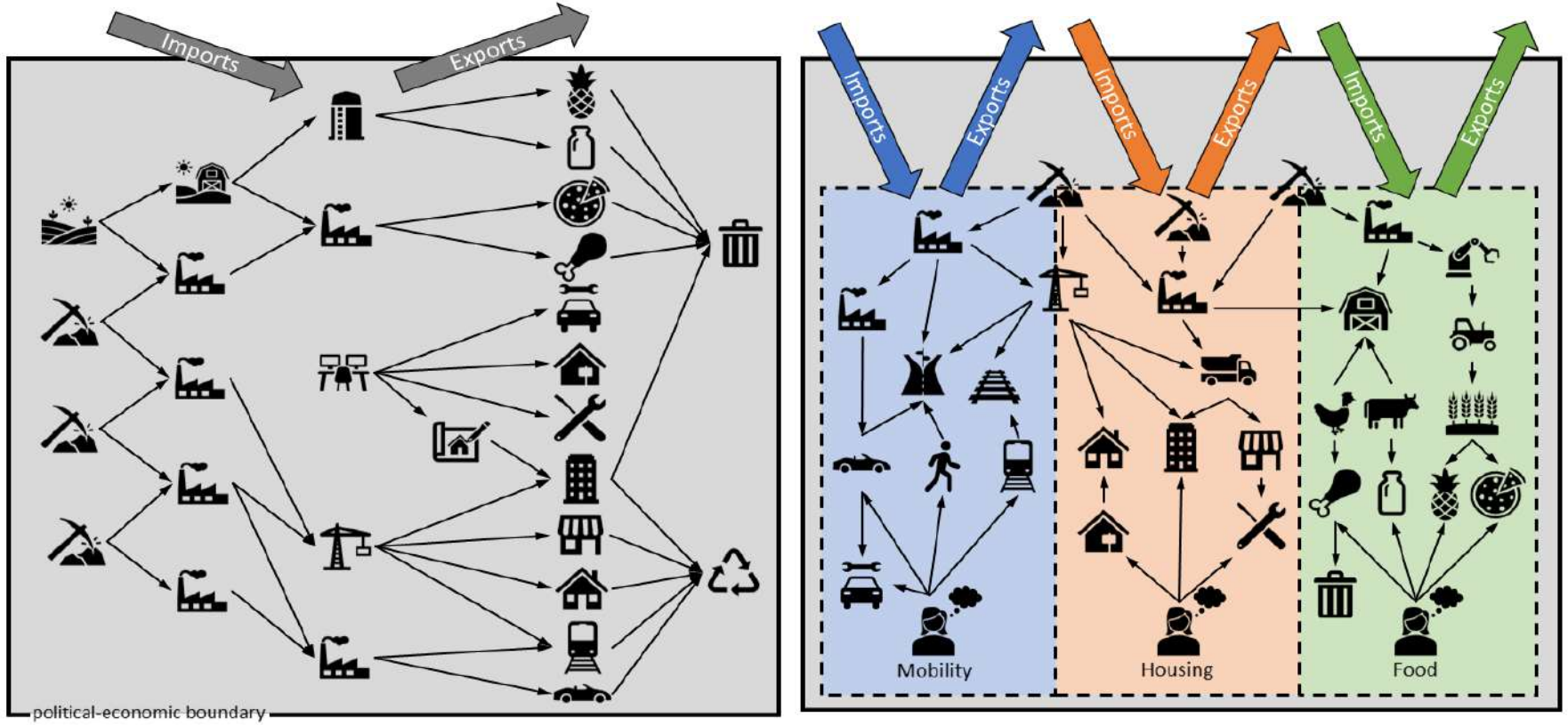
Max-Neef, M. (1991). *Human Scale Development: Conception, Application and Further Reflections*. The Apex Press.

Doyal, L., & Gough, I. (1991). *A theory of human need* (1. publ). Macmillan.

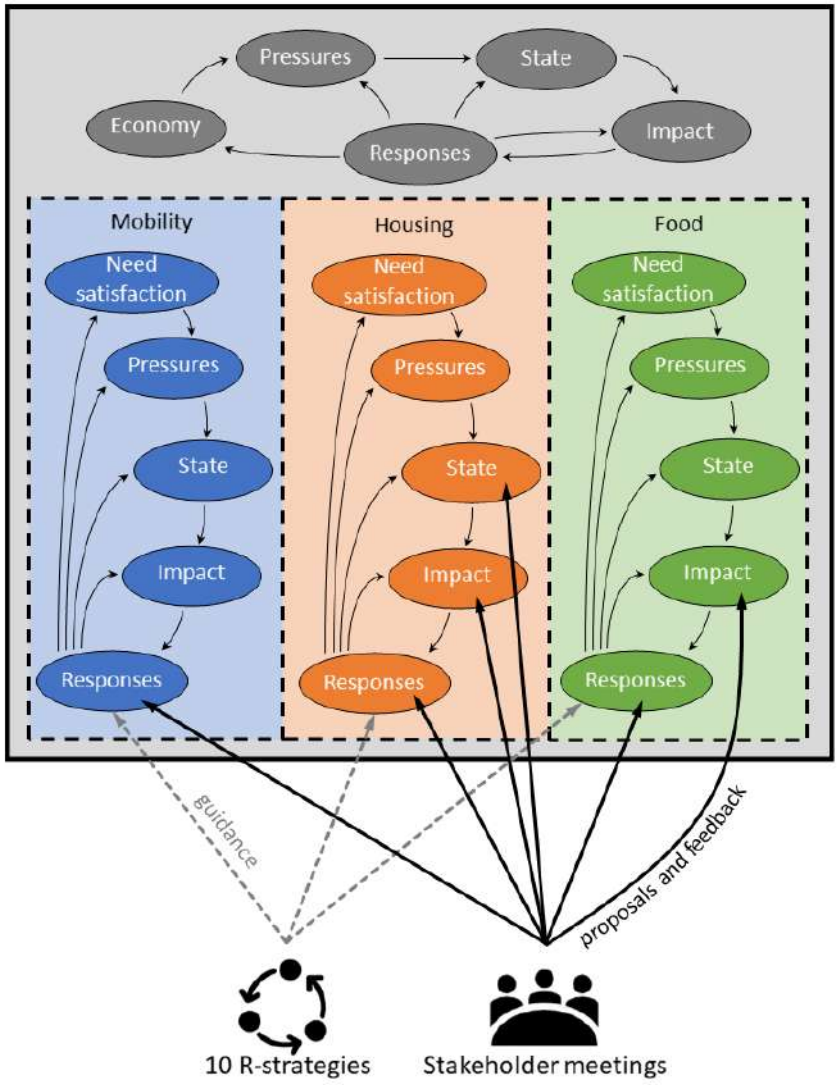
Gough, I. (2015). Climate change and sustainable welfare: the centrality of human needs. *Cambridge Journal of Economics*, *39*(5), 1191–1214.

Need Satisfier Systems (NSS)

Need satisfiers require a system producing, delivering, marketing, etc. the satisfiers



How to measure NSS?



Structure data along DPSIR framework:

- **N**eed satisfaction: societal output
- **P**ressures: cause-effect relations
- **S**tates: environmental description
- **I**mpacts: environmental, societal, economical
- **R**esponse: political programs, initiatives, laws

Case study: Housing in Flanders

	Indicator	Result (per year)
Need satisfaction	Total floor area per building	1’224 mil m^2
	Total floor area of all buildings	
	Total number of households	2’845’252
	Total number of businesses	1’010’635
Pressures	Material Footprint of the NSS	34’746 kt
	Weight per building and material type	
	Carbon Footprint of the NSS	8’360 kt CO_2eq
	Land area of buildings	231’587 ha
	Weight and composition of demolition waste	15’200-16’200 kt, 85-92 % inert
State	Weight of Virgin raw materials reserves	18’600 kt loam, 24’200 kt clay, 911’900 kt sand
	Volume of water reserves	8’666 mil m^3
	Concentration of air emissions	415 ppm
	Area of natural land	355’300 ha

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Case study: Housing in Flanders

	Indicator	Results (pre year)
Impacts	Number of people affected by water scarcity	1’372’283
	Number of people affected by emissions	6’516’011
	Number of homeless people	5’456
Responses	Number of provided social housing units	156’744
	Building occupancy rate	93.7%
	Material weight per floor area	
	Floor area provided per built surface area	7’156 m^2/ha
	Value share of building repair and maintenance	
	Value share of building renovation	
	Share of recycled materials in building construction	91.0 % fine sand, 17.2% constr. sand, 10.1% quartz sand, 53.0% clay, 30.8% loam
	Share of supervised demolitions	31.8%
	Average lifetime of buildings	57.2 years

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Conclusions

The method provides:

- more details about the circularity of an economy
- different aspects (environmental, socio-economical) next to each other
- structures data
- cause-effect relationships
- feedback for policies
- improved communication
- spotlight on data gaps

Questions and discussion

René H. Reich
rene.reich@kuleuven.be

KU LEUVEN

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Monitor Your Circular Economy

Arnout Sabbe – Delft University of Technology

Monitor your circular economy

- Chair Environmental Technology & Design
- 20 staff
- Focus on circular economy, urban metabolism

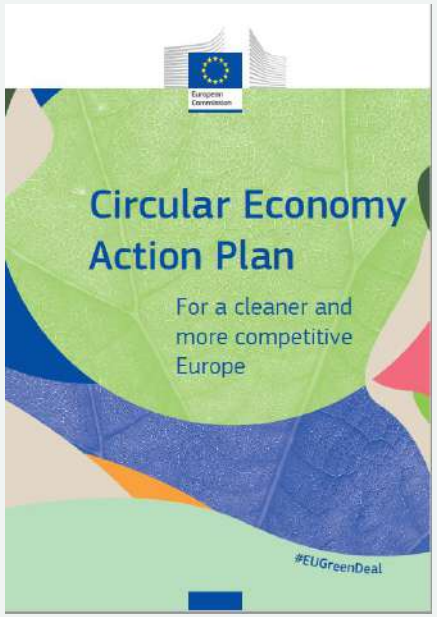
- Amsterdam Institute for **A**dvanced **M**etropolitan **S**olutions
- Collaboration MIT, TUDelft, Wageningen University with City of Amsterdam

- Spin-off project TUDelft en AMS Institute
- 7 staff
- Technology x Circular Economy

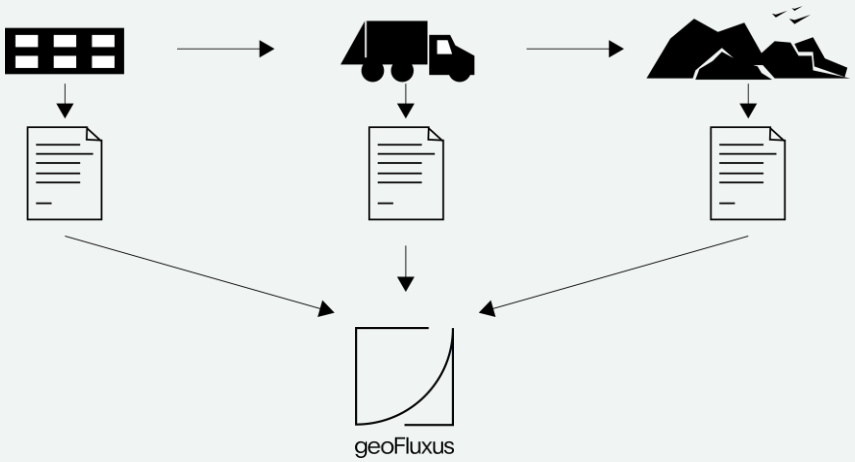
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688920 and grant agreement no 776751


Gemeente
Amsterdam
Amsterdam
Circulair
2020-2025
Strategie


Nederland circulair
in 2050


Circular Economy
Action Plan
For a cleaner and
more competitive
Europe
#EUGreenDeal


Show stocks
Show actors
Show flows
Display materials
Cluster locations
Light/dark
Animate flows
lines only
dotted
Leaflet | © OpenStreetMap contributors, © CartoDB



+ data cleaning
+ geolocation
+ geospatial data enrichment
+ machine learning for the free text field interpretation
+ semantic reclassification of (waste) materials

89%

of all waste comes from companies.

Only

11%

is household waste.

[Metropoolregio Amsterdam, 2019]

22%

of all waste in Amsterdam has the potential to be directly reused

[Metropoolregio Amsterdam, 2019]

70%

of all waste
is produced by
only

7%

of all companies.

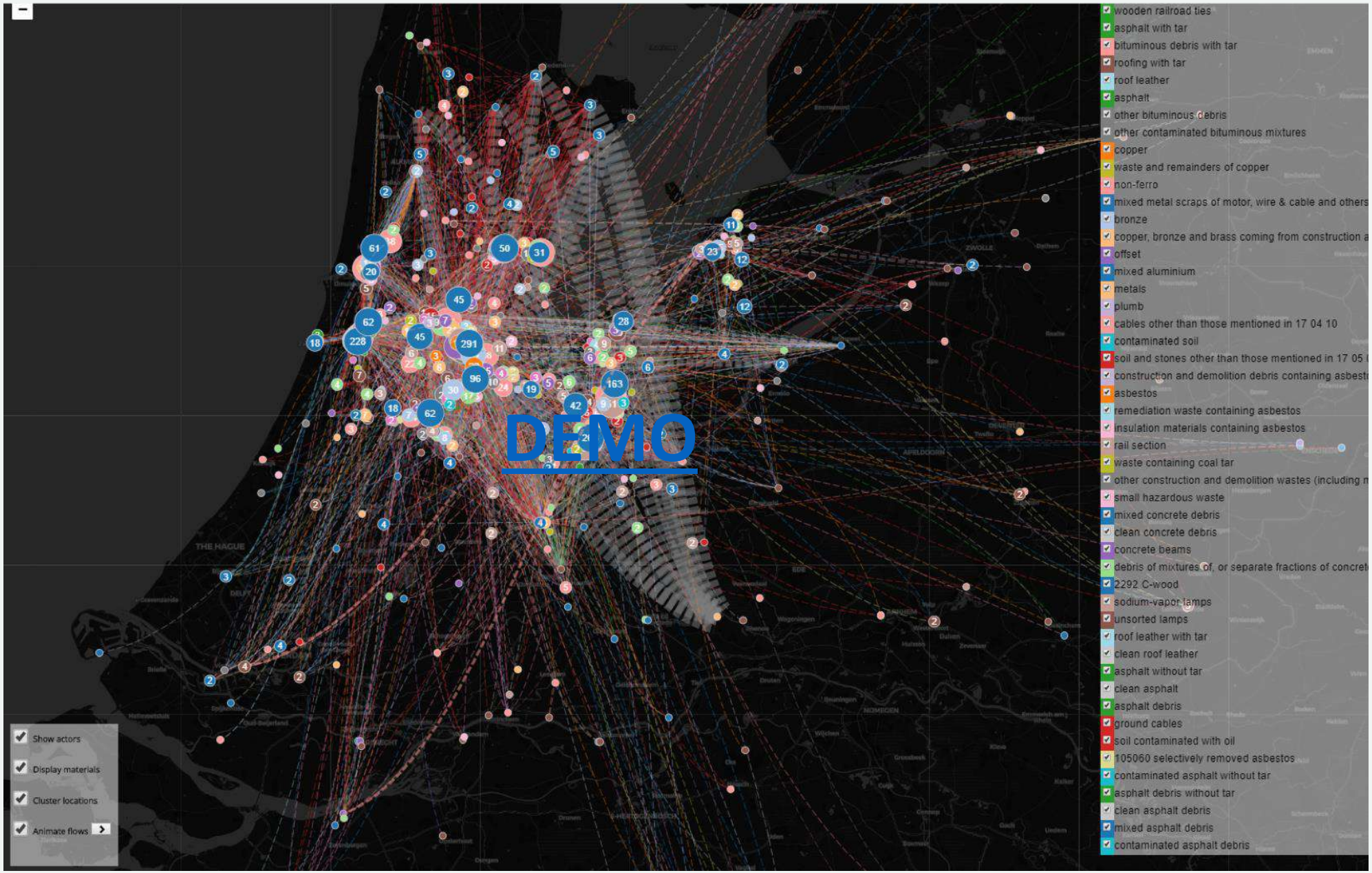
[Metropoolregio Amsterdam, 2019]

More than

9 million km

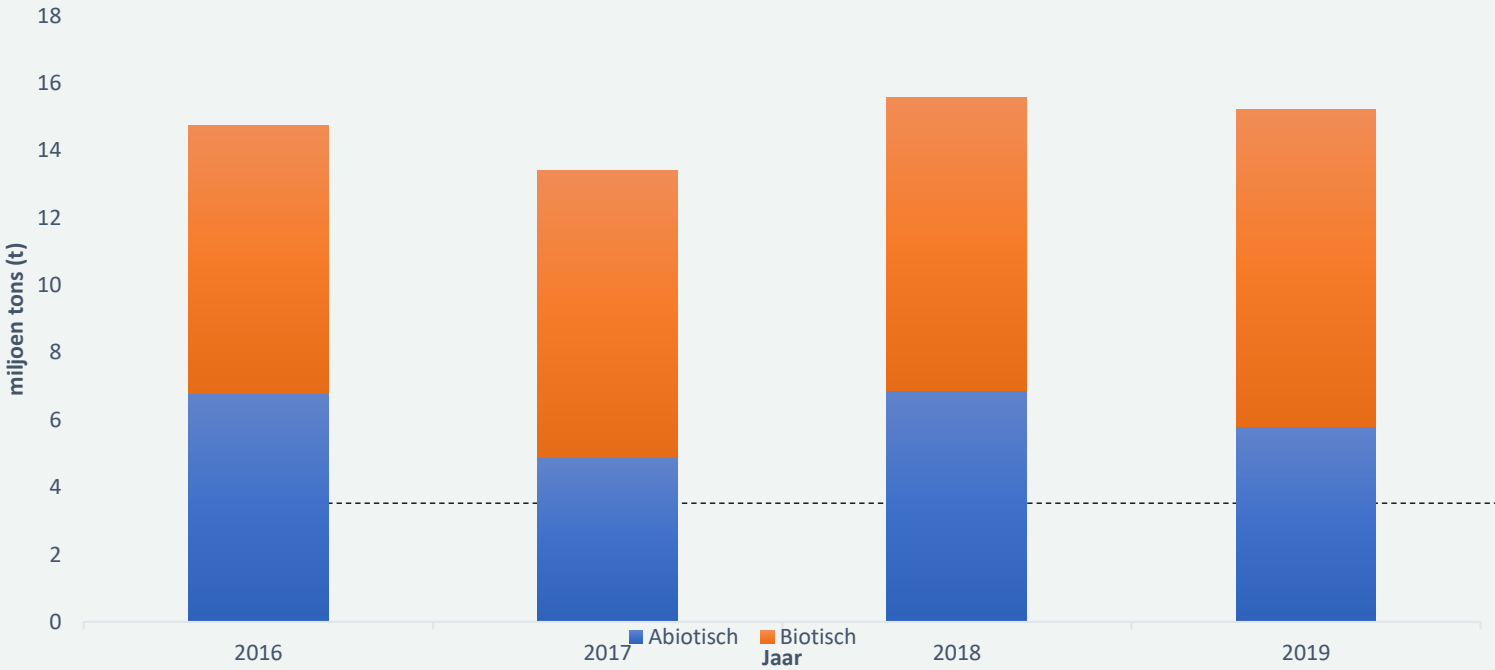
are being travelled yearly to transport waste from Amsterdam to waste processors across the NL.

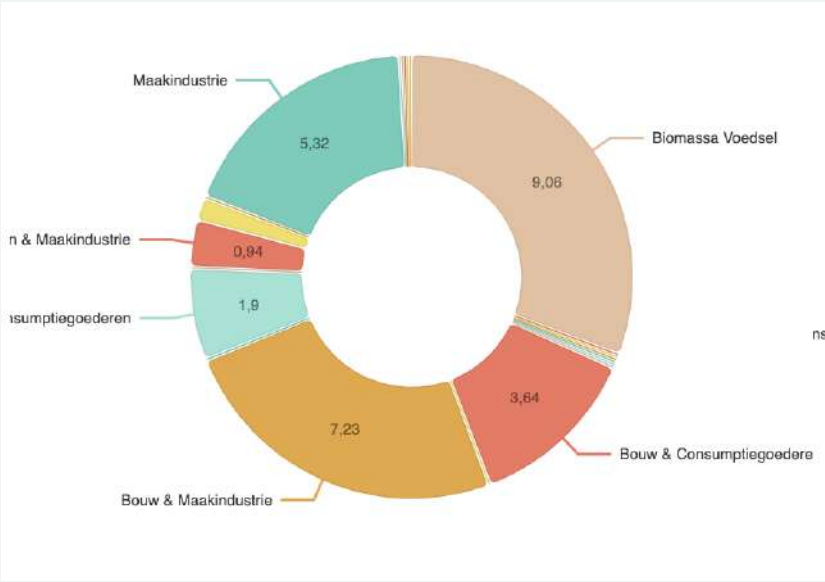
[Metropoolregio Amsterdam, 2019]

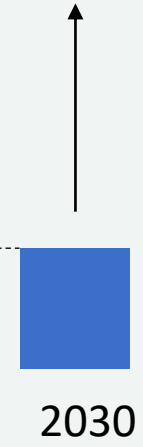

DEMO
Show actors
Display materials
Cluster locations
Animate flows
wooden railroad ties
asphalt with tar
bituminous debris with tar
roofing with tar
roof leather
asphalt
other bituminous debris
other contaminated bituminous mixtures
copper
waste and remainders of copper
non-ferro
mixed metal scraps of motor, wire & cable and others
bronze
copper, bronze and brass coming from construction a
offset
mixed aluminium
metals
plumb
cables other than those mentioned in 17 04 10
contaminated soil
soil and stones other than those mentioned in 17 05
construction and demolition debris containing asbest
asbestos
remediation waste containing asbestos
insulation materials containing asbestos
rail section
waste containing coal tar
other construction and demolition wastes (including
small hazardous waste
mixed concrete debris
clean concrete debris
concrete beams
debris of mixtures of, or separate fractions of concret
2292 C-wood
sodium-vapor lamps
unsorted lamps
roof leather with tar
clean roof leather
asphalt without tar
clean asphalt
asphalt debris
ground cables
soil contaminated with oil
105060 selectively removed asbestos
contaminated asphalt without tar
asphalt debris without tar
clean asphalt debris
mixed asphalt debris
contaminated asphalt debris


Waste
EWC
Economic activities
NACE
Product
CN
Resource
GSS

50% less primary abiotic materials 2030







Data: Provincie Utrecht, 2016-2019

geoFluxus

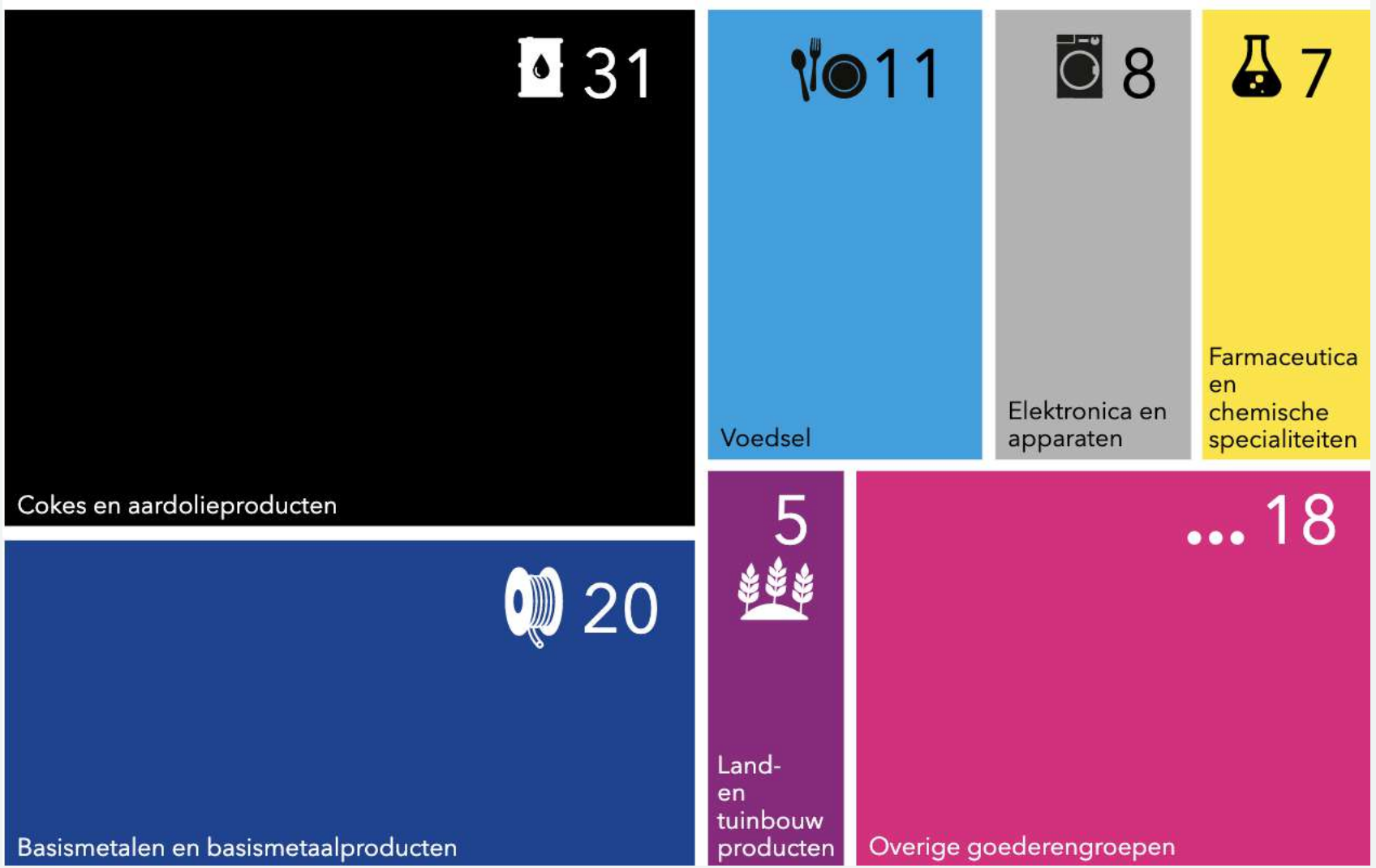
+ “Improve the security of supply of products, components and materials”

+ “Reduce the environmental impact of material use”

+ “Develop future-proof regional economies”

Improve the security of supply of products, components and materials

geoFluxus


31
Cokes en aardolieproducten
11
Voedsel
8
Elektronica en apparaten
7
Farmaceutica en chemische specialiteiten
20
Basismetalen en basismetaalproducten
5
Land- en tuinbouw producten
... 18
Overige goederengroepen

5,842 ton A-wood / year

Sufficient for **172,160 window frames**

€4.5 miljoen raw material costs

Saves **3,526 ton** CO_2 due to not incinerating

De eerste 100% circulaire raamkozijnen ter wereld

Time to make the world less linear

arnout.sabbe@tudelft.nl
arnout@geofluxus.com

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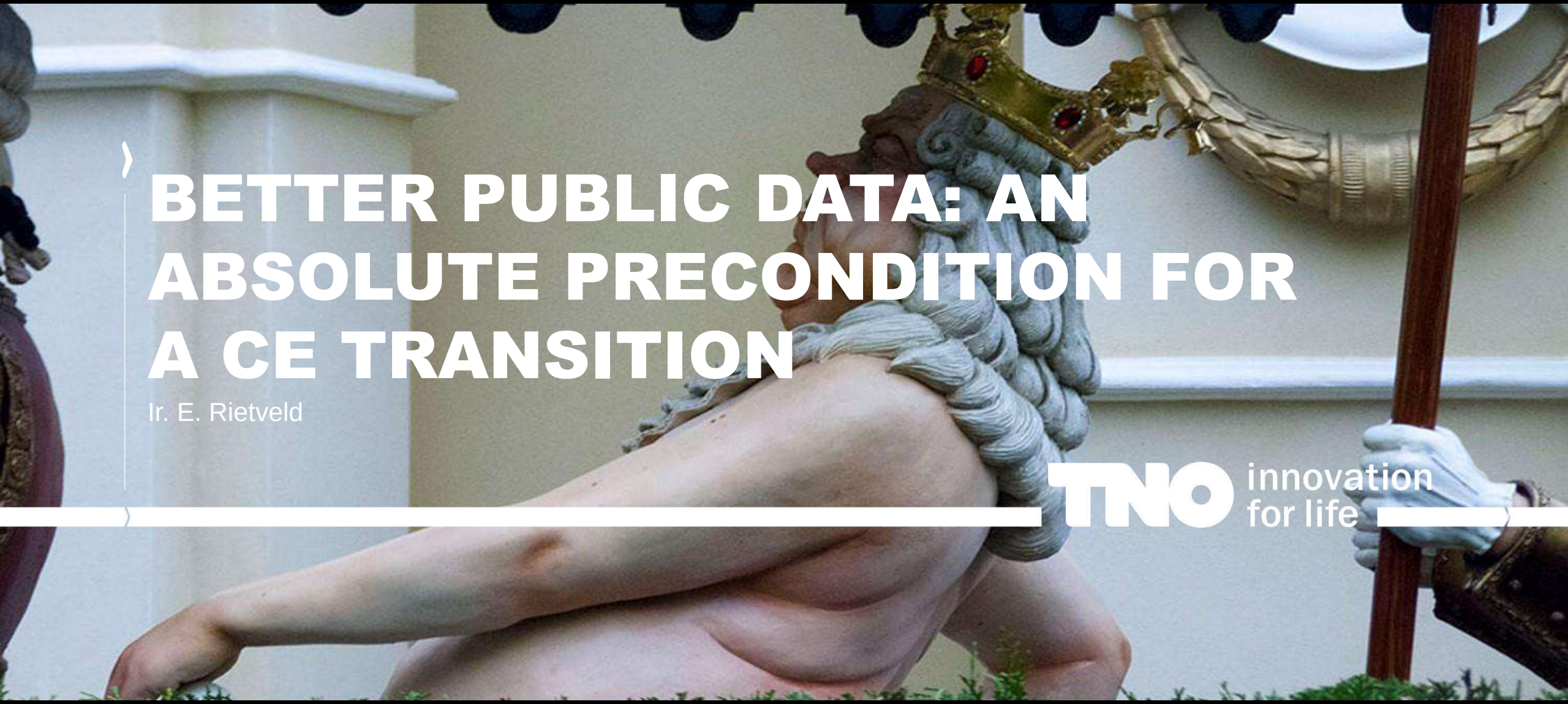
Better Public Data: An Absolute Precondition for a CE Transition

Elmer Rietveld – Netherlands Institute for Applied Scientific Research



BETTER PUBLIC DATA: AN ABSOLUTE PRECONDITION FOR A CE TRANSITION

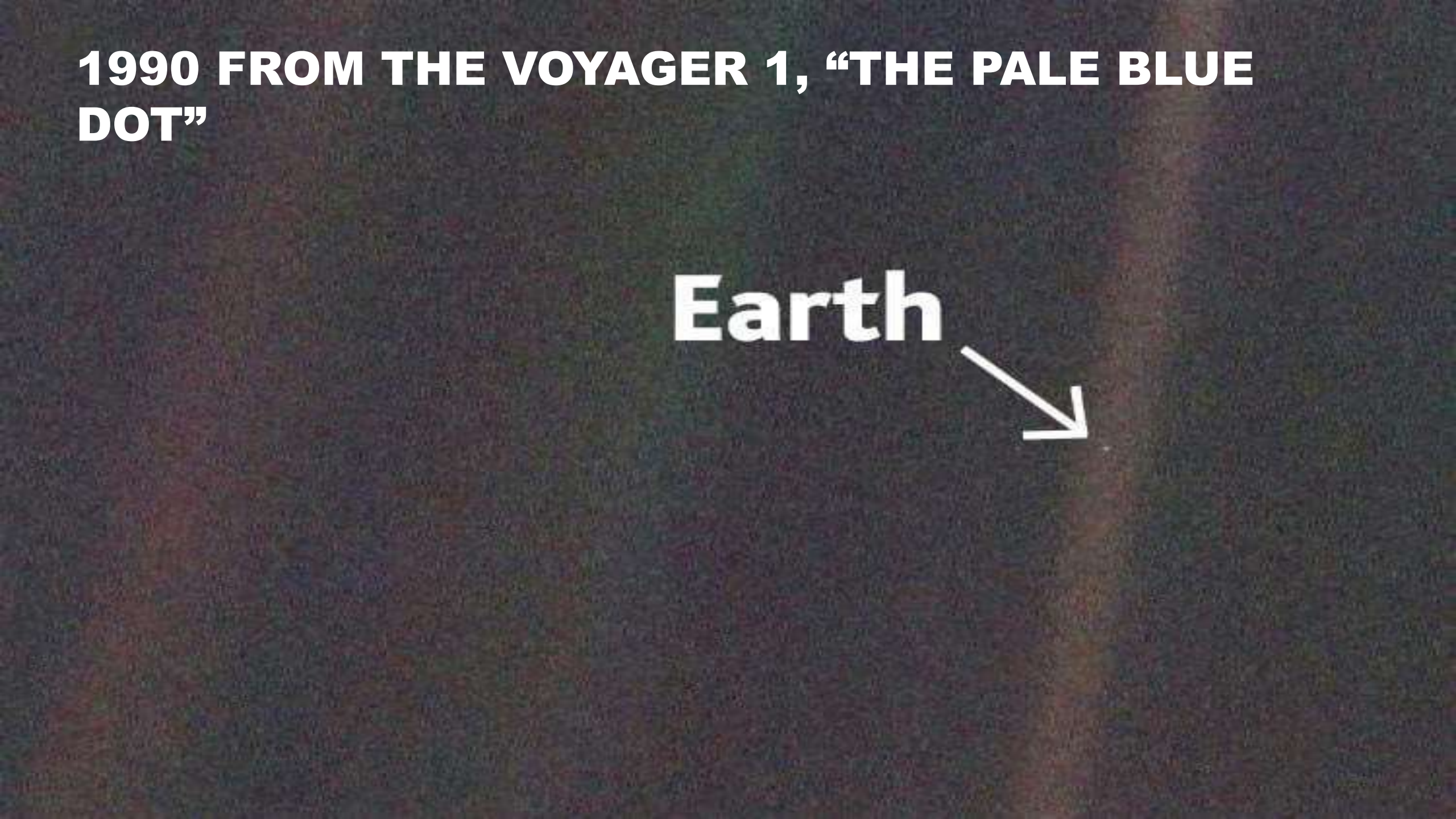
Ir. E. Rietveld

TNO innovation for life

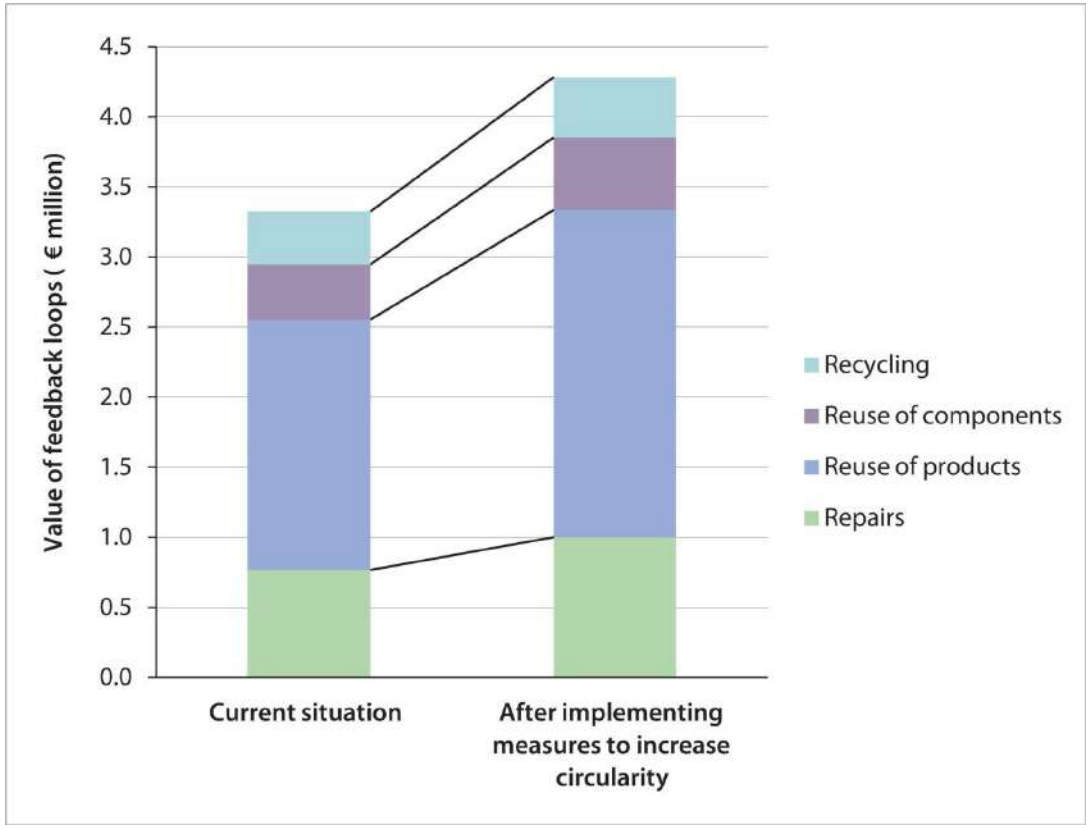

OVER 2 BILLION PRODUCTS FOR SALE IN MAJOR DEVELOPED CITIES.
PULL&BEAR
AND THEIR 2 BILLION VALUE CHAINS

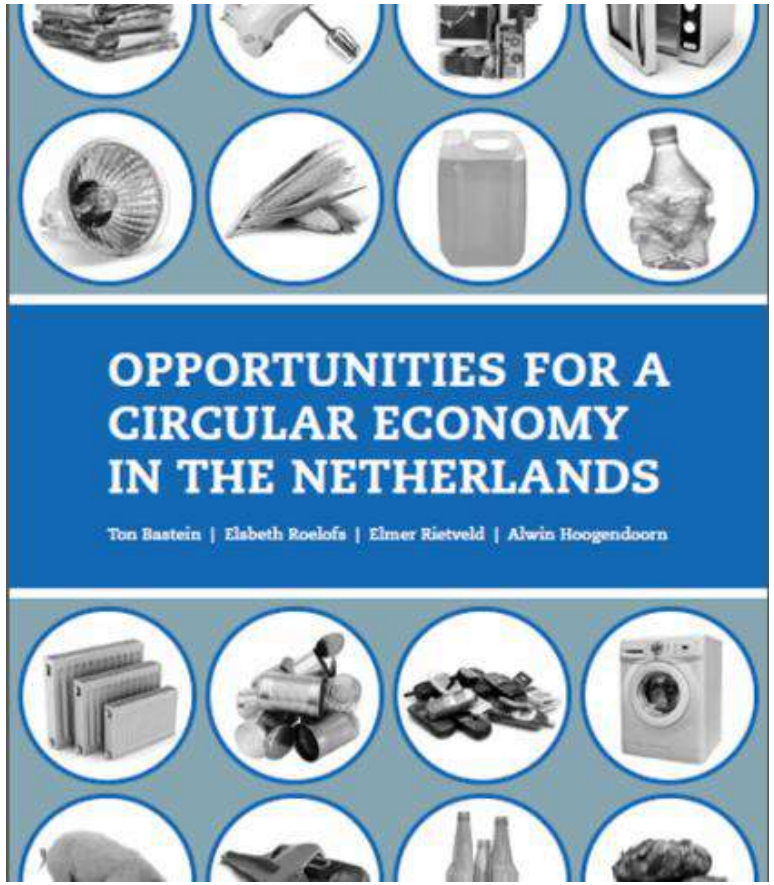
SOCIAL IMPACT OF CE: A FAVORABELE SIDE-EFFECT OR A DEMOCRATIC INEVITABILITY?

1990 FROM THE VOYAGER 1, “THE PALE BLUE DOT”



TNO ASSESSED OPPORTUNITIES IN 2013, BASED ON VALUE RETENTION OPTINOS OF PRODUCT GROUPS





PROGRESS BETWEEN 2013 AND 2018

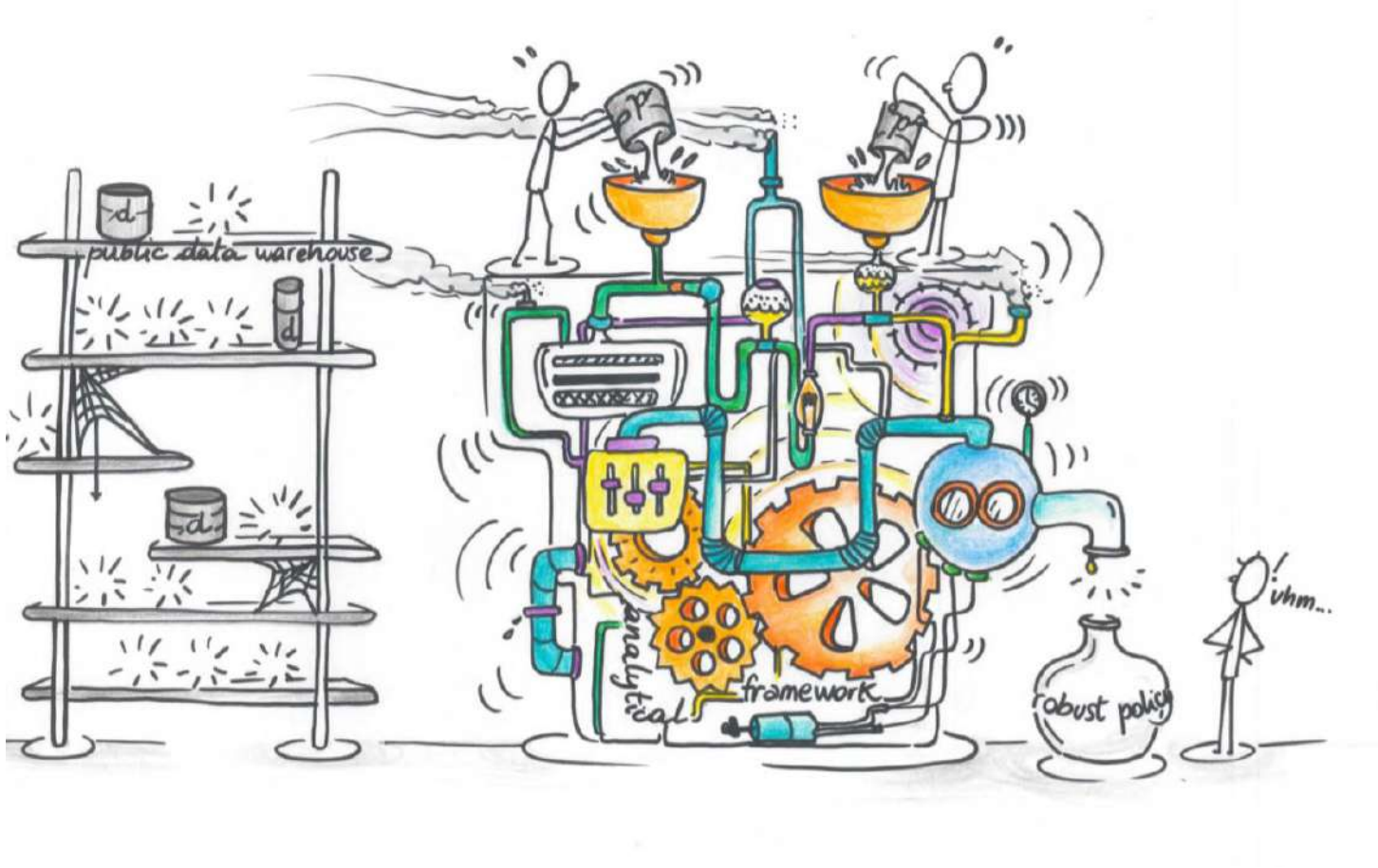
ARE WE ON TRACK TO REALISE 7.3 BILLION EXTRA VALUE ADDED (2013 PRICES)

Yes,

I think,

I guess

MANY INDICATORS, EMPTY PUBLIC DATA WAREHOUSES



Indicator	Unit
Resource use, direct (DMI resource)	kton
Resource use, chain (RMI resource)	kton
Resource consumption chain (RMC)	kton
Land use, direct	% cultivated land
Water use, direct	MiO m^3
CO_2 emission direct	Mton
CO_2 emission footprint	Mton
Economic growth (CE sectors)	EUR
Employment (CE sectors)	% of total FTE
Added value recycling sectors	EUR, 2014 prices
Self-sufficiency resources	DEU/DMI
Resources used, excluding export	DMC
Material productivity	GDP/DMC
Waste production	kton
Relative waste production	kton waste/DMC
Circular Material Use Rate	% of secondary material in DMC
Value Based Recycling Index	Price of recyclable waste/price of ingoing waste flows

WHOA, WHOA YOU SCEPTIC! ISN'T THE CE TRANSITION IS IN MOTION?

SEARCH 11 november, 2019 The New York Times

BUSINESS | TECH | ECON | MEDIA | MONEY | DEALBOOK

Berry Global Joins SABIC in the Production and Use of Circular Polymers from Chemical Recycling

LEASE A BIKE

fd. Mijn nieuws Laatste nieuws Krant Dossiers Beurs Meer AEX 610,18 -0,66% Abonneren

Pieter Lelkens 26 nov 19

INDUSTRIE

Batterijrecycler investeert in Rotterdamse haven

Het Finse recyclebedrijf uRecycle gaat een fabriek bouwen in de Rotterdamse haven. De nieuwe vestiging wordt de Europese hub voor het recyclen en hergebruiken van draagbare en industriële batterijen, waaronder batterijen

Volgen via Mijn nieuws

Havenbedrijf Rot...

FINANCIAL TIMES

HOME WORLD US COMPANIES TECH MARKETS GRAPHICS OPINION WORK & CAREERS LIFE & ARTS HOW TO SPEND IT

Get a fresh start.

Latest on ESG investing

Climate change threatens quant funds

Green loans catch on in push for companies to clean up

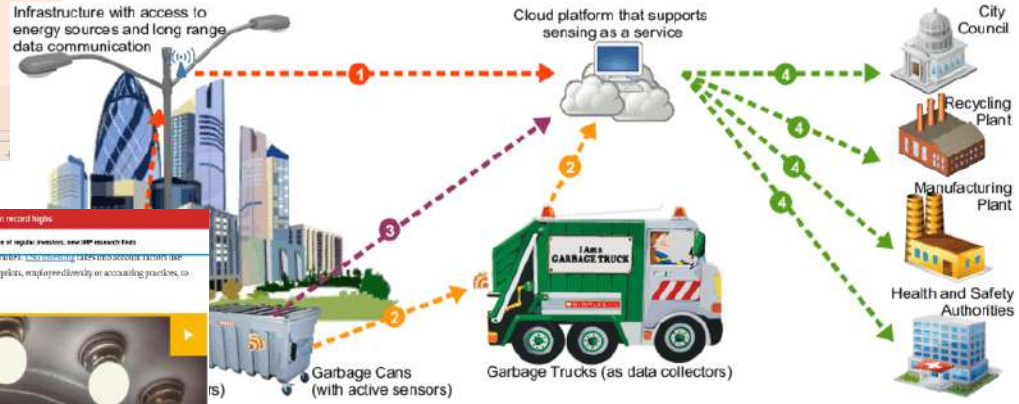
Moral Money Spe... day one

ESG investing + Add to myFT

BlackRock launches fund to cash in on recycling push

Money will buy stocks that stand to benefit from the 'circular economy'

Henry Sanderson OCTOBER 8 2019



G7 Workshop on Value Retention Policies

Paris, November 18-19 2019

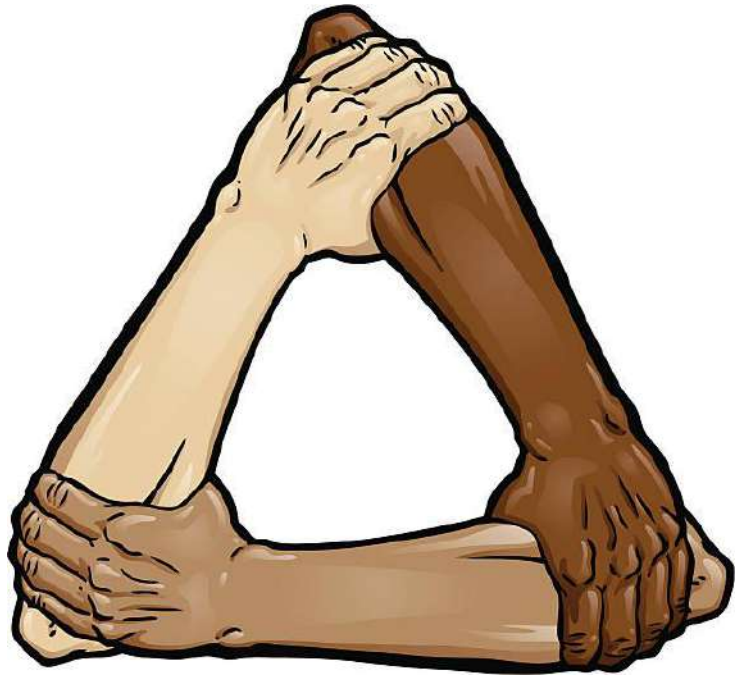
NOVEMBER 18, 2019

DATA CENTER SERVICES

CNBC October 10, 2019

A STALEMATE, THAT BETTER DATA CAN BREAK

Companies: will invest when markets emerge or are created (forbid or command)



Government: play the political game and look issues that are top mind to voters (like prices)

Households: will act out of habit 99% of the time, and if not, will act based on clear cause-effect benefits

DO WE EXPECT INDIVIDUALS TO CHANGE THEIR BEHAVIOUR JUST LIKE THAT?

POLITICAL LEADERS ACT ON ISSUES THAT GET THEM RE-ELECTED (OK, WELL, MOST OF THEM)

CE BUSINESS-CASES ARE STRUGGLING

PROOF THAT POLICY CAN CREATE MARKETS

Tesla 3, reducing NOx emissions, phasing-out lightbulbs,....

#HOW, #WHAT (LINK)

#	What better data do we need?	Why do we need the better data?	How would this help robust policy, for example?
1	Data that are clearly related to a product or a product group	What are products? And what are the materials involved? A seemingly trivial question, but fuzzy product definitions can cause enormous amounts of ambiguity in many conversations and studies. We suggest considering international trade data and products that are directly linked to current economic activities. Trade data are made available in a global classification called the Harmonized System or Combined Nomenclature (HS/CN). Economic activities are linked to products by the classifications of products by activity (CPA). The HS/CN and CPA classifications are the most detailed in terms of product specification, and they are geographically specified by nation state. These classifications should be improved by increasing the level of detail on product groups, getting from general labels such as "electronics" to 6–8 or even 10 digits that describe relevant and specific products.	Benchmarking a product innovation to the rest of the product group.
2	Data that are clearly related to economic sectors of activity	Arguably the most used public data are organized by economic sector, describing labour markets, capital stock and sector-specific taxes and subsidies. These data are described by the global International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4 from the UN or Nomenclature statistique des Activités économiques dans la Communauté Européenne (NACE) Rev. 2 from the EU. Currently, sector are described on a 1-, 2-, 3- or 4-digit level. The NACE and ISIC classifications are the same on a 4-digit level, representing over 600 sectors or "classes". The coverage of global data should improve to a 4-digit standard.	Liaising sectors to all relevant ISO standards of the ISO/TC 323 circular economy (ISO 2018).
3	More detailed systems of national accounts (SNAs) or input-output tables	Better sector and product data lead to better national accounts. The abovementioned better product and sector detail will improve the analytical power of any SNA. The best examples of accounts with an existing high level of detail ("granularity") are the ones from the United States and Japan. Bringing the European system of national and regional accounts (ESA) to the level of the US or Japan would already be a huge leap for work dir in assessing impacts over supply chains. Also, accounts should be assembled at least once every five years by thorough surveys using state-of-the-art ICT techniques.	Assessing an impact related to a product or sector in a region, nation state or world economy, including assessing typical supply chains, which are generally global and therefore described by data with global multiregional SNA scope.
4	Improve physical supply- and-use tables	Where SNAs are expressed in monetary terms ("money"), it is necessary to have consistent physical extensions: material s. Detailed physical supply and use data (e.g., 400 product groups in physical weight units) are available for research purposes from the German and Netherlands Statistical Offices. These are not published at that level of detail because of confidentiality requirements, but they could be used at an aggregated level to update public SNAs at a European level. Conversely, material flow analyses on a national level, based on other sources than SNA, should transparently be mapped to the SNA to create mutual analytical strength.	Unlocking a wealth of material flow analysis by merging it with SNAs; disciplining monetary data by matching it with possible limits to the use of natural resources.
5	Make use of data from product lots of eco-directive	There is a wealth of information available about products subject to the EU Ecodesign Directive (ECEE 2019). The EU Ecodesign Directive covers all energy-related products sold in the domestic, commercial and industrial sectors. This information needs to be linked to databases that can be queried and directly related to macro-economic statistics. Such properties as energy consumption, material composition, components used and lifetime distribution can be mapped in a consistent way, using or referring to existing information	Discussing the viability of proposals for extended producer responsibility.
6	Better data on general waste flows	Waste flow data are currently collected using classifications like the Waste Statistics Regulation, the Extractive Waste Directive in the EU or , globally, under the Basel Convention. But these data can show many data gaps and contain or outright unreliable results, which frustrate making accurate estimations on size and purity/quality of a flow. The waste data problem is described as the "hole in the circular economy". Furthermore, the data should enable us to answer questions about the vital "end-of-waste criteria" and the circular strategy that involves recycling that is highly dependent on sensible and dynamic end-of-waste criteria. The need for better waste data is also described in the Raw Materials Scoreboard (EC 2016b), which has, for almost all circular indicators, a section dedicated to "The search for suitable data..." For the most relevant waste flows like waste of electronics and electrical equipment (WEEE), it is difficult but highly relevant to have a clear picture of how much waste is actually generated, collected and then prepared for re-use/recycling/recovering at national and EU levels.	Giving a boost to the market for secondary materials and thereby stimulating new circular businesses, optimizing public investment in waste treatment while respecting available social capital and the labour market.
7	Better data on industrial waste flows	The waste streams generated during the manufacturing process have some characteristics that are different from general waste flows. As a result, opportunities to retain value of industrial waste, though industrial symbiosis for instance, have different and cement and data requirements. Industrial waste is often measured as part of regulatory monitoring and emissions, such as the European Pollutant Release and Transfer Register (E-PRTR). Evaluations (EC 2016c) of this legal register mention issues with data quality. For example, shortcomings in the data provided by operators, shortcomings in validation, lack of time-series data, too strong dependency on modelled or estimated data, etc.	Assessing quality (i.e., technical value) of possible streams within a processing plant or chain while adding the option to compare it to similar waste flows.
8	Expanding the use of open-source life-cycle inventories	The data that fuels life-cycle assessments is delivered by life-cycle inventories (LCI). These are often made public, for instance when providing supporting information for academic papers. Some excellent initiatives have even centralized these data. [1] As an example, the ILCD database (EC approved) is available at no charge. PEF also provides a database to be used in product declarations. This is free to use s that are developing rules for product categories.	Free and online LCI will strengthen the base for common methodologies such as PEF.
9	Data on repair & refurbishment	Waste data might be suboptimal, but data on materials and components used in repair and refurbishment are almost absent (Hoekstra et al. 2015). Allocating research budgets to document repair and refurbishment activities is a no-brainer investment when developing a circular economy.	Offering perspective to policy makers to enable business models aimed at economical lifetime extension strategies
10	Combining life-cycle inventories and macro-economic models	LCI sources should be linked to macro-economic models (Wiebe et al. 2019), to create a definitive link between the micro-level products and processes and the macro-level national economic accounts. This would significantly improve the usefulness of hybrid LCA approaches (Crawford et al. 2018).	Benchmarking a product to the rest of the product group; developing policies on sector and product level (production and consumption); relating specific CE innovations to national targets.
11	Quantity of (specific) raw materials	Despite an extensive body of work containing material flow analyses, a direct link between products from official classifications and raw material content is not formally available below a 2-digit level, let alone amounts of materials per product. Given the existing macro-economic data (for instance, about products that are put on the market annually), this presents a real opportunity for future research (EIT RawMaterials 2019).	Mapping the amount of specific metals embedded in intermediate and final goods traded around the world. It would subsequently help to assess the impact of strategic policie measures in reinforcing such supply chains.
12	Size of the urban mine	Urban mining considers stocks of materials in society as potential mines. Existing urban mine studies should be promoted to official statistics, introducing stock data in regular corporate and governmental statistics. Future research could be linked to public GIS data and data on monetary capital stock (Aguilar-Hernandez et al. 2019).	Estimating the amount of secondary major metals that we can expect to be offered for processing in the coming five years.
13	Documented product lifetimes	Every product group has a typical lifetime distribution that can be described statistically. Some studies have started to model these lifetimes (Bakker et al. 2014b), but these are not monitored or documented in a central database. Lack of knowledge about the aging dynamics of in-use stocks means that future end-of-life recycling input rates (EoL-RIR) cannot be effectively modelled (Mayer et al. 2019). The impact of lifetime extension strategies cannot be assessed without these data.	Improving corporate accounting and stock assessment for households and corporate slow-moving equipment.
14	Reliable waste exports	The quantity of end-of-life products exported legally or illegally (for example, by building on the CWIT e-waste export report, sensors in public infrastructure or waste-collection systems) is important given the need to assess regional catchment areas. Another relevant use of these data will be to fight the devastating effects of waste dumping on a global scale.	Assessing the optimal size of end-of-life recycling on an international level.
15	Better data on secondary materials	Data on secondary materials that are put back into the economy as "quasi" raw materials are still inadequate for many policy decisions. The data should be able to compare qualities of primary and secondary material to ascertain the EoL-RIR of materials (including waste treated outside of the EU). This EoL-RIR rate means recycling that can truly replace the need for primary extracted raw materials.	Chasing the holy grail of the most common circular strategy: recycling. To what extent can we truly circulate material after use cycle? And updating the influential work of UNEP (2011).
16	Better data on secondary components	For suggestions about the value of components, the initial public data effort should be focused on linking into corporate data using the latest ICT technology (Goodall et al. 2019). The term "closed-loop remanufacturing" should be introduced to label all the remanufacturing that is already going on within corporate supply chains, clearly identifying what part of that chain can be mapped with public information.	Enabling credible assessments of remanufacturing on any level, also enabling the assessment of options for servitization business models.
17	Price data as proxy for secondary material potential and progress	Apart from quantity, we should be able to determine the quality of secondary material. Prices of secondary flows, apart from metals, prioritizing plastics, wood, rubber, glass should be published in a centralized way. We should also consider these prices as the best proxy for the quality of the recycled materials. Estimates that assess the potential recycling rates of metals should, apart from price signals, be based on sound metallurgy and the laws of thermodynamics (Malo and Rem 2015).	Using value-per-unit as a proxy for entropy: how valuable is recycled material compared to virgin material?
18	Updated footprint coefficients	Footprint calculations try to estimate the material use and corresponding environmental impacts all along the value chain, for instance from cradle-to-gate or from cradle-to-grave. The current raw material equivalent (RME) coefficients used by Eurostat are a very helpful tool for that, but they need to be updated and improved (Eurostat 2017).	Assessing the contribution of a circular strategy to GHG emission reduction
19	Data to monitor operational performance of capital stock	Big data from operations, for instance from servitization enterprises, should be gathered to get a general aggregated sense of the performance of the products that are offered as-a-service. Providing these data at a sector level is considered realistic (Linder et al. 2017). These data should only be collected to overcome barriers in an emerging type of service, provided that both authorities and service providers see the need to overcome this barrier (see textbox "The narrative of the coastline village"). Simply gathering these data for the sake of fundamental research is probably not feasible.	Improving asset accounting by introducing functional units and predictive maintenance.
20	Basic data about innovations that are relevant for a circular transition	Innovations are recorded through patent systems. Researchers are increasingly finding that these systems work well for a decreasing number of sectors and products. This means that there is a need to monitor R&D, especially publicly funded R&D, in a more detailed way in terms of sectors and products (Mazzucato 2013). Better information about the destination (again, sectors and products) and size of venture capital could also provide important evidence to support decision making. Examples of innovations since 2013 could include new biogenetics, block-chain products, additive manufacturing/3D printing, e-commerce and delivery apps, etc. The technology readiness level (TRL) of these data can probably only be between 7 and 9, which means that only innovations that (almost) found their way to the marketplace are documented. If an innovation has a TRL lower than 6 or less, it is still likely to be a wonderful possibility for innovation at some point in the future.	Distributing funds in the next round of public R&D.

EXAMPLES OF POLICY REQUIRING PROPER DATA

- Expand **Extended Producer Responsibility** based on credible cost-benefit calculations
- Progressive and or dynamic pricing through **subsidies & taxation**, particularly those aimed at reducing cost of labour in circular sectors and supporting servitisation. (but obviously also CBAM)
- Removing **legal barriers** to use secondary materials, including enabling international waste flows that can use of (responsible) economies of scale in treatment
- Circular demands in **public procurement** (public expenditure was 53,1% of EU-27 GDP in 2020)

TAKE-AWAY MESSAGES

- Real impact comes from robust policy. Robust policy requires proper information. Information needs data.
- If we don’t take public data seriously, we might as well forget about creating any impact on the CE transition from public policy
- Statistical offices have received no significant increase in resources to conduct their tasks
- The promise of systems of product passports will not only revolutionize enterprises, it could and should spill over to public data


THANK YOU FOR YOUR ATTENTION
Take a look:
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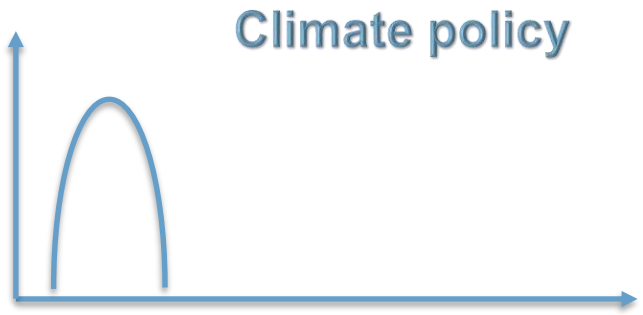
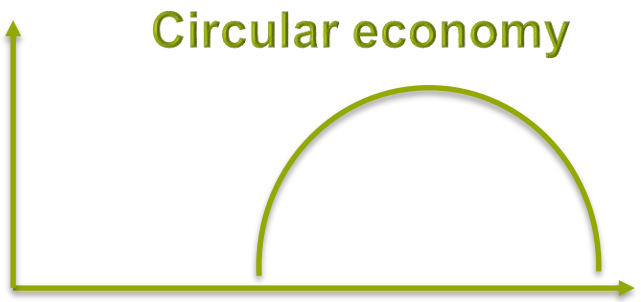
TNO
innovation for life

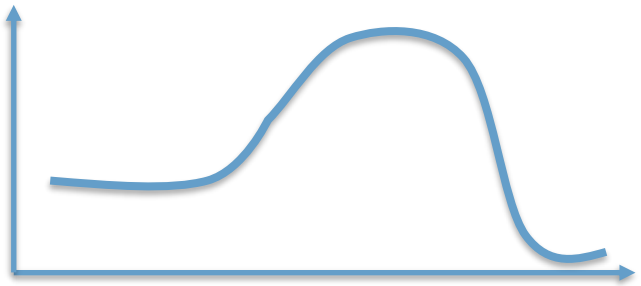
CLIMATE POLICY AS EXAMPLE FOR CE



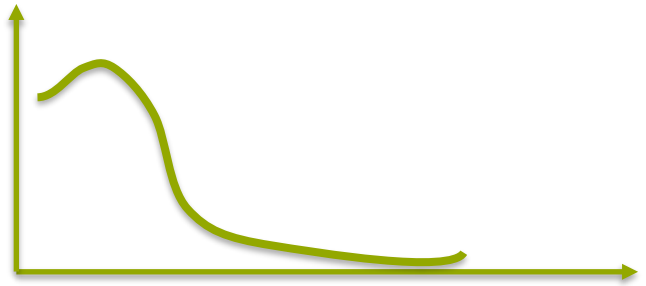
policy goals



policy goals



Sense of urgency



Sense of urgency

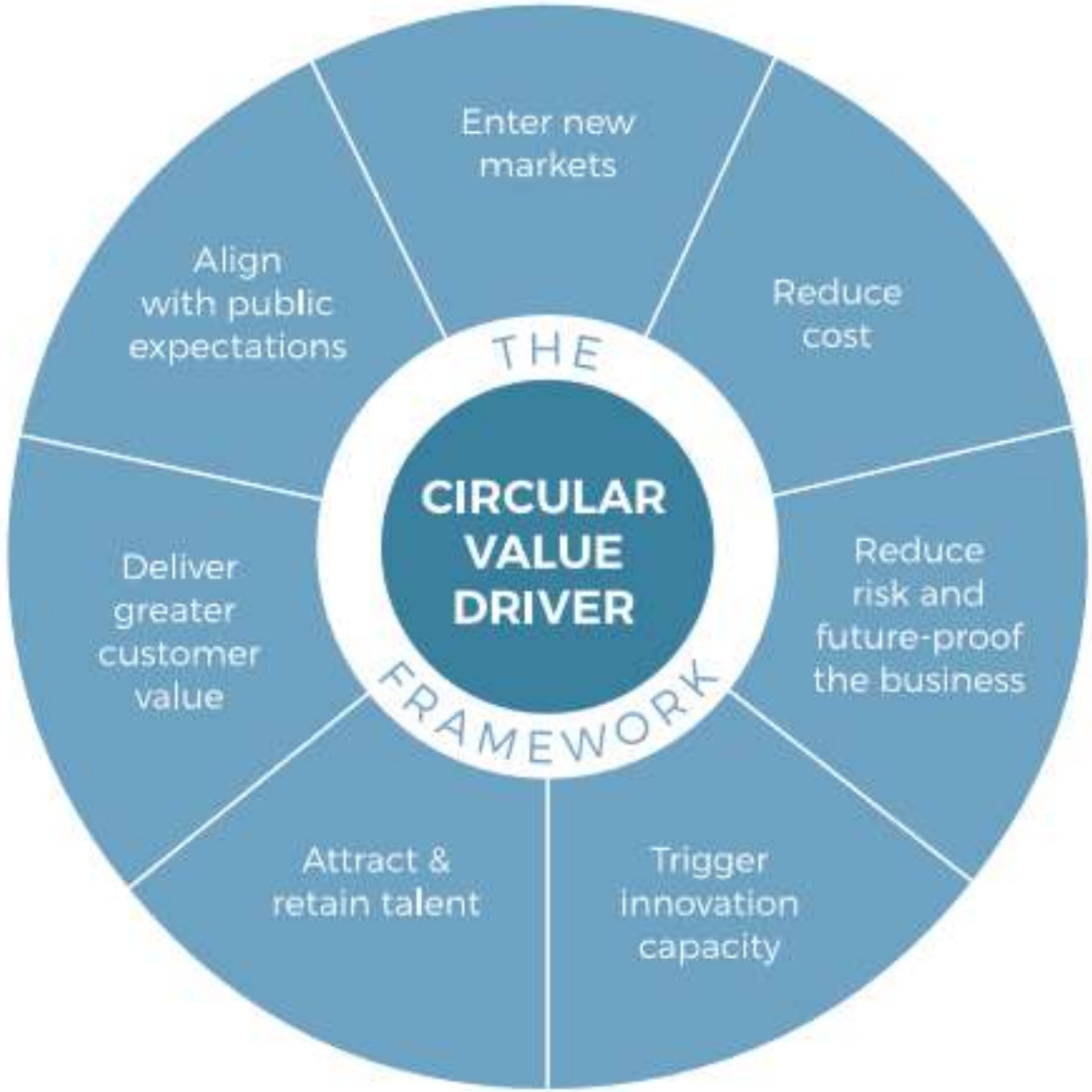
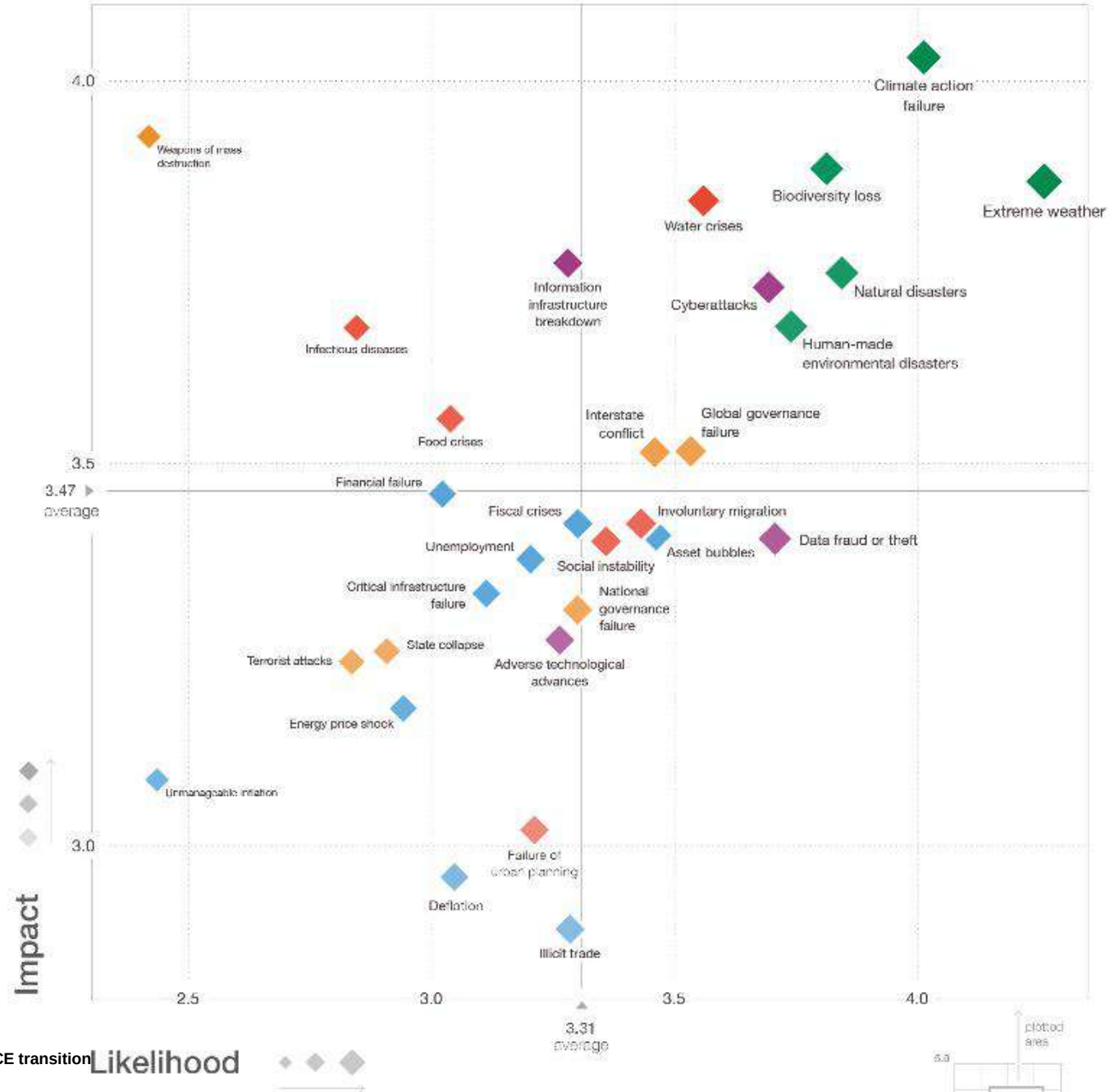

Enter new markets
Reduce cost
Reduce risk and future-proof the business
Trigger innovation capacity
Attract & retain talent
Deliver greater customer value
Align with public expectations
THE
CIRCULAR VALUE DRIVER
FRAMEWORK

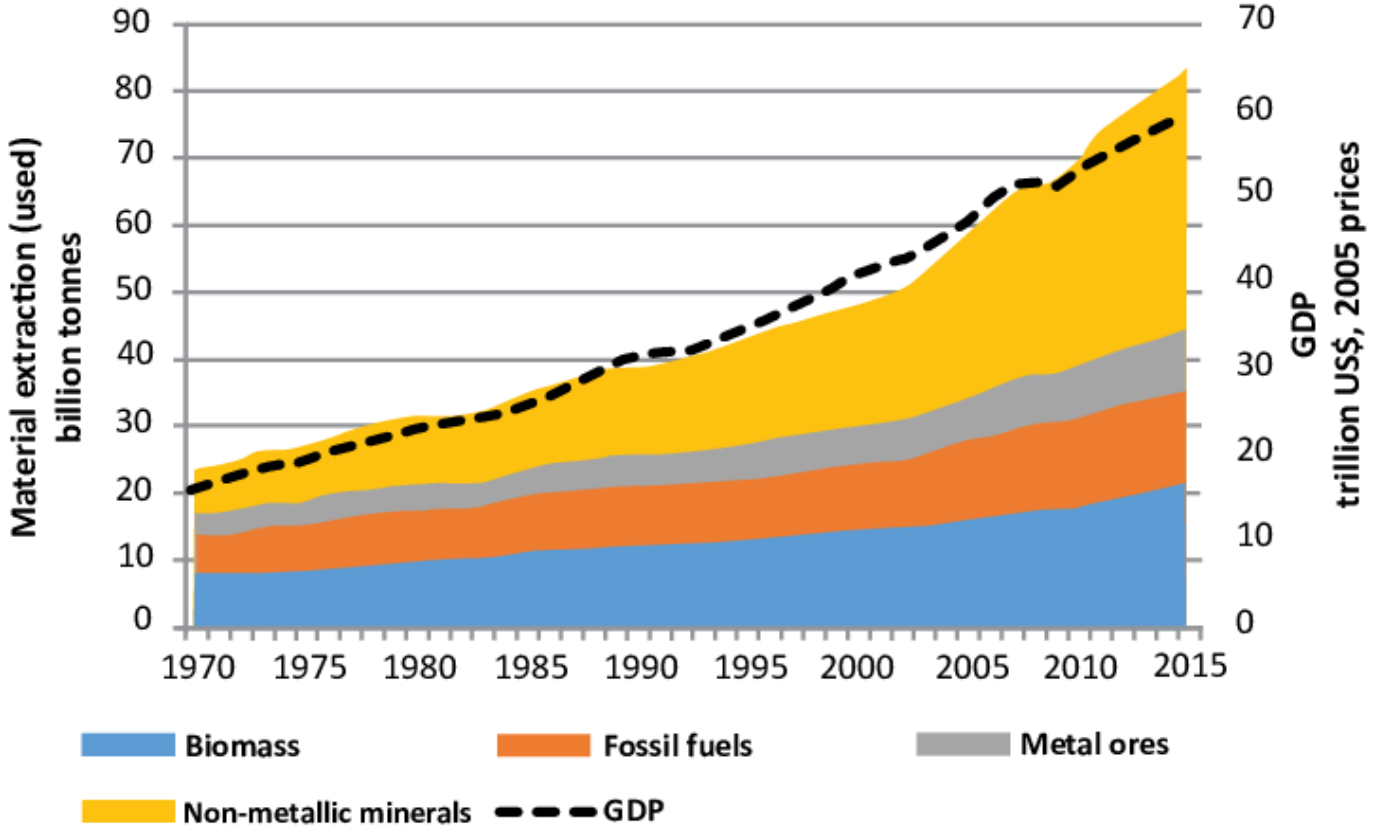
Figure II: The Global Risks Landscape 2020



WE LIVE (FAR) BETTER LIVES THAN THEM

DECOUPLING CAN SO FAR BE DEBUNKED

TWO (OR THREE) MORE PLANETS, ANYONE?



DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE
A collaboration of Rijkswaterstaat and Delft University of Technology

Coffee Break

11:00 - 11:30 | 25th May 2022

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE
A collaboration of Rijkswaterstaat and Delft University of Technology

Keynote Speech

Rusne Silertye – Delft University of Technology

11:30 - 12:30 | 25th May 2022

Rusnė Šileryte

24 05 2022

PhD Supervisors:

prof. Arjan van Timmeren,
prof. Alexander Wandl

geoFluxus

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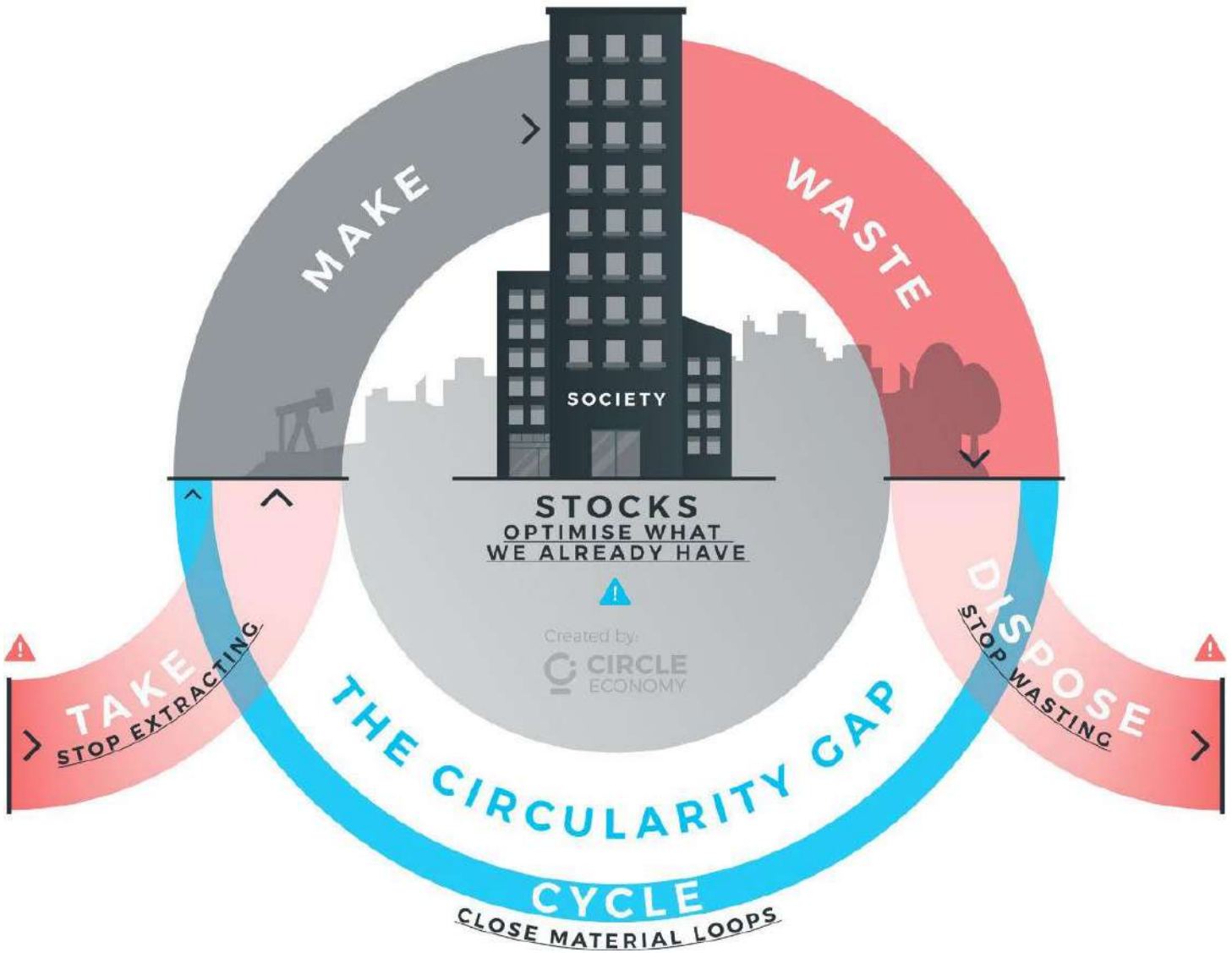
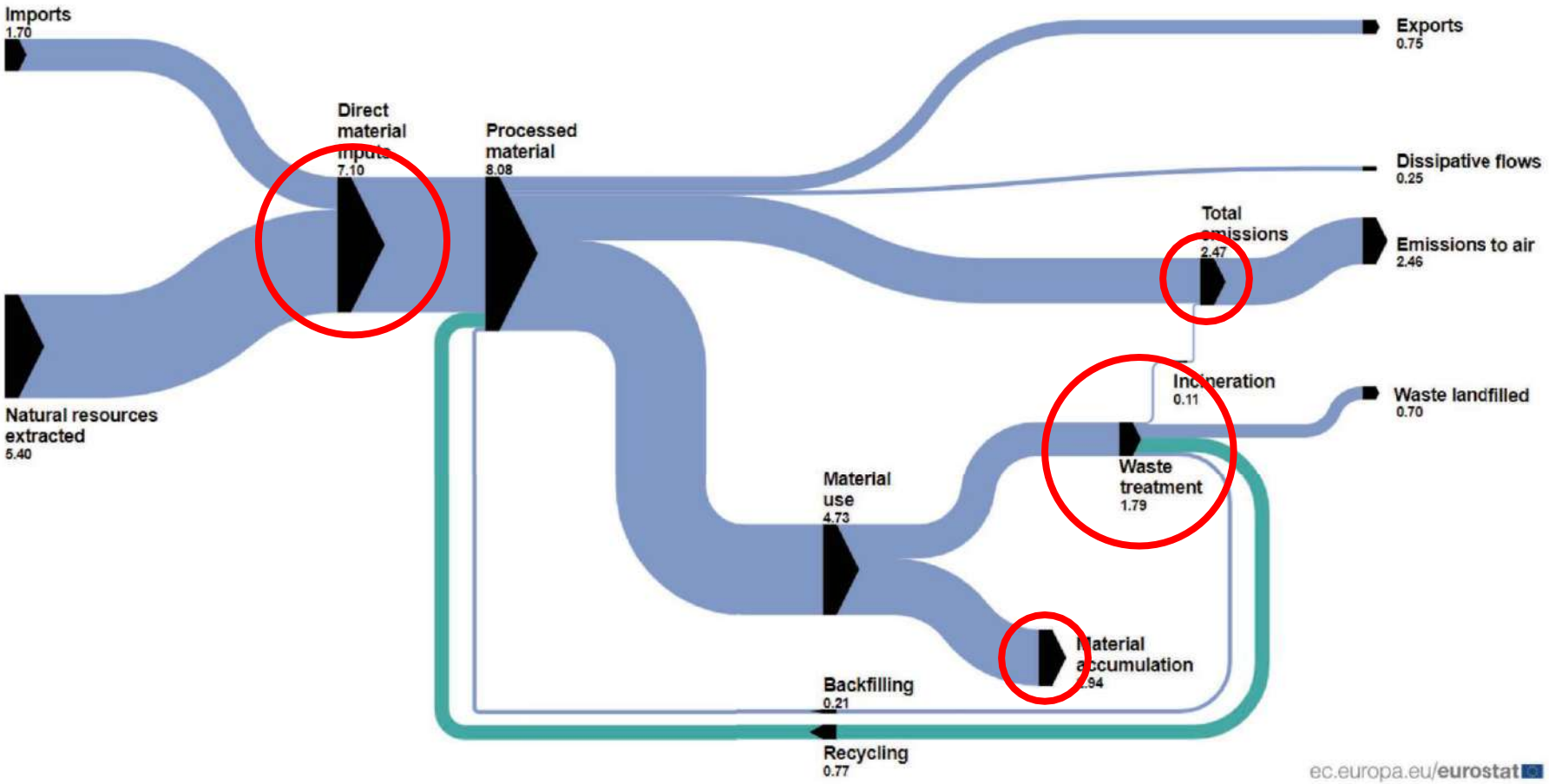
AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS

TU Delft

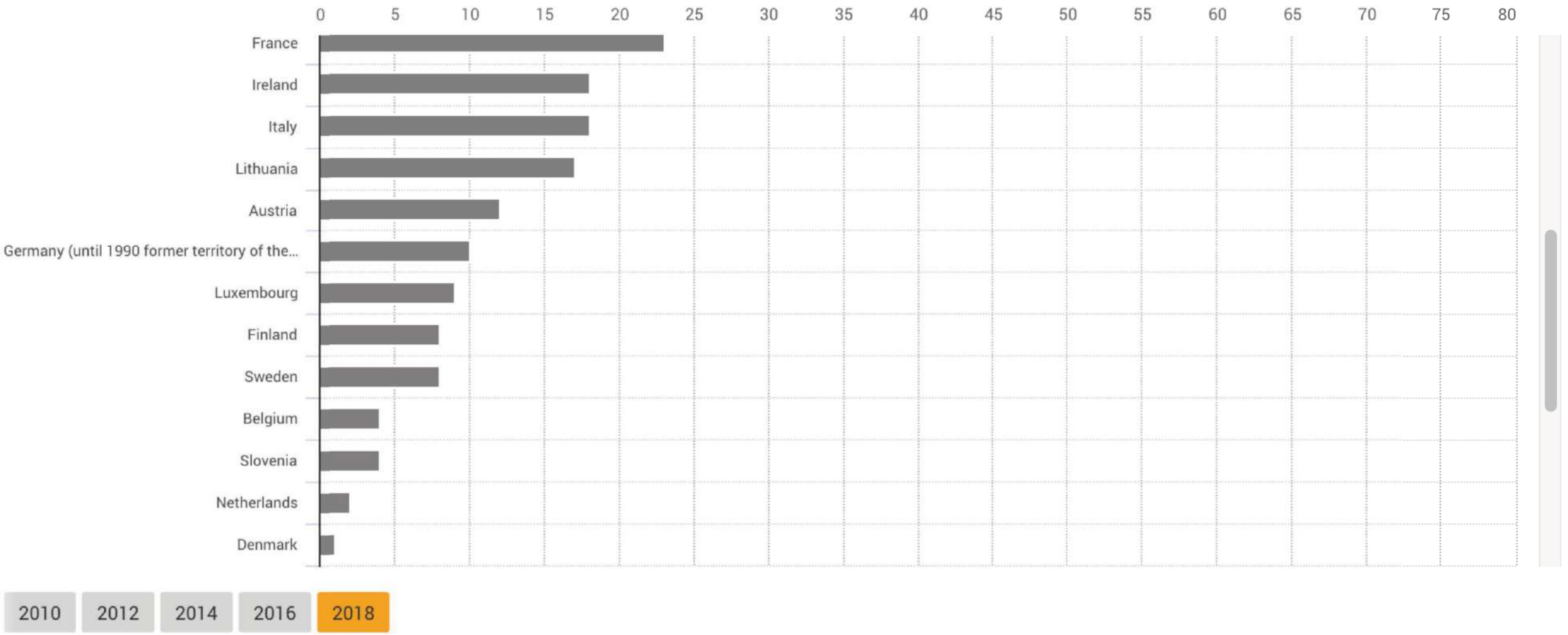
WASTE GEOGRAPHY

EUROPEAN WASTE STATISTICS IN PURSUIT OF A CIRCULAR ECONOMY


MAKE
WASTE
SOCIETY
STOCKS
OPTIMISE WHAT
WE ALREADY HAVE
Created by:
CIRCLE
ECONOMY
TAKE
STOP EXTRACTING
DISPOSE
STOP WASTING
THE CIRCULARITY GAP
CYCLE
CLOSE MATERIAL LOOPS



Material flows true scale in Gt/year (billion tonnes per year) in 2019, EU27. Source: Eurostat



Landfill rate of waste excluding major mineral wastes, first 13 EU countries, 2018.
Source of data: Eurostat

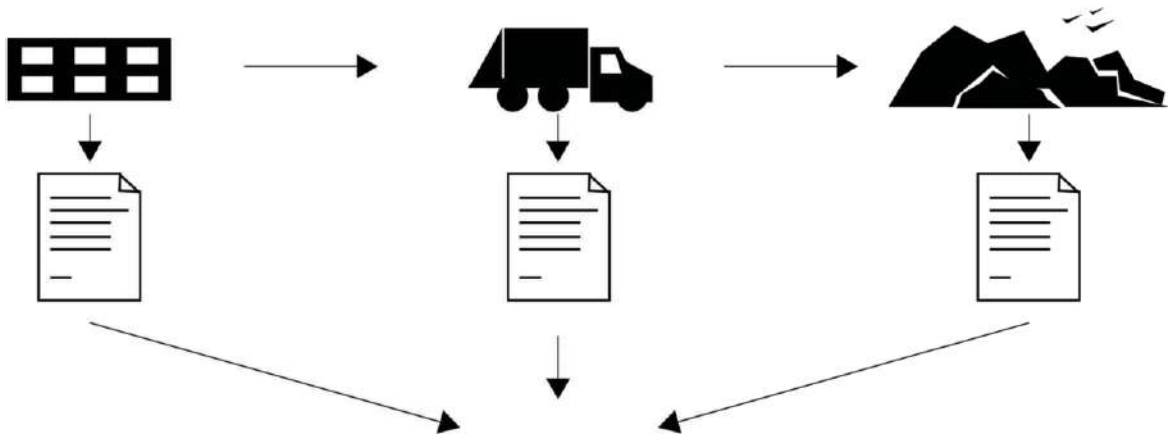
IS THERE ENOUGH WASTE FOR A CIRCULAR ECONOMY?

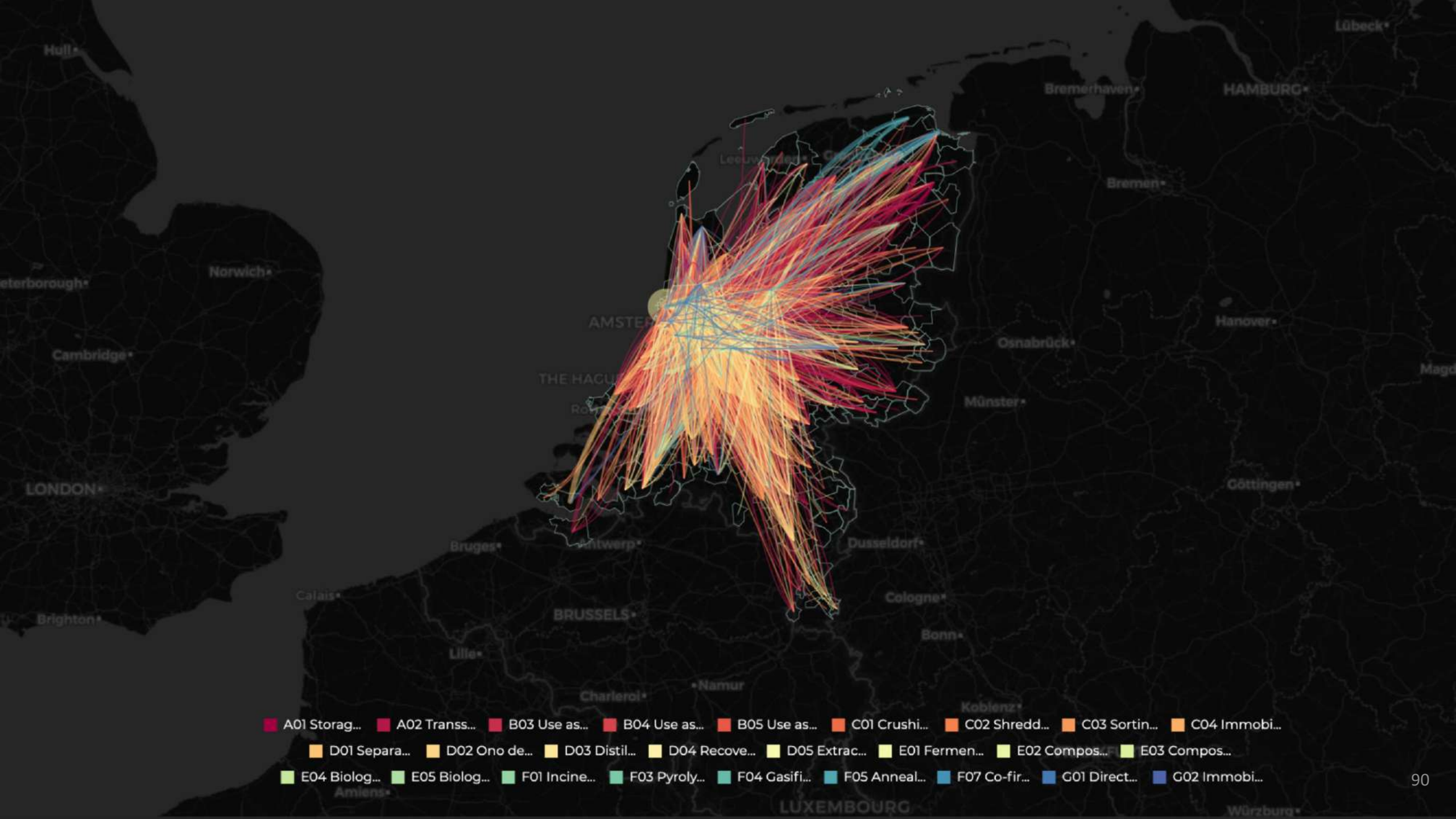
IS THERE ENOUGH WASTE FOR A CIRCULAR ECONOMY?

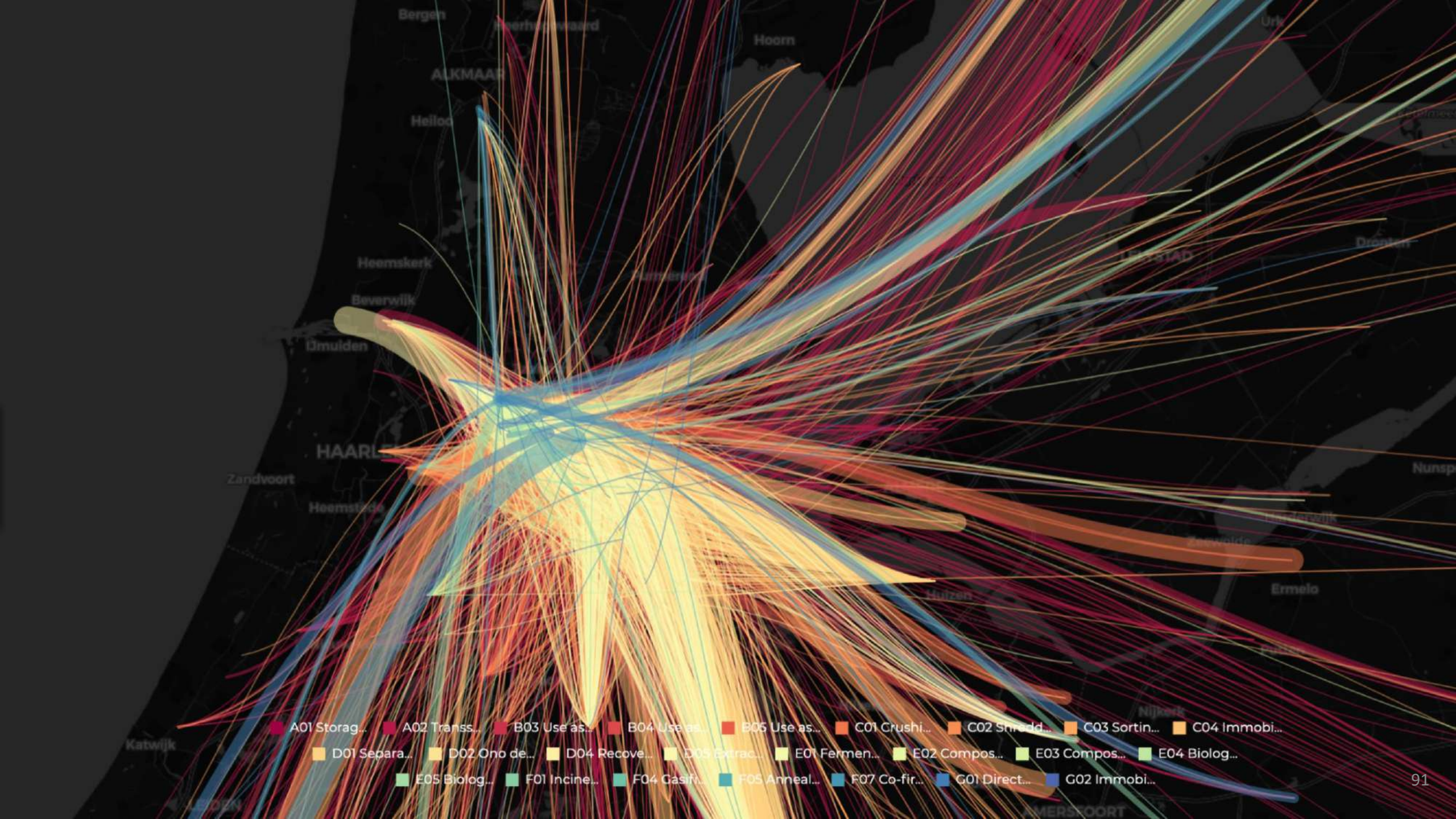
Why is European Waste Statistics not responding to the key challenge of data availability to advance the transition towards a circular economy?


Hamburg 2018
Amsterdam 2016
Ghent 2017
Lodz 2018
Katowice 2019
Maribor 2019
Pecs 2017
Trento 2019
Umag 2019
Bilbao 2019
Naples 2016

DATA COLLECTION

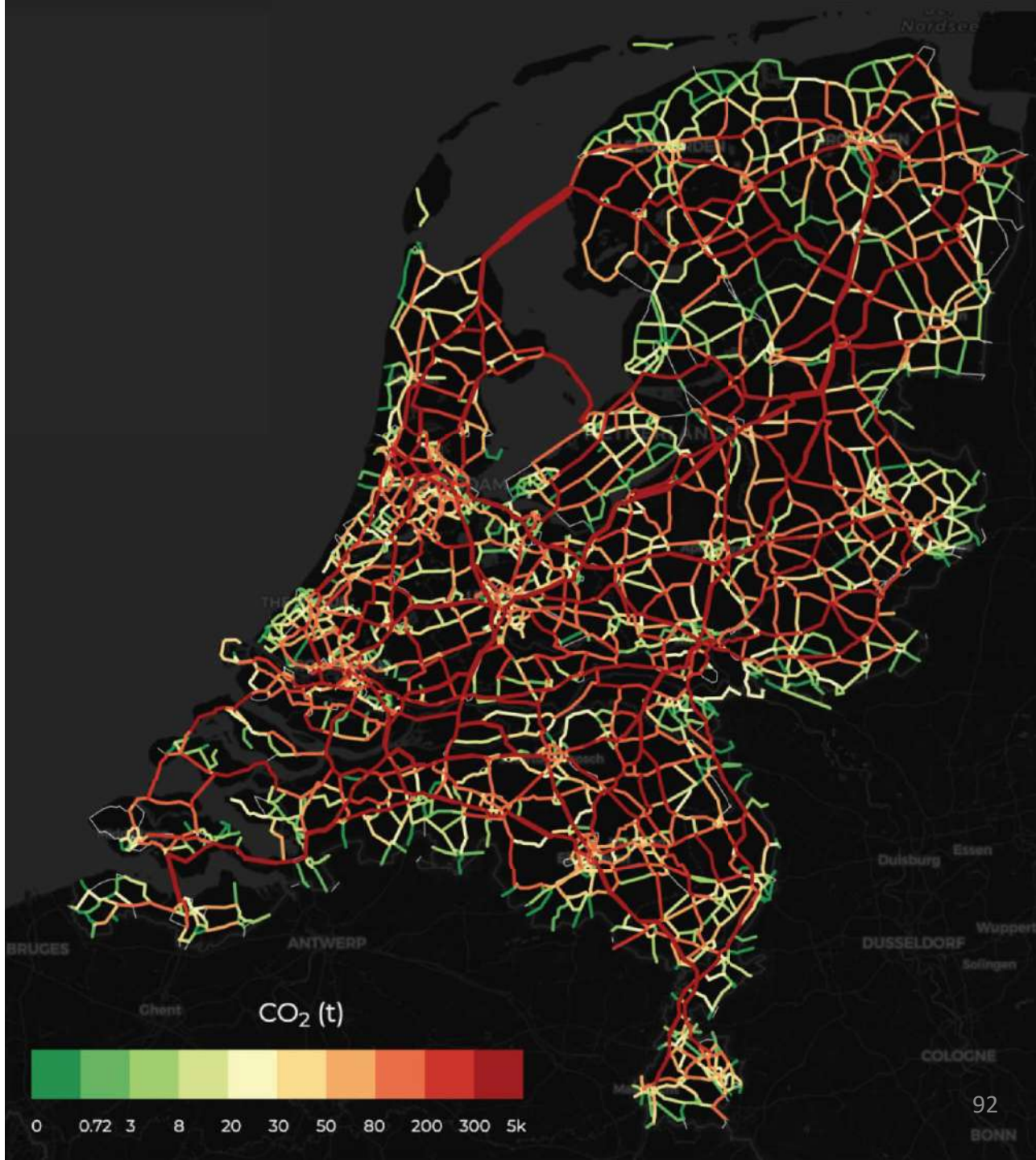



A01 Storag...
A02 Transs...
B03 Use as...
B04 Use as...
B05 Use as...
C01 Crushi...
C02 Shredd...
C03 Sortin...
C04 Immobi...
D01 Separa...
D02 Ono de...
D03 Distil...
D04 Recove...
D05 Extrac...
E01 Fermen...
E02 Compos...
E03 Compos...
E04 Biolog...
E05 Biolog...
F01 Incine...
F03 Pyroly...
F04 Gasifi...
F05 Anneal...
F07 Co-fir...
G01 Direct...
G02 Immobi...


Bergen
Hoorn
ALKMAAR
Heiloo
Heemskerk
Beverwijk
IJmuiden
HAARLEM
Zandvoort
Heemstede
Katwijk
Urk
Dronten
LELYSTAD
Nijkerk
Ermelo
Nunspeet
A01 Storag...
A02 Transs...
B03 Use as...
B04 Use as...
B05 Use as...
C01 Crushi...
C02 Shredd...
C03 Sortin...
C04 Immobi...
D01 Separa...
D02 Ono de...
D04 Recove...
E01 Fermen...
E02 Compos...
E03 Compos...
E04 Biolog...
E05 Biolog...
F01 Incine...
F07 Co-fir...
G01 Direct...
G02 Immobi...

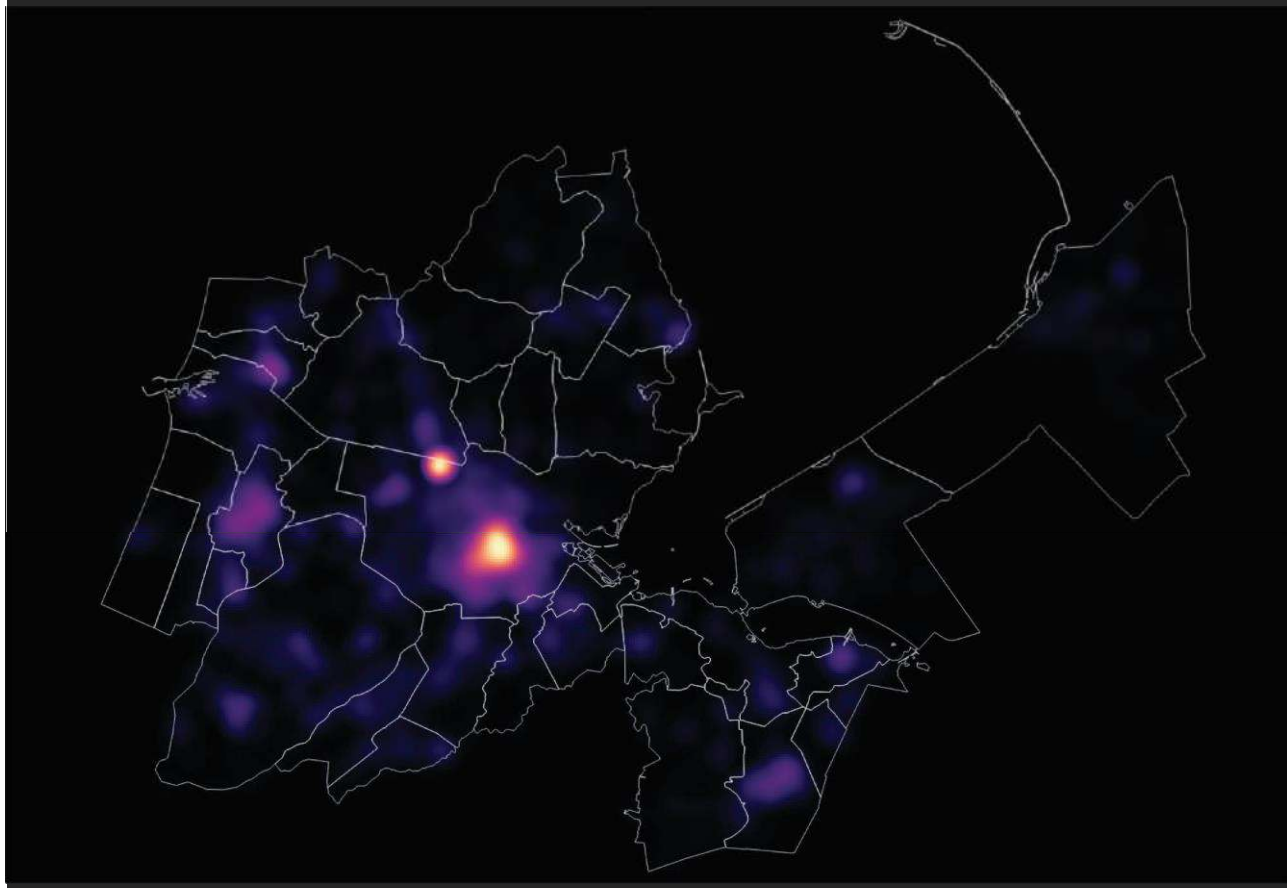
OPPORTUNITIES

- Detailed impact assessment
- Optimal location of storage and processing hubs
- Supporting industrial symbiosis



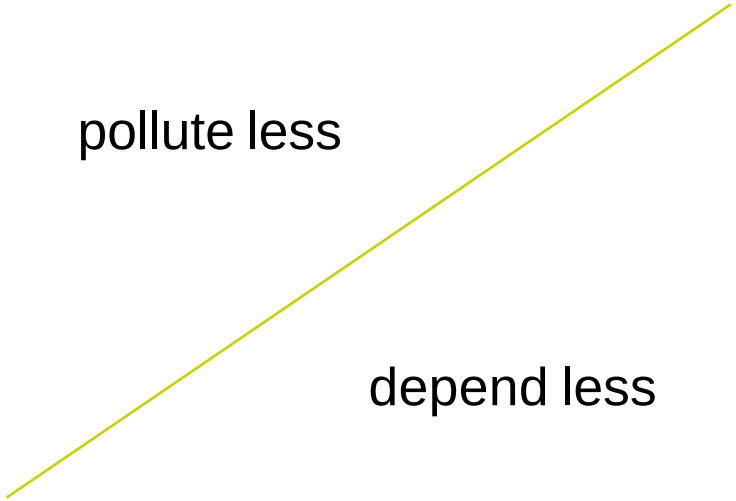
OPPORTUNITIES

- Consistent tracking over years
- Analysis of frequency & seasonality
- Identifying companies & events that cause significant amounts of waste

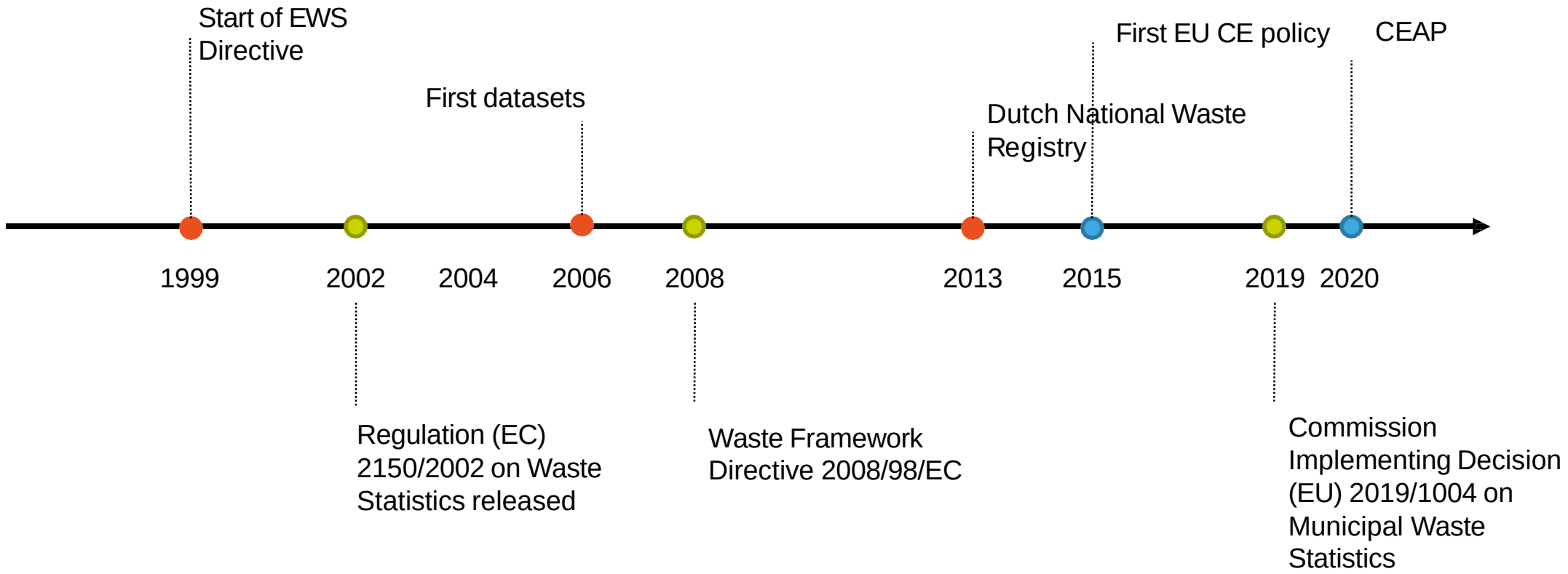


Why is European Waste Statistics not responding to the key challenge of data availability to advance the transition towards a circular economy?

REASON 1. PATH DEPENDENCY



EUROPEAN WASTE STATISTICS

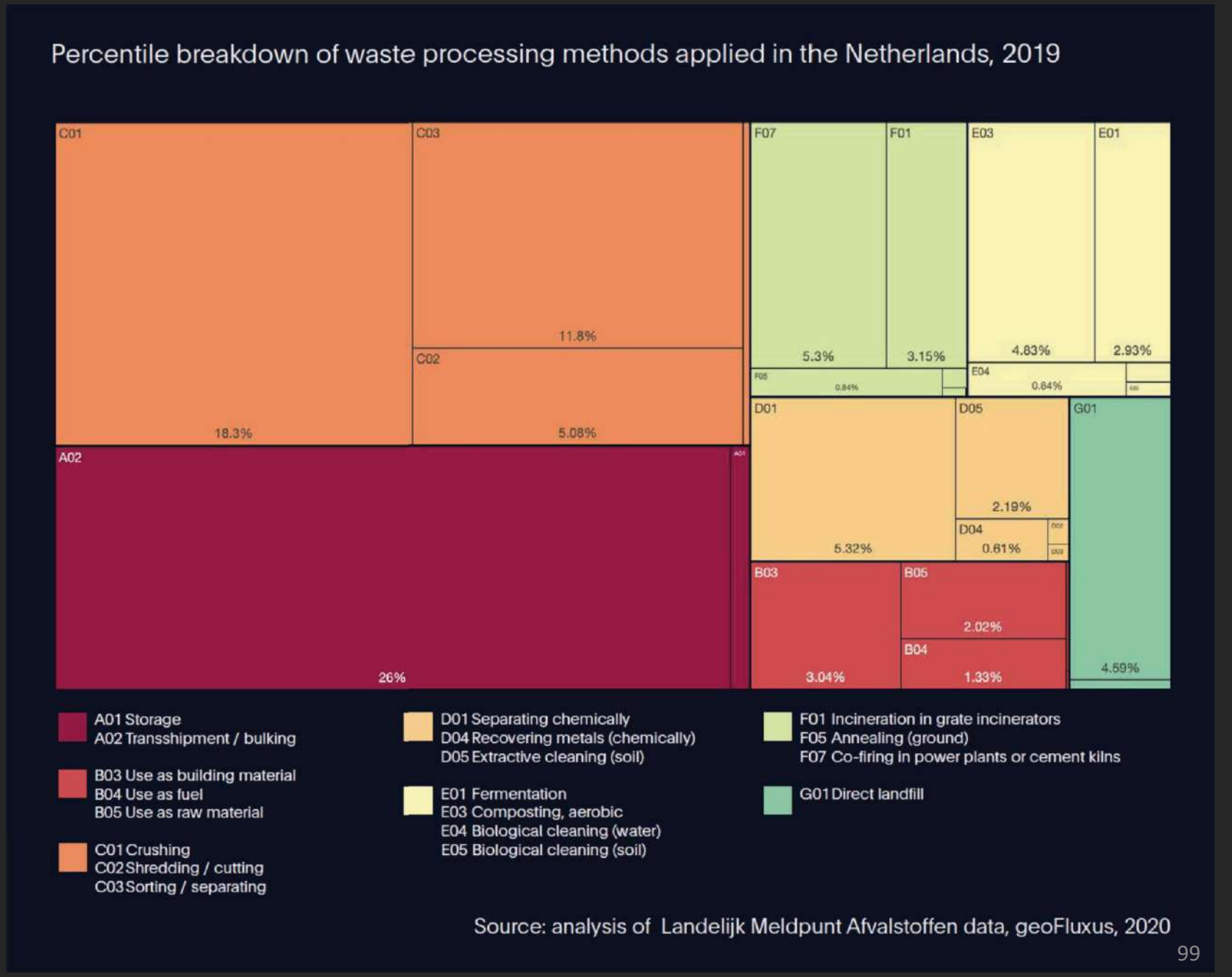


REASON 1. PATH DEPENDENCY

RECOMMENDATION 1: Provide financial and expert support to the institutions with the old regulation legacy

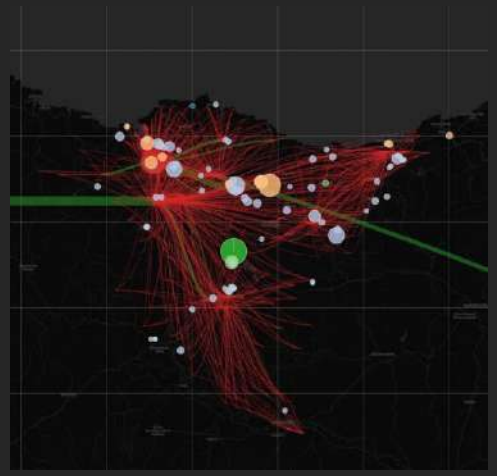
REASON 2. DATA INCOMPLETENESS AND FRAGMENTATION

WASTE TREATMENT

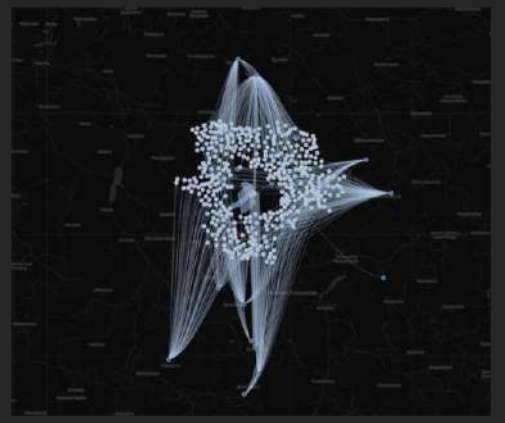


Naples, Italy

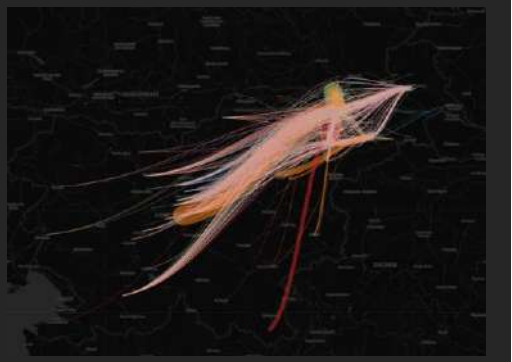
Flanders, Belgium



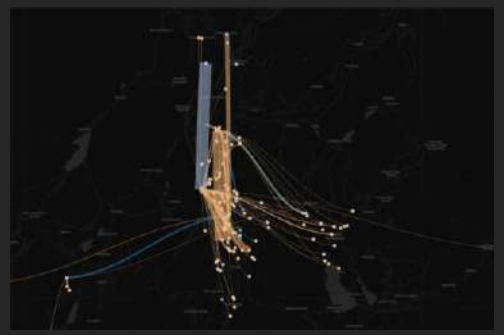
Bilbao, Spain



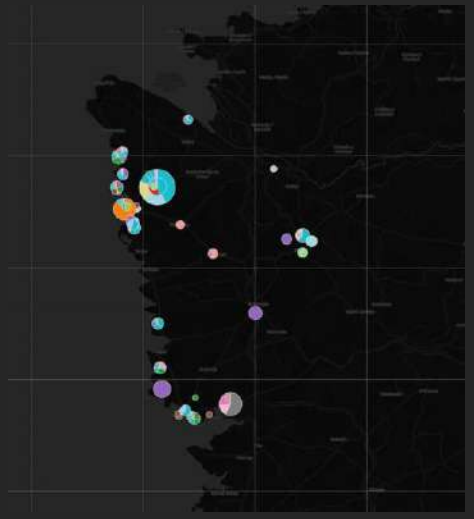
Lodz, Poland



Maribor, Slovenia

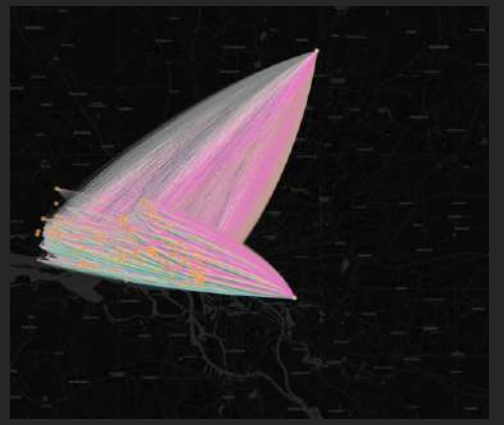


Trento, Italy

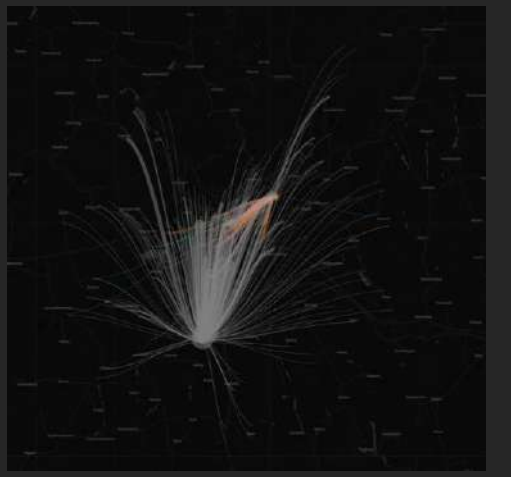


Umag, Croatia

Katowice, Poland



Hamburg, Germany

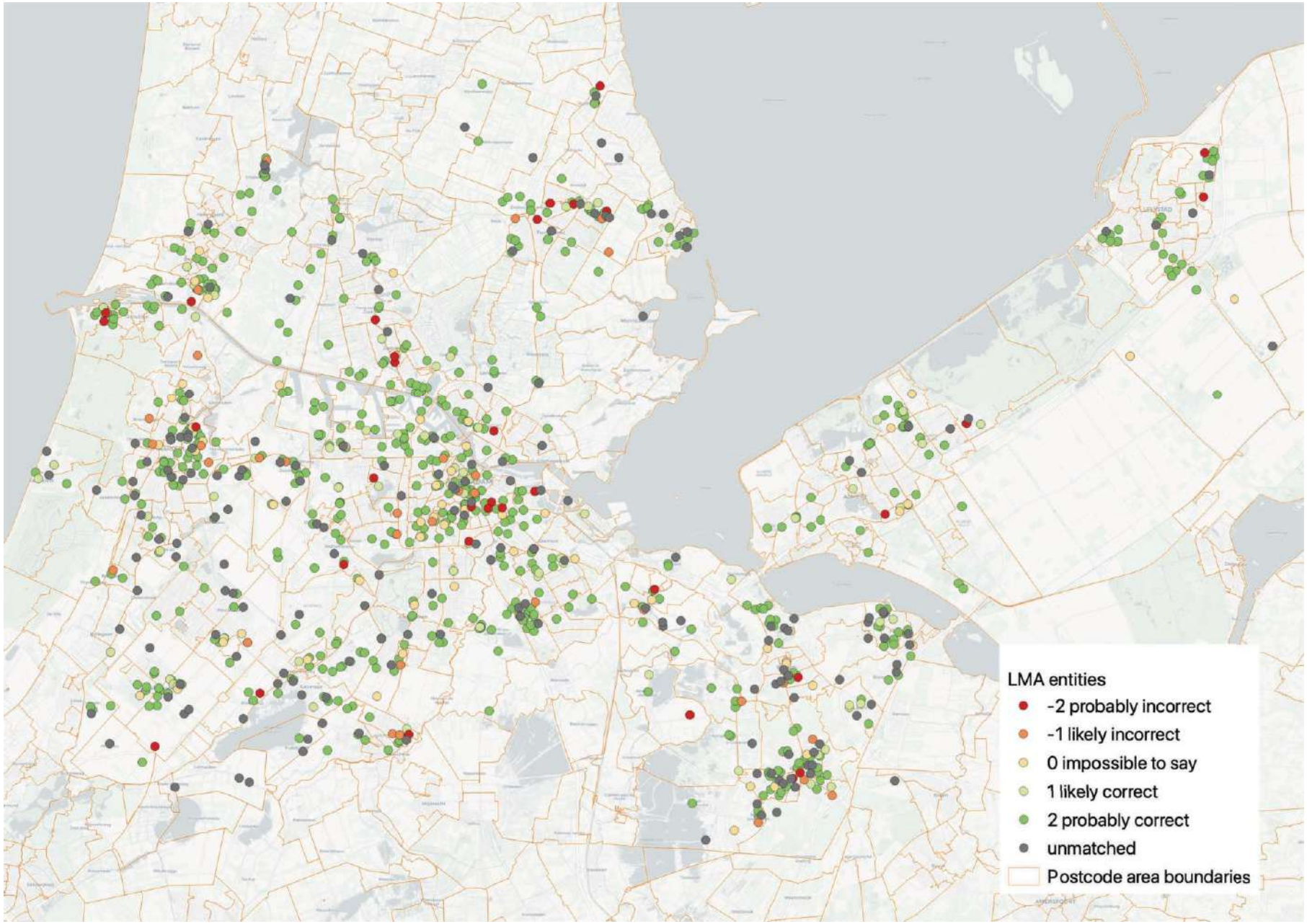


Pecs, Hungary

REASON 2. DATA INCOMPLETENESS AND FRAGMENTATION

RECOMMENDATION 2: Expanding reporting obligations beyond the environmental concerns

REASON 3. LIMITED DATA INTEROPERABILITY


LMA entities
-2 probably incorrect
-1 likely incorrect
0 impossible to say
1 likely correct
2 probably correct
unmatched
Postcode area boundaries

Nummer	Wat gebeurt er?	Codes
A	U bewaart afval. Of u slaat afval tijdelijk op. Het afval verandert hierdoor niet.	A.01 = Bewaren A.02 = Overslag / opbulken
B	U gebruikt het afval meteen. Hierdoor verandert het afval niet.	B.01 = Inzetten als veevoer B.02 = Inzetten als meststof B.03 = Inzetten als bouwstof B.04 = Inzetten als brandstof B.05 = Overig inzetten als grondstof
C	U behandelt het afval mechanisch of fysisch. • U doet dit procesmatig. • Er is geen chemische omzetting. • U moet het afval nabehandelen. • Het afval wordt niet minder zwaar.	C.01 = Breken C.02 = Shredderen / knippen C.03 = Sorteren/scheiden C.04 = Immobiliseren voor hergebruik
D	U behandelt het afval mechanisch of fysisch. • U doet dit procesmatig. • Wat u doet, valt niet onder C, E of F.	D.01 = Chemisch/fysisch scheiden D.02 = ONO is ontgiften, neutraliseren en ontwateren D.03 = Destilleren D.04 = Metaal terugwinnen (chemisch) D.05 = Extractief reinigen (grond) D.06 = Oxidatie onder hoge druk
E	U behandelt het afval microbiologisch. • U doet dit procesmatig. • Er is een chemische omzetting door micro-organismen.	E.01 = Vergisten E.02 = Composteren, anaeroob E.03 = Composteren, aeroob E.04 = Biologisch reinigen (water) E.05 = Biologisch reinigen (grond)
F	U behandelt het afval thermisch. • U doet dit procesmatig. • U verhit het afval.	F.01 = Verbranden in roosterovens F.02 = Verbranden in draaitrommelovens F.03 = Pyrolyse F.04 = Vergassen F.05 = Uitgloeien (grond) F.06 = Verbranden met terugwinnen materiaal (chloor, zwavel ..) F.07 = Verbranden met terugwinnen energie (bijstoken)
G	U stort het afval. • U doet dit niet procesmatig. • Dit is het laatste wat met het afval gebeurt.	G.01 = Direct storten G.02 = Immobiliseren

REASON 3. LIMITED DATA INTEROPERABILITY

RECOMMENDATION 3: Creating international standard for waste reporting

REASON 4. CONSERVATIVE DEFINITION OF WASTE

“Waste is any substance or object which the holder discards or intends or is required to discard”

European Union Waste Framework Directive, 2008/98/EC

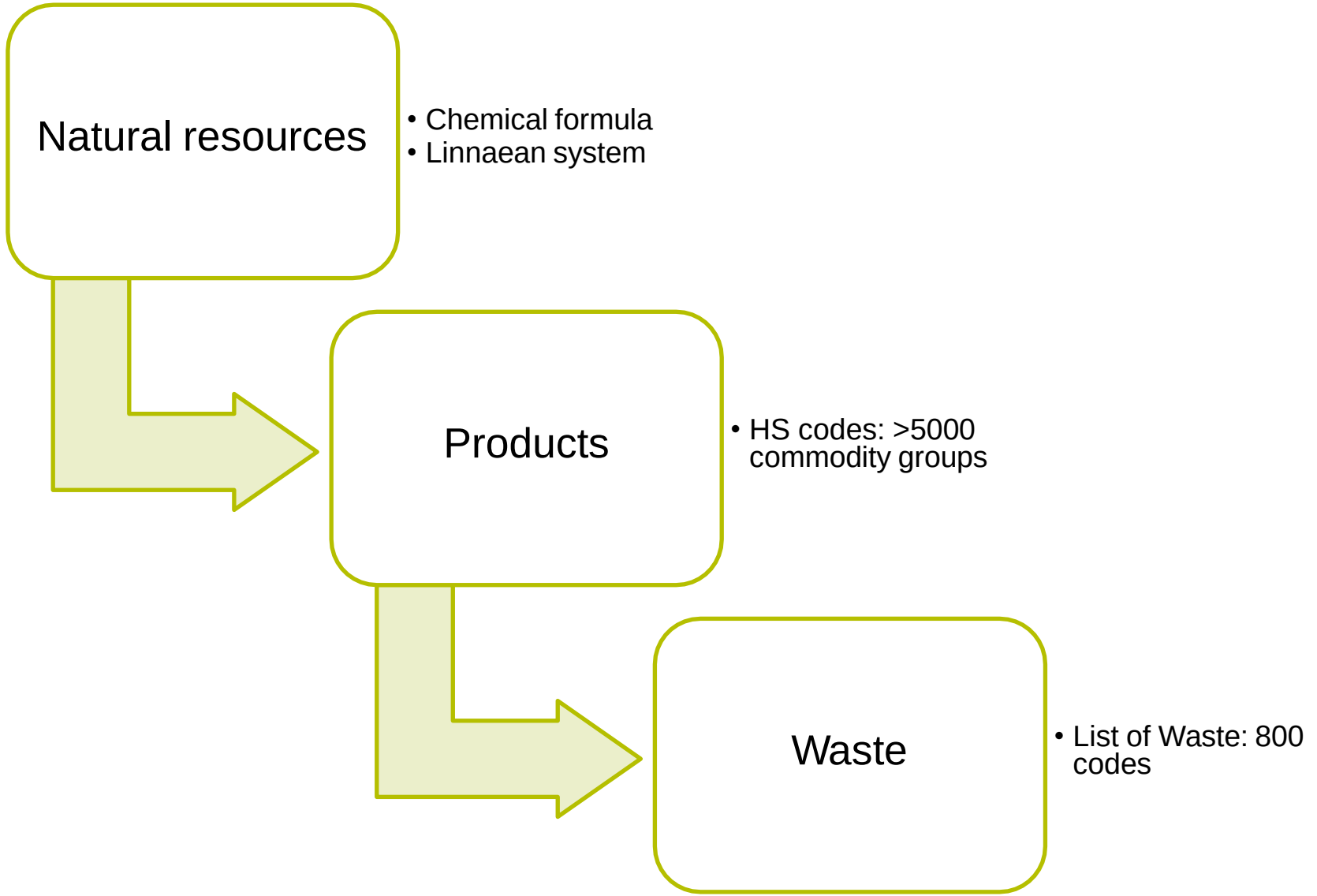
“Waste is any substance or object which the holder discards or **intends** or is required to discard”

European Union Waste Framework Directive, 2008/98/EC

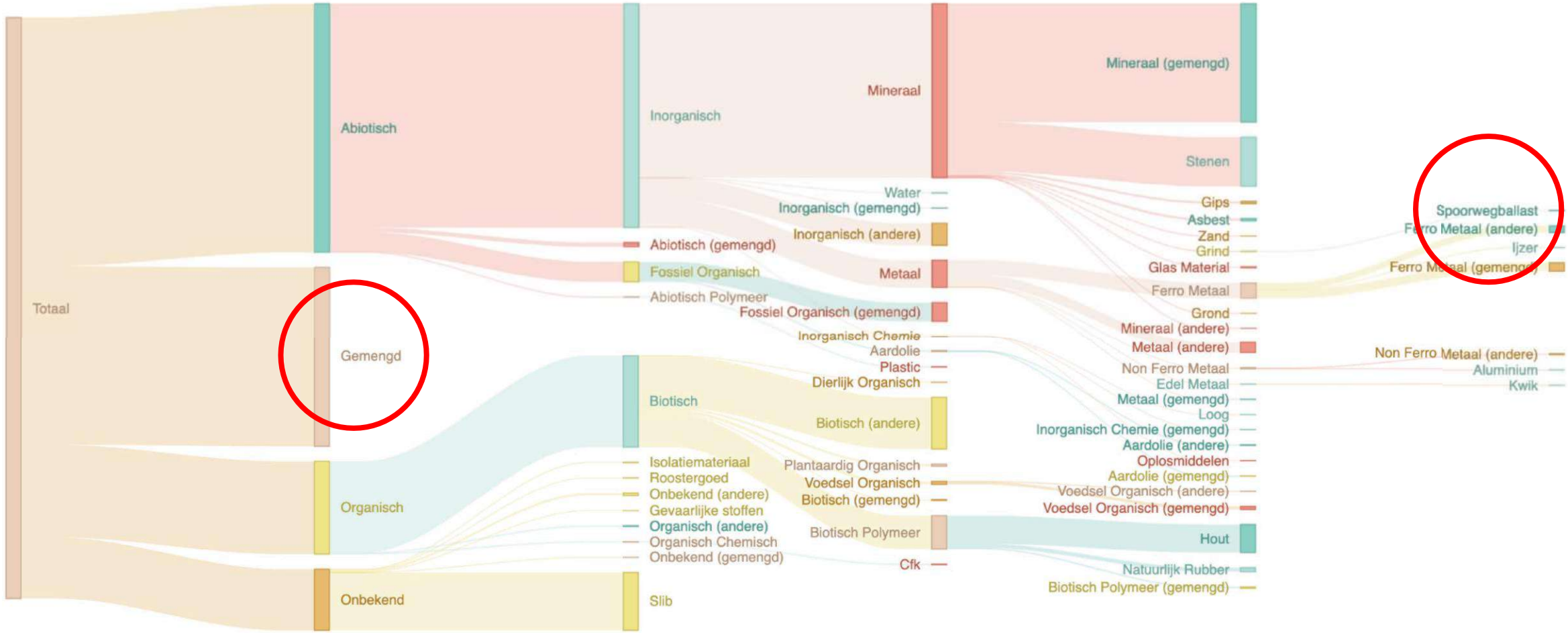
REASON 4. CONSERVATIVE DEFINITION OF WASTE

RECOMMENDATION 4: Expanding the definition of waste to include underutilized resources before they are discarded in the waste management system

REASON 5. SEMANTIC ASSYMETRY BETWEEN RAW RESOURCES, PRODUCTS AND WASTE


Natural resources
• Chemical formula
• Linnaean system
Products
• HS codes: >5000 commodity groups
Waste
• List of Waste: 800 codes

3. MATERIAL


Totaal
Abiotisch
Gemengd
Organisch
Onbekend
Inorganisch
Abiotisch (gemengd)
Fossiel Organisch
Abiotisch Polymeer
Biotisch
Isolatiemateriaal
Roostergoed
Onbekend (andere)
Gevaarlijke stoffen
Organisch (andere)
Organisch Chemisch
Onbekend (gemengd)
Slib
Mineraal
Water
Inorganisch (gemengd)
Inorganisch (andere)
Metaal
Fossiel Organisch (gemengd)
Inorganisch Chemie
Aardolie
Plastic
Dierlijk Organisch
Biotisch (andere)
Plantaardig Organisch
Voedsel Organisch
Biotisch (gemengd)
Biotisch Polymeer
Cfk
Mineraal (gemengd)
Stenen
Gips
Asbest
Zand
Grind
Glas Material
Ferro Metaal
Grond
Mineraal (andere)
Metaal (andere)
Non Ferro Metaal
Edel Metaal
Metaal (gemengd)
Loog
Inorganisch Chemie (gemengd)
Aardolie (andere)
Oplosmiddelen
Aardolie (gemengd)
Voedsel Organisch (andere)
Voedsel Organisch (gemengd)
Hout
Natuurlijk Rubber
Biotisch Polymeer (gemengd)
Spoorwegballast
Ferro Metaal (andere)
Ijzer
Ferro Metaal (gemengd)
Non Ferro Metaal (andere)
Aluminium
Kwik

REASON 5. SEMANTIC ASSYMETRY BETWEEN RAW RESOURCES, PRODUCTS AND WASTE

RECOMMENDATION 5: Aligning taxonomies used to describe raw resources, products and waste

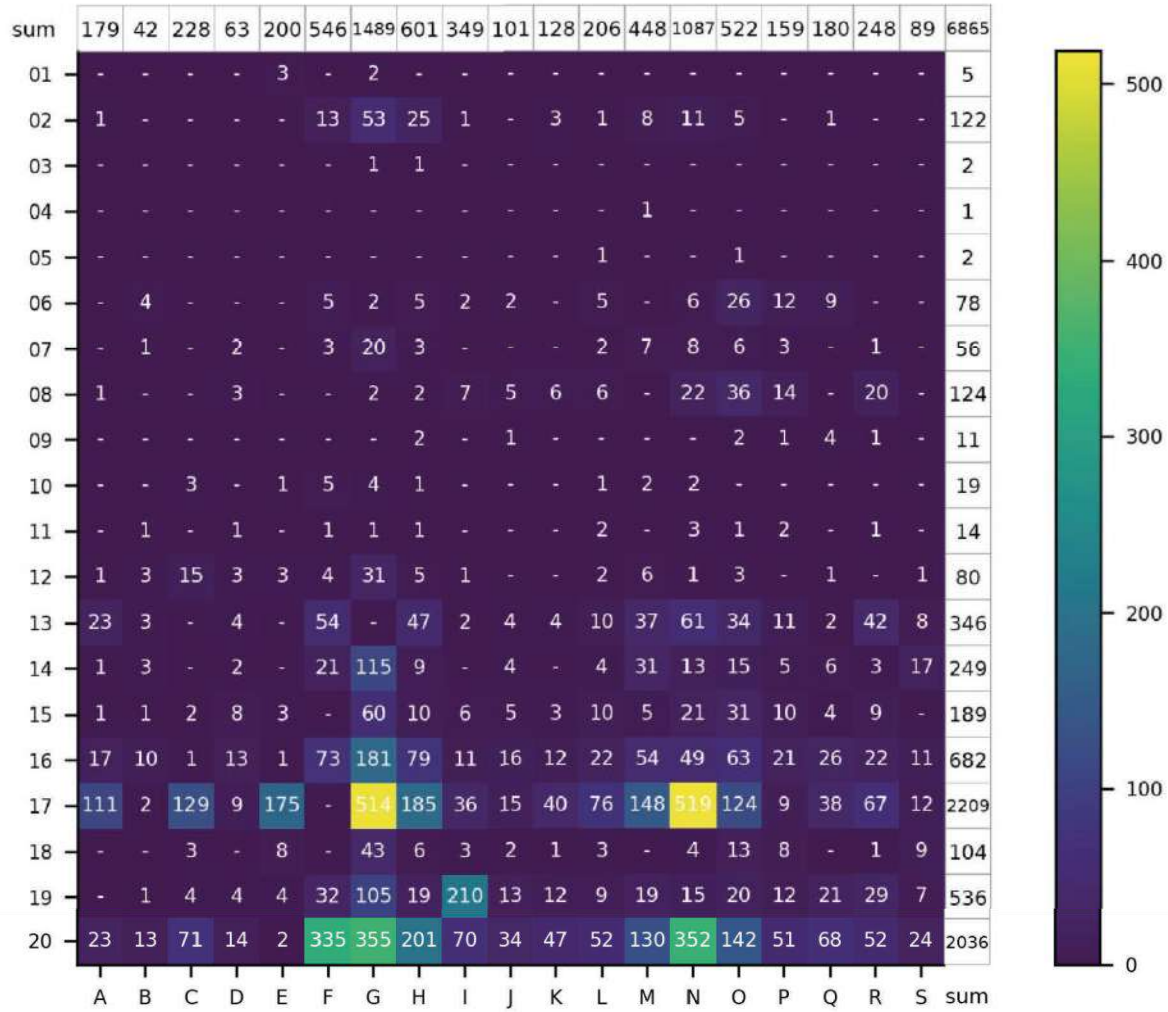
REASON 6. THE AMBIGUITY OF WASTE PRODUCER RESPONSIBILITY

70% of waste produced

by 7% of companies

Number of entities per each combination of NACE and EWC section

a) non-compliant to the guidelines



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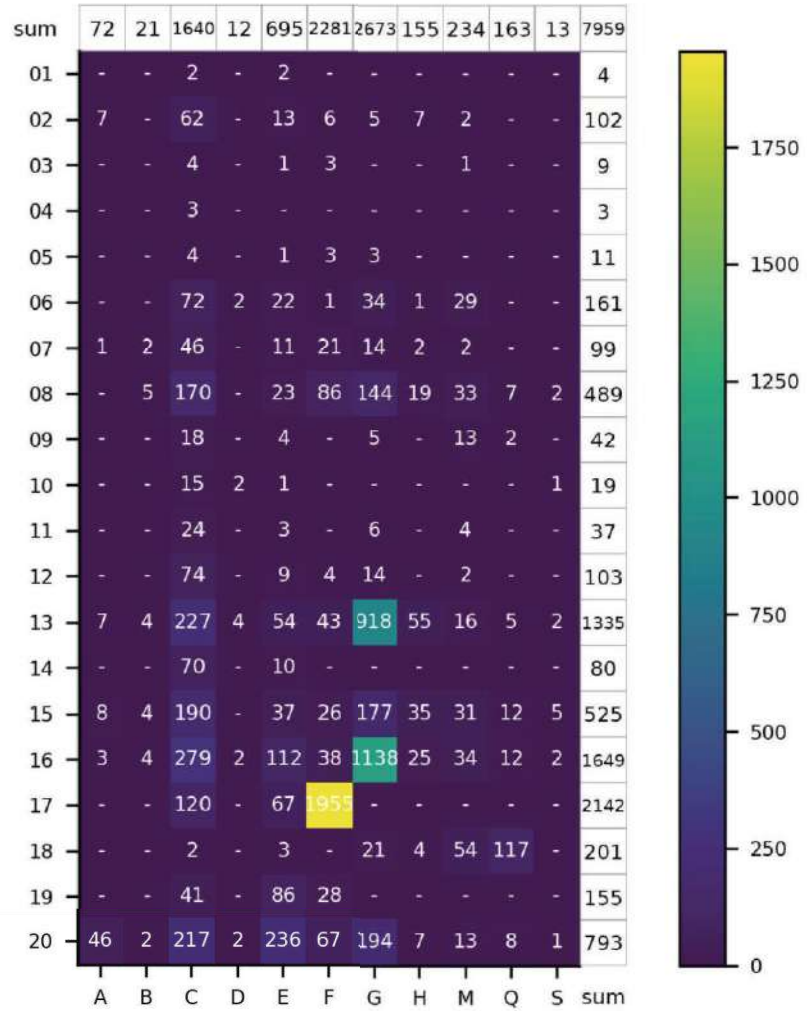
01		-	-	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	5
02		1	-	-	-	-	13	53	25	1	-	3	1	8	11	5	-	1	-	-	122
03		-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	2
04		-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
05		-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2
06		-	4	-	-	-	5	2	5	2	2	-	5	-	6	26	12	9	-	-	78
07		-	1	-	2	-	3	20	3	-	-	-	2	7	8	6	3	-	1	-	56
08		1	-	-	3	-	-	2	2	7	5	6	6	-	22	36	14	-	20	-	124
09		-	-	-	-	-	-	-	2	-	1	-	-	-	-	2	1	4	1	-	11
10		-	-	3	-	1	5	4	1	-	-	-	1	2	2	-	-	-	-	-	19
11		-	1	-	1	-	1	1	1	-	-	-	2	-	3	1	2	-	1	-	14
12		1	3	15	3	3	4	31	5	1	-	-	2	6	1	3	-	1	-	1	80
13		23	3	-	4	-	54	-	47	2	4	4	10	37	61	34	11	2	42	8	346
14		1	3	-	2	-	21	115	9	-	4	-	4	31	13	15	5	6	3	17	249
15		1	1	2	8	3	-	60	10	6	5	3	10	5	21	31	10	4	9	-	189
16		17	10	1	13	1	73	181	79	11	16	12	22	54	49	63	21	26	22	11	682
17		111	2	129	9	175	-	514	185	36	15	40	76	148	519	124	9	38	67	12	2209
18		-	-	3	-	8	-	43	6	3	2	1	3	-	4	13	8	-	1	9	104
19		-	1	4	4	4	32	105	19	210	13	12	9	19	15	20	12	21	29	7	536
20		23	13	71	14	2	335	355	201	70	34	47	52	130	352	142	51	68	52	24	2036
	sum	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	sum

b) compliant to the guidelines



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01		-	-	2	-	2	-	-	-	-	-	-	4
02		7	-	62	-	13	6	5	7	2	-	-	102
03		-	-	4	-	1	3	-	-	1	-	-	9
04		-	-	3	-	-	-	-	-	-	-	-	3
05		-	-	4	-	1	3	3	-	-	-	-	11
06		-	-	72	2	22	1	34	1	29	-	-	161
07		1	2	46	-	11	21	14	2	2	-	-	99
08		-	5	170	-	23	86	144	19	33	7	2	489
09		-	-	18	-	4	-	5	-	13	2	-	42
10		-	-	15	2	1	-	-	-	-	-	1	19
11		-	-	24	-	3	-	6	-	4	-	-	37
12		-	-	74	-	9	4	14	-	2	-	-	103
13		7	4	227	4	54	43	918	55	16	5	2	1335
14		-	-	70	-	10	-	-	-	-	-	-	80
15		8	4	190	-	37	26	177	35	31	12	5	525
16		3	4	279	2	112	38	1138	25	34	12	2	1649
17		-	-	120	-	67	1955	-	-	-	-	-	2142
18		-	-	2	-	3	-	21	4	54	117	-	201
19		-	-	41	-	86	28	-	-	-	-	-	155
20		46	2	217	2	236	67	194	7	13	8	1	793
	sum	A	B	C	D	E	F	G	H	M	Q	S	sum

REASON 6. THE AMBIGUITY OF WASTE PRODUCER RESPONSIBILITY

RECOMMENDATION 6: Creating taxonomies of different roles in waste discarding process and reasons of disposal

REASON 7. INSUFFICIENTLY DEFINED GOALS OF THE CIRCULAR ECONOMY MONITORING

REASON 7. INSUFFICIENTLY DEFINED GOALS OF THE CIRCULAR ECONOMY MONITORING

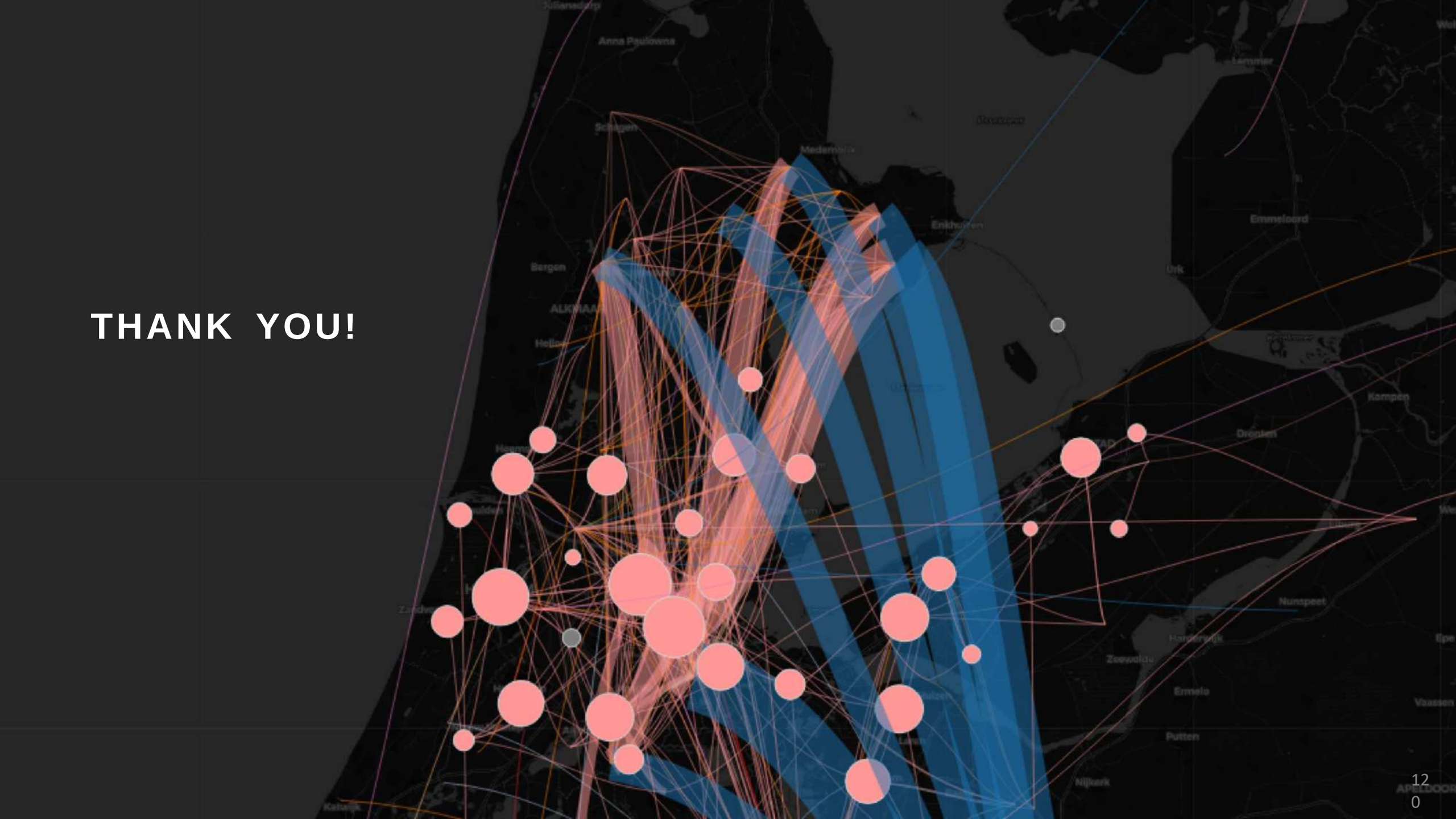
RECOMMENDATION 7: Advancing the new CEAP-oriented amendment to the European Waste Statistics Regulation

NEXT SESSION:

OPEN LETTER TO THE EUROPEAN COMMISSION

WITH THE RECOMMENDATIONS FOR THE NEW REGULATION

THANK YOU!


Anna Paulowna
Schagen
Medemblik
Enkhuizen
Bergen
ALKMAAR
Heiloo
Emmeloord
Urk
Kampen
Dronten
Nunspeet
Harderwijk
Zeewolde
Ermelo
Putten
Nijkerk
Vaassen

LIST OF PUBLICATIONS

1) Silertye, R., Sabbe, A., Bouzas, V., Meister, K., Wandl, A., & van Timmeren, A. (2022). **European Waste Statistics data for a Circular Economy Monitor: Opportunities and limitations from the Amsterdam Metropolitan Region**. Journal of Cleaner Production 358:131767, https://doi.org/10.1016/j.jclepro.2022.131767

2) Silertye, R., Wandl, A., & van Timmeren, A. (2021). **The Responsibility of Waste Production: comparison of European Waste Statistics Regulation and Dutch National Waste Registry.** OSF Preprints. Accepted for publication in the Journal of Waste Management, https://doi.org/10.31219/osf.io/p974m

3) Silertye, R., Wandl, A., & van Timmeren, A. (2021). **A Bottom-up Ontology-based Approach to Monitor Circular Economy: Aligning User Expectations, Tools, Data and Theory.** OSF Preprints. Accepted for publication in the Journal of Industrial Ecology, https://doi.org/10.31219/osf.io/sgcdv

4) Silertye, R., Gil, J., Wandl, A., & van Timmeren, A. (2018). **Introducing Spatial Variability into Impact Significance Assessment.** Geospatial Technologies for All. Springer International Publishing, pp 189-209, https://doi.org/10.1007/978-3-319-78208-9_10

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE
A collaboration of Rijkswaterstaat and Delft University of Technology

Lunch

12:30 - 13:30 | 25th May 2022

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE
A collaboration of Rijkswaterstaat and Delft University of Technology

Recommendations Preparation Session

13:30 - 15:30 | 25th May 2022

13:30 - 15:30

OPEN LETTER TO THE EUROPEAN COMMISSION

with the recommendations for the new regulation

3 sessions of 20min:

- Definition of waste

- Scope of reporting obligations

- International data infrastructure

- Open source standards & taxonomies

- ?

TU Delft

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE
A collaboration of Rijkswaterstaat and Delft University of Technology

Conference Close

15:30 - 15:45 | 25th May 2022

DATA FOR CIRCULARITY
INTERNATIONAL CONFERENCE

Drinks & Snacks

15:45 – 17:00 | 25th May 2022