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Joint Research Centre

European Commission

JRC B5: Circular Economy and Industrial Leadership

Part of the **'Growth and Innovation'** Directorate. Based in Seville.

Projects/areas of work in support of circular economy policies:

- Environmental and waste management, recycling, secondary raw-materials
- Product policy support (EU Ecolabel, Green Public Procurement, Eco-design, Energy Label)
- European Integrated Pollution Prevention and Control Bureau (EIPPCB)
- Economics of sustainable production and consumption

EUROPEAN COMMISSION

Brussels, XXX
[…](2012) XXX draft

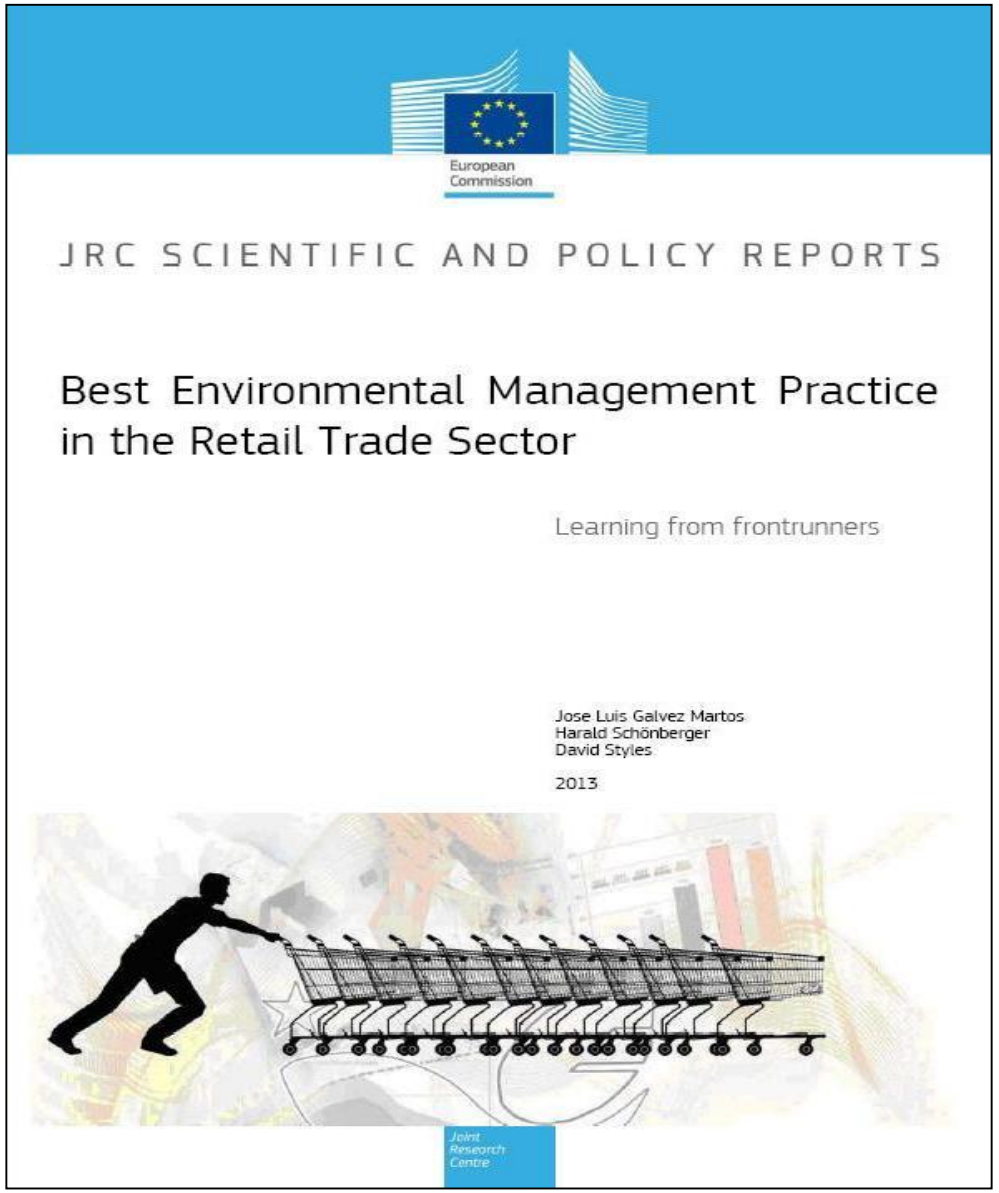
COMMISSION DECISION

of XXX

on Reference Document on Best Environmental Management Practice, Sector Environmental Performance Indicators and Benchmarks of Excellence for the Retail Trade Sector under the Eco-Management and Audit Scheme EMAS Regulation (EC) No 1221/2009

(Text with EEA relevance)

EN



RE PAiR

H2020
Circular Economy in peri-urban EU areas - LCA

European Commission

Sustainability Assessment of Organic P-fertilizer

Davide Tonini, Dries Huygens, Hans Saveyn

Joint Research Centre, European Commission

European Commission

BACKGROUND

I. Revision of fertiliser directive to make status of waste-derived fertiliser equal to that of mineral

II. JRC working on **criteria** for organic fertilizers to be in the market

III. Market analysis + **LCA + LCC**

IV. This LCA work is part of a larger (3 years project)

V. AIM of EC (DG Grow): establishing **conditions** for organic P-fertilizers market to grow in next decades → part of circular economy actions

SCOPE

Functional Unit:

1 kg of bioavailable P in marketable P-fertiliser applied on land

Feedstock: manure, sewage sludge

Reference of comparison: Single Super Phosphate

Geographic scope: EU, focus on high and low density

Technology: state of the art and pilot (TRL > 7-8)

Approach: Consequential LCA

Impact categories: ILCD 2011, all. Only selected have been retained

Tool: Easetech v2.9

CONCLUSION

I. Budget cost (conventional) **HIGHER** for most P-recovery scenarios

II. Societal Cost of circular economy pathways **LOWER** than linear

III. Environmental impacts **LOWER** for most scenarios in most categories

IV. Circular economy solutions promising, **socio-economically**! (HDA)

V. Low Density Areas: Conventional/societal/environmental costs HIGHER (soil not P-saturated, no need to remove N, etc.)

Thank You!

Any questions?

You may also contact me at Davide.Tonini@ec.europa.eu

Submitted to *Nature Sustainability*

The views expressed in this presentation are the sole responsibility of the authors and in no way represent the view of the European Commission and its service

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REPAiR H2020: Sustainability Framework

Davide Tonini*, David Sanjuan-Delmas, Sue-Ellen Taelman**, Jo Dewulf****

**Joint Research Centre, European Commission*
***UGENT*

REPAiR H2020

- To integrate MFA and LCA models in a geodesign decision support environment (GDSE)
- To demonstrate the feasibility of the GDSE for enhancing waste and resource management
- Focus: Food waste, C&D
- Living labs (peri-urban areas): Amsterdam, Naples, Lodz, Pecs, Hamburg, Gent
- JRC, Ugent, TUD, Amsterdam, Unina, etc.

Sustainability Framework

Innovations of the new framework (compared to literature)

CLEAR METHODOLOGY FOR THE SELECTION OF THE IMPACTS

INVOLVEMENT OF STAKEHOLDERS

HOLISTIC/COMPREHENSIVE ESPECIFICALLY FOR WM SECTOR

MULTIDISCIPLINARY IMPACTS

Economic
e.g., capital expenditure

Social
e.g., private space consumption

Environmental
e.g., global warming

MULTISIZE IMPACTS

Micro
e.g., odour disamenities

Meso
e.g., ecotoxicity

Macro
e.g., ozone depletion

MULTI-SCALE IMPACTS

Local
e.g., Ghent

Regional
e.g., Flanders (Belgium)

Global

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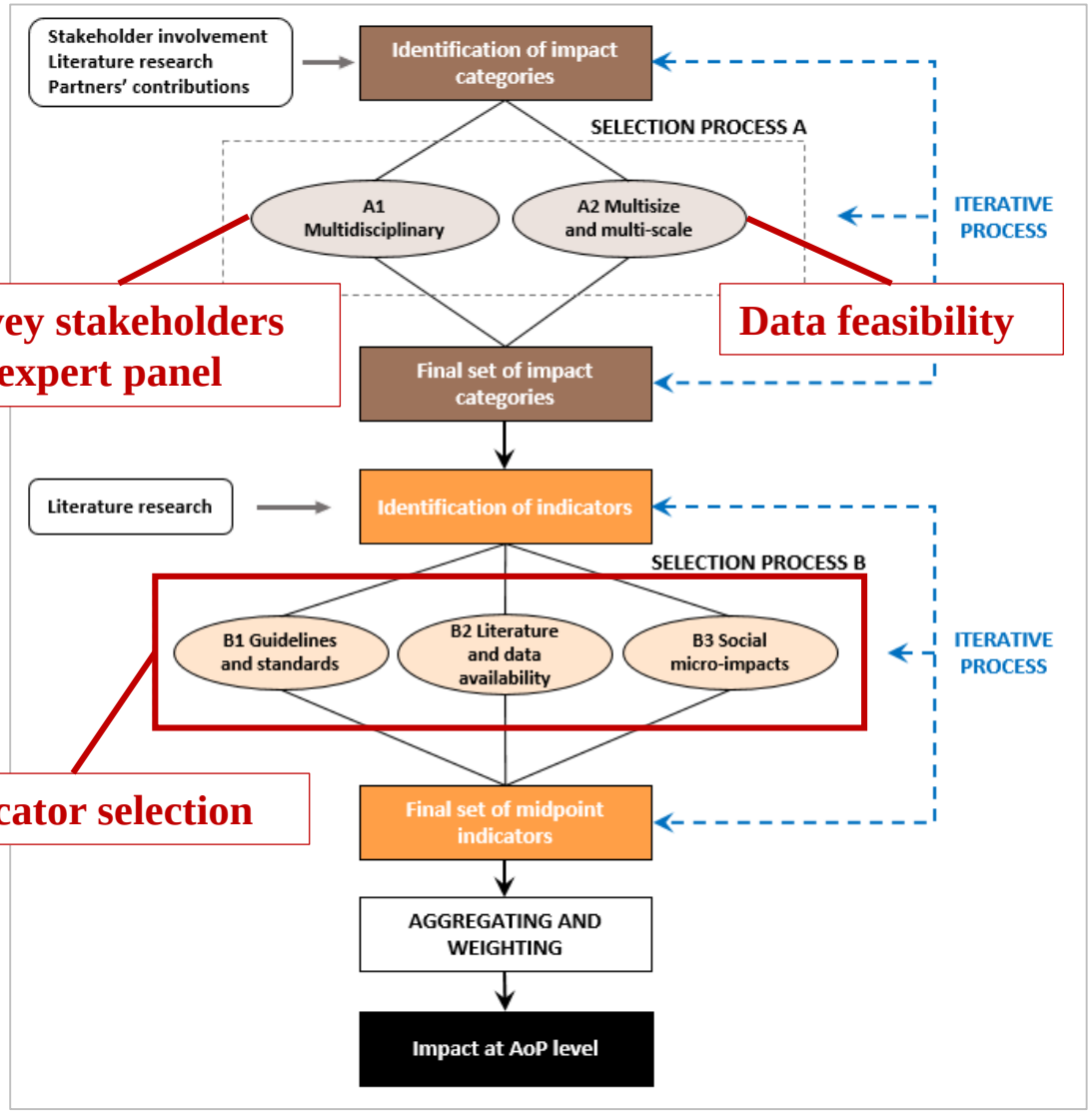
Sustainability framework
Methodology for the development of the framework



Methodology for the development of the framework

- **First, definition of the impact categories**
  - Stakeholders involvement
  - Expert panel
  - Considering data limitations
- **Second, definition of appropriate indicators for the assessment of each impact category**
  - Partners of the project
  - Particularly demanding for social micro-impacts (e.g., odour, accessibility)

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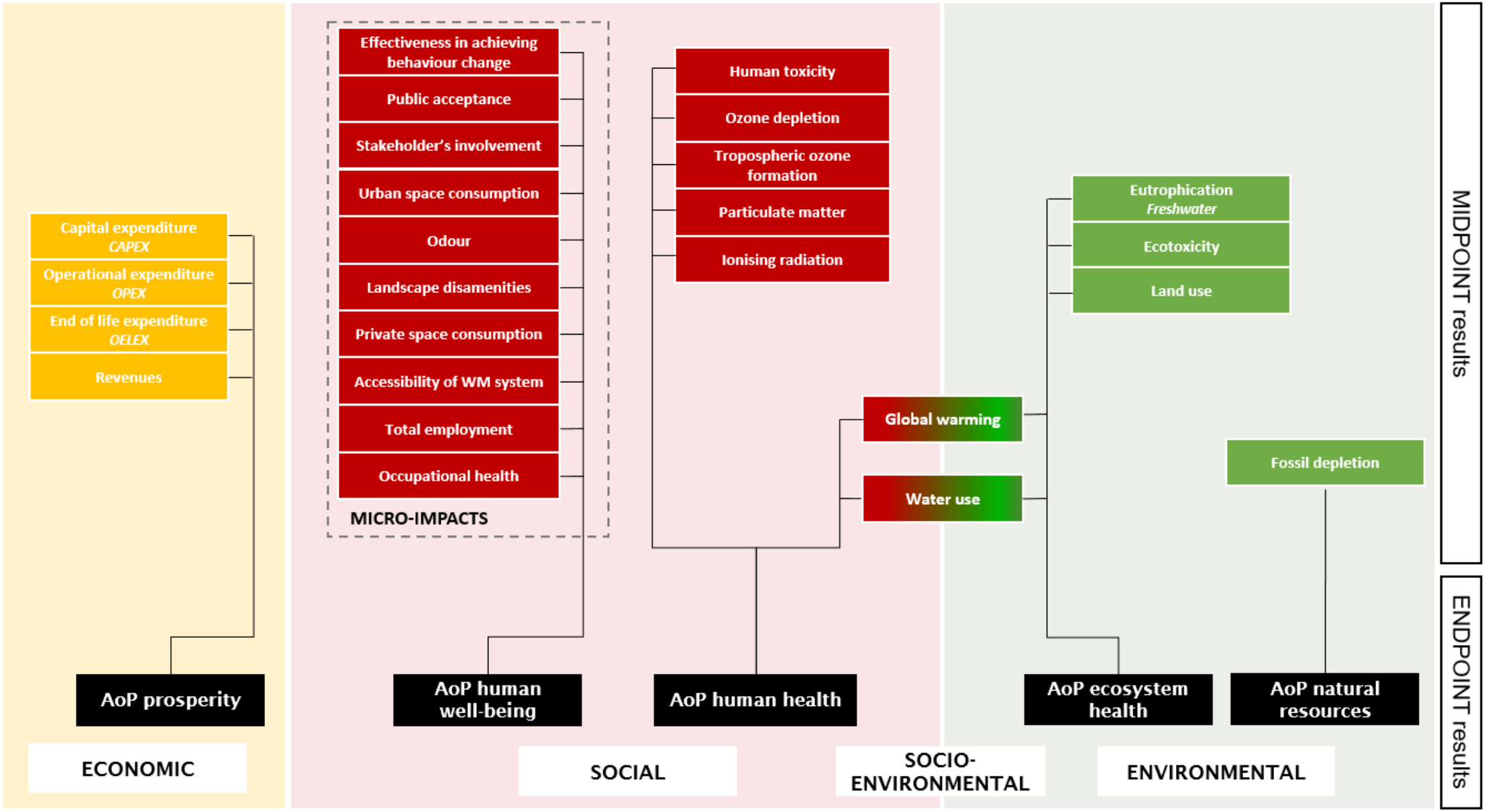
Sustainability framework
Final set of impact categories selected



Sustainability framework

Social and environmental categories (2)

Impact categories	Indicator	Reference	AoP
Eutrophication	Freshwater eutrophication	Helmes et al. 2012	Ecosystem health
Ecotoxicity	Freshwater, Marine, Terrestrial ecotoxicity	Van Zelm et al. 2009	Ecosystem health
Land use	Occupation and time-integrated transformation	De Baan et al. 2013; Curran et al. 2014	Ecosystem health
Fossil depletion	Fossil resource scarcity	Jungbluth and Frischknecht 2010	Natural resources
Global warming	Climate change	Baseline model of 100 years of the IPCC (based on IPCC, 2013)	Ecosystem health + Human health
Water use/depletion	Water consumption	Available WAter Remaining (AWARE) in UNEP, 2016*	Ecosystem health
Human toxicity	Human carcinogenic and non-carcinogenic toxicity	Van Zelm et al. 2009	Human health
Ozone depletion	Stratospheric ozone depletion	WMO 2011	Human health
Tropospheric ozone formation	Ozone formation, human health	Van Zelm et al. 2016	Human health
Particulate matter	Fine particulate matter formation	Van Zelm et al. 2016	Human health
Ionising radiation	Ionising radiation increase	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)	Human health

(*) Recent report of AWARE : Boulay et al. 2018

- Indicators were selected focusing on the latest recommendations and methods available
  - **Product Environmental Footprint** (1)
  - **ReCiPe** (2)

(1) Product Environmental Footprint (PEF). European Commission (2018). Product Environmental Footprint Category Rules Guidance. Version 6.3 - May 2018. http://ec.europa.eu/environment/eussd/smgp/pd lance_v6.3.pdf

(2) Huijbregts et al. (2017). ReCiPe 2016: a harmor impact assessment method at midpoint and endpoint level. The International Journal of Life ment, 22(2), 138–147.

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REPAiR H2020: Aggregation

Davide Tonini*, David Sanjuan-Delmas, Sue-Ellen Taelman**, Jo Dewulf****

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Contents

- What is aggregation?
- Approaches investigated
- Approach applied to Repair
- Perspectives

What is aggregation?

What:

- Process of integrating sustainability indicators into a single composite index (or a ranking).

Aim:

- Synthesis of the multi-dimensional impact & communication

Implies:

- Normalisation, for indicators to be on a common scale
- Weighting, to reflect relative importance of indicators and pillars (social, economic and environmental)

Approaches investigated

- **We analyse state-of-the-art for <u>aggregation</u>:**

  Normalisation/weighting sets available for <u>some</u> environmental indicators (PEF; Sala et al., 2018)

  Normalisation sets available for <u>some</u> social-economic indicators (PROSUITE)

  ↓

  <u>Lack</u> specific normalisation and weighting sets to be applied to REPAiR

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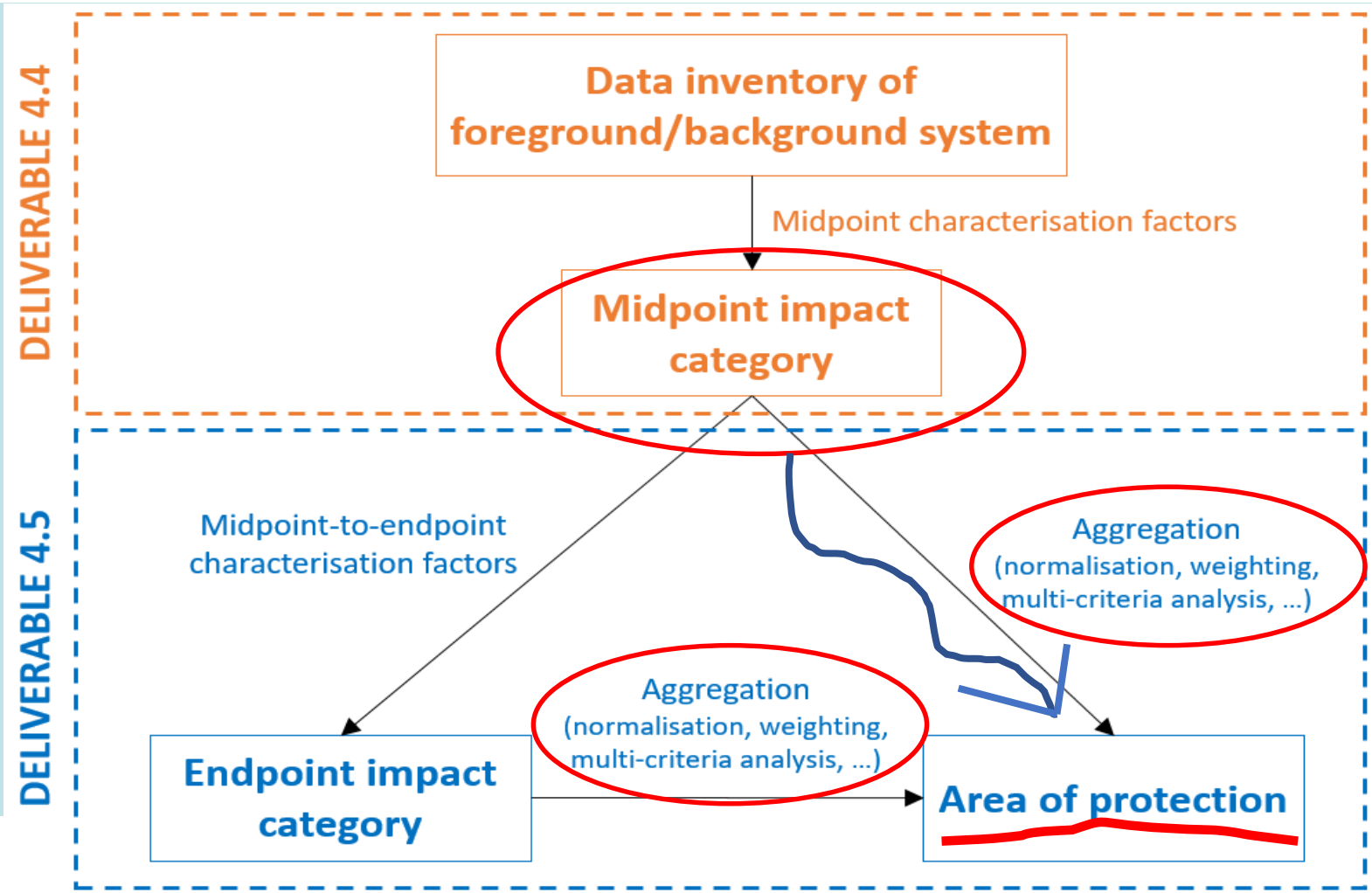
  <u>Ad hoc</u> approach for REPAiR

Approaches investigated

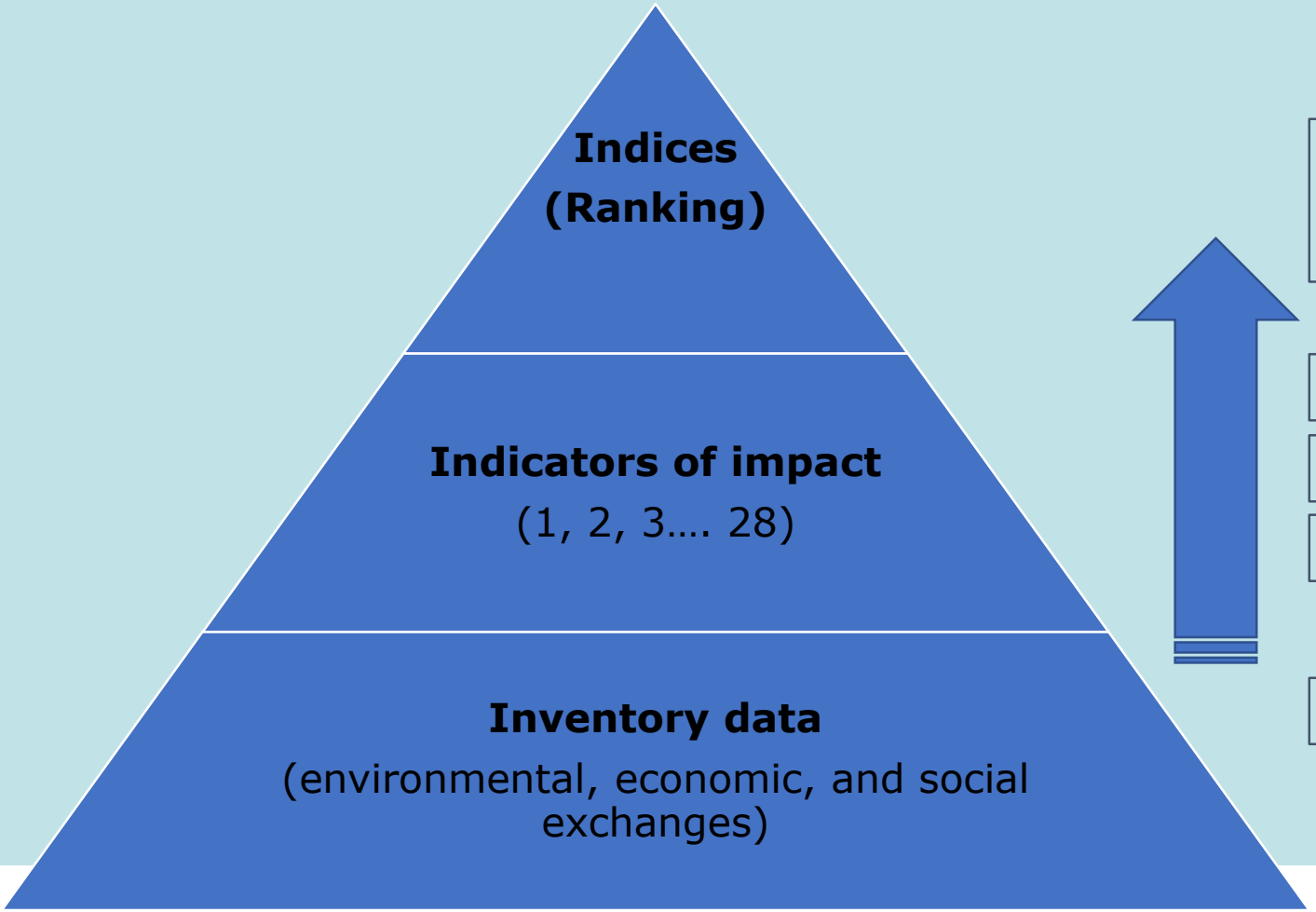
Complementary work - D4.4 / D4.5



We choose to aggregate from midpoint as all our indicators are at midpoint level

Approach applied to Repair

Key steps in aggregation of sustainability information



Aggregation (compensatory versus non-compensatory method)

Normalisation

Characterisation

Selection of indicators

Inventory data collection

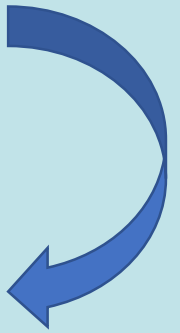
Approach applied to REPAiR

1) **Normalisation** (we apply 'min-max' or 'rescaling')

2) **Weighting** (based on earlier survey; see Deliverable D4.2)

3) **Multi-Criteria Decision Analysis** (MCDA; we apply method 'Electre II')

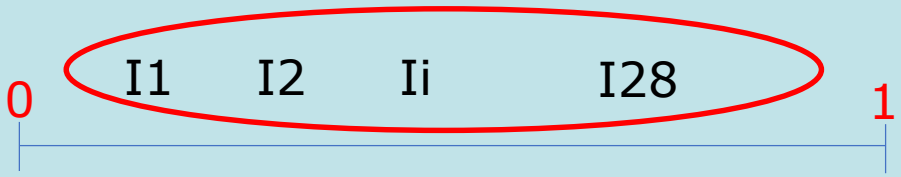
i) developed to solve problems of ranking alternatives from best to worst
ii) freeware and maths transparently documented
iii) complexity (compared to ELECTRE III or similar) deemed sufficient for our objectives



Normalisation (1)

- $For\ j = 1, \dots, m$
- $r_{ij,norm} = \frac{r_{ij} - min_i(r_{ij})}{max_i(r_{ij}) - min_i(r_{ij})} \quad \forall i, i = 1, \dots, n$

In a given AoP all indicators results will be rescaled between [0 1] → All normalised indicators will have a <u>strictly positive</u> value !



Weighting (2)

- 'Derived' with **Public Opinion** approach (we re-used the results of the Survey in D4.2)
- Public Opinion generally expresses 'concerns' rather than importance of indicators
- Alternative weighting approaches exist, e.g. **Analytic Hierarchy Process** based on pairwise comparison
- Do we **need** another survey ??

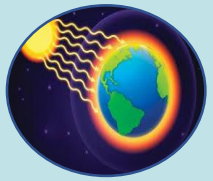
Impact category	Average score (1-4) of representative sample	ω_j per AoP
AoP ecosystem health		
Global warming	3,22	0,22
Eutrophication	2,67	0,18
Ecotoxicity	2,67	0,18
Land use	3,06	0,21
Water use	3,21	0,22
Σ	14,83	1
AoP human health		
Global warming	3,22	0,15
Water use	3,21	0,15
Human toxicity	3,08	0,15
Ozone depletion	2,94	0,14
Trop. Ozone formation	2,94	0,14
Particulate matter	2,72	0,13
Ionising radiation	2,94	0,14
Σ	21,05	1
AoP prosperity		
CAPEX	2,75	0,24
OPEX	2,775	0,25
OELEX	2,92	0,26
revenues	2,79	0,25
Σ	11,235	1

Multi-Criteria Decision Analysis (3)

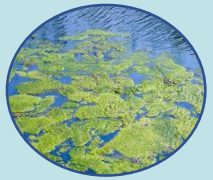
Pairwise comparison of alternatives (*A1, A2..Am*) based on a set of criteria (*I1,I2,..In*)

Alternatives = Eco-innovative solutions (*A1, A2..Am*)

Criteria = Indicators (*1, 2, ..28*)



I1=Global Warming



I2=Eutrophication

In=OPEX

AoP3 - Human Well-Being								
	I1	I2	I3	I4	I5	I6	I7	I8
A1	1	1	1	1	1	1	1	1
A2	0	1	0	0	0	0	0	0
A3	0	1	0	0	0	0	0	0
A4	0	1	0	0	0	0	0	0
A5	0	0	0	0	0	0	0	0

Elaboration of Concordance and Discordance Matrix for a selected scenario A1 (Electre II)

Multi-Criteria Decision Analysis (3)

Result

We get to **a ranking** of the alternatives assessed per **each** AoP (i.e. **5 rankings**)

SUSTAINABILITY AGGREGATION RESULTS		
	MCDA-ELECTRE II	
	Score	Rank
A1	0	5
A2	1	3
A3	1	3
A4	2	2
A5	3	1

We also implemented Sustainability Index by Diaz-Romero and Baltero (2004) for eventual comparison (i.e. 5 indices)

SUSTAINABILITY AGGREGATION RESULTS		
	Sustainability Index	
	SI	Rank
A1	0.184527	5
A2	0.183954	4
A3	0.093072	1
A4	0.122407	2
A5	0.153009	3

Highlights and Perspectives

- We developed a framework for sustainability assessment
- We developed an aggregation procedure based on multi-criteria analysis
- We will test it in the case studies: *status quo* vs eco-innovative solutions proposed by stakeholders

Thank You!

Any questions?

You may also contact me at Davide.Tonini@ec.europa.eu

Submitted to *Res Cons Recycl*

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LCA of alternative feedstock for plastic production

Davide Tonini
Hans Saveyn
Peter Eder

B5 unit – Circular Economy and Industrial Leadership
DG Joint Research Centre, European Commission

Sevilla, 23 October 2017

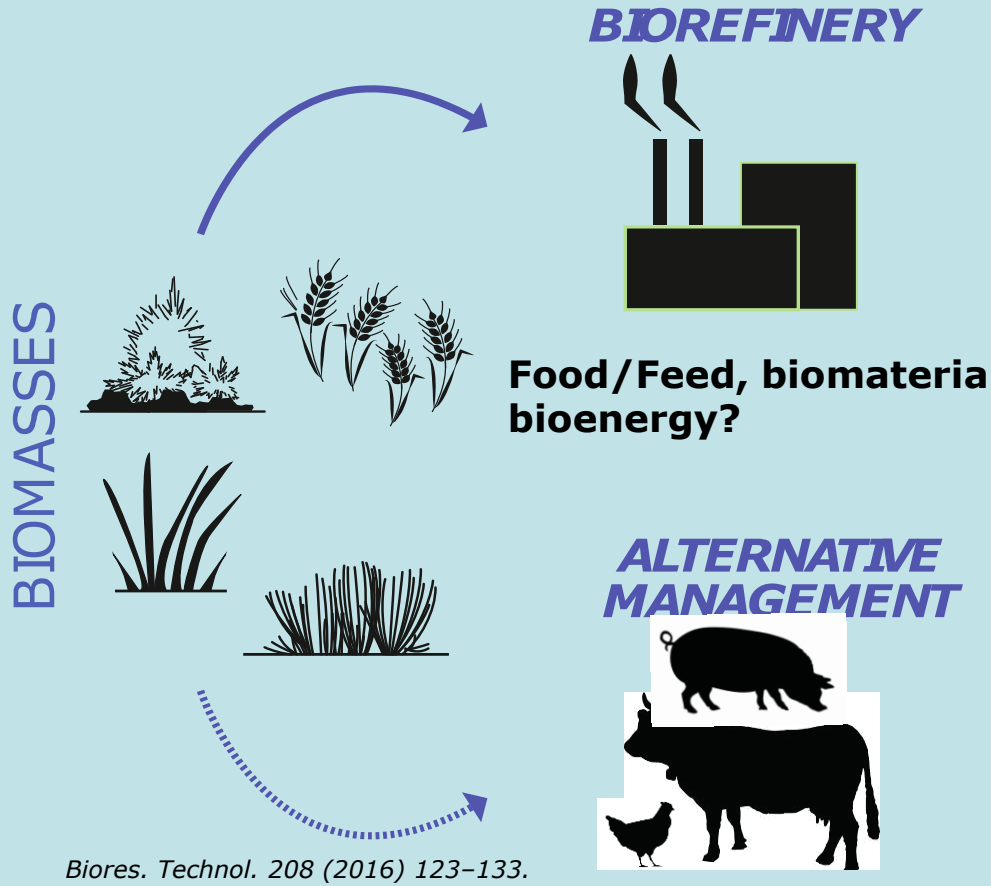
European Commission

Environmental sustainability of using alternative feedstock

- **GOAL**: assessing the environmental impact of using **alternative feedstock** for plastics to support decision-making based on scientific evidence.
- **CLIENT**: DG GROW
- **PLASTIC ARTICLES**: To be decided based on initial screening
- **IMPACTS ASSESSED**: Global Warming, but also other (fossil resources/ land).
- **ALTERNATIVE FEEDSTOCK**: biomass, recycled plastics, CO2.
- **END OF LIFE**: Various end-of-life scenarios (including material recycling, biodegradation, incineration) will be assessed.

Sustainability assessment: Life Cycle Assessment (LCA)

- Holistic perspective → accounting for **direct** and **indirect** burdens.
- Indirect burdens: **trade-offs** due to the use of the alternative feedstock.
- An example is **Land Use Change** impacts due to competition with food sector.
- **Life Cycle Assessment (LCA)**



Biores. Technol. 208 (2016) 123–133.

Status of the project

- **Screening LCA** (**DONE**)**:** packaging, mulching film, insulation, automotive panels
- **To do:** Full LCA of 10 plastic articles
- **End:** September 2019

Any questions?

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