



BIO CIRCULAR CITIES

Exploring the circular
bioeconomy potential
in cities

Biocircularcities unlocked! The Brussels stop

Final conference of the Biocircularcities project
Brussels, 28 September 2023

Why and how to unlock a local and circular bioeconomy – Barriers and solutions

Moderated by Jean-Benoit Bel (ACR+)

Amalia Zucaro (ENEA)

Karin Meisterl (ENT)

Laurène Chochois (LIST)

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The Brussels stop**



BIO CIRCULAR CITIES

The Biocircularcities project in a nutshell

Karin Meisterl, Fundació ENT

28 September 2023

 **Bio-based Industries
Consortium**



Horizon 2020
European Union Funding
for Research & Innovation



This project has received funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101023516. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

BIOCIRCULARCITIES (BCC)

Exploring the circular bioeconomy potential in cities.
Proactive tools for implementation by policy makers and stakeholders.

Coordination and Support Action



Bio-based Industries
Consortium



Final Conference
28 September 2023

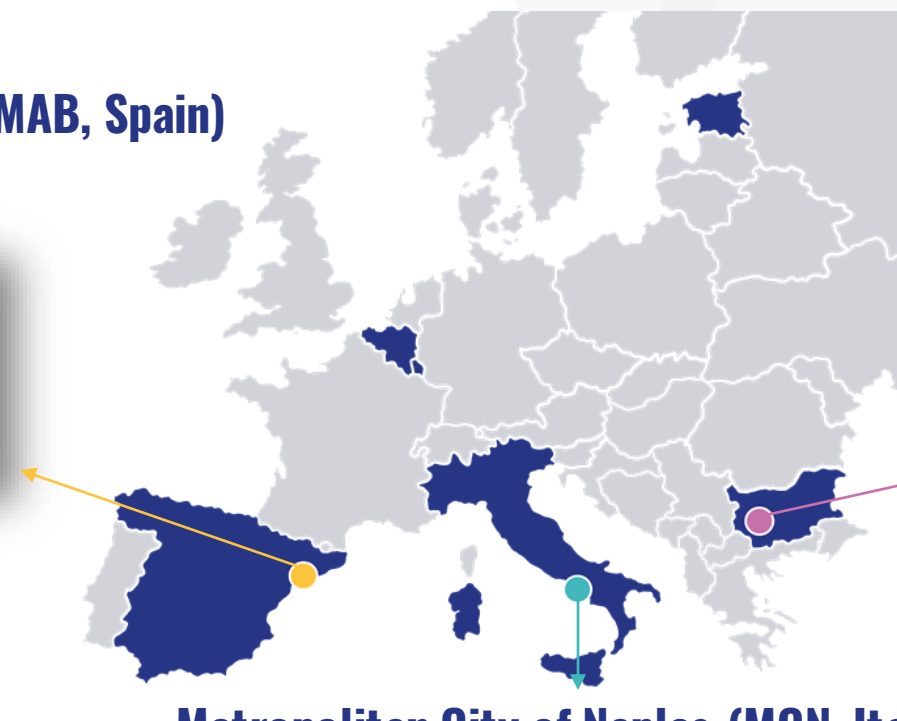
Aims

- Supporting the development of innovative regulatory frameworks aligned with circular bioeconomy principles
- Exploring the CBE potential of unexploited bio-based waste streams in 3 pilot areas

8 consortium partners



3 BCC pilot areas with different value chains



Metropolitan Area of Barcelona (MAB, Spain) Separately collected biowaste



Metropolitan Area of
Barcelona (ES)



- Improving separate biowaste collection
- Upgrading biogas from anaerobic digestion into biomethane for the local gas grid

Pazardzhik Province (PP, Bulgaria) Forestry residues



Region of
Pazardzhik (BG)



- Lignocellulosic valorisation (production of bio-based chemicals)
- CHP plant (bioenergy)

Metropolitan City of Naples (MCN, Italy) Agro-industrial organic waste

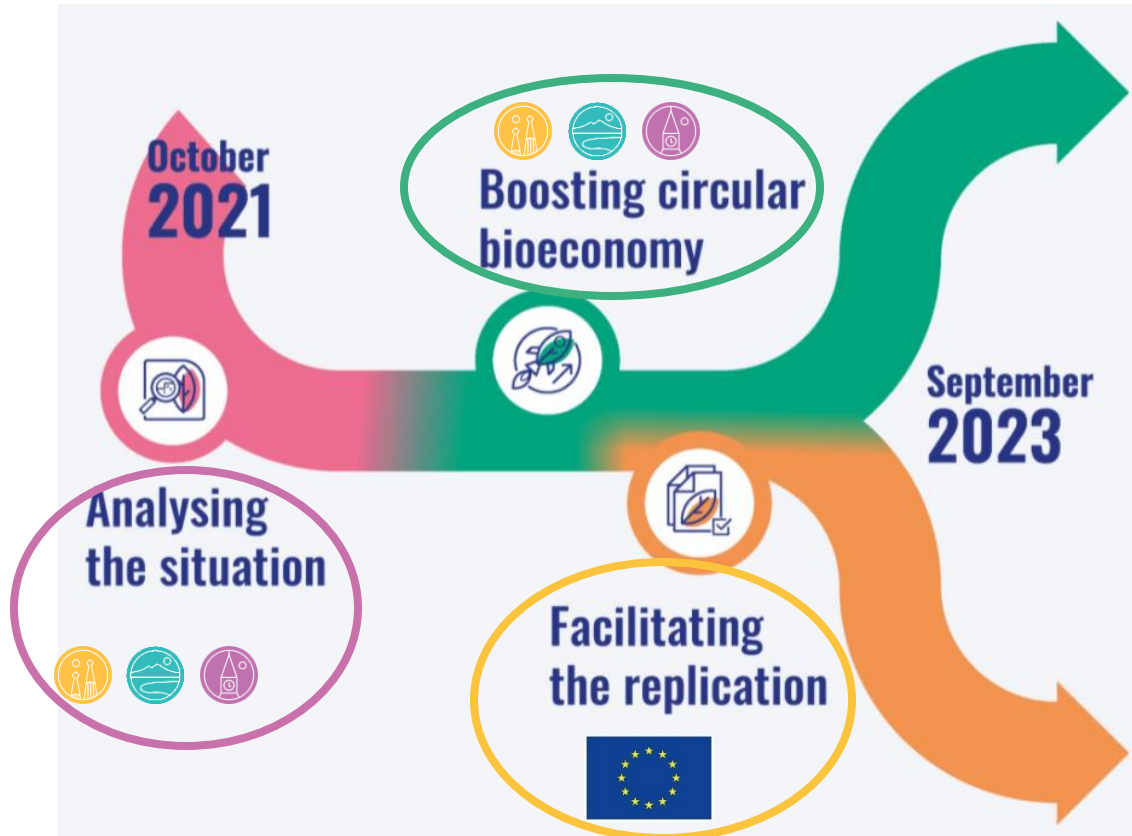


Metropolitan City of
Naples (IT)



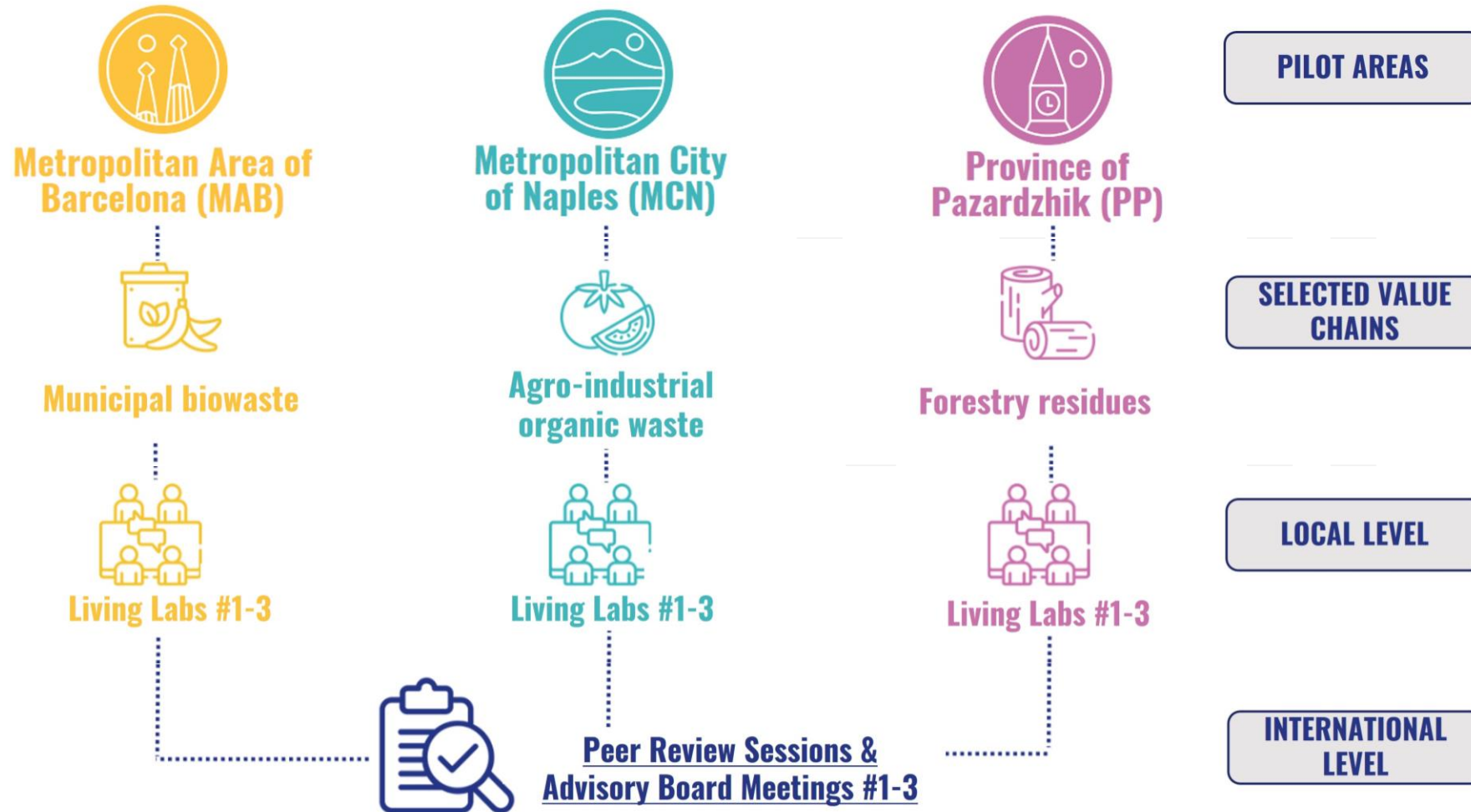
- Processing coffee roasting residues (coffee silverskin) into functional ingredients

BBC Main outcomes



- **LCA and LCC** of the 3 selected pilot value chains to compare the current state with the alternative scenarios.
 - **Policy recommendations** based on drivers and barriers identified in the policy framework of the 3 selected value chains
 - **Web-based tool (guidelines)** to assist policy makers and industry in designing biowaste management strategies
- **Multi-actor approach:** Continuous involvement of local and international stakeholders in the project outcomes.

BCC multi-actor contribution





Discover Biocircularities in video: https://youtu.be/kMQp_vmlWqE (EN)

Watch this video also in [Bulgarian](#), [Catalan](#), [Italian](#), or [Spanish](#).

Roundtable: Why and how to unlock a local and circular bioeconomy – Barriers and solutions

Moderated by Jean-Benoit Bel (ACR+)

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BIO CIRCULAR CITIES

The benefit of unlocking local bioeconomy

Amalia Zucaro, ENEA

28 September 2023

 **Bio-based Industries
Consortium**



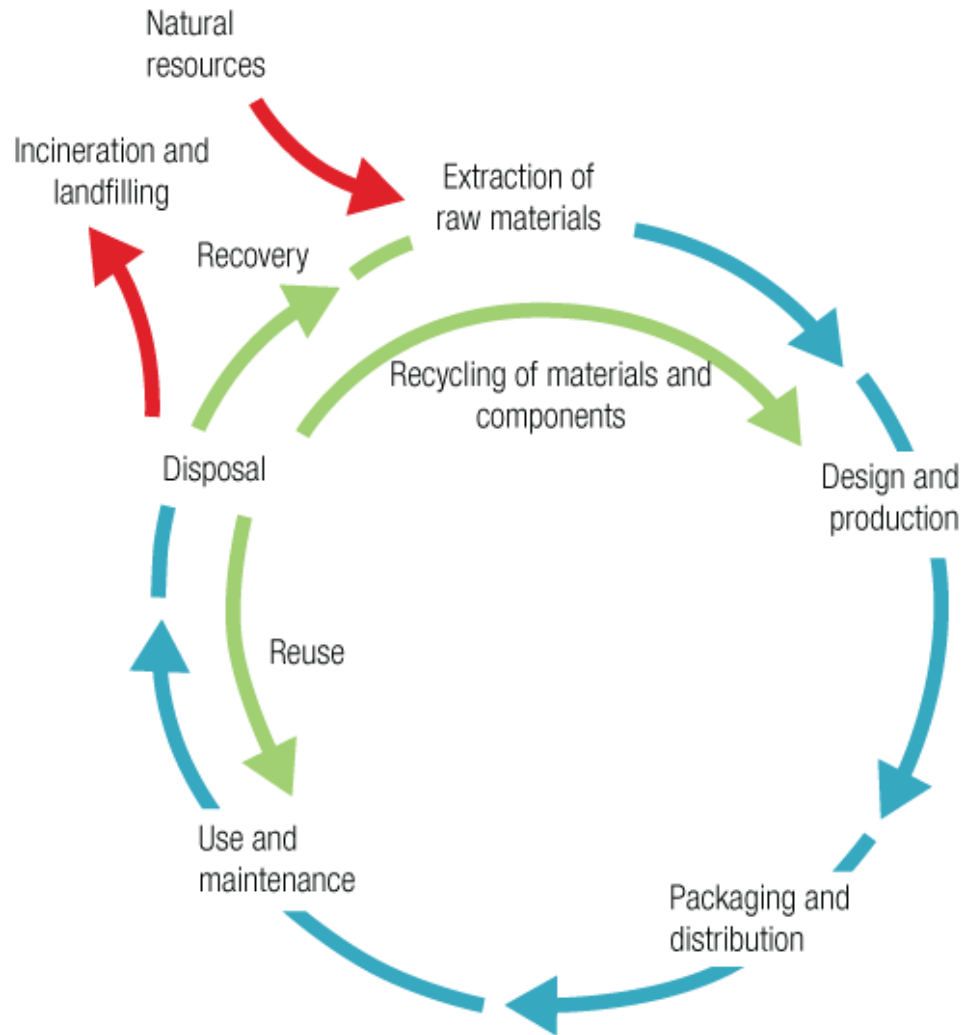
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LIFE CYCLE THINKING (LCT)

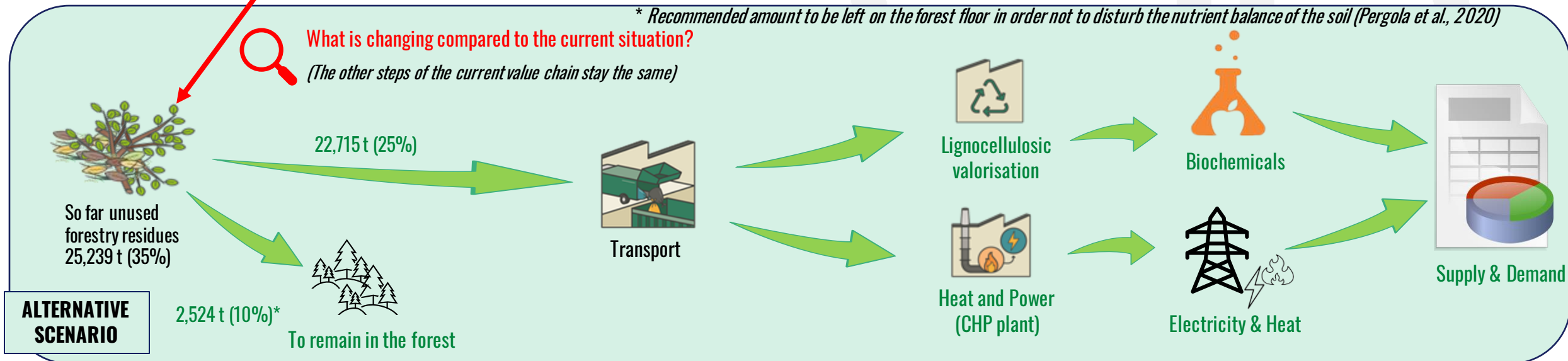
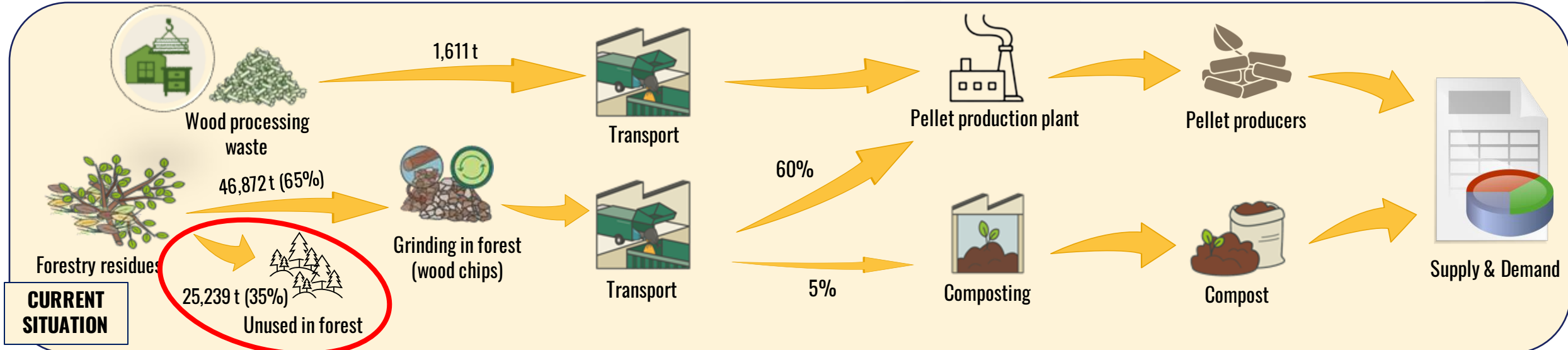


- **PRE-PRODUCTION** (procurement of raw materials)
- **PRODUCTION** (transformation of materials, assembly and finish)
- **DISTRIBUTION** (logistics, sales and packaging)
- **USE AND CONSUMPTION** (including maintenance)
- **END OF LIFE** (Reuse, Recycle, Recovery, Disposal)

The forestry residues chain in Pazardzhik Province (PP)

Life Cycle Assessment (LCA) and
Life Cycle Costing (LCC) results

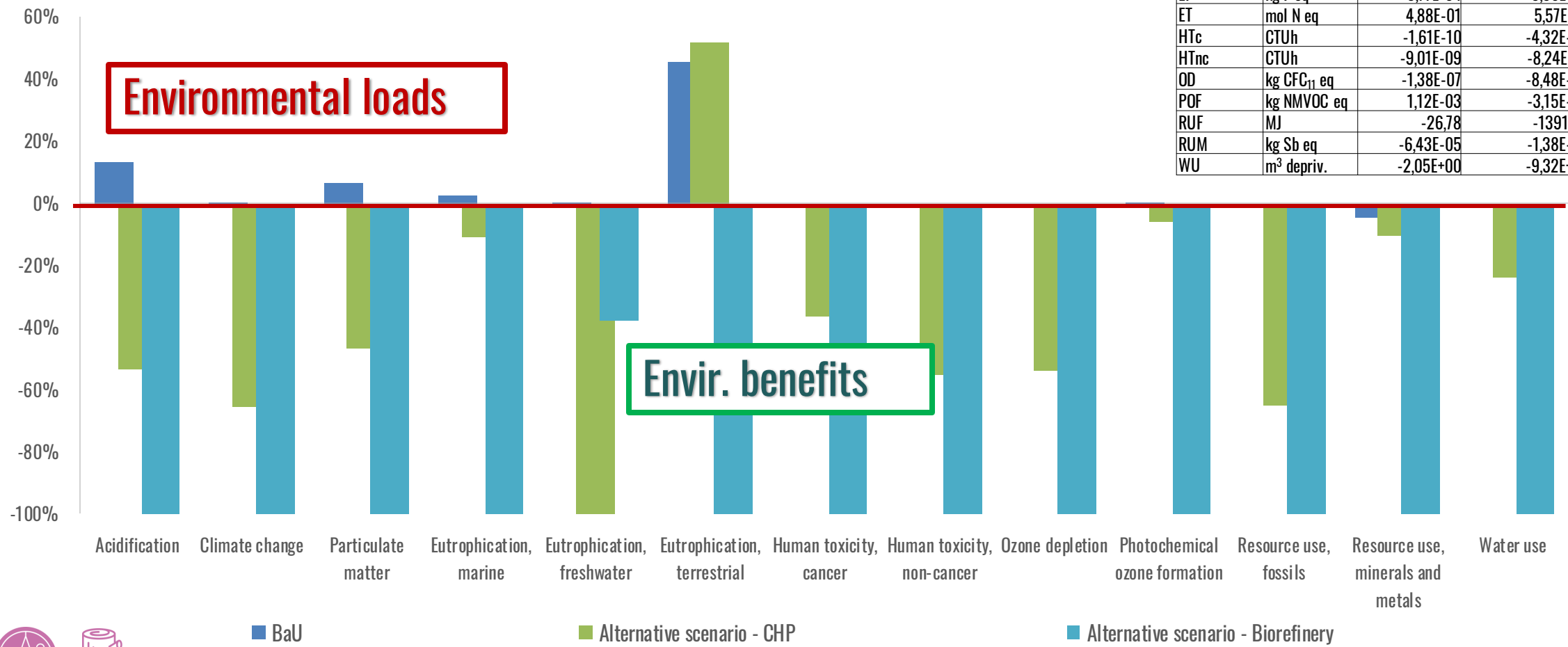
The selected chain in PP



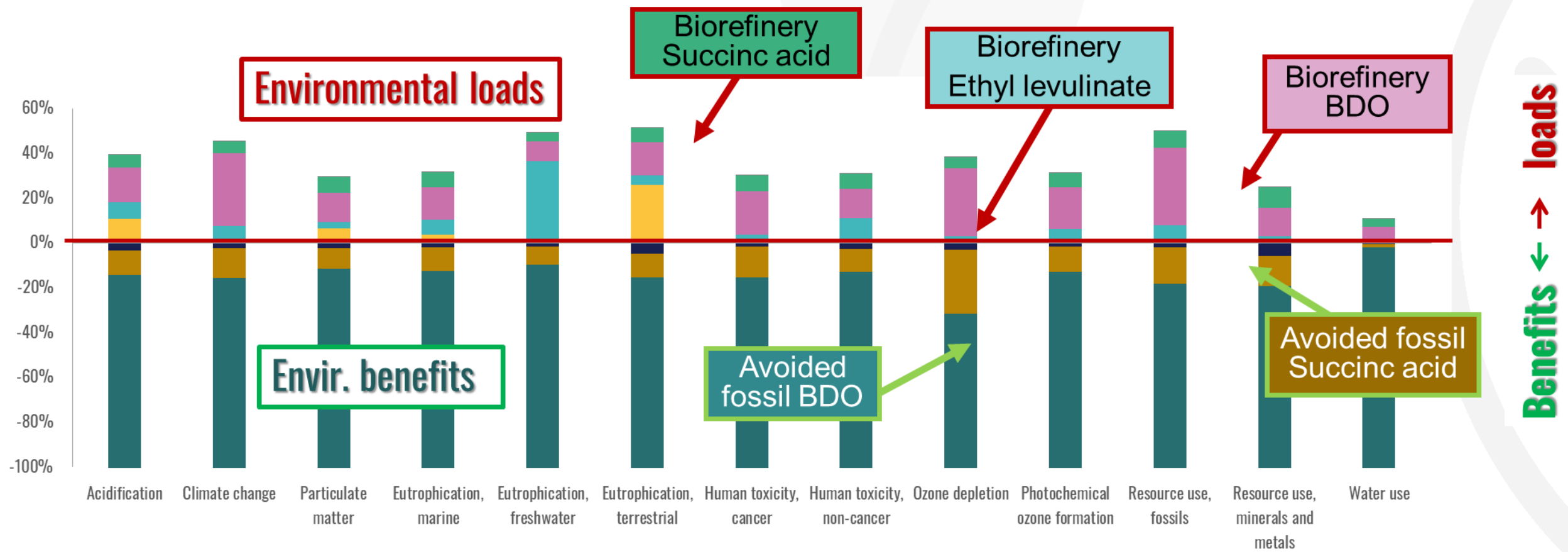
Current/ not changing situation
 Alternative scenario changes

Net environmental impacts of the three scenarios

Impact category	Unit	BaU	Alternative scenario CHP	Alternative scenario Biorefinery
AC	mol H ⁺ eq	9,94E-02	-4,01E-01	-7,51E-01
CC	kg CO ₂ eq	1,70E-02	-8,34E+01	-1,27E+02
PM	disease inc.	5,60E-07	-4,08E-06	-8,73E-06
EF	kg N eq	3,70E-03	-1,52E-02	-1,41E-01
EF	kg P eq	3,77E-04	-9,96E-02	-3,74E-02
ET	mol N eq	4,88E-01	5,57E-01	-1,07E+00
HTc	CTUh	-1,61E-10	-4,32E-08	-1,18E-07
HTnc	CTUh	-9,01E-09	-8,24E-07	-1,50E-06
OD	kg CFC ₁₁ eq	-1,38E-07	-8,48E-06	-1,57E-05
POF	kg NMVOC eq	1,12E-03	-3,15E-02	-5,19E-01
RUF	MJ	-26,78	-1391,49	-2133,44
RUM	kg Sb eq	-6,43E-05	-1,38E-04	-1,34E-03
WU	m ³ depriv.	-2,05E+00	-9,32E+01	-3,91E+02



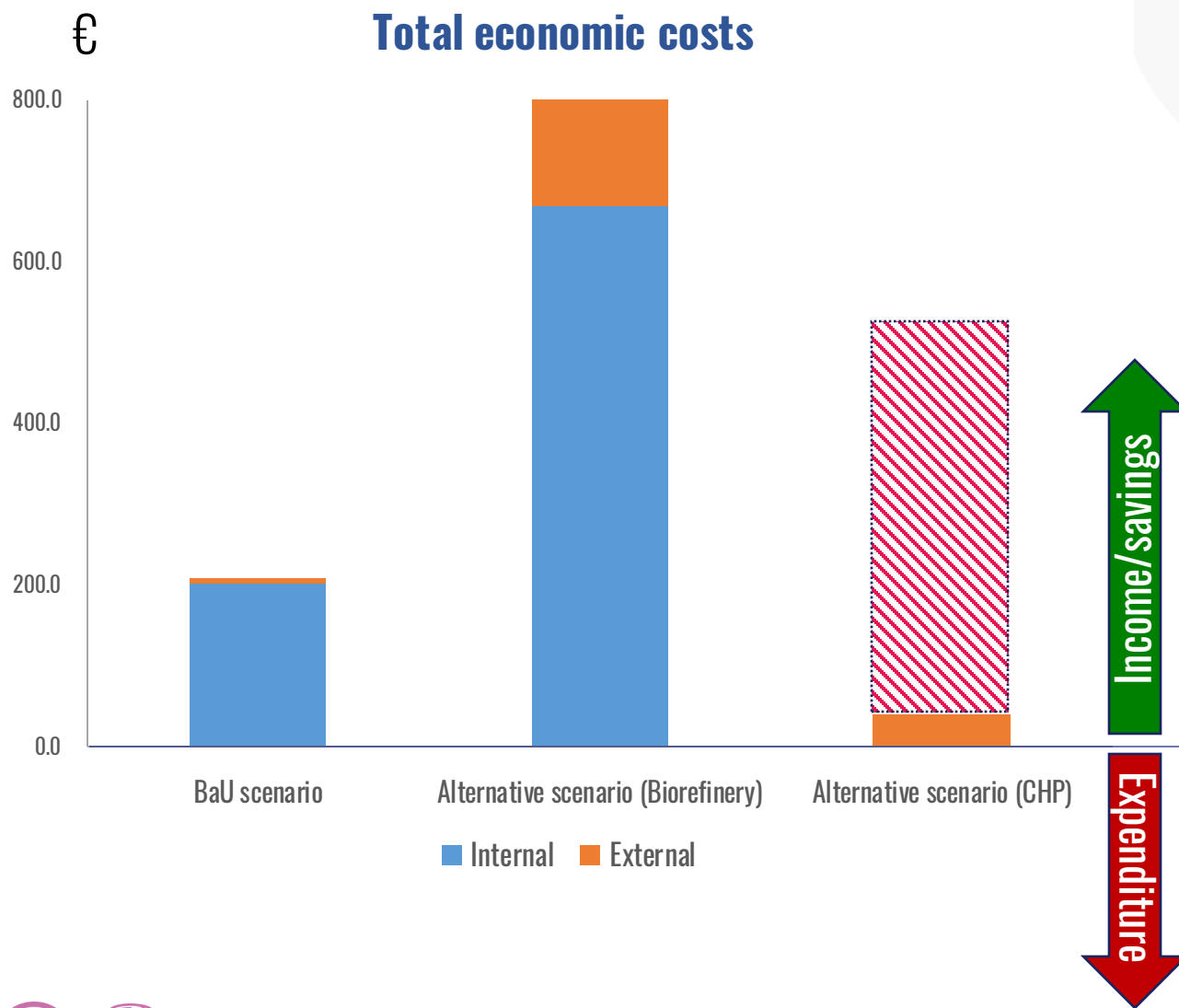
Net environmental impacts of the Biorefinery scenario



- Pellets
- Compost
- Biorefinery - Succinic acid
- Transport
- Avoided fossil Butane-1,4-diol (BDO)
- Avoided fossil Ethyl levulinate
- Biorefinery-Ethyl levulinate
- Avoided Inorganic fertiliser (N, P2O5, K2O)
- Biorefinery - BDO
- Avoided fossil Succinic acid



eLCC: Total economic costs for PP system (F.U. 1 ton of forestry residues)



Total BaU scenario economic costs		
Category	Unit	Cost
NET INTERNAL COSTS (income)	€/ton	202,5
NET EXTERNAL COSTS (savings)	€/ton	7,0
TOTAL NET BALANCE	€/ton	209,5

Total Alternative scenario (Biorefinery) economic costs		
Category	Unit	Cost
NET INTERNAL COSTS (income)	€/ton	670,1
NET EXTERNAL COSTS (savings)	€/ton	165,6
TOTAL NET BALANCE	€/ton	835,7

Total Alternative scenario (CHP) economic costs		
Category	Unit	Cost
NET INTERNAL COSTS (income or expenditure?)	€/ton	?
NET EXTERNAL COSTS (savings)	€/ton	39,3
TOTAL NET BALANCE	€/ton	39,3



Conclusions from LCA & LCC in PP chain



- The **Biorefinery scenario** turns out to be the most sustainable, thanks to the benefits deriving from the production of bio-based chemicals.
- The greatest environmental **advantages** come from the **avoided production of fossil BDO**.
- The **highest impact** (hotspot) is due to **electricity** consumption.
- The valorization of 25% of currently unused forest waste, through its conversion into biochemicals (Alternative scenario - Biorefinery), would **allow to quadruple the economic benefits**, considering both the earnings from all the valorization activities and the **savings of environmental remediation costs**.

These results suggest:

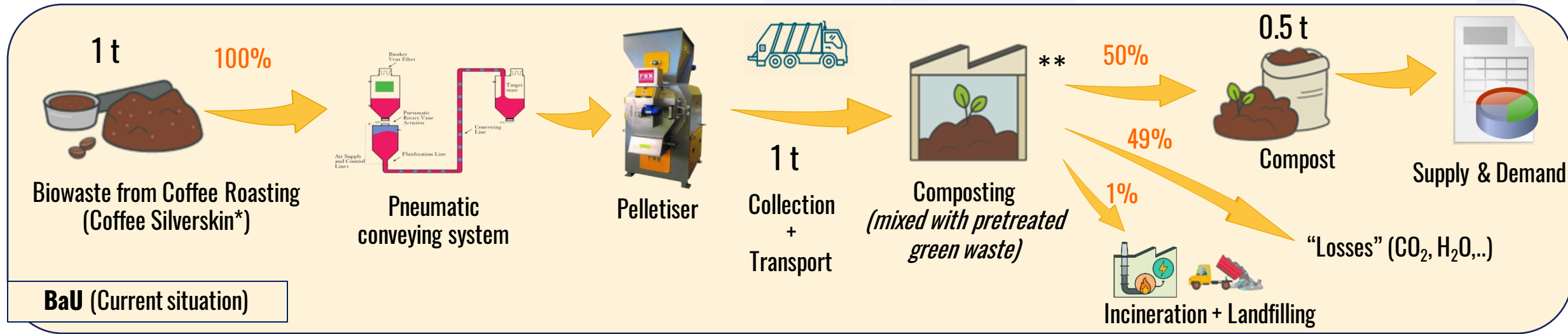
- Increasing the production of bio-based BDO.
- Increasing the use of renewable energy and/or of low energy consumption machinery.



The agro-industrial organic waste chain in the Metropolitan City of Naples (MCN)

Life Cycle Assessment (LCA) and
Life Cycle Costing (LCC) results

The selected chain in MCN



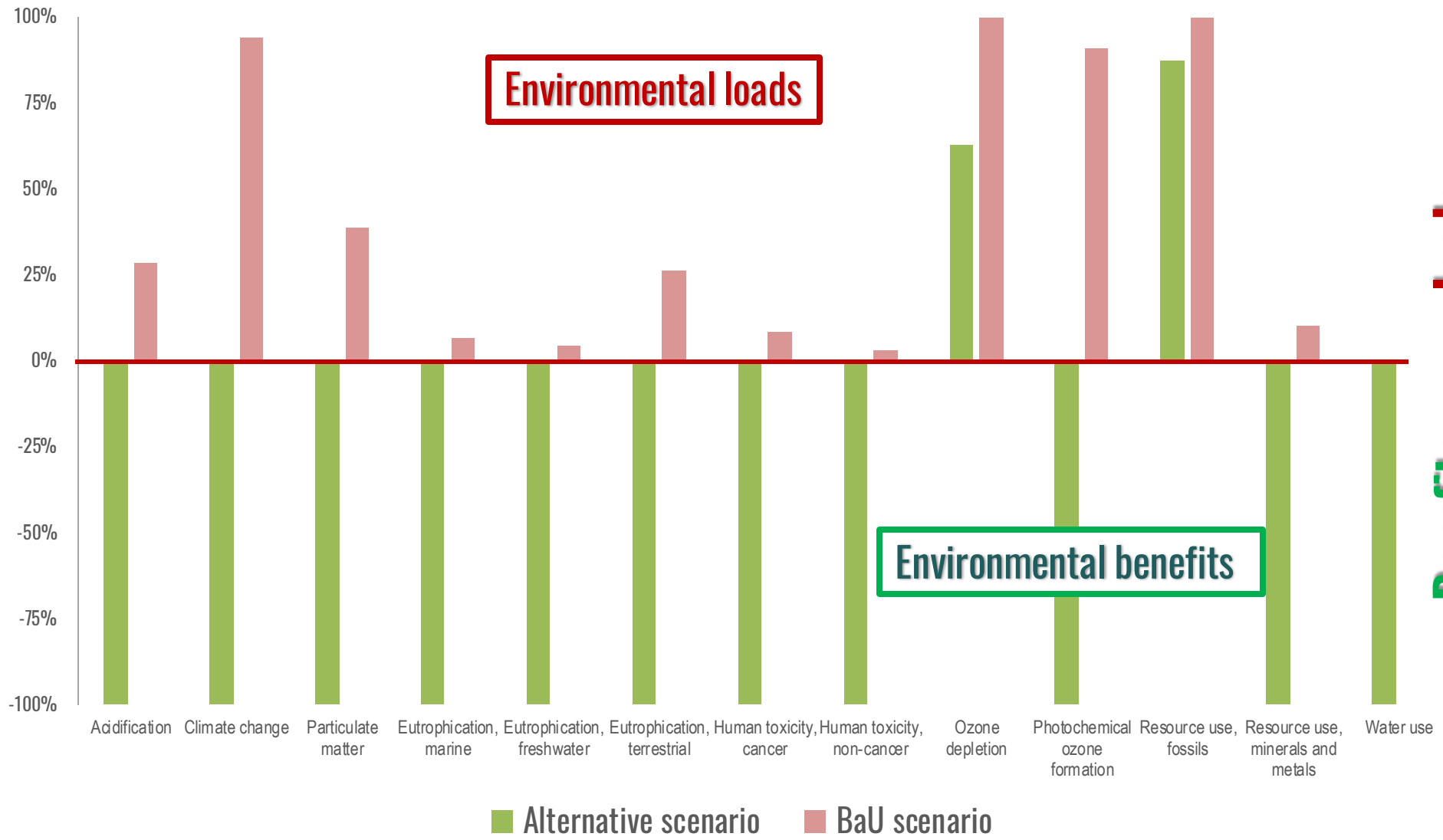
**According to the Ecoinvent LCA database



Current/ not changing situation → Alternative scenario changes

* About 90% of total biowaste from coffee roasting (besides discarded beans) Biocircularities unlocked! The Brussels stop | 28/09/2023

Net environmental impacts of BaU and Alternative scenarios

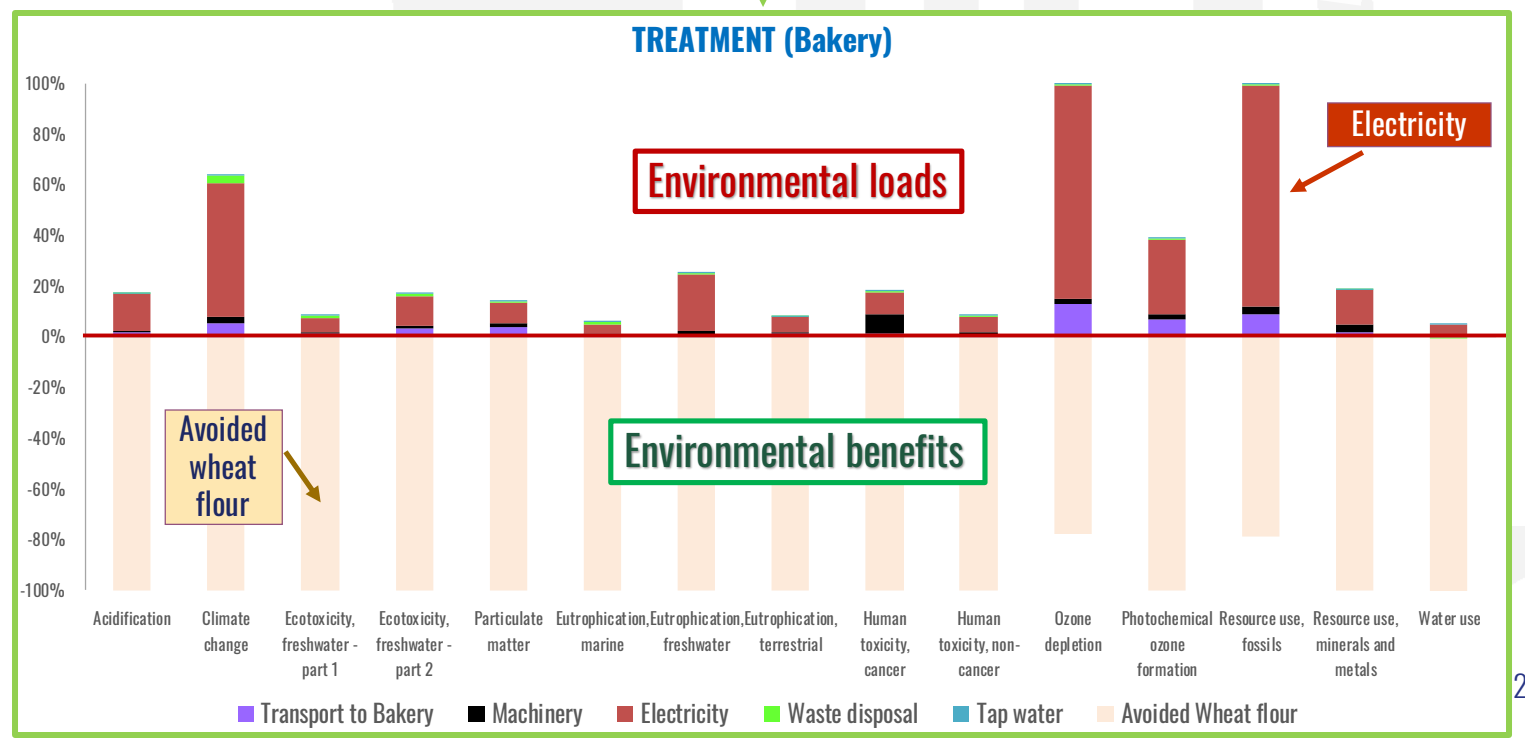
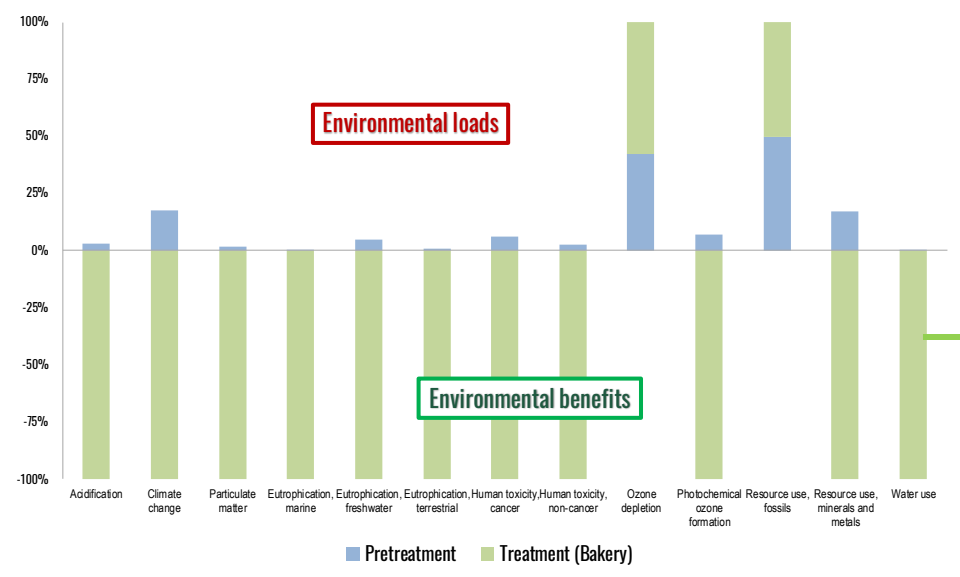


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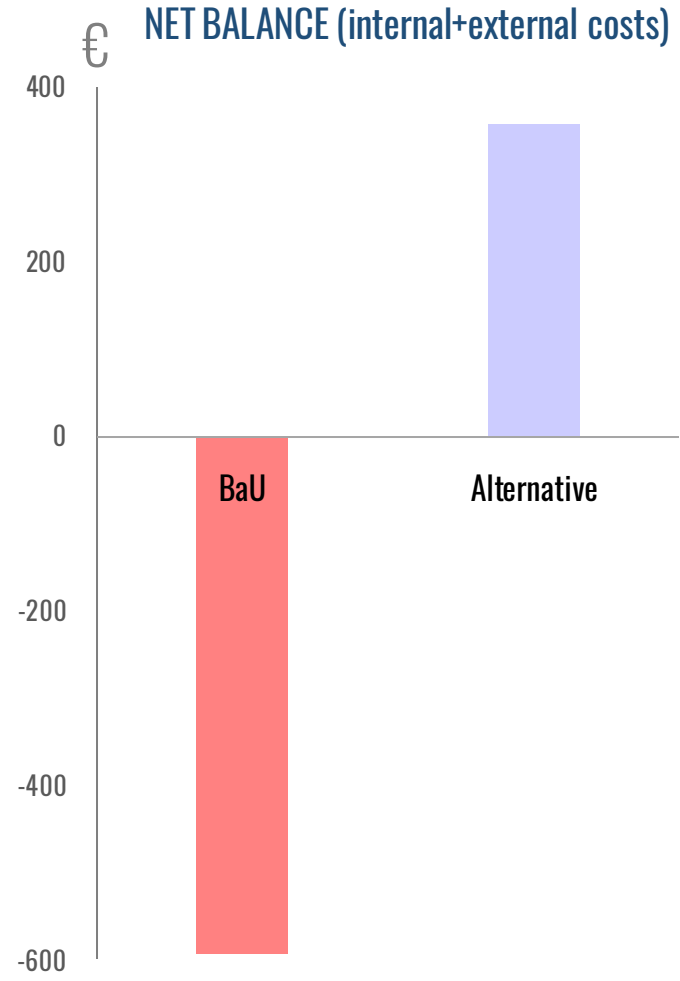
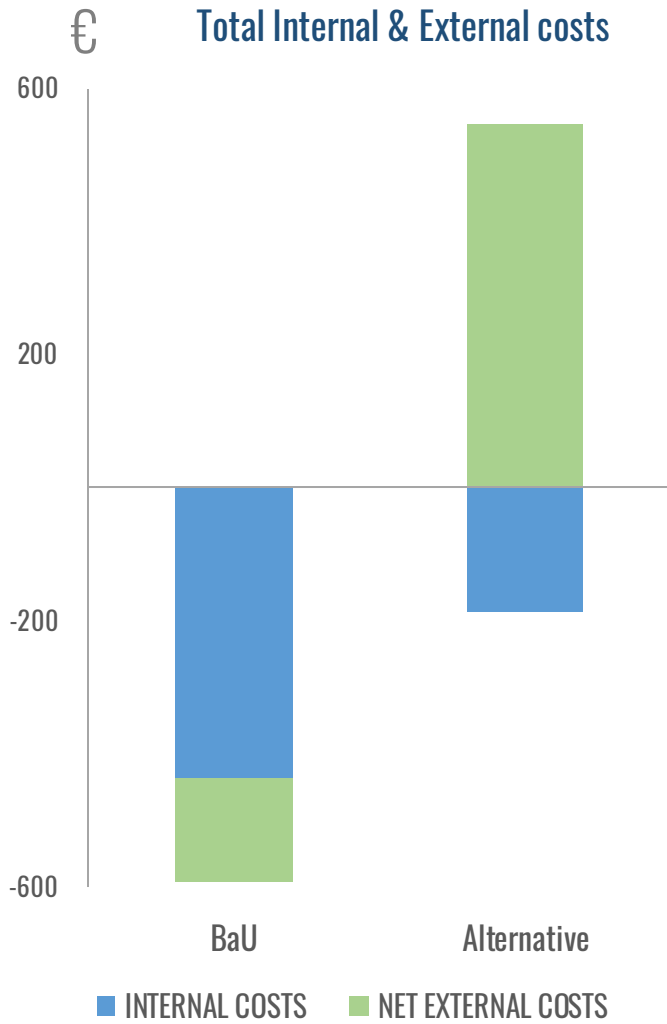
Impact category	Unit	Alternative scenario	BaU scenario
Acidification	mol H ⁺ eq	-1,14E+01	3,29E+00
Climate change	kg CO ₂ eq	-2,50E+02	2,36E+02
Particulate matter	disease inc.	-8,81E-05	3,41E-05
Eutrophication, marine	kg N eq	-8,21E+00	5,32E-01
Eutrophication, freshwater	kg P eq	-3,96E-01	1,68E-02
Eutrophication, terrestrial	mol N eq	-5,41E+01	1,43E+01
Human toxicity, cancer	CTUh	-1,00E-06	8,63E-08
Human toxicity, non-cancer	CTUh	-3,61E-05	1,09E-06
Ozone depletion	kg CFC11 eq	2,59E-05	4,11E-05
Photochemical ozone formation	kg NMVOC eq	-1,99E+00	1,81E+00
Resource use, fossils	MJ	2,50E+03	2,86E+03
Resource use, minerals and metals	kg Sb eq	-5,18E-03	5,27E-04
Water use	m ³ depriv.	-7,92E+03	1,17E+01



Net environmental impacts of the Alternative scenario



eLCC: Total economic costs for MCN system (F.U. 1 ton of C.S.)



Coffee company total costs

Total BaU scenario economic costs

Category	Unit	Cost
NET INTERNAL COSTS	€/ton	-438.6
NET EXTERNAL COSTS	€/ton	-155.8
TOTAL NET BALANCE	€/ton	-593.8

Total Alternative scenario economic costs

Category	Unit	Cost
NET INTERNAL COSTS (expenditures)	€/ton	-118.6
NET EXTERNAL COSTS (savings)	€/ton	545.8
TOTAL NET BALANCE	€/ton	+357.8



Conclusions from LCA & LCC in the MCN chain



- The Alternative scenario turns out to be the most sustainable, thanks to the benefits deriving from the **avoided production of flour**.
- The most **impacting processes** are **electricity** consumption and **transport**.
- The Alternative scenario results to be **more economically convenient** than the BaU, in terms of savings in both biowaste disposal costs and environmental remediation costs.

These results suggest:

- increasing the use of renewable energy and/or of low energy consumption machinery;
- having local treatment facilities (less transport);
- there are more economically convenient solutions than the public system for disposing of biowaste from the agro-industrial sector.

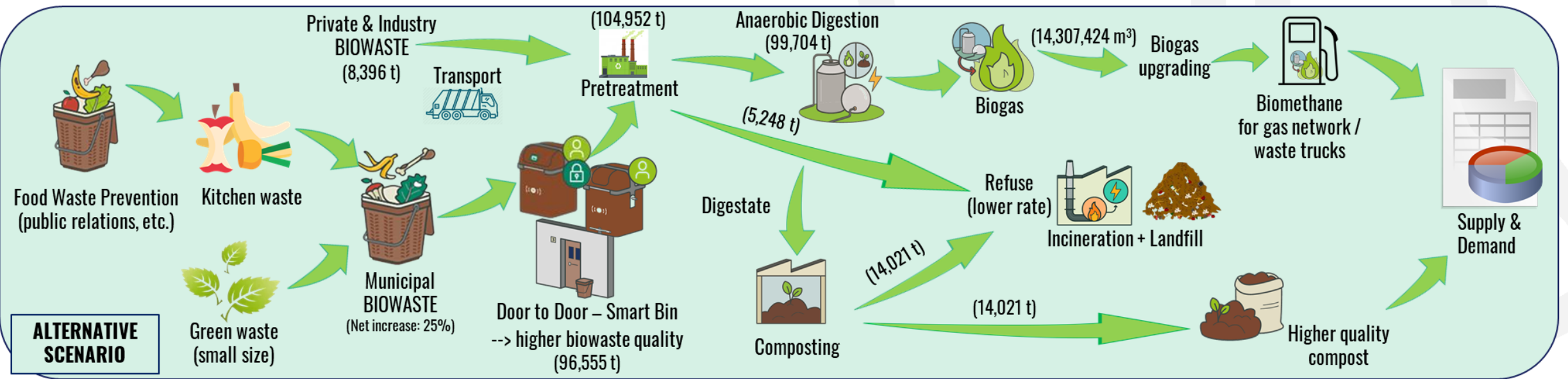
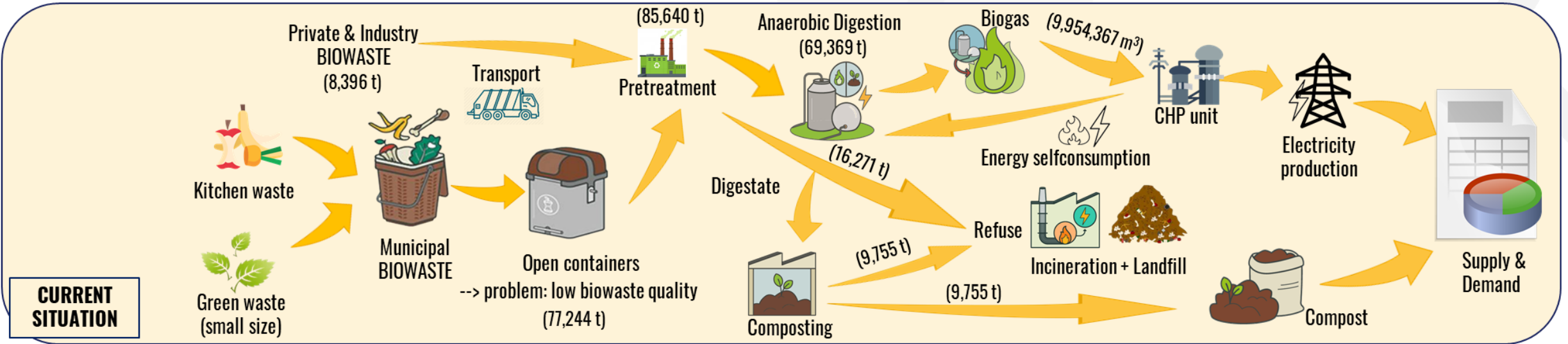


The municipal biowaste chain in the Metropolitan Area of Barcelona (MAB)

Life Cycle Assessment (LCA) and
Life Cycle Costing (LCC) results

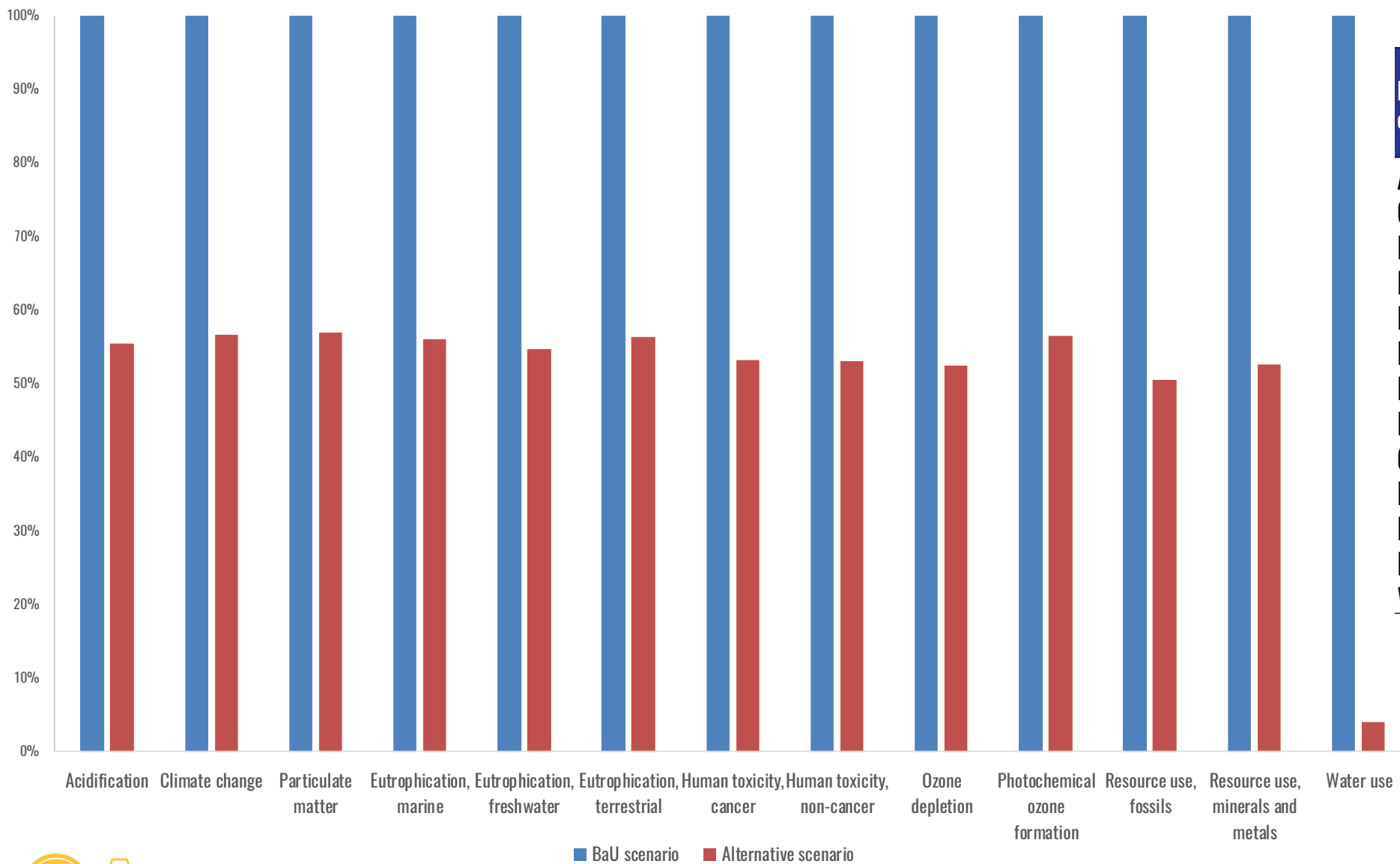


The selected chain in the MAB



Current/ not changing situation
 New situation

Environmental impacts of the two scenarios

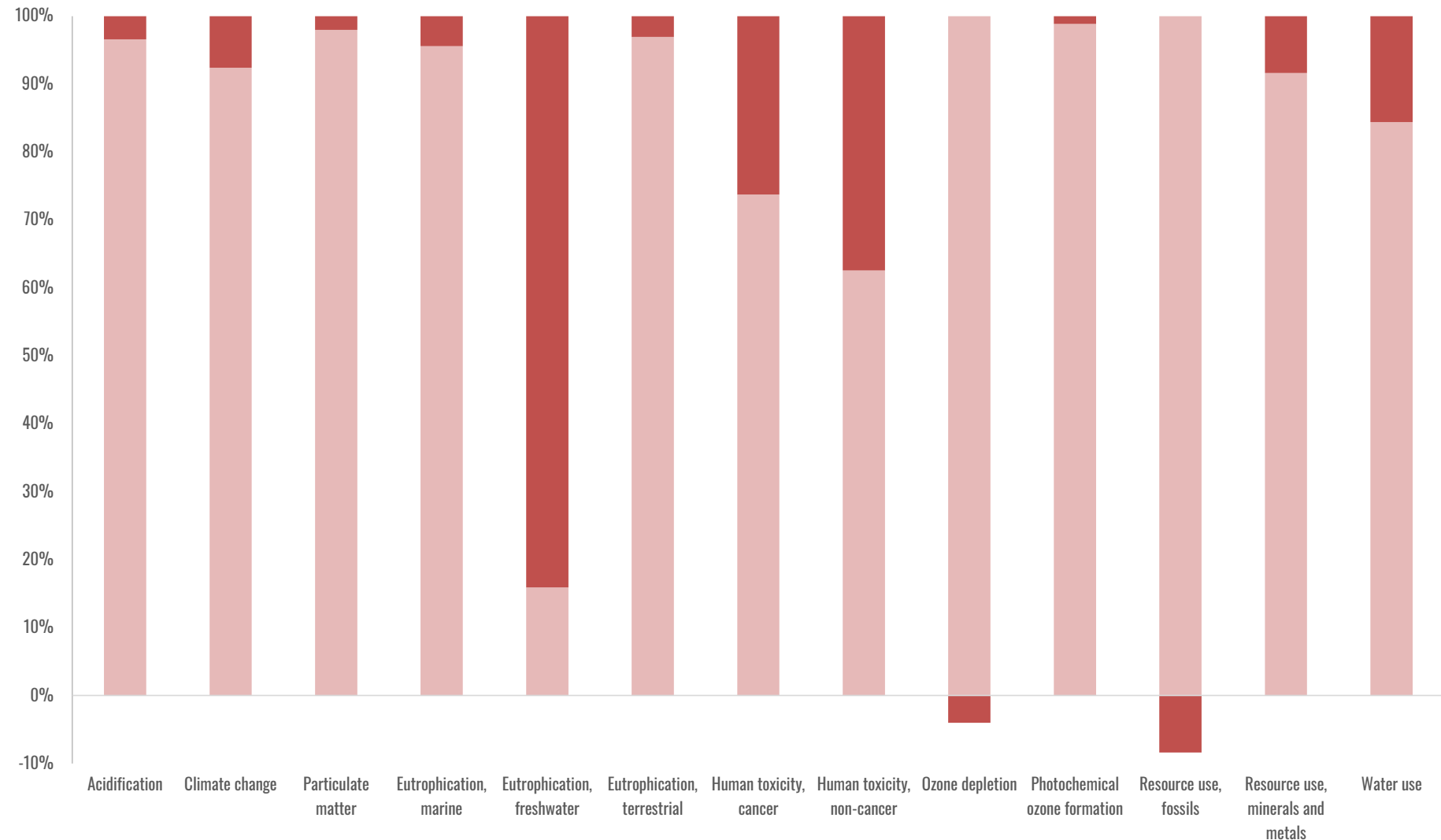


Impact category	Unit	BaU scenario	Alternative scenario
A	mol H ⁺ eq	3.15E+01	1.75E+01
CC	kg CO ₂ eq	5.06E+03	2.87E+03
PM	disease inc.	6.74E-04	3.84E-04
EM	kg N eq	1.26E+01	7.09E+00
EF	kg P eq	5.47E-01	2.99E-01
ET	mol N eq	1.36E+02	7.67E+01
HTc	CTUh	8.60E-07	4.57E-07
HTnc	CTUh	1.75E-05	9.26E-06
OD	kg CFC ₁₁ eq	1.06E-03	5.56E-04
POF	kg NMVOC eq	4.68E+01	2.65E+01
RUF	MJ	6.59E+04	3.33E+04
RUM	kg Sb eq	4.53E-03	2.38E-03
WU	m ³ depriv.	9.87E+02	3.93E+01

Reduction of impacts from 43% in PM and CC up to 96% in WU



Environmental impacts of the Alternative scenario



Impact category	Unit	Collection	Treatment
A	mol H ⁺ eq	1.69E+01	5.96E-01
CC	kg CO ₂ eq	2.65E+03	2.17E+02
PM	disease inc.	3.77E-04	7.73E-06
EM	kg N eq	6.78E+00	3.12E-01
EF	kg P eq	4.77E-02	2.52E-01
ET	mol N eq	7.44E+01	2.34E+00
HTc	CTUh	3.37E-07	1.20E-07
HTnc	CTUh	5.79E-06	3.47E-06
OD	kg CFC ₁₁ eq	5.79E-04	-2.32E-05
POF	kg NMVOC eq	2.62E+01	3.01E-01
RUF	MJ	3.63E+04	-3.05E+03
RUM	kg Sb eq	2.18E-03	1.99E-04
WU	m ³ depriv.	3.32E+01	6.14E+00

Environmental benefits



Collection Treatment



Life Cycle Costing (LCC) analysis



Total economic costs: internal costs and environmental damage costs (externalities)
(F.U. 1 ton of collected biowaste).

BaU scenario TOTAL COSTS

Category	Unit	Cost
Internal costs (only for collection)	€/ton	268,17
External costs	€/ton	2.7E+03
TOTAL COSTS	€/ton	2,97E+03

Alternative scenario TOTAL COSTS

Category	Unit	Cost
Internal costs (only for collection)	€/ton	205,61
External costs	€/ton	1.4E+03
TOTAL COSTS	€/ton	1,61E+03



Conclusions from LCA & LCC in the MAB chain



- The **solutions proposed** (prevention measures, different collection systems and treatment) in the Alternative scenario **resulted to be more sustainable** than the current solutions in the BaU scenario from both the environmental and economic point of view.
- The environmental and economic **impacts generated by the collection activities**, in both investigated scenarios, **are greater than those generated by the treatment processes**.
- The highest environmental and economic **benefits** come **from the biomethane production** and the consequently avoided supply of fossil methane.
- The Ozone depletion and Resource use (fossils) impact categories record a NET benefit from the proposed solutions.
- The **Alternative scenario allows for an average reduction of 70% in the environmental impacts**.



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The Brussels stop**



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Policy recommendations

Karin Meisterl, Fundació ENT

28 September 2023

 **Bio-based Industries
Consortium**



Horizon 2020
European Union Funding
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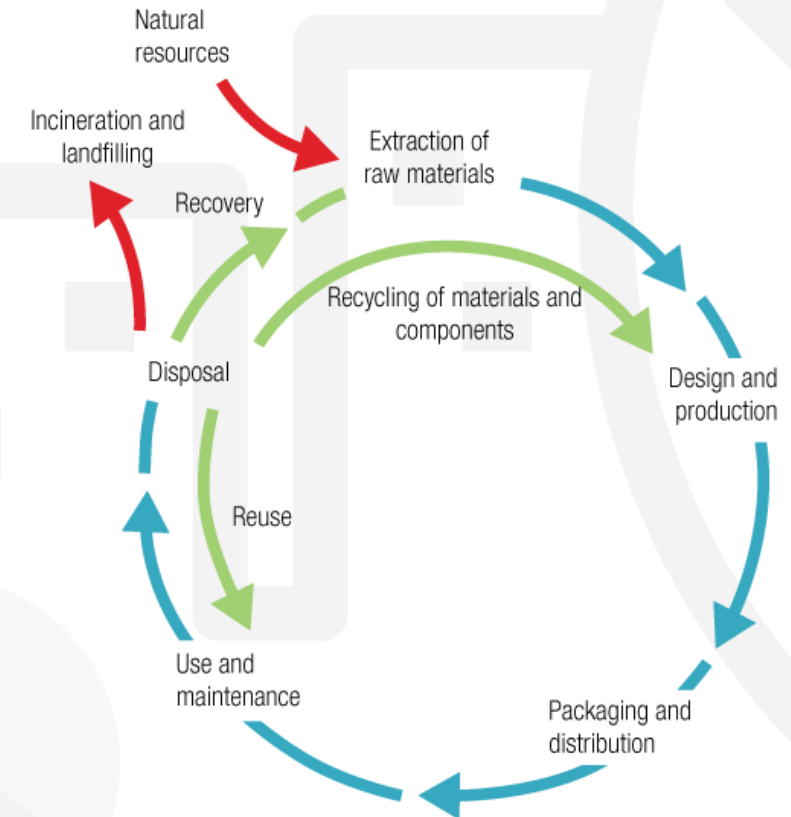


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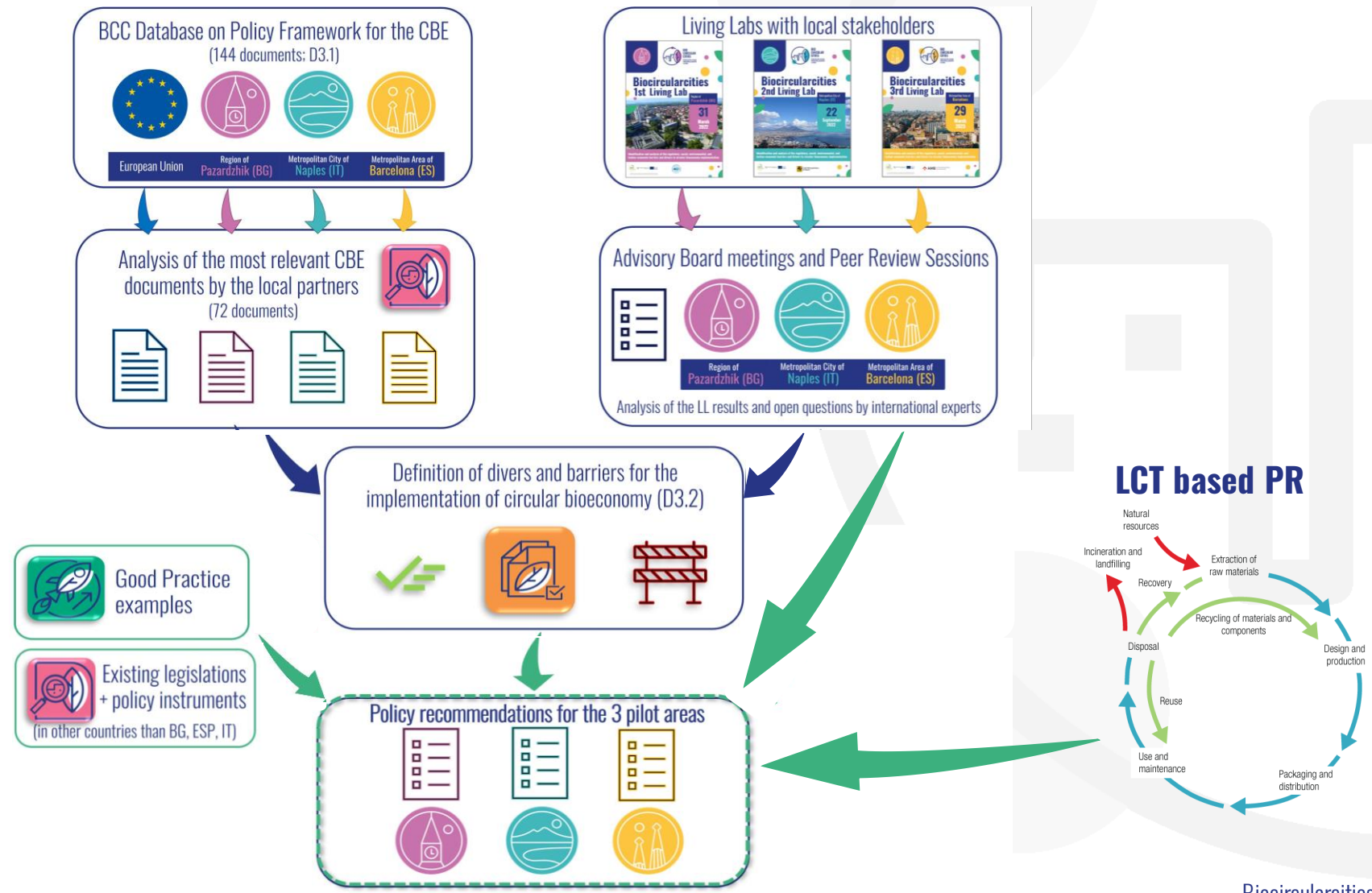
The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

LCA/LCC based Policy recommendations

- **Use renewable energy sources in the valorisation processes**
- **Purchase energy-efficient machinery**
- **Optimise transport**
- **Reuse and recycle, take action against planned obsolescence, and promote the spread of eco-design (to facilitate repair and recycling)**
- **Fiscal and financial incentives to realize these actions**



Methodology: Policy Recommendations (PR)



94 BCC policy recommendations

In total 30 general PR relevant to all three pilot areas on the topics of:

- Data management
- Organic waste treatment and sustainable biorefineries
- Market incentives for bio-based products
- Public awareness and support
- Stakeholder involvement
- (Bioplastics)

In total 64 PR specific to different pilot areas, including:

- Forestry residues (collection; biochemicals & bioenergy production)
- Agro-industrial organic waste & novel food
- Municipal biowaste (food waste prevention, separate collection. AD/biogas/biomethane)



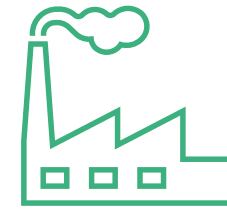
Data management



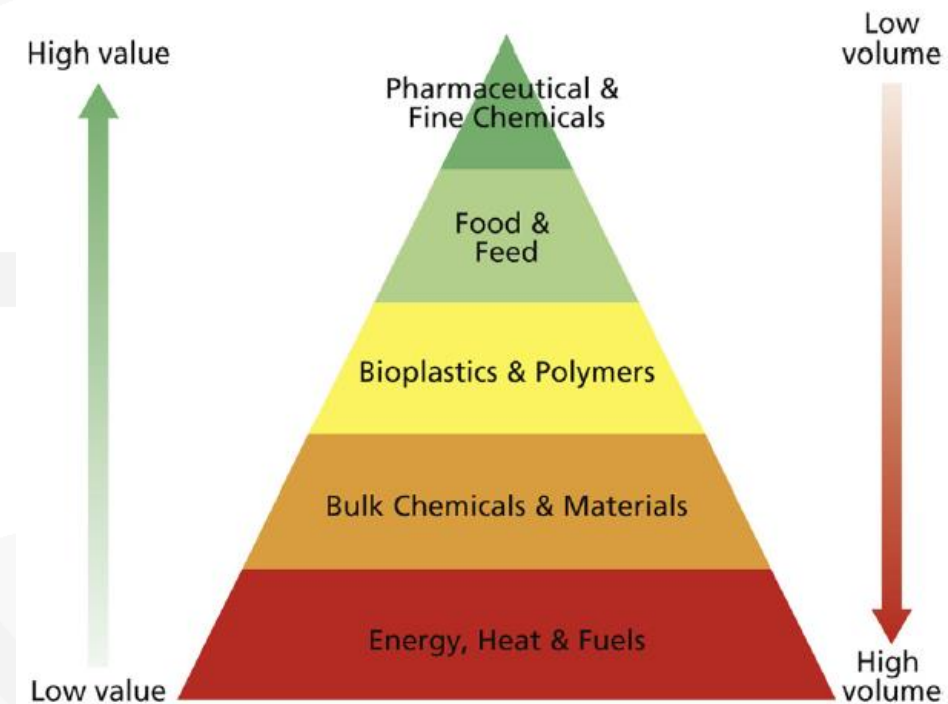
- **At EU level, introduce standardised guidelines for data collection and analysis** for all types of organic waste.
- **At national and regional level, introduce into law annually updated, comprehensive, transparent, and freely accessible databases** on municipal biowaste streams using European standardised guidelines.
- **At national level, consolidate and accelerate the development of national electronic platforms for waste management** regarding the documentation, registration, and reporting obligations in the waste management sector and data exchange between all regions in one country.



Organic waste treatment and sustainable biorefineries

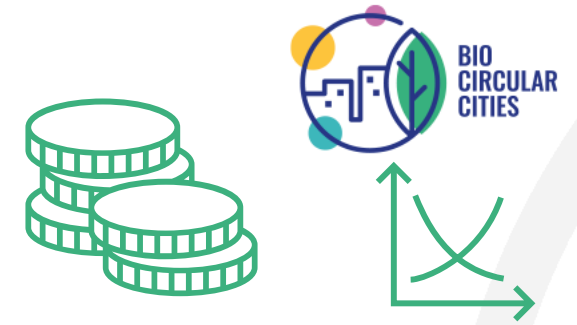


- **At EU and national level, ensure planning security with regard to legal framework conditions and subsidies, and phase out subsidies not consistent with the EU waste hierarchy and CBE targets.**
- **At regional level, introduce financial incentives for technical improvements of existing treatment plants, the use of BAT and for the construction of new biorefineries, giving preference to bio-based products according to the "cascading use of biomass principle".**
- **At national level, build capacity in the municipalities to speed up the permitting process for new biorefineries.**



Source: Stegman, P., Londo, M., & M. Junginger (2019): *The circular bioeconomy: Its elements and role in European bioeconomy clusters. Resources, Conservation & Recycling: X6 (2020) 100029*

Market incentives for sustainable bio-based products



- **At national, regional, and local level, support Green Public Procurement to stimulate the growth of the sustainable bio-based product market, using the EU guidance for bio-based products in procurement.**
- **At EU or national level, introduce VAT reductions for bio-based products (e.g., biochemicals) and other environmentally friendly products and services produced in the EU compared to fossil-based alternatives (integrated approach) and products from outside the EU.**



Public awareness and support

- **At regional and local level, finance well-developed, continuous environmental education programmes** on food waste prevention, separate collection, and the benefits of bio-based products.
- **At regional and local level, monitor the success of awareness raising campaigns using common indicators for MSW management.**

Stakeholder involvement

- **At regional or local level, promote the participative approach by enshrining stakeholder involvement in legislation.**
- **At EU and regional level, promote technology and innovation clusters and networking platforms** (e.g., Biomethane Industrial Partnership) for policy makers, researchers, and market players.



Pazardzhik Province



- **At national level, funding should be made available for local environmental impact assessments** to determine the range between forestry residues that must remain on the ground to preserve soil quality and biodiversity and residues that can be used to produce new bio-based products.
- **At national level, introduce a fee and incentive scheme to promote the pre-treatment and sustainable collection of forestry waste** for biorefineries – especially in difficult terrain – also with a view to reducing the costs of firefighting and reforestation after fires.
- **At EU level, introduce incentives for bioenergy compared to fossil energy** through measures such disincentives for the use of **fossil energy (e.g., increasing taxes)** or an incentive mechanism based on **carbon footprint assessment**.* The lower the carbon footprint [CO₂ g/MJ], the higher the price/incentive should be for this product/energy source.



**according to the International Sustainability and Carbon Certification ([ISCC](#)).*

Metropolitan City of Naples



- **At national level, introduce financial incentives and administrative and technical support for companies to use their by-products** (e.g., coffee silverskin) **internally** for the production of new products (e.g., functional food) to avoid classification as waste.
- **At regional and local level, incentivise local industrial symbiosis**, i.e., the physical exchange of resources, energy and/or by-products among different industries
- **At national level, set up collection systems for agro-industrial organic waste:** Give financial incentives to companies or businesses to collect and store a certain waste stream (e.g., collection of spent coffee grounds in cafeterias)
- **Novel food:** **At national level, provide financial support for laboratory analyses in support of risks assessments for EFSA** (European Food Safety Authority), which provides independent scientific advice and informs on existing and emerging risks in the food chain with a view to granting market authorisation (minimum 2-year process).



Metropolitan Area of Barcelona: Separate biowaste collection



- **At national level, introduce mandatory door-to-door (DtD) or smart bin collection systems.** The introduction of new "open bins" should be prohibited.



Ventilated kitchen bin
The small kitchen bin has a special airy structure to ensure optimal oxygenation of the bag and its content and thus minimizing the inconvenience related to the formation of odors and liquids.

25 compostable bags
Bags made of bioplastics have properties and characteristics of use very similar to traditional plastics, but at the same time, they are biodegradable and compostable according to the European standard EN 13432

Wheeled bin
120 lt. wheeled bin at the curbside. Standard equipment for every building. Also available a smaller 35 lt. bin on request

Note: bins are given free loan to citizens



<https://www.municipalwasteeurope.eu/sites/default/files/6.Danilo%20Vismara.pdf>

- **At the local level, DtD collection controls should be introduced - with fines for non-compliance.**
- **At national level, introduce the mandatory application of the pay-as-you-throw (PAYT) principle.**



Metropolitan Area of Barcelona



- **At national and regional level, introduce stricter limits for biowaste impurities (CAT:5%; ESP: 10% by 2027) → Low impurity levels are important for obtaining high-quality compost!**
- **At national level, integrate a higher minimum biogas target (at least 5 bcm by 2030) and biomethane target (at least 5% of the total gas consumed) linked to the target for new plants to be built into the Spanish Biogas Roadmap 2022.^[1]**
- **At national level, promoting biomethane demand by awareness raising campaigns about the guarantee of origin certificate (by Enagás) ^[2] for energy produced from renewable sources (when and where it was produced, the type of production facility and energy source).**



^[1]https://energia.gob.es/es-es/Novedades/Documents/OOHR_Biogas_V6.pdf

^[2]https://www.miteco.gob.es/es/prensa/220517_cm_ndpelgobiernopuebalelistemadegarantiasdeorigenparalosgasesrenovables_tcm30-540454.pdf

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BIO CIRCULAR CITIES

BioCircularCities guidelines (webtool)

Laurène Chochois, LIST

28 September 2023

 **Bio-based Industries
Consortium**



Horizon 2020
European Union Funding
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BCC guidelines: Methodological approach

BCC webtool: <https://bcc.list.lu/>

- ✓ Analysis of the **scope of the global Circularity and Bioeconomy concepts**, the associated **European targets** and incentives, and the correlations which can be established between them.
- ✓ Analysis of the **main drivers and barriers** towards the development of sustainable circular bioeconomy value chains (D4.1 literature review; D3.2 policy framework analysis at EU and pilot level).
- ✓ **Review of the existing supporting approaches, guidelines and tools** in order to position the BCC guidelines and clearly define its objectives.
- ✓ D4.2 “Report documenting the definition of the decision tree background logic”.
- D4.3 “Webtool in practice: short guidance for the practitioner”.
Soon available at <https://biocircularcities.eu/resources/>

Objective and scope of the BCC Guidelines

Target group: Biowaste managers/technicians reporting to public/private decision makers.

Different feedstock



Municipal biowaste



Forestry residues



Agro-industrial organic waste

How to avoid landfill and create added-value?



Which valorisation option is the most suitable?

Some examples:

- Recycling into high-value biochemicals
- Recycling into biogas or biomethane and/or compost
- Incineration with energy recovery



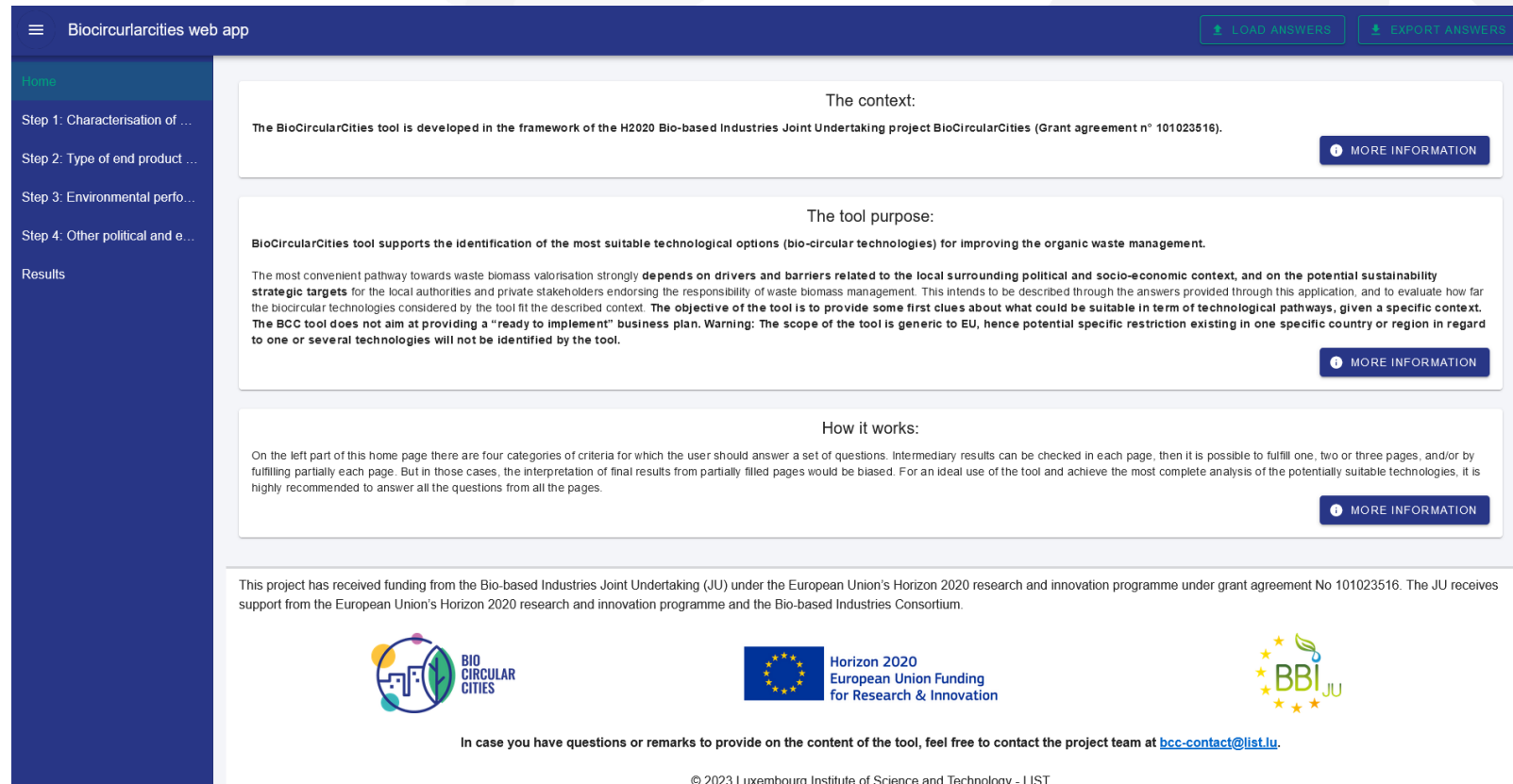
BBC webtool -> Identification of the most suitable bio-circular valorisation technology considering the specific context

Setting guidelines for identifying the most suitable biowaste treatment options

➤ BCC Guidelines format:

Webtool supporting the identification of the most relevant options in terms of biowaste management and valorisation technologies.

<https://bcc.list.lu/>



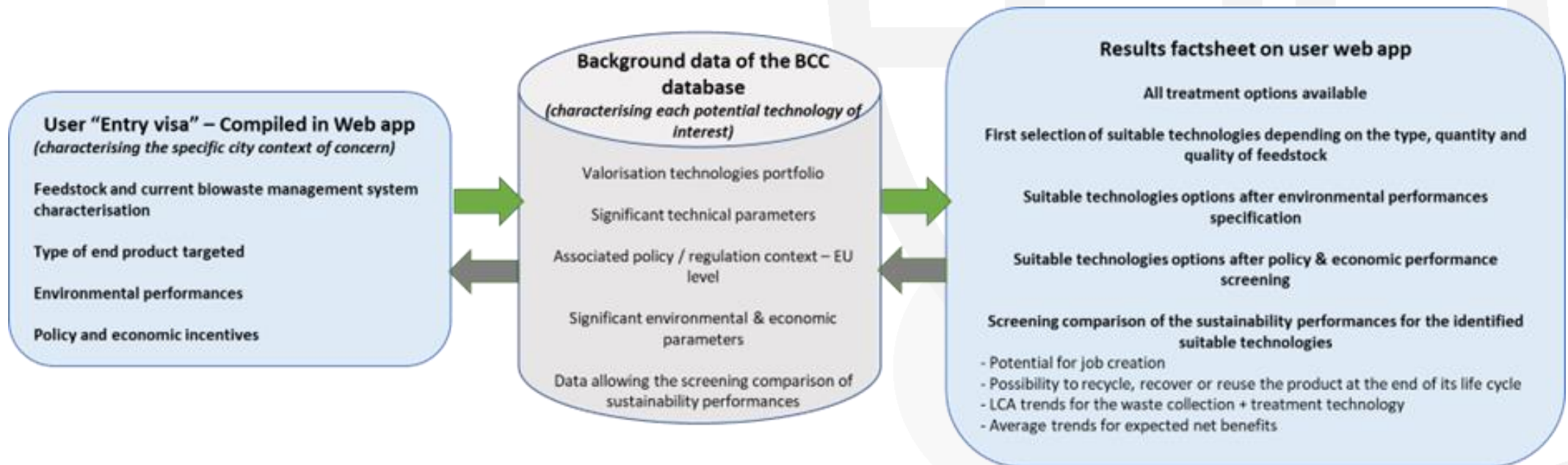
The screenshot displays the 'Biocircularcities web app' interface. The top navigation bar includes a hamburger menu, the app name, and buttons for 'LOAD ANSWERS' and 'EXPORT ANSWERS'. A left sidebar lists navigation options: 'Home', 'Step 1: Characterisation of ...', 'Step 2: Type of end product ...', 'Step 3: Environmental perfo...', 'Step 4: Other political and e...', and 'Results'. The main content area is divided into three sections, each with a 'MORE INFORMATION' button:

- The context:** The BioCircularCities tool is developed in the framework of the H2020 Bio-based Industries Joint Undertaking project BioCircularCities (Grant agreement n° 101023516).
- The tool purpose:** BioCircularCities tool supports the identification of the most suitable technological options (bio-circular technologies) for improving the organic waste management. The most convenient pathway towards waste biomass valorisation strongly depends on drivers and barriers related to the local surrounding political and socio-economic context, and on the potential sustainability strategic targets for the local authorities and private stakeholders endorsing the responsibility of waste biomass management. This intends to be described through the answers provided through this application, and to evaluate how far the biocircular technologies considered by the tool fit the described context. The objective of the tool is to provide some first clues about what could be suitable in term of technological pathways, given a specific context. The BCC tool does not aim at providing a "ready to implement" business plan. Warning: The scope of the tool is generic to EU, hence potential specific restriction existing in one specific country or region in regard to one or several technologies will not be identified by the tool.
- How it works:** On the left part of this home page there are four categories of criteria for which the user should answer a set of questions. Intermediary results can be checked in each page, then it is possible to fulfill one, two or three pages, and/or by fulfilling partially each page. But in those cases, the interpretation of final results from partially filled pages would be biased. For an ideal use of the tool and achieve the most complete analysis of the potentially suitable technologies, it is highly recommended to answer all the questions from all the pages.

At the bottom, a funding notice states: 'This project has received funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101023516. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.' Logos for BioCircularCities, the European Union (Horizon 2020 European Union Funding for Research & Innovation), and BBIJU are displayed. A contact email bcc-contact@list.lu is provided. The footer includes the copyright notice: © 2023 Luxembourg Institute of Science and Technology - LIST.

Setting guidelines for identifying the most suitable biowaste treatment options

- **BCC Guidelines format: Webtool** supporting the identification of the most relevant options in terms of biowaste management and valorisation technologies.



BCC webtool: 14 technologies considered



		Type of processes			
		Biochemical processes	Thermochemical processes	Chemical processes	Other
Type of bio-based product	Bulk/Specialty chemicals	Enzymatic hydrolysis Industrial fermentation Solid state fermentation	Gasification Hydrothermal process* Pyrolysis**	Heterogeneous catalysis	Pulping
	Bio-based functional ingredients (novel) food				
	Biogas			Anaerobic digestion (AD) Mechanical Biological Treatment (MBT) + AD	
	Biomethane			Anaerobic digestion + Biomethanation	
	Compost			MBT + Composting	
	Other				Landfilling Incineration of MSW (containing biowaste) + energy recovery

* only applicable to food related waste

** only applicable to wood processing waste and forestry residues

BCC webtool: data entry by the user

Access: <https://bcc.list.lu/>



Biocircularcities web app

LOAD ANSWERS EXPORT ANSWERS

Home

Step 1: Characterisation of a ...

Step 2: Type of end product ...

Step 3: Environmental perfo...

Step 4: Other political and e...

Results

Step 1: Characterisation of available feedstock and current existing organic waste management s...

Which type of organic waste will serve as feedstock to the biocircular technology that could be implemented?

Separated organic fraction from Municipal Solid Waste

Please indicate if the organic waste fraction separation at source is already implemented for the organic waste of concern?

Yes

Is the organic fraction of concern pre-treated before its treatment?

Yes, the pre-treatment occurs, the organic fraction has impurity rate between 2% and 16%

After the organic waste has been collected and sorted, are there remaining impurities? If yes tick the box, otherwise tick 2 times the box, to leave it empty.

Which fraction (%) of impurities is remaining?

10

If you know the information, specify or estimate the waste composition after being collected and sorted. If you don't know, leave it as is.

Organic fraction (%)

90

Plastic impurities (%)

2

Is the biowaste flow available continuously and in regular quantity throughout the year? If yes tick the box, otherwise tick 2 times the box, to leave it empty.

Which amount of the selected organic waste, in tons, is generated in total, annually?

20000

If the feedstock organic waste was not used as raw material for the technology, it could be landfilled. Are you ready to accept equivalent, lower or higher costs for a better valorisation of organic waste than the landfill tax?

Higher

Does the feedstock availability and/or its supply chain is exclusively local (from the urban area or region of concern) or is it larger (multi-regional, country, international)?

Exclusively local

Please describe how the organic waste under consideration is currently managed, by associating percentage to each valorisation or treatment options:

High value value products from biorefinery (materials / chemicals recycling)

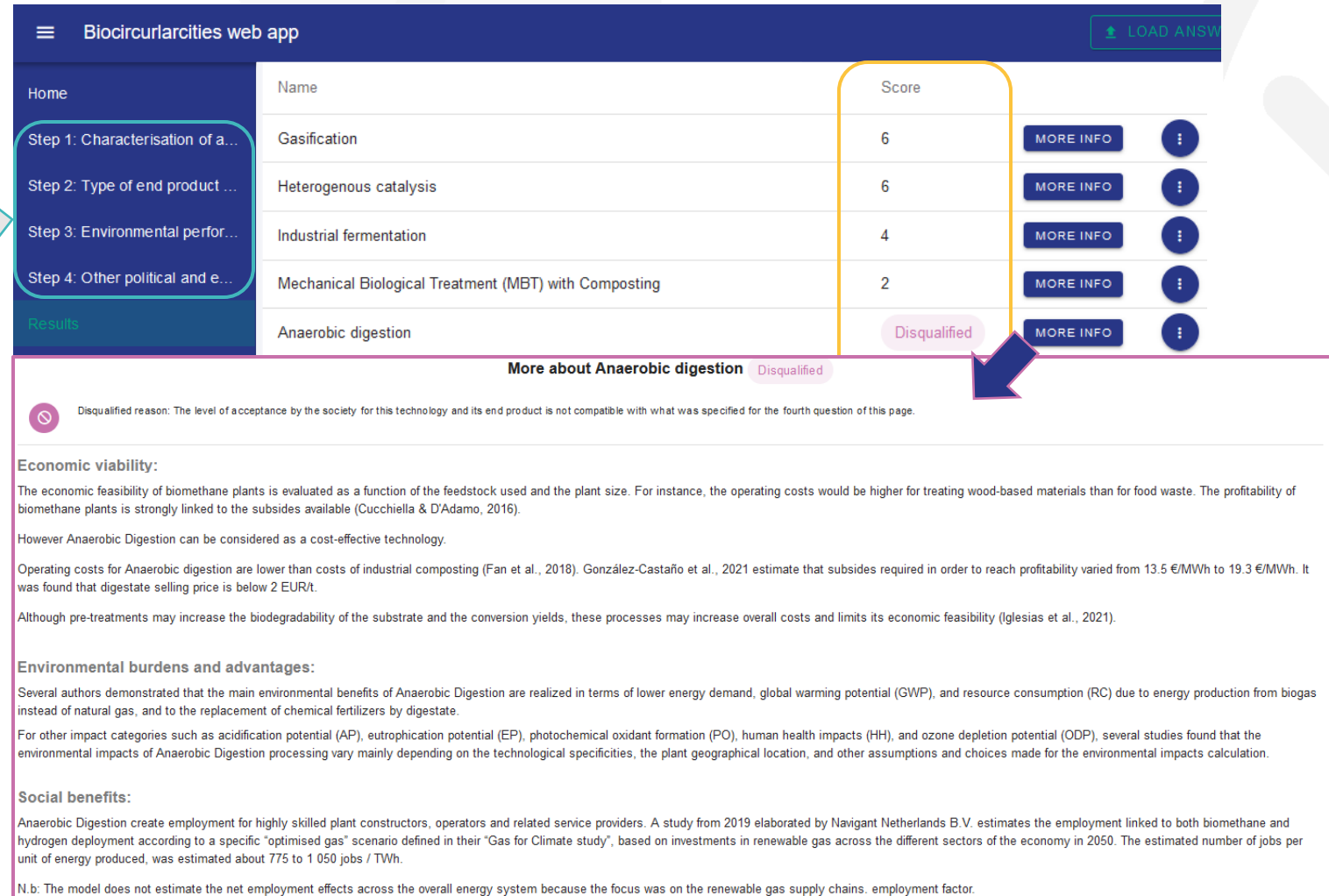
BCC webtool: database and results

BACKGROUND DATABASE for technology selection

- Valorisation technologies portfolio
- Significant technical parameters
- Associated EU policy framework
- Significant environmental & economic parameters
- Data for sustainability comparisons

RESULTS: Ranking of the 14 integrated technologies, depending on the:

- Type, quantity and quality of feedstock
- Specification of environmental performances
- Available political and economic incentives
- Job creation potential
- The possibility to recycle/recover/reuse a product (end-of-life stage) etc.



The screenshot shows the 'Biocircularcities web app' interface. On the left, a navigation menu lists 'Home', 'Step 1: Characterisation of a...', 'Step 2: Type of end product ...', 'Step 3: Environmental perfor...', 'Step 4: Other political and e...', and 'Results'. The main content area displays a table of technologies with their scores and 'MORE INFO' buttons. The 'Anaerobic digestion' entry is highlighted as 'Disqualified'.

Name	Score	More Info
Gasification	6	MORE INFO
Heterogenous catalysis	6	MORE INFO
Industrial fermentation	4	MORE INFO
Mechanical Biological Treatment (MBT) with Composting	2	MORE INFO
Anaerobic digestion	Disqualified	MORE INFO

More about Anaerobic digestion Disqualified

Disqualified reason: The level of acceptance by the society for this technology and its end product is not compatible with what was specified for the fourth question of this page.

Economic viability:
The economic feasibility of biomethane plants is evaluated as a function of the feedstock used and the plant size. For instance, the operating costs would be higher for treating wood-based materials than for food waste. The profitability of biomethane plants is strongly linked to the subsidies available (Cucchiella & D'Adamo, 2016).
However Anaerobic Digestion can be considered as a cost-effective technology.
Operating costs for Anaerobic digestion are lower than costs of industrial composting (Fan et al., 2018). González-Castaño et al., 2021 estimate that subsidies required in order to reach profitability varied from 13.5 €/MWh to 19.3 €/MWh. It was found that digestate selling price is below 2 EUR/t.
Although pre-treatments may increase the biodegradability of the substrate and the conversion yields, these processes may increase overall costs and limits its economic feasibility (Iglesias et al., 2021).

Environmental burdens and advantages:
Several authors demonstrated that the main environmental benefits of Anaerobic Digestion are realized in terms of lower energy demand, global warming potential (GWP), and resource consumption (RC) due to energy production from biogas instead of natural gas, and to the replacement of chemical fertilizers by digestate.
For other impact categories such as acidification potential (AP), eutrophication potential (EP), photochemical oxidant formation (PO), human health impacts (HH), and ozone depletion potential (ODP), several studies found that the environmental impacts of Anaerobic Digestion processing vary mainly depending on the technological specificities, the plant geographical location, and other assumptions and choices made for the environmental impacts calculation.

Social benefits:
Anaerobic Digestion create employment for highly skilled plant constructors, operators and related service providers. A study from 2019 elaborated by Navigant Netherlands B.V. estimates the employment linked to both biomethane and hydrogen deployment according to a specific "optimised gas" scenario defined in their "Gas for Climate study", based on investments in renewable gas across the different sectors of the economy in 2050. The estimated number of jobs per unit of energy produced, was estimated about 775 to 1 050 jobs / TWh.

N.b: The model does not estimate the net employment effects across the overall energy system because the focus was on the renewable gas supply chains. employment factor.

Why and how to unlock a local and circular bioeconomy – Barriers and solutions

