Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

Tools for Resource Efficiency and GHG Mitigation: Industrial Symbiosis and Resources Audit

ENEA Headquarter Rome, Lungotevere Thaon de Revel, 76

LCS-R net 11th Annual Meeting 17/10/2019

Ms. Erika Mancuso – Resources Valorization Laboratory

Resource efficiency and the low-carbon society

Priority objective 2 of the 7th Environment Action Programme (EU, 2013) identifies the need to 'turn the Union into a resource-efficient, green, and competitive low-carbon economy'.

Resource efficiency and the low-carbon society have emerged as central themes in global discussions on the transition to a green economy (OECD, 2014; UNEP, 2014b).

->*Toward* 8th EAP

Council of the European Union

Brussels, 4 October 2019
(OR. en)

12795/19

ENV 827
DEVGEN 188
ECO 103
SAN 418
PECHE 429
AGRI 482
IND 247
CHIMIE 128
ENER 454
RECH 451
TRANS 469

OUTCOME OF PROCEEDINGS

From:	General Secretariat of the Council
To:	Delegations
Subject:	The 8th Environment Action Programme - Turning the Trends Together - Council conclusions

Resource efficiency and Circular Economy

More circularity - Transition to a sustainable society Council conclusions.

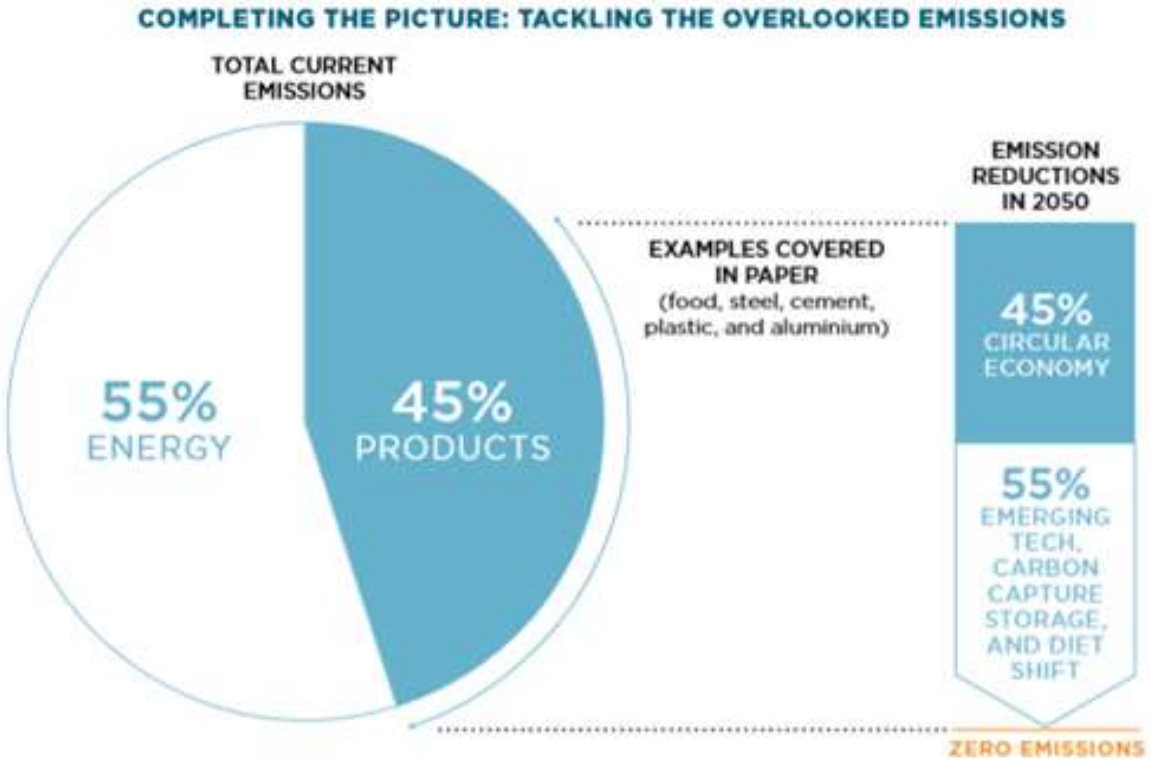
Brussels, 4 October 2019

European Council invites the Commission to present, by the beginning of 2020 at the latest, an ambitious and targeted proposal for the 8th Environmental Action Program (EAP).

In its conclusions, the Council emphasizes that further ambitious efforts are needed to stimulate a systemic transition towards a sustainable society. The circular economy is an important driving force for reducing greenhouse gas emissions, respecting the limits of our planet and achieving the United Nations sustainable development goals.

The conclusions are based on the new EU strategic agenda adopted by the European Council on 20 June 2019, which insists on the urgent need to build a green, fair, social and climate-neutral Europe.

Circular Economy and GHG Emission



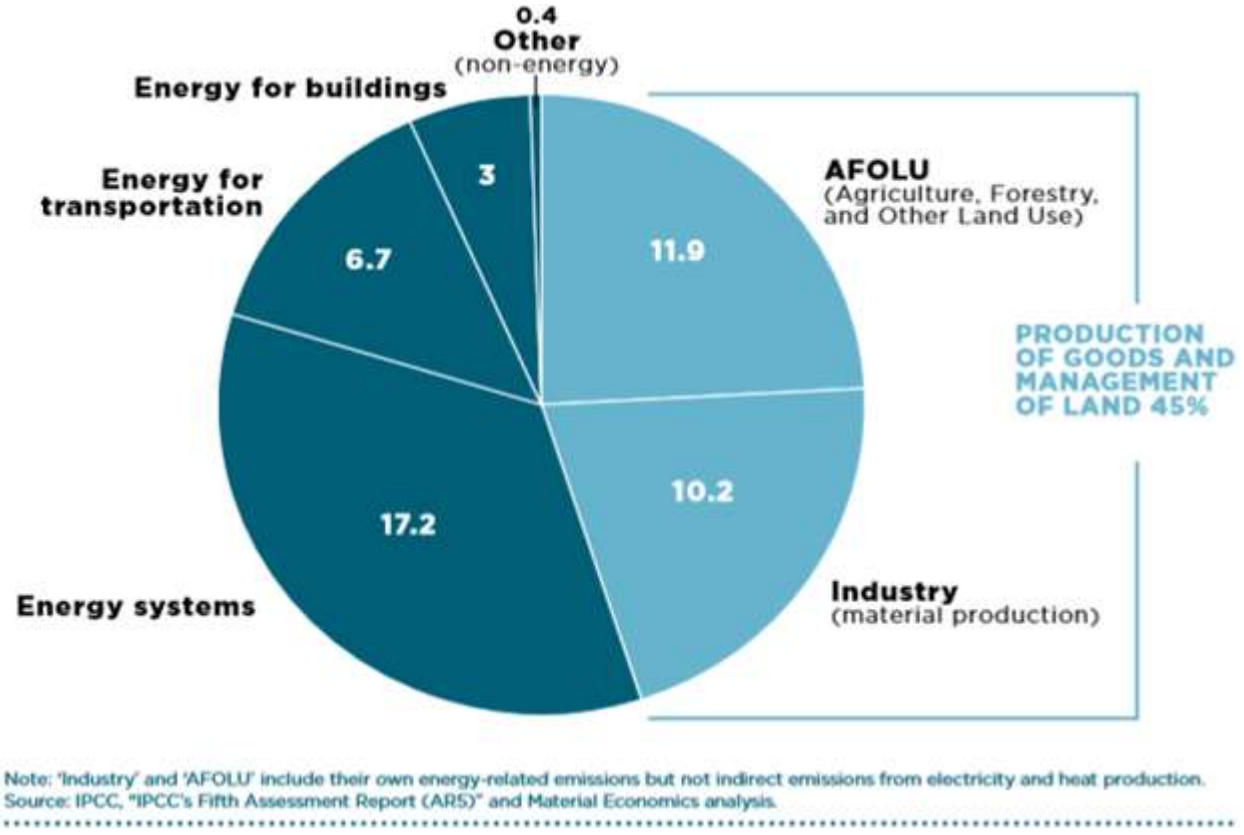
"Today's efforts to combat climate change have focused mainly on the critical role of renewable energy and energy-efficiency measures. However, meeting climate targets will also require tackling the remaining 45% of emissions associated with making products. A circular economy offers a systemic and cost effective approach to tackling this challenge.[1]

1. Completing the Picture: How the Circular Economy Tackles Climate Change (2019) www.ellenmacarthurfoundation.org/publications

Circular Economy and GHG Emission

Global GHG emissions 2010
Billion tonnes of CO_2e per year

45% OF GLOBAL GHG EMISSIONS CAN BE ATTRIBUTED TO THE PRODUCTION OF MATERIALS, PRODUCTS, AND FOOD, AS WELL AS THE MANAGEMENT OF LAND



Note: 'Industry' and 'AFOLU' include their own energy-related emissions but not indirect emissions from electricity and heat production.
Source: IPCC, "IPCC's Fifth Assessment Report (AR5)" and Material Economics analysis.

1. Completing the Picture: How the Circular Economy Tackles Climate Change (2019) www.ellenmacarthurfoundation.org/publications

Circular Economy and GHG Emission

Design out waste and pollution **to reduce GHG emissions** across the value chain

Resources Audit is based firstly on the analysis of input-output resources used and produced by a company and then on the investigation of possible options to optimize them, by having sensitive emission reductions

Keep products and materials in use **to retain the embodied energy** in products and materials

Industrial symbiosis is a form of brokering to bring companies together in innovative collaborations, finding ways to use resources from one as raw materials for another. By preserving the energy originally used for those materials.

Source of Images: Completing The Picture How The Circular Economy Tackles Climate Change Ellen Macarthur Foundation (2019)

Circular Economy and GHG Emission

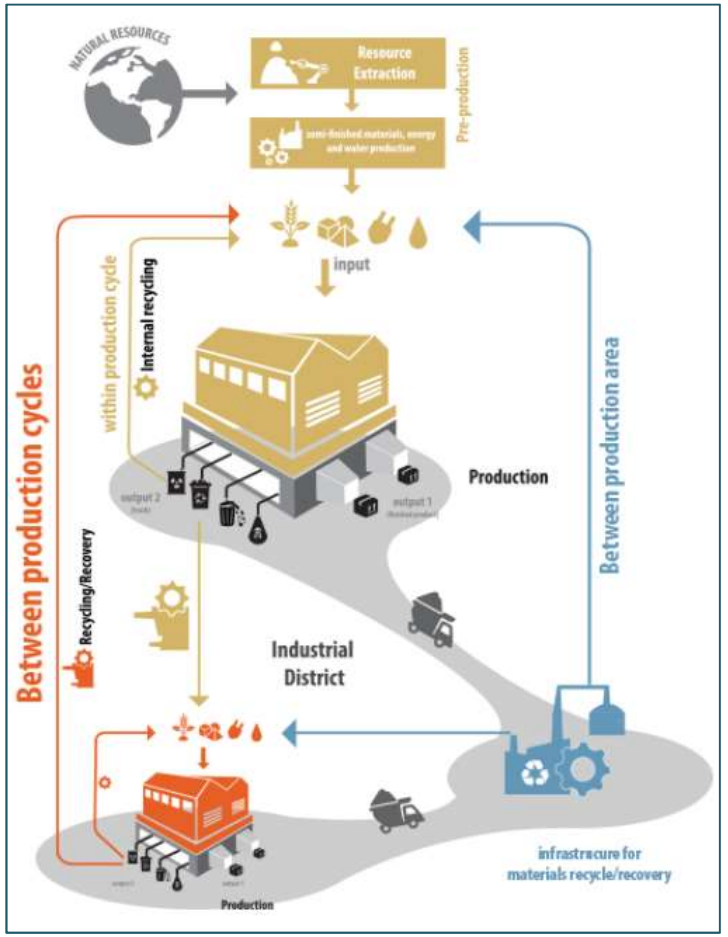
Circular economy represents a radical paradigm shift from the linear economy model and also supports the development of new sustainable business models, with the final aim to increase both the potential for closed-loop productive systems and the resource efficiency in a territory. Implementation tools could be:

- The audit of resources is focused on the inventory and optimisation of input and output resources used and/or produced.

- Industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water and by-products (Chertow, 2000)

Industrial Symbiosis

- The essence of IS as a tool for innovative green growth: IS engages diverse organizations in a network to foster eco-innovation and long-term culture change.[1]
- Local or wider co-operation in industrial symbiosis can reduce the need for virgin raw material and waste disposal, thereby closing the material loop – a fundamental feature of the circular economy and it can also reduce emissions and energy use and create new revenue streams[2].



1. Redefining Industrial Symbiosis Crossing Academic–Practitioner Boundaries (Lombardi, Laybourn ,2012)
2 https://fissacproject.eu/en/what-is-industrial-symbiosis/

Industrial Symbiosis and resource efficiency tools

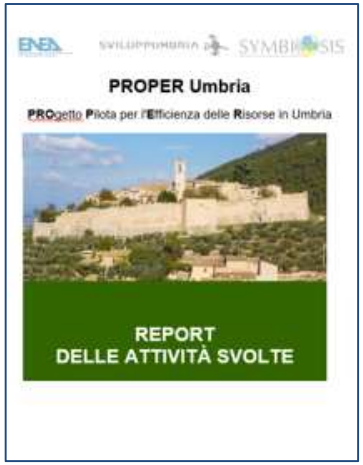
Pilot for the Efficiency of Resources in Umbria "PROPER Umbria" Project developed by Enea and Sviluppumbria Regional Agency for Umbria's competitiveness and economic growth

Two tools developed by Enea to make more efficient productive processes:

- Resource Audit as an internal evaluation to make more efficient the production process
- industrial symbiosis as an external choice for valorize waste, by-product, residues;

PROPER Umbria Project provides to exploit interesting synergies among climate change and resource management policies

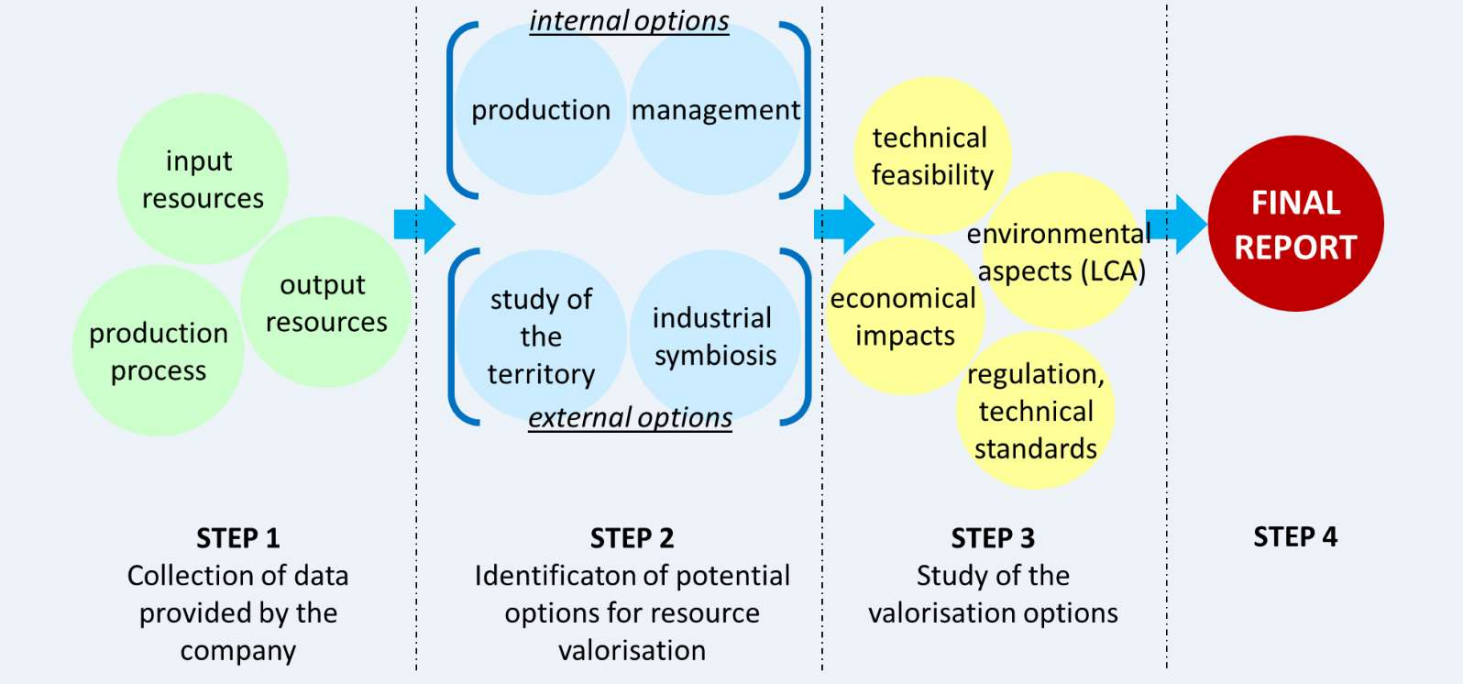
"PROPER Umbria" Project offers an opportunity to carry out a preliminary evaluation of Resource management in terms of Emission reduction



Industrial Symbiosis and resource efficiency tools

- The resources audit has been developed on the basis of an analogy with the energy audit, a well-known methodology which is mandatory in Italy and which, has pushed Italian companies to become more and more energy-efficient

- The main aim of the audit is to save company's resources by means of their optimisation and savings at internal and external level.



Industrial Symbiosis and resource efficiency tools

The resources audit is focused on the inventory, understanding and optimisation of input and output resources used and/or produced by a single entity, such as a company or a part of it.

Non-renewable materials

Material type	Source (ext./int.)	Resources (commercial name)	Quantity (t)	Quantity (m^3)

Other materials used*

Material type	Source (ext./int.)	Resources (commercial name)	Quantity (t)	Quantity (m^3)

*all forms of materials and components that are part of the final product

Recycled materials

Recycled input materials used	Quantity (t)	Quantity (m^3)

TOTAL input materials used (t, m^3)

TOTAL recycled input materials used (t, m^3)

TOTAL WEIGHT OF WASTE BY TYPE AND DISPOSAL METHOD

WEIGHT OF TRASPORTED, IMPORTED, EXPORTED, OR TREATED WASTE DEEMED HAZARDOUS UNDER THE TERMS OF THE BASEL CONVENTION ANNEX I, II, III, AND VIII, AND PERCENTAGE OF TRASPORTED WASTE SHIPPED INTERNATIONALLY

Description of waste	Waste type	Phisical state	Destination of waste	Total weight waste(kg)	Description of waste	Type of waste	Destination of waste	Total weight hazardous waste (kg)

(*)= to specify the frequency of the controls, dates last control laboratory that effects the controls

TOTAL WATER DISCHARGE BY QUALITY AND DESTINATATION

Type of water discharges (*)	Destination	Declared?	Treated?	Treatment process	Whether it was reused by another organization	Total water discharge (m^3/year)	Possible changes to reduce the quantities of water discharges during future productive cycles

(*)= escluding collected rainwater and domestic sewage

TOTAL WATER DISCHARGE	

Energy and material Flows counted by Resource Audit methodology

ENEA

Industrial Symbiosis and resource efficiency tools

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	Aspects							
	Organisation profile	**Materials**	**Energy**	**Water**	**Emissions**	**Effluents and Waste**	**Products and services**	**Transport**
INDICATORS	- Name - Primary brands, products, services - Location - Headquarters - Number and names of countries where it operates or has significant operations - Nature of ownership and legal form - Markets served - Scale (employees, operations) - Supply chain - Quantity of products or services provided	- Materials used - Percentage of materials used that are recycled input materials	- Energy consumption outside of the organisation - Energy consumption within the organisation - Energy intensity - Reduction of energy consumption - Reductions in energy requirements of products and services	- Total water withdrawal by source - Water sources significantly affected by withdrawal of water - Percentage and total volume of water recycled and reused	- Direct-greenhouse gas (GHG) emissions - Energy indirect GHG emissions - GHG emissions intensity - Reduction of GHG emissions - Emissions of ozone depleting substances (ODS)	- Total water discharge by quality and destination - Total weight of waste by type and disposal method - Weight of transported, imported, exported, or treated waste - Percentage of transported waste shipped internationally	- Extent of impact mitigation of environmental impacts of products and services - Percentage of products sold and their packaging materials	- Significant environmental impacts of transporting products and other goods and materials for the organization's operations - Significant environmental impacts of transporting members of the workforce

Main indicators counted by the resource audit methodology

Industrial Symbiosis and resource efficiency tools

In the methodology, the environmental impacts and the potential advantages related to more efficient resource use and resource management is estimated by means of life-cycle based methods and tools, such as ISO LCA method (ISO 2006), based on Life Cycle Thinking (LCT) approach, which can identify the main environmental burdens of the current resource use at company level and the possible benefits obtained by the implementation of industrial symbiosis paths.

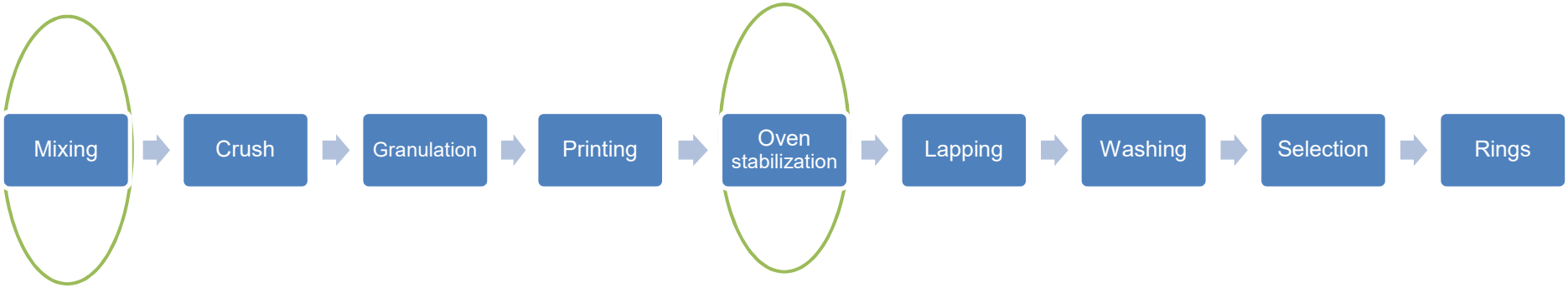
The holistic approach of LCA method can efficiently support the evaluation of the environmental performance of symbiotic systems because it includes the whole supply chain.

An accurate diagnosis of the resources that go through the production cycle useful for a monitoring plan at company level.

Industrial Symbiosis and resource efficiency case study

CASE STUDY: The production process for making the coal rings

Multinational Company from mechanical sector
Mechanical seals for Standard Duty



Industrial waste processed: industrial sludge mixed industrial dust

Industrial Symbiosis and resource efficiency case study

INDUSTRIAL SLUDGE

- Valorization in an anerobic digestion plant for the production of biogas
- Valorization in cement plants for energy production
- Valorization as a filler for bituminous conglomerates
- Valorization for the production of cements, bricks and bricks

INDUSTRIAL POWDERS

- Reuse as material recovery upstream of the production process
- Valorization as secondary solid fuel in cement plants
- Valorization as a filler for bituminous conglomerates

Industrial Symbiosis and resource efficiency case study

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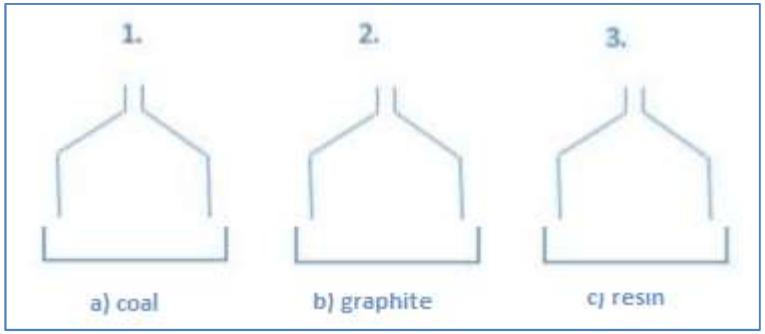
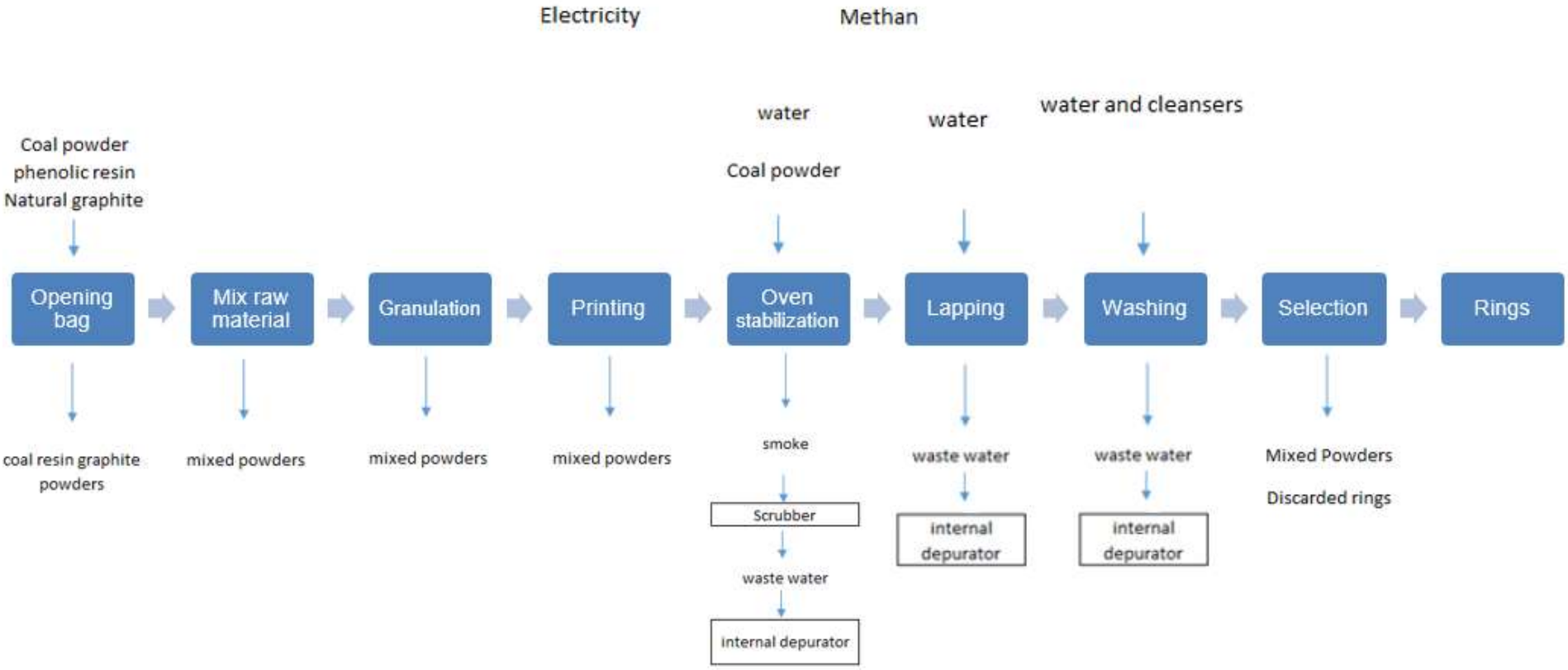
Industrial Symbiosis and resource efficiency case study



SPECIFIC HOODS TO CAPTURE



Industrial Symbiosis and resource efficiency case study

Some economic assessments

Quantity and costs for raw materials, 2018

Raw material	Quantity (t/a)	%	Unit cost (€/t)	Annual cost (€/a)	%
Coal	45	61%	3.500	157.500	61%
Graphite	9	12%	4.500	40.500	16%
Resin	20	27%	3.000	60.000	23%
Total	74	100%		258.000	100%

Potential saving from internal reuse of powders

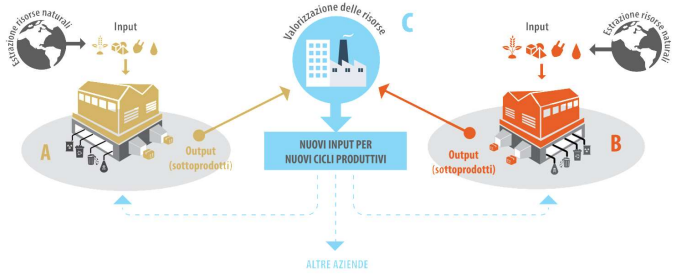
Powders	Raw material supply saving (€/t)	Disposal saving (€/t)	Total savings (€/t)
Coal	3.500	526	4.026
Graphite	4.500	526	5.026
Total			9.052

Industrial Symbiosis and resource efficiency case study

Valorization of mixed powders as secondary solid fuel in cement plants

- ✓ To verify technical feasibility (standards, specifications, etc.)
- ✓ To comply with the laws (administrative obligations, definition of “solid secondary fuel” ...)
- ✓ To involve local institutions (stakeholders, local entities, associations of category
- ✓ To find potentially interested companies (authorized cement plant)

Valorization scenario aims to avoid disposal of industrial dust for a comparative advantage

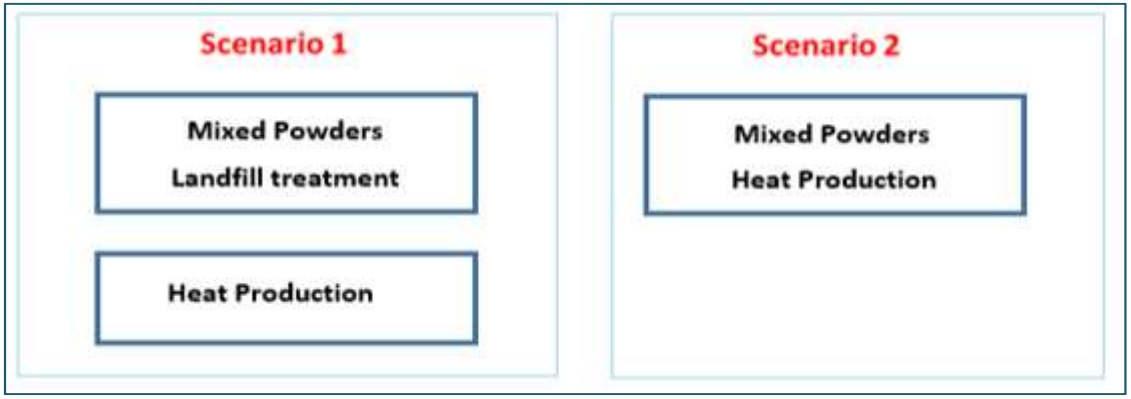


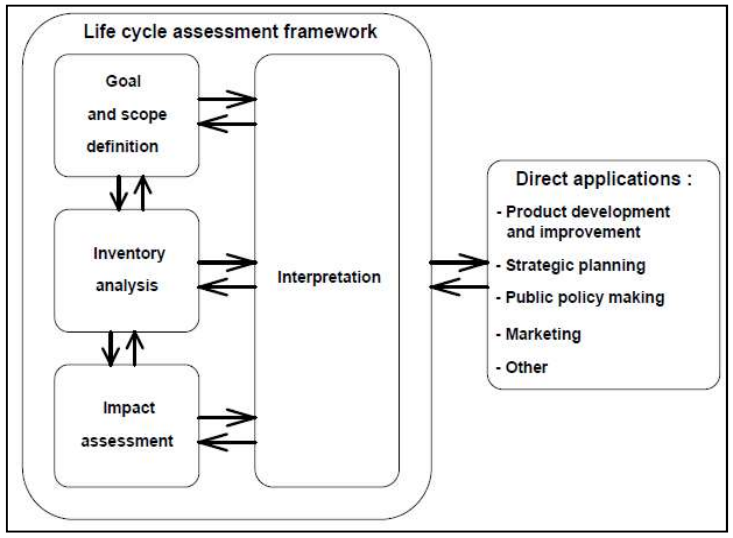
Industrial Symbiosis and resource efficiency case study

Life Cycle Assessment (LCA)

LCA and standard application

(ISO 14040 14044)



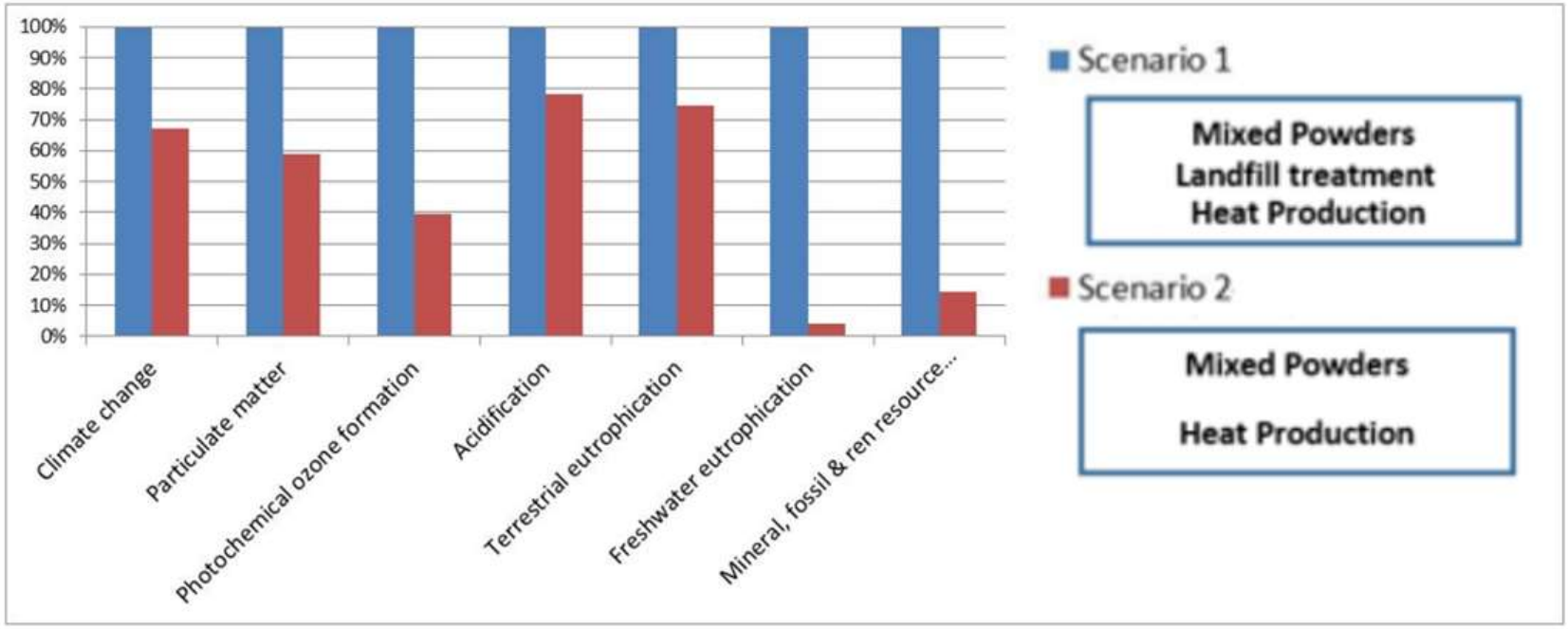


The objective of the study is the comparison of the environmental impacts deriving from the landfill treatment of mixed powders produced by Company (scenario 1) and those deriving from the use of mixed powders as fuel in a cement plant for heat production (scenario 2).

Industrial Symbiosis and resource efficiency case study

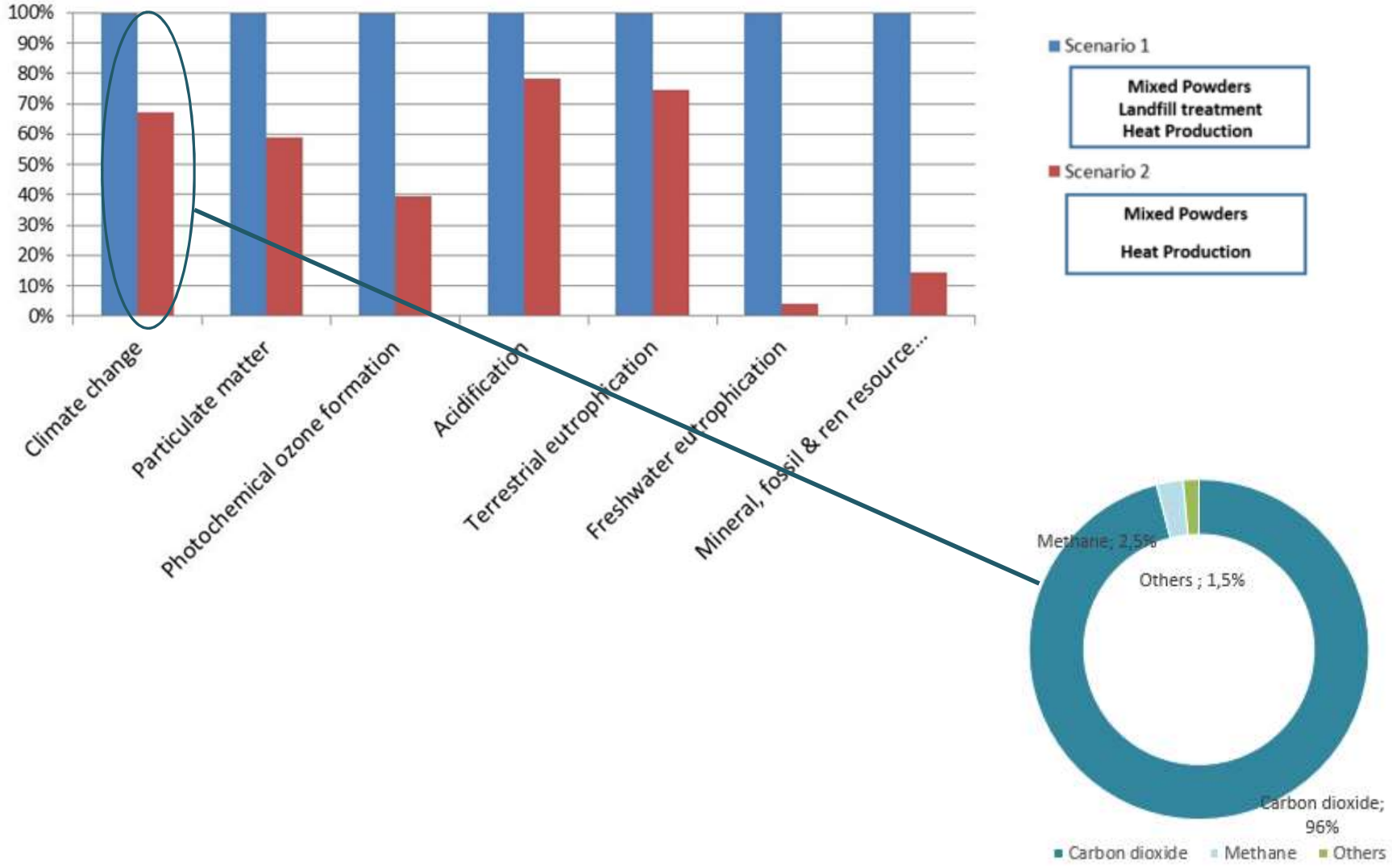
Life cycle analysis (LCA)

Functional unit:11.721 kg mixed powders



The use of mixed powders as a fuel leads to a reduction in environmental impacts ranging from 22% for the category of impact Acidification, to 33% for the category Climate change and to 86% for the category Exhaustion of Mineral and Fossil Resources.

Industrial Symbiosis and resource efficiency case study



Network and Tools for circular economy

Thank you for attention!

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SUN Symbiosis Users Network

RISE

Resources Valorization Laboratory

ENEA