UNIVERSITÀ DEGLI STUDI DI ROMA "TOR VERGATA"

Life Cycle Assessment (LCA) of two different technologies to convert OFMSW into compost: analysis and comparison

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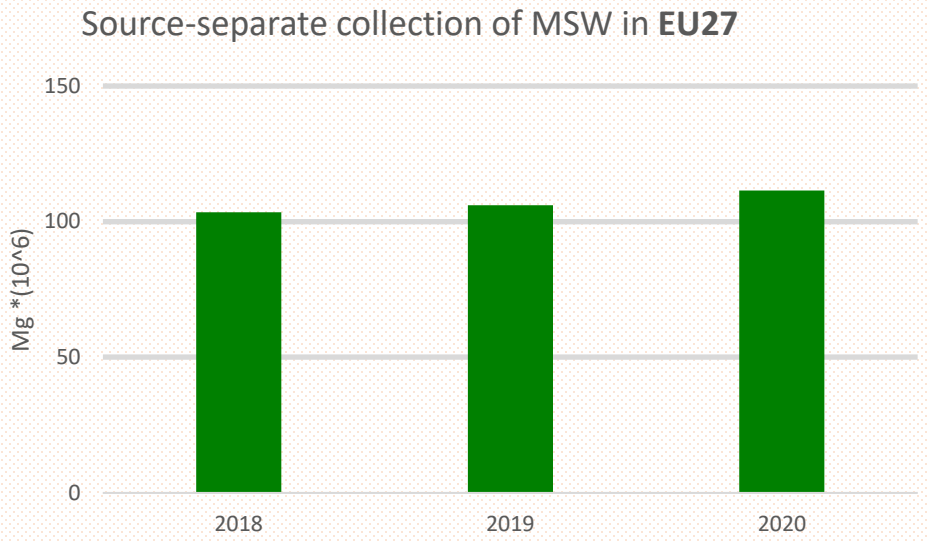
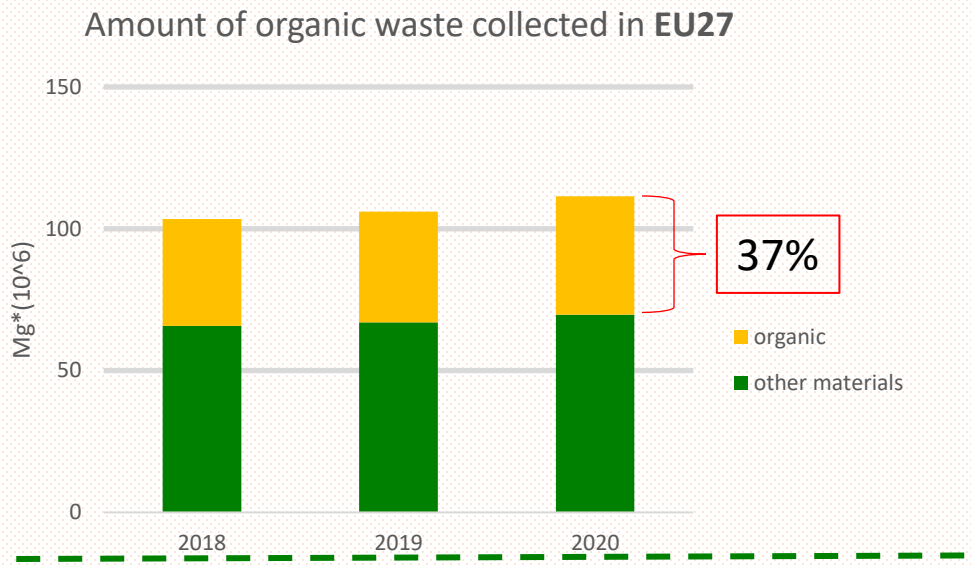
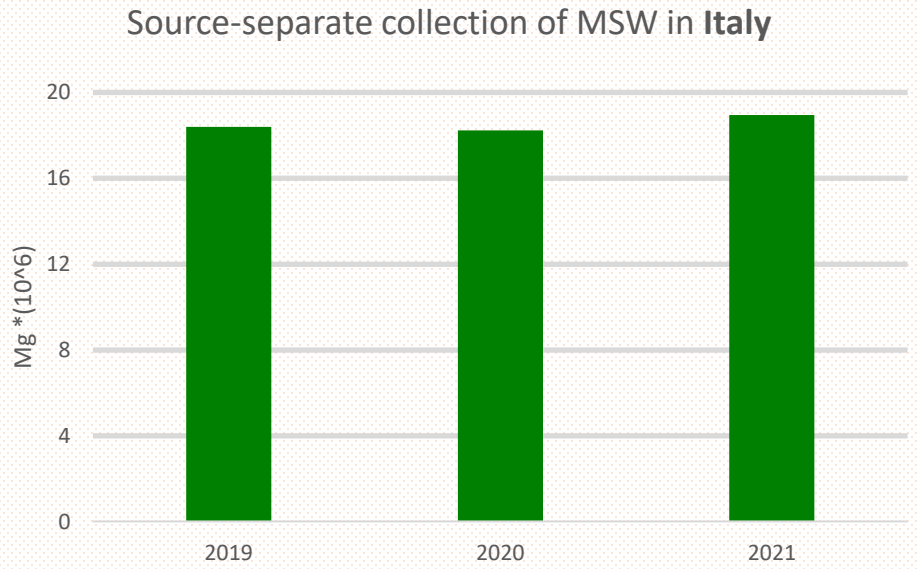
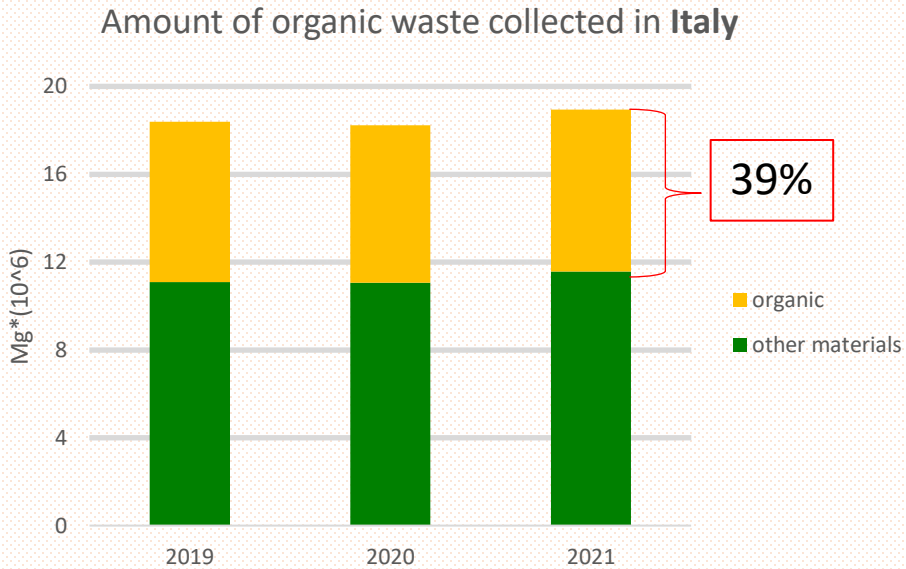
Source-Separated Organic Waste Collection



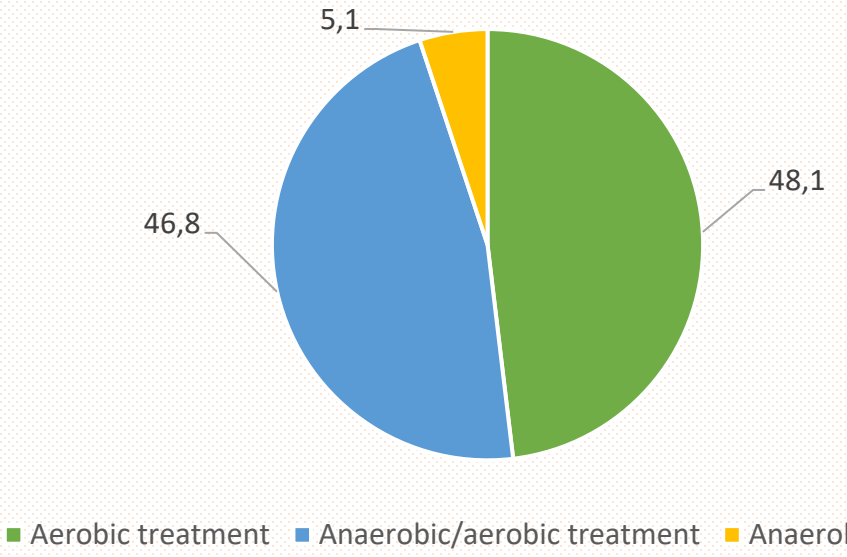






Organic waste treatment in Italy (2021)

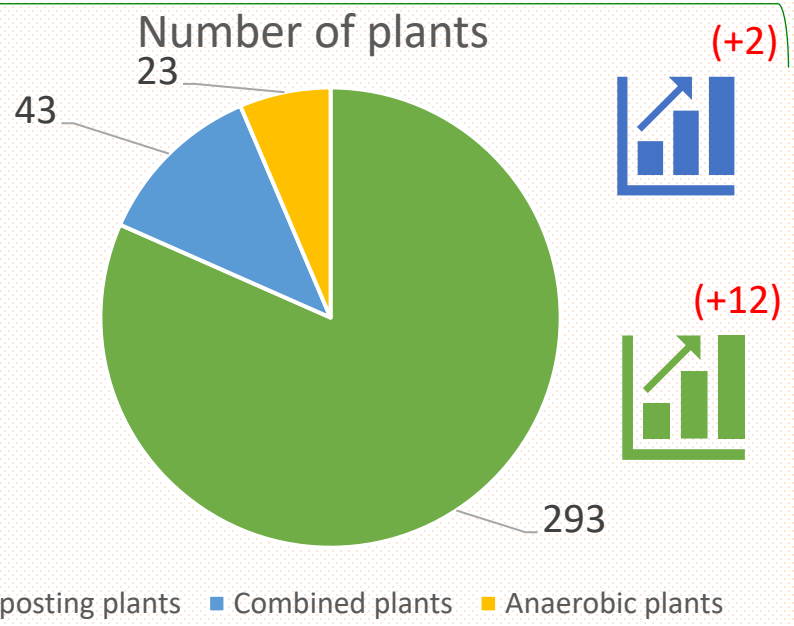
7 million tons of OFMSW treated



Average size

11,000 tons/year

72,000 tons/year



The main products

1,91*10⁶ Mg of compost

5.9*10⁵ Mg of digestate

358 Nm³ of Biogas

Main types of composting technologies

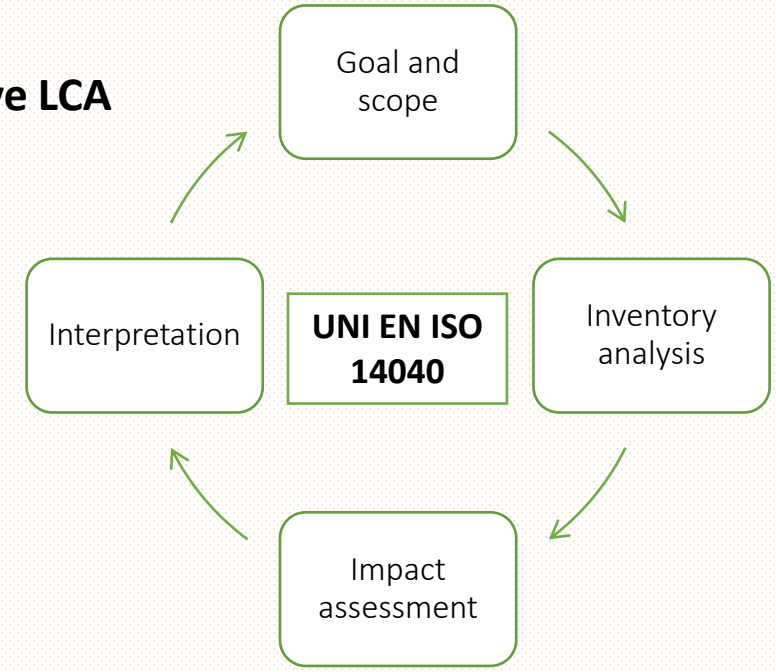
Dynamic windrow process (e.g. Biomax-G®)

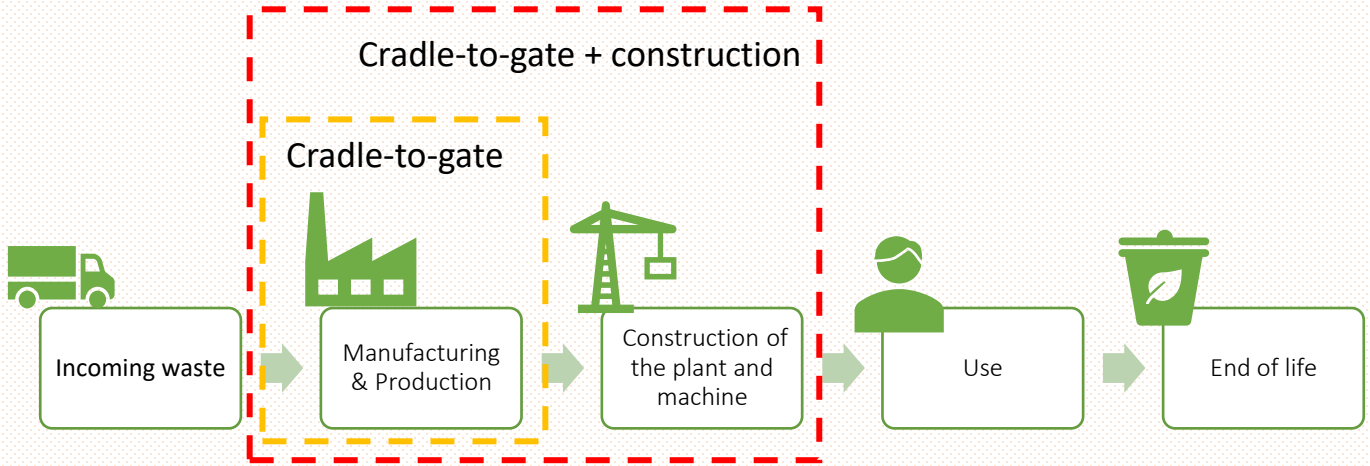
Static in-vessel process (Biocells)

Objective of the study and methodology

Compare the environmental impacts of two composting technologies: the dynamic windrow process and the static in-vessel one for treating OFMSW in a medium size composting plant

Comparative LCA





Database

ecoinvent

System model

Allocation at the point of substitution

Method

ILCD Midpoint 2011+ V1.11/EC-JRC-IES Global, equal weighting

Software

SimaPro

Goal and scope

This study takes into consideration two different scenarios

Scenario n.1:
Dynamic windrow composting process patented by Sorain Cecchini Tecno's (SCT), the Biomax-G®

Scenario n.2:
Static in-vessel composting process, the Biocells

Functional unit:
25,000 t/y OFMSW + 5,000 t/y Lignocellulosic waste (LW)

The two Technologies

Scenario n.1

The Biomax-G®

N.1 reactor designed for 35.000 t/y

102x23 m²

6.5-7 weeks

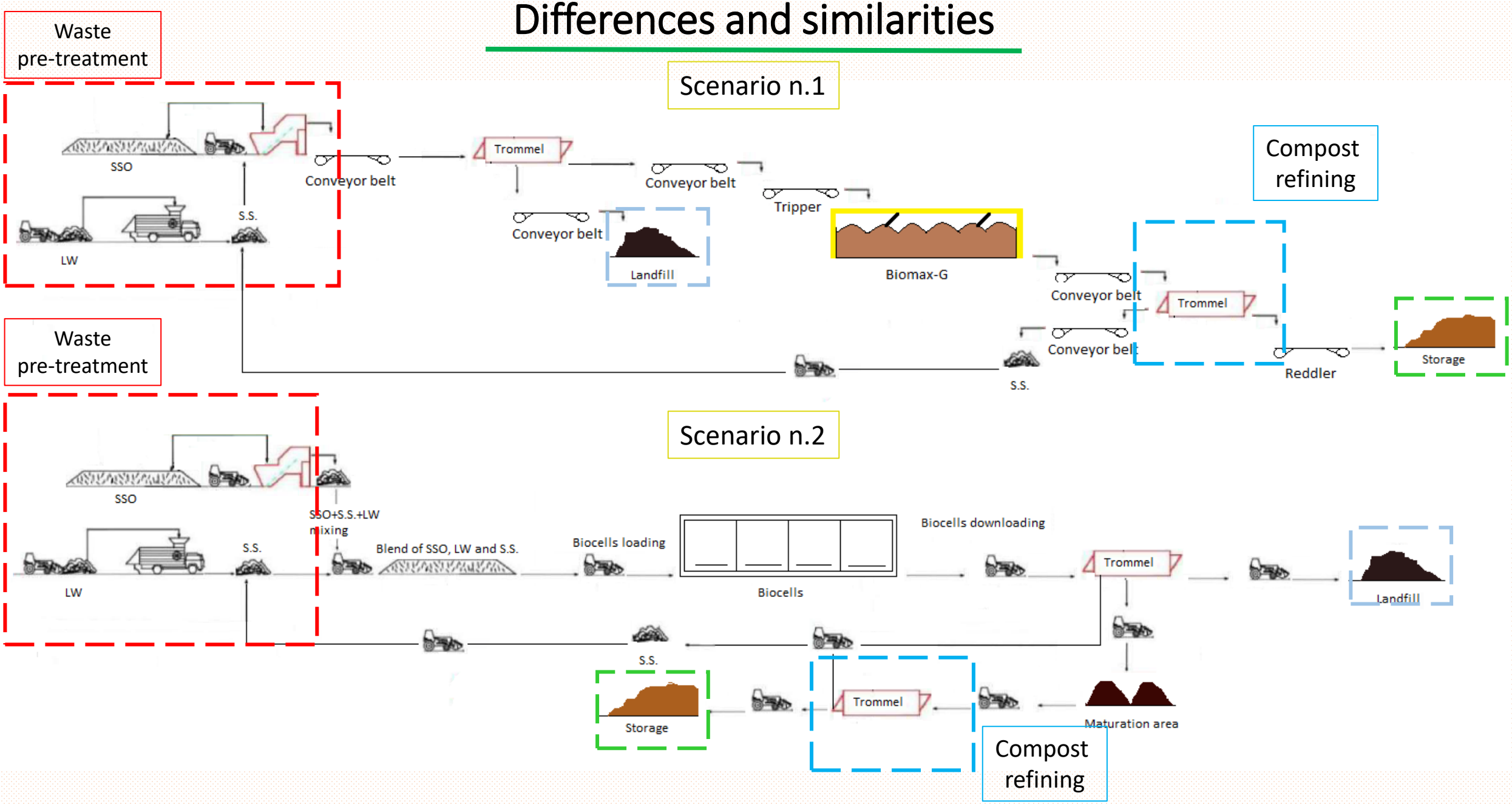
Biomax-G® (single-trolley)

Scenario n.2

The Biocells

N.10 Biocells		Maturation area
10x(30x5) m²	+	3,000 m²
2.5 weeks		11.5 weeks

Differences and similarities



Data sources and collection

Scenario n.1: Biomax-G®

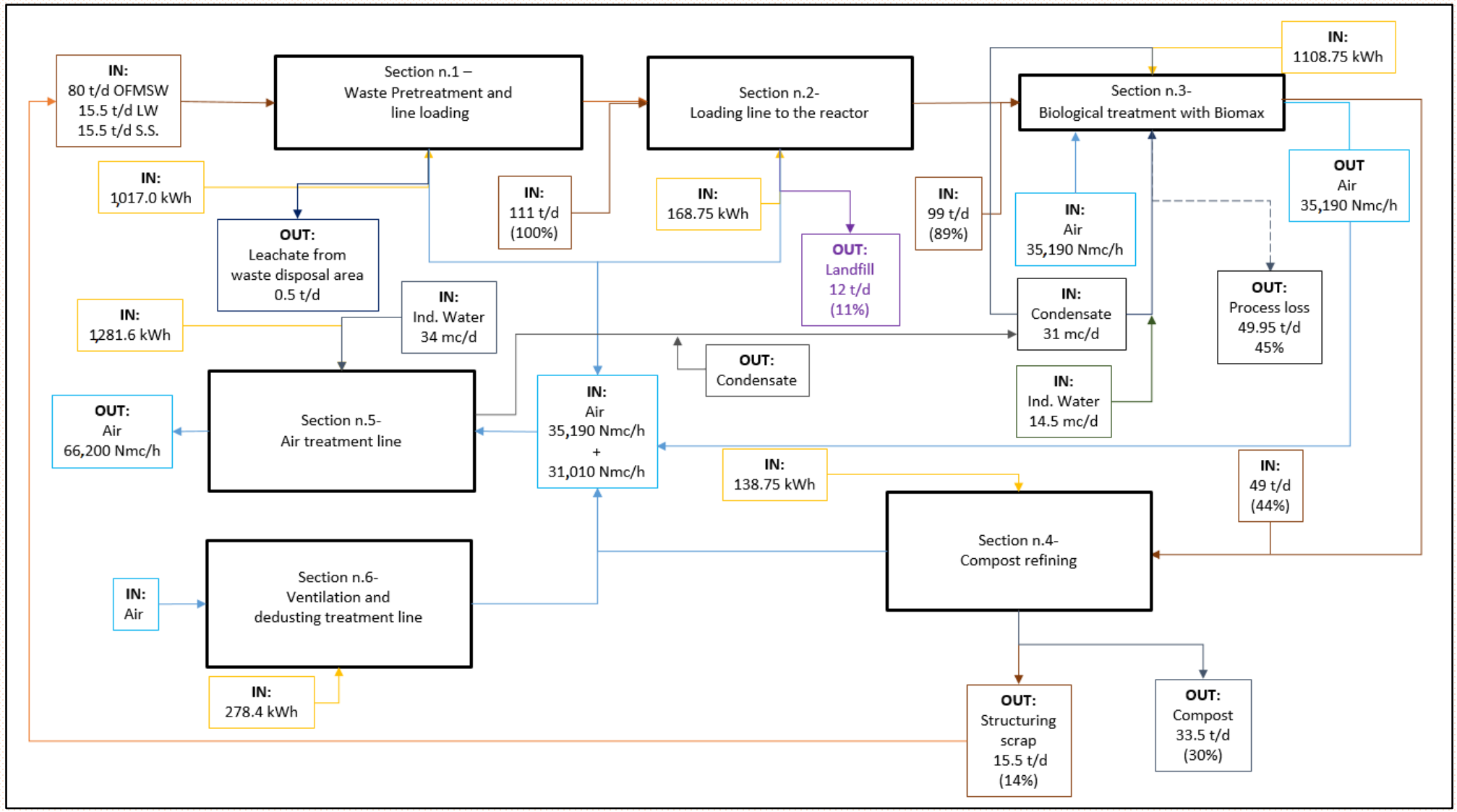
- MCC423 (Electricity consumption)
- JUA230 (Materials needed to build the walls of the reactor)
- MAC183 (Pre-treatment)
- IASI262(Compost refining)
- Field collected data
- Burés Professional (Biofilter: infill material)
- Coparm APR 200 (Catalog)
- Hammel VB450D (Catalog)
- CAT938K (Catalog)
- Sennebogen 818e (Catalog)
- Biolab Technical report (Size of the reactor)
- Simapro® database
- External consultants
- Elaborations and hypotheses

Scenario n.2: Biocells

- Composting plant of Tricase (LE) (Technical report)
- W2M Viterbo (Biocells reinforced concrete walls and front gate)
- https://www.hydros.net/rifiuti/portoni-per-biocelle.html (Biocells front gate)
- MCC 423 (Sections d, e and f)
- Burés Professional (Biofilter: infill material)
- Coparm APR 200 (Catalog)
- Hammel VB450D (Catalog)
- CAT938K (Catalog)
- https://www.ferrariventilatori.com/it-fe/ (Ventilatori da 32kW (Catalog)
- MTB Bellolampo nel comune di Palermo-1° Lotto funzionale (Biocells fans dimension confirmation of 32kWh)
- Simapro® database
- External consultants
- Elaborations and hypotheses

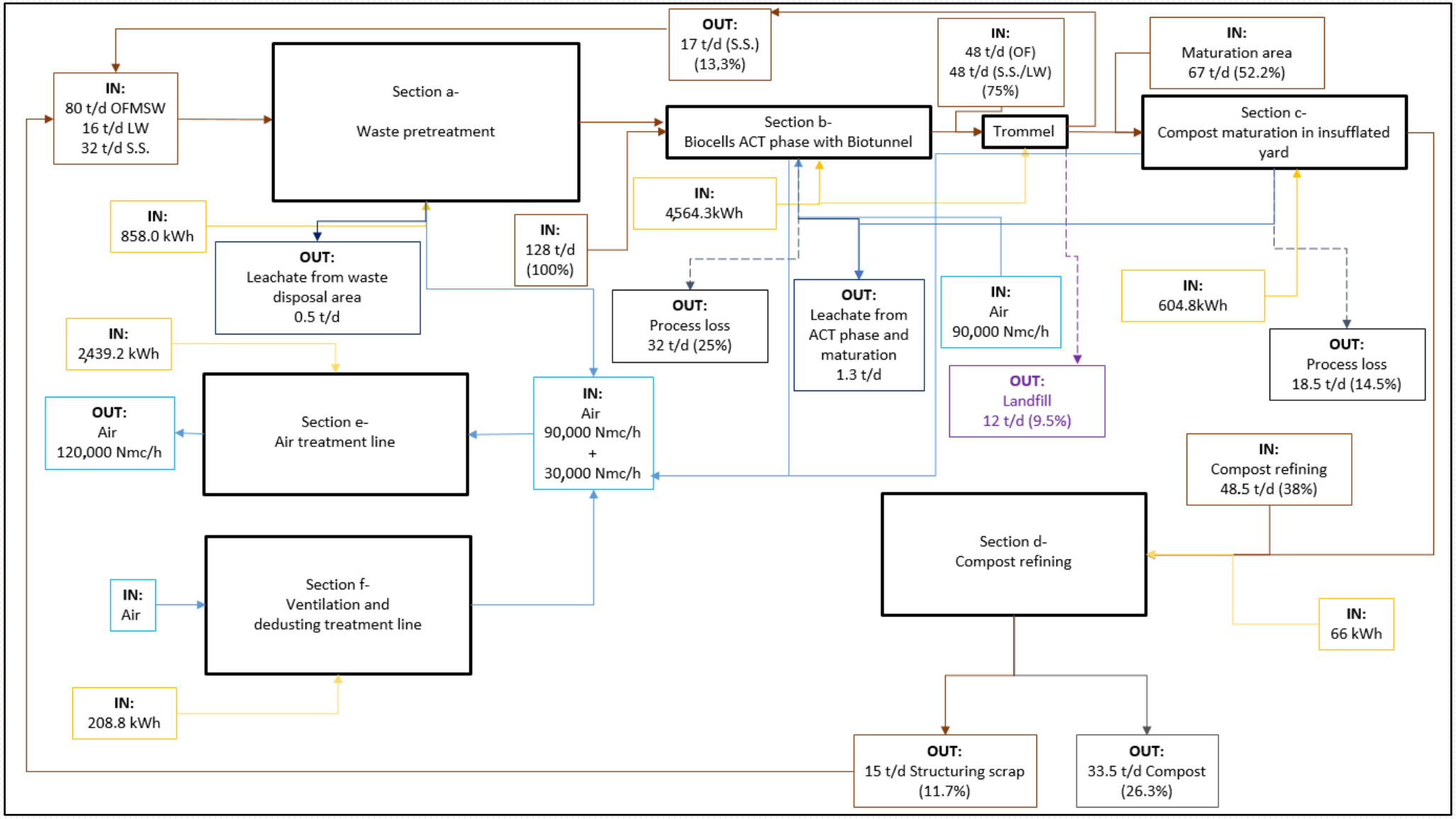
Flow diagram of the plant with Biomax-G® technology

- **Scenario n.1**



Flow diagram of the plant with biocells technology

- **Scenario n.2**

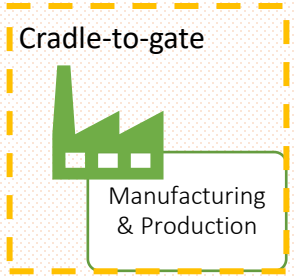


Inventory Analysis

Parameter	Biomax-G®	Biocells
Organic fraction (Mg/y)	25,000	25,000
Lignocellulosic waste (Mg/y)	5,000	5,000
Structuring scraps (Mg/y)	5,000	10,000
Compost annual production amount (Mg/y)	9,000	9,000
Scraps towards to landfill, annual production amount (Mg/y)	3,675	3,675
Biological process duration (d)	50	18+81
Water amount (m^3/d)	31+14,5	1+3
Air amount (Nm^3/h)	35,190	90,000
Production site area (m^2)	16,200	49,000
Biological compartment area (m^2)	2,346	1,500+3,000
Biofilters area (m^2)	500	900
Main structures area (m^2)	5,625	11,025
Main structures + biofilters area (m^2)	6,125	11,925
Biofilters watering: water total amount (m^3/d)	34	5
Biofiltration: air total amount (Nm^3/h)	66,200	120,000
Total annual electricity consumption (kWh)	1,344,751	3,354,874
Electricity consumption-total amount of incoming waste(KWh/t) ratio	39	84

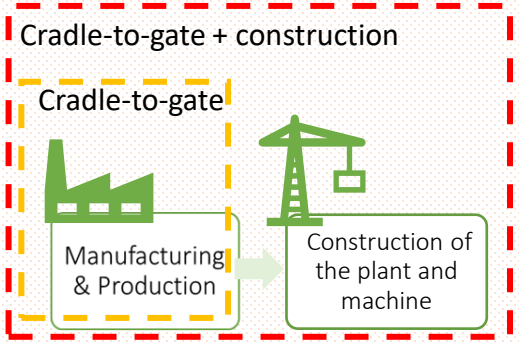
The three phases of the study

Our study takes into consideration the following three phases for each scenarios



Phase n.1:
"Annual ordinary management of the plant (consumption and waste) "

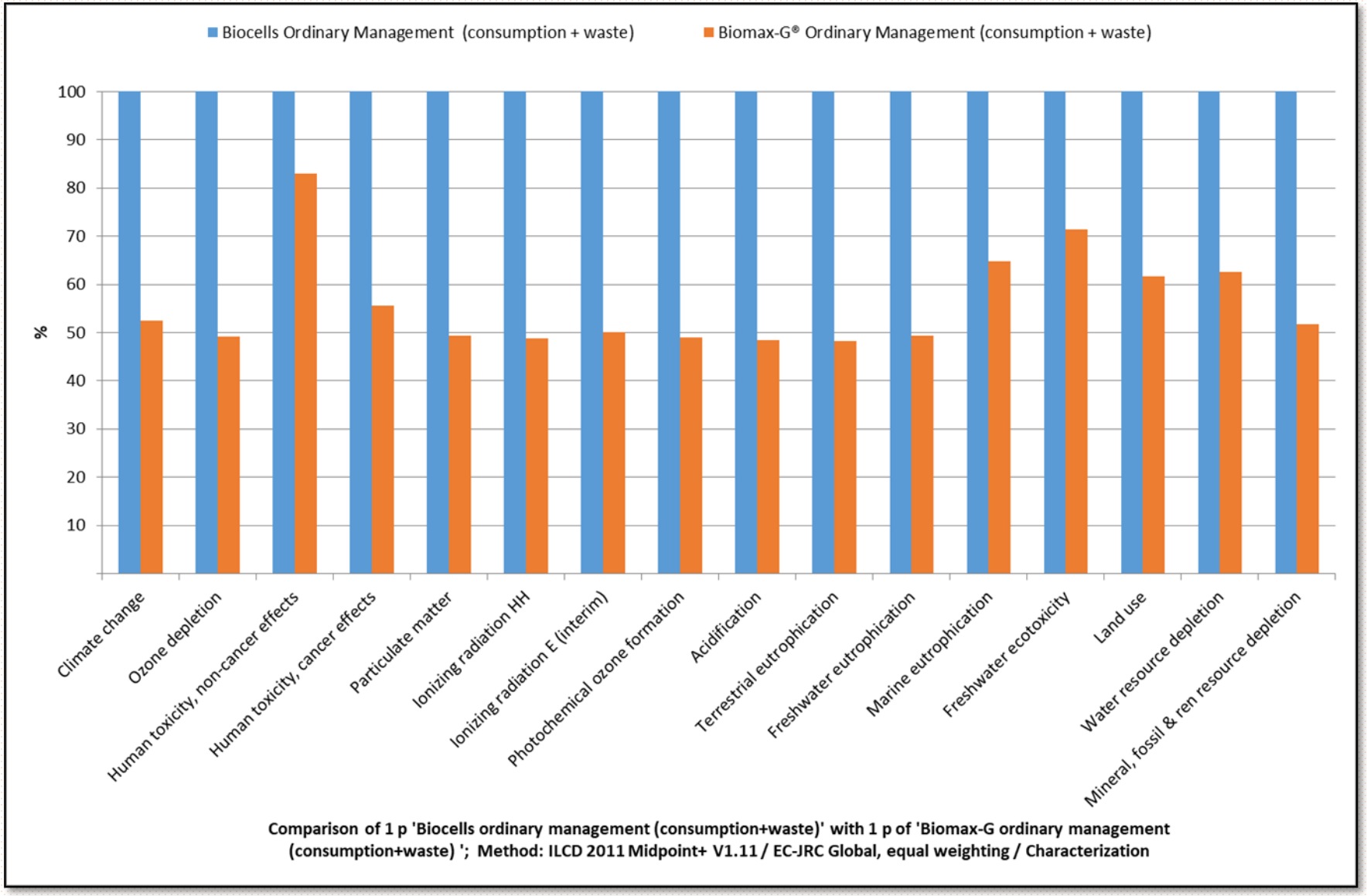
Phase n.2:
"Annual ordinary management of the plant, materials used to build the main machines, the structures and the land use"



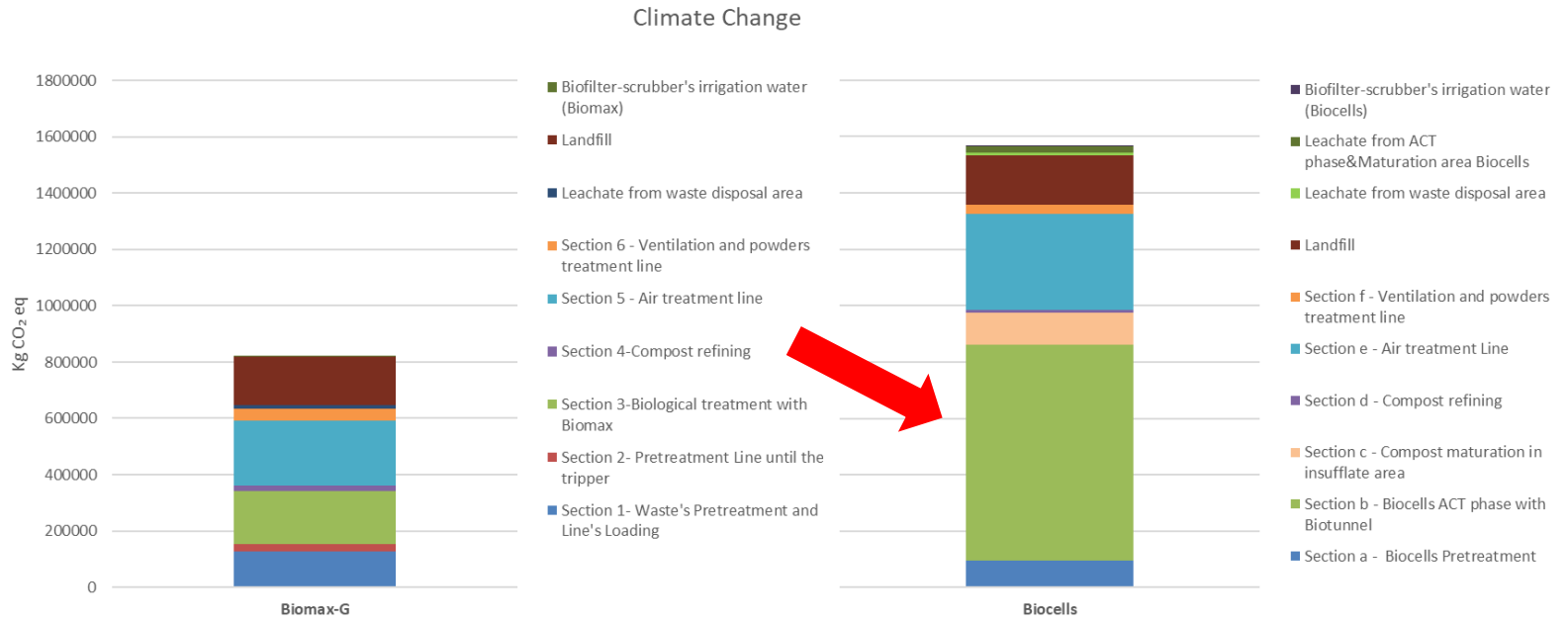
	Use life
Plant main machines	30 years
Structures	50 years
Wheel loader-Waste handler	10,000 h

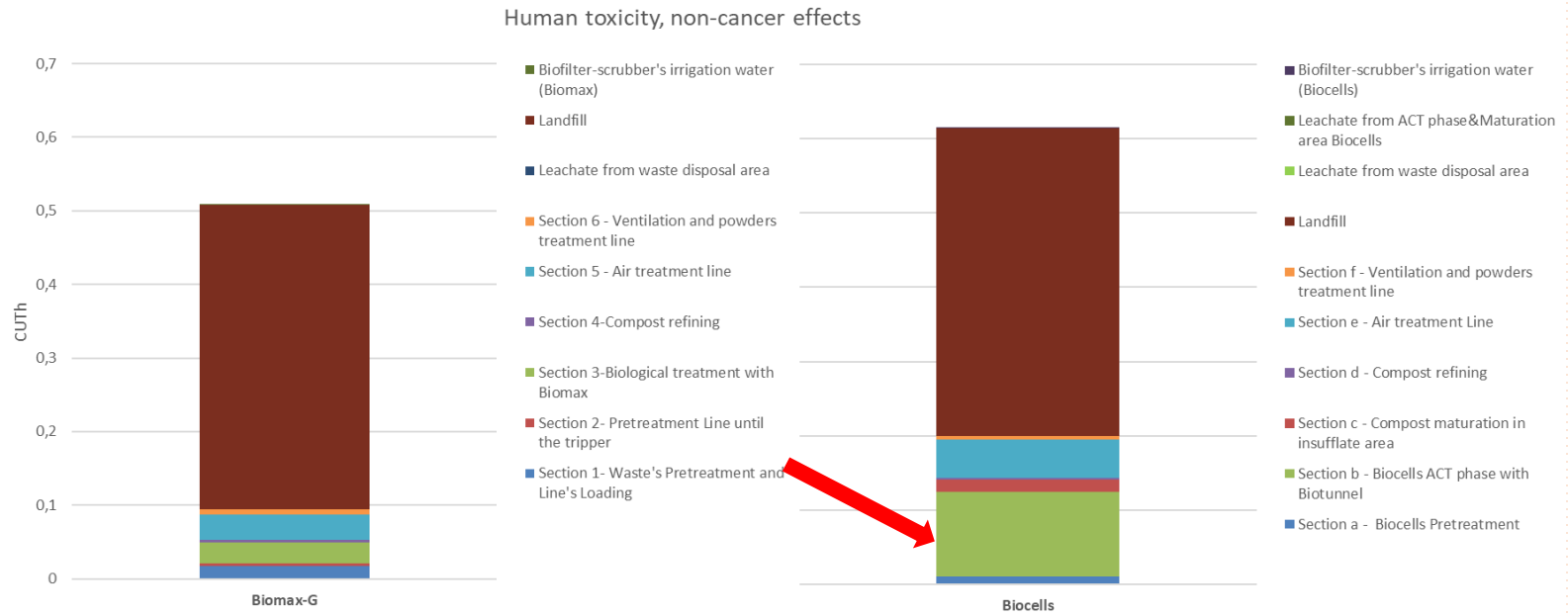
Phase n.3:
"Annual ordinary management of the plant, materials used to build the main machines, the structures, land use and comparison with the avoided production of soil improver from other sources"

Impact assessment: Phase n.1 Characterization

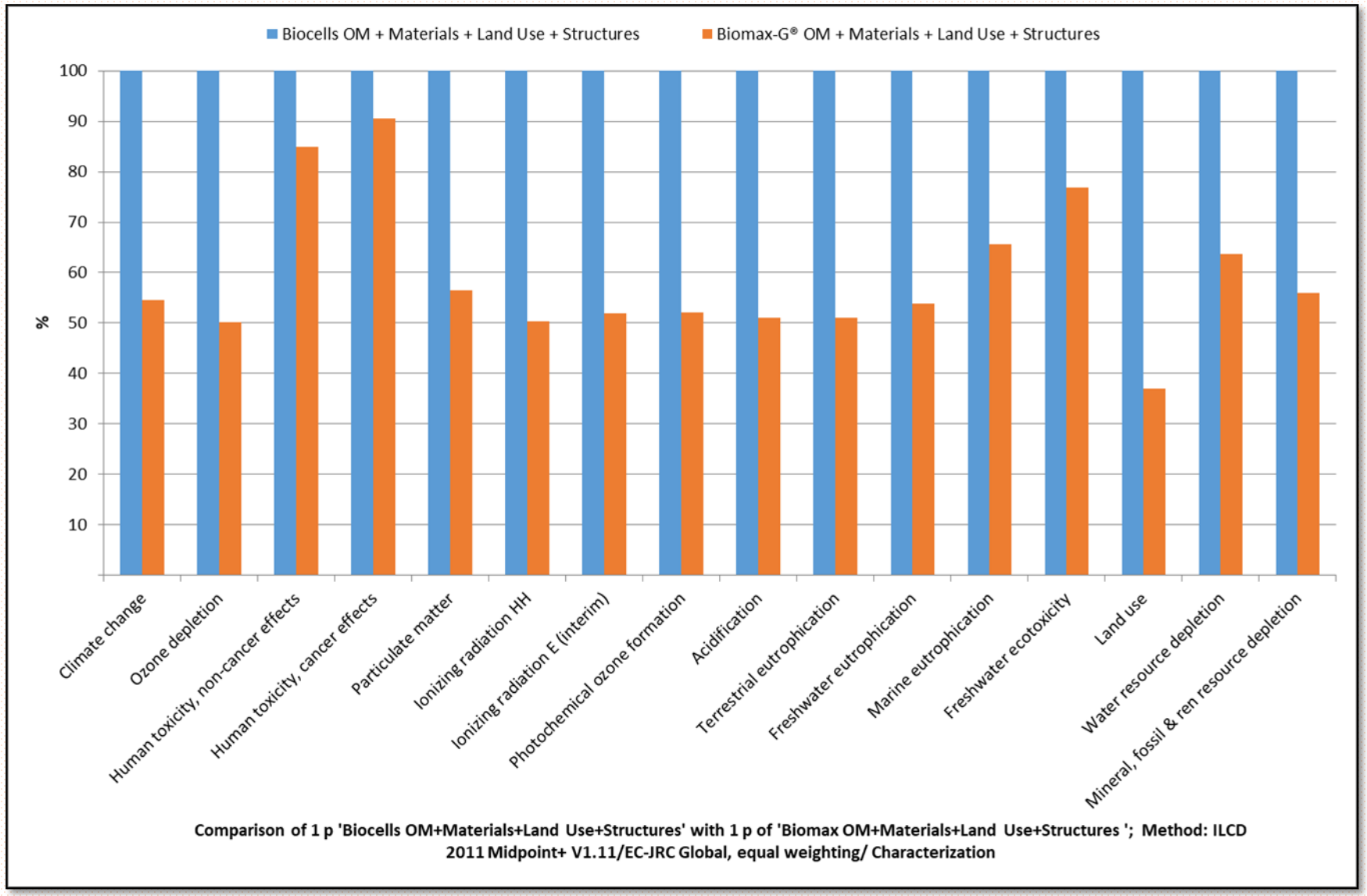


Impact assessment: Phase n.1 comparison

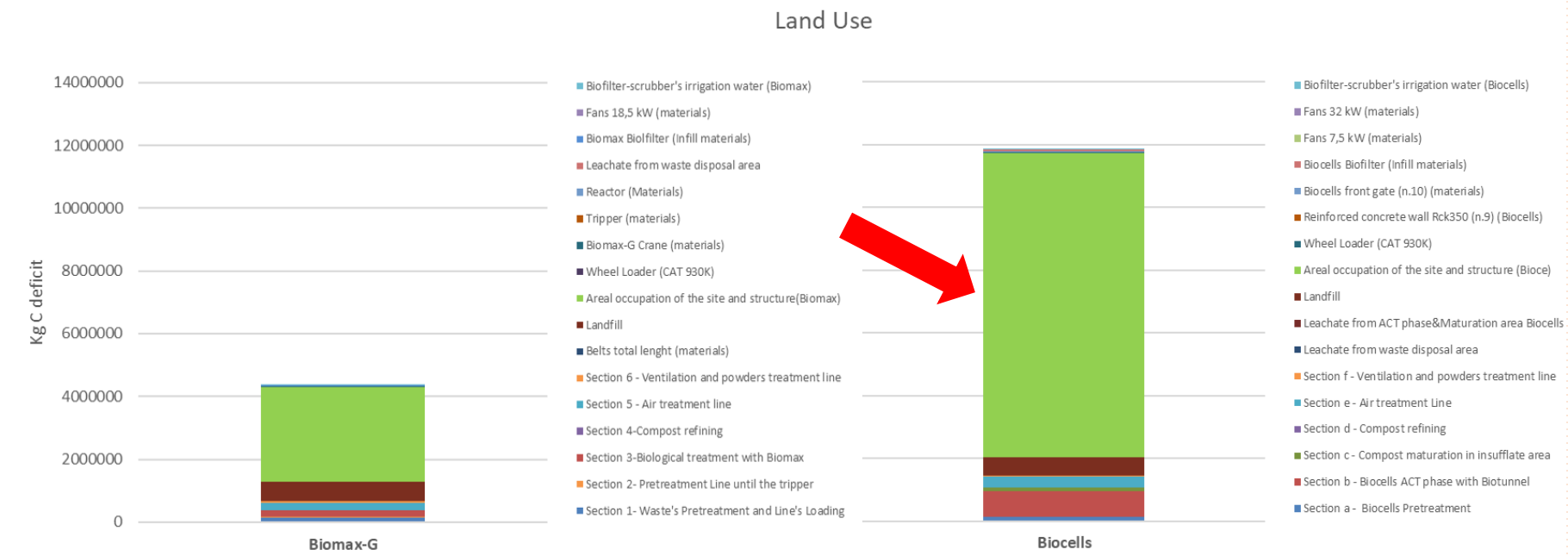


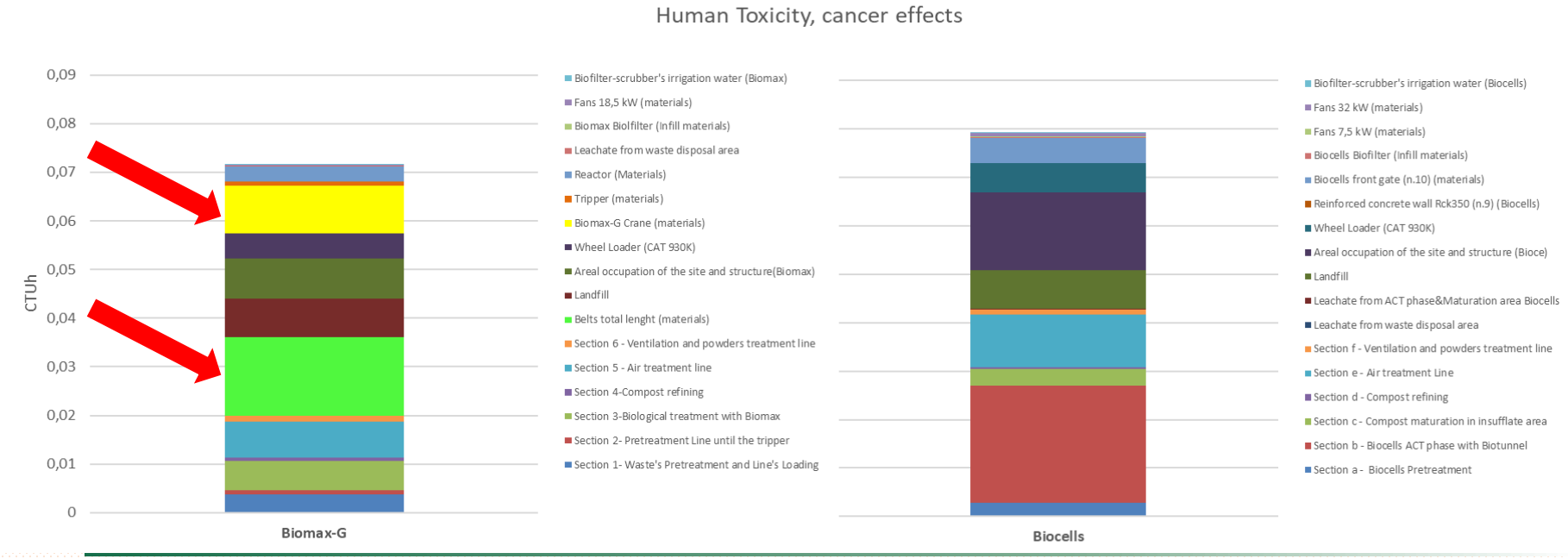


Impact assessment: Phase n.2 Characterization

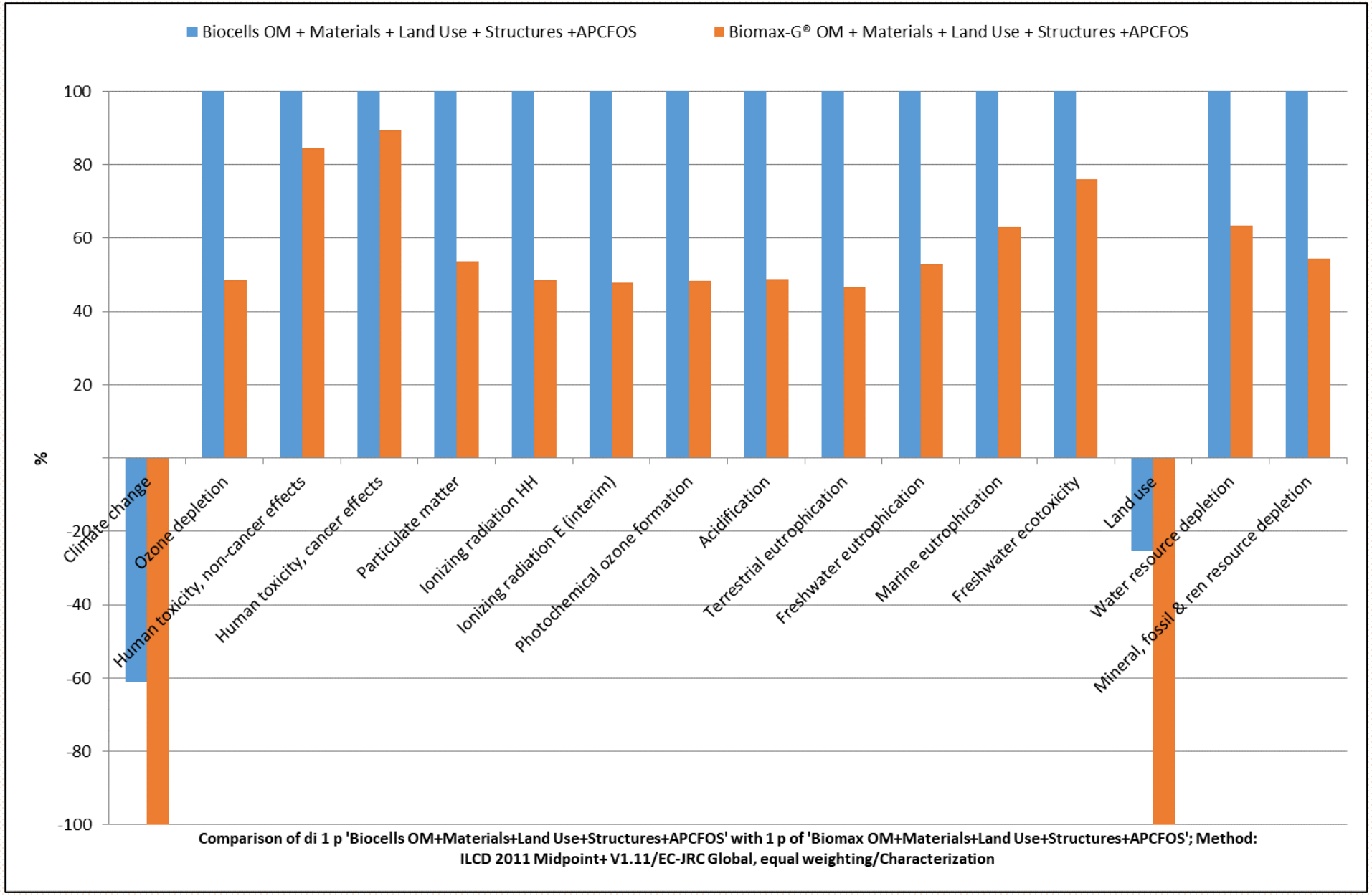


Impact assessment: Phase n.2 comparison





Impact assessment: Phase n.3 Characterization



Conclusions

- The dynamic system technology consumes approximately half of the electricity needed for the Biocells system
- The dynamic system technology shows a lower environmental impact for all the considered impact categories
- Both scenarios, show similar environmental impacts regarding the ‘Human Toxicity, cancer effects’, ‘Human Toxicity non-cancer effects’ and ‘freshwater ecotoxicity’
- The compost production from OFMSW shows avoided environmental impacts for the ‘Climate change’ and ‘Land Use’ in both scenarios, compared to peat moss production
- Sensitivity analysis related to the treatment size of the plant

Thank you for your attention