congrès [avniR]
8ème édition, les 7 et 8 novembre 2018 à Lilliad, Lille, France

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AN EASY-TO-USE BIOPLASTICS LCA TOOL:
EVALUATING QUICKLY THE ENVIRONMENTAL PERFORMANCE OF NEW SOLUTIONS FOR THE PLASTIC INDUSTRY

November 8, 2018

Cecile Querleu
Consultant

Bioplastics market
And Challenge

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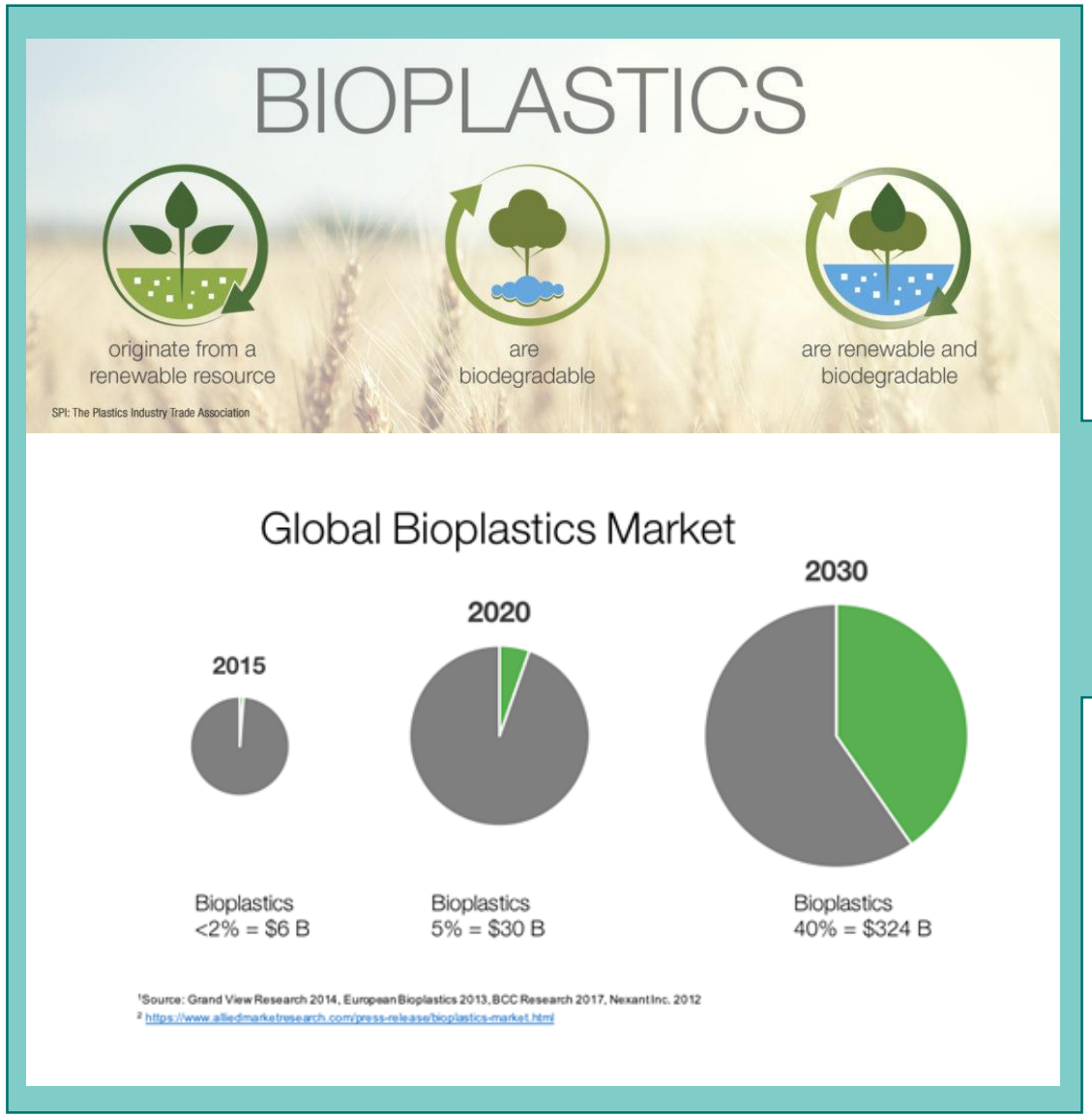
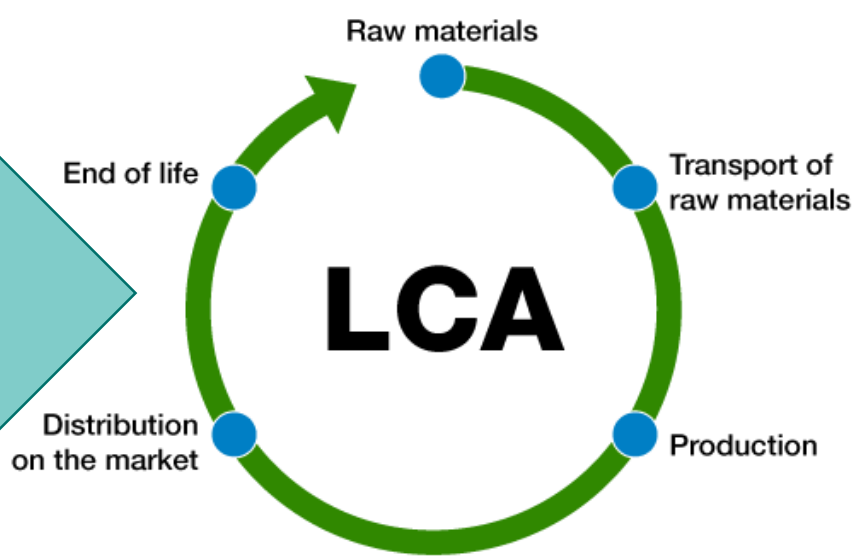
Bioplastics market





Challenge

- **LCA: time and resource demanding activity**
  + data and LCA competences
- **Small and medium-sized enterprises (SMEs)**
  → can represent a too large hurdle
- **Challenge:** can be huge!

Why this tool?
thinkstep solution

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Why this tool?

Origin of the development

- With support from the **IfBB (Institute for Bioplastics and Biocomposites) → easy-to-use tool** to calculate and communicate the environmental performance of bio-plastic products.

IfBB
Institute for Bioplastics and Biocomposites

- Based on **GaBi Envision Web platform** (standard web browser - high quality LCA models and GaBi database).

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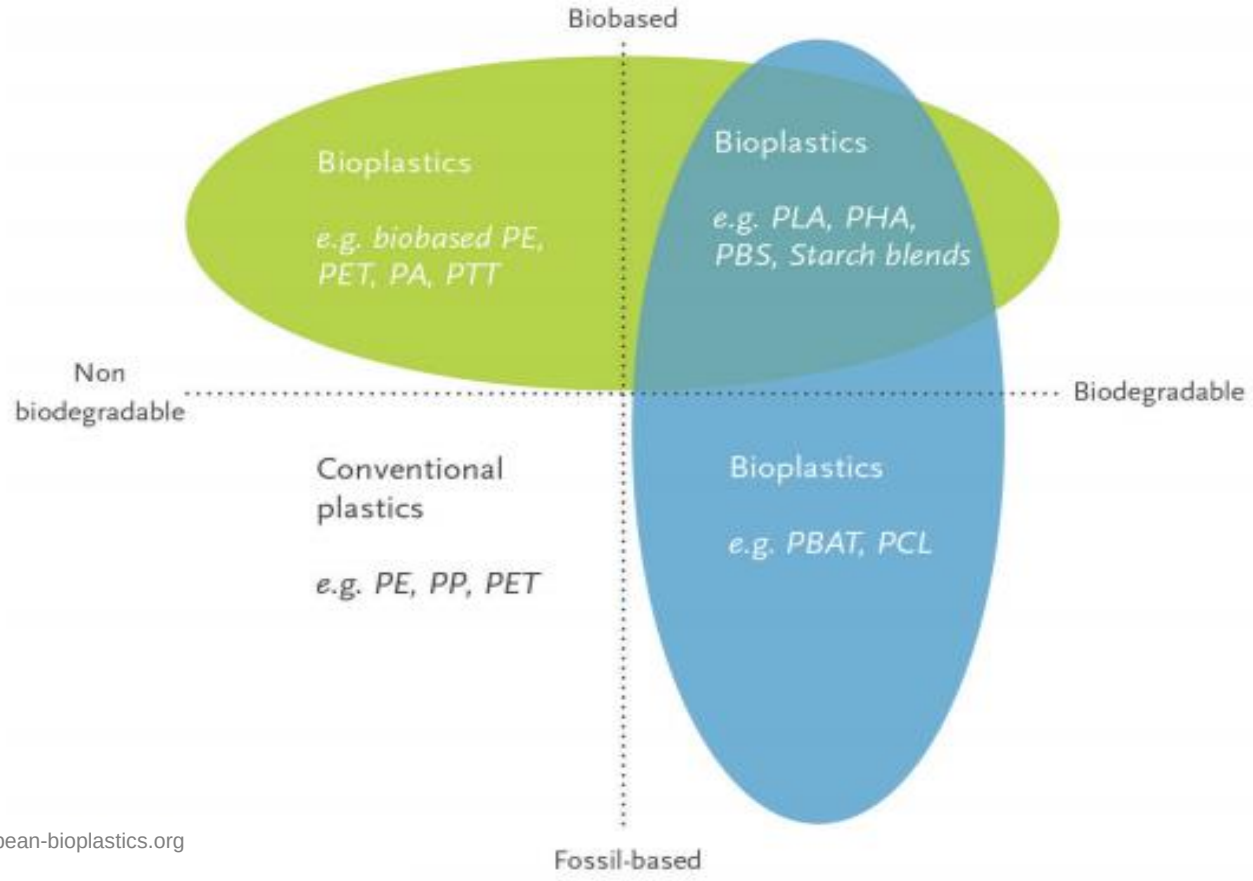
GaBi

Why this tool?

Origin of the development

- **Comparison of** different product **scenarios**
- **Immediate results** (customized PDF report)
- **Complete life-cycle** of bioplastics
- Comparison with **petrochemical-based plastics** possible



European-bioplastics.org

The Bioplastics Tool

Main Principles

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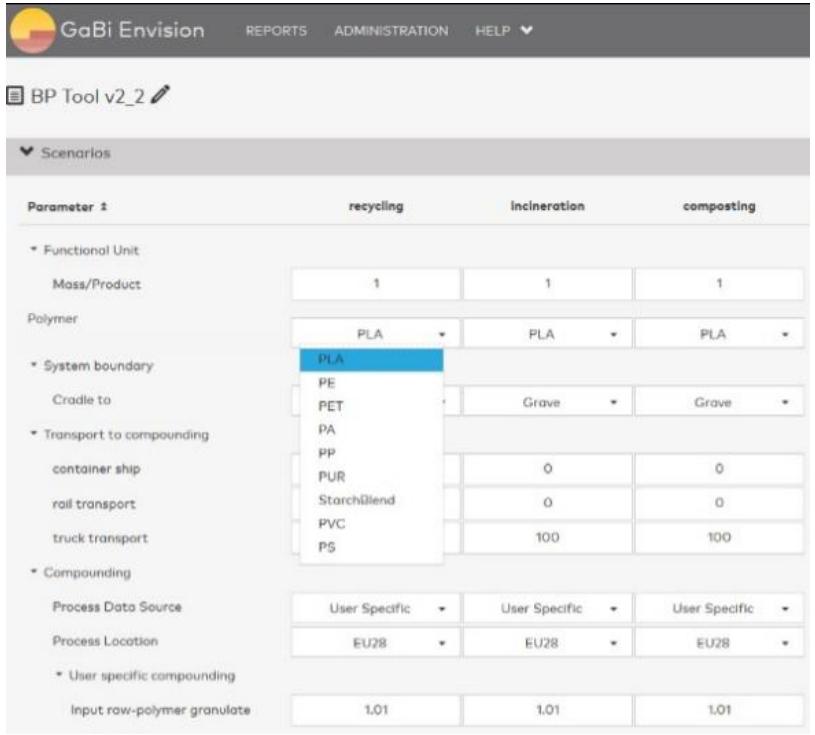
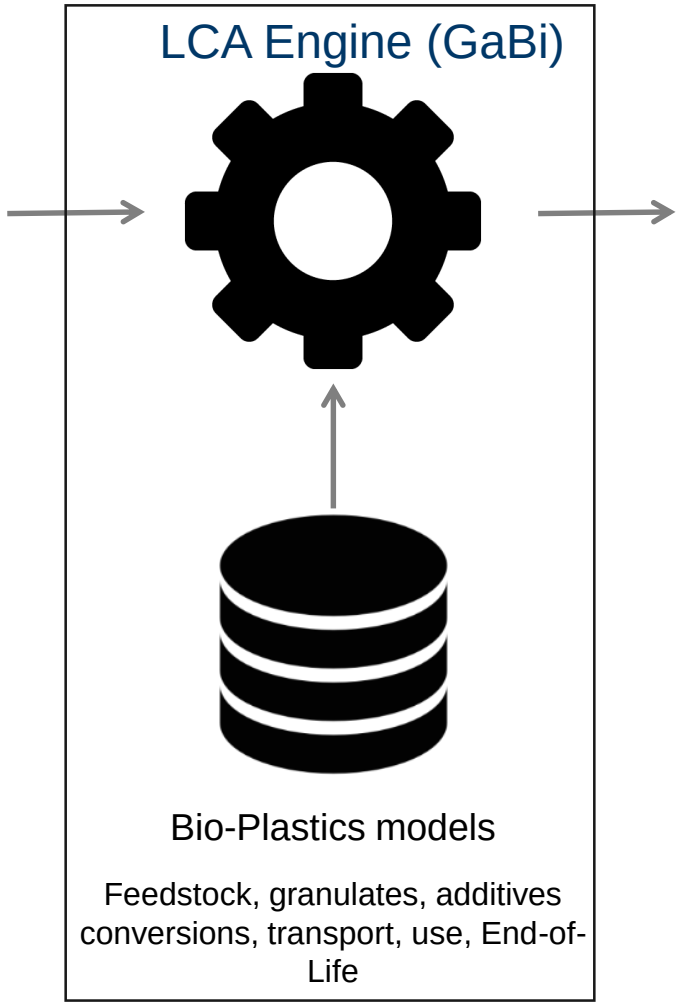
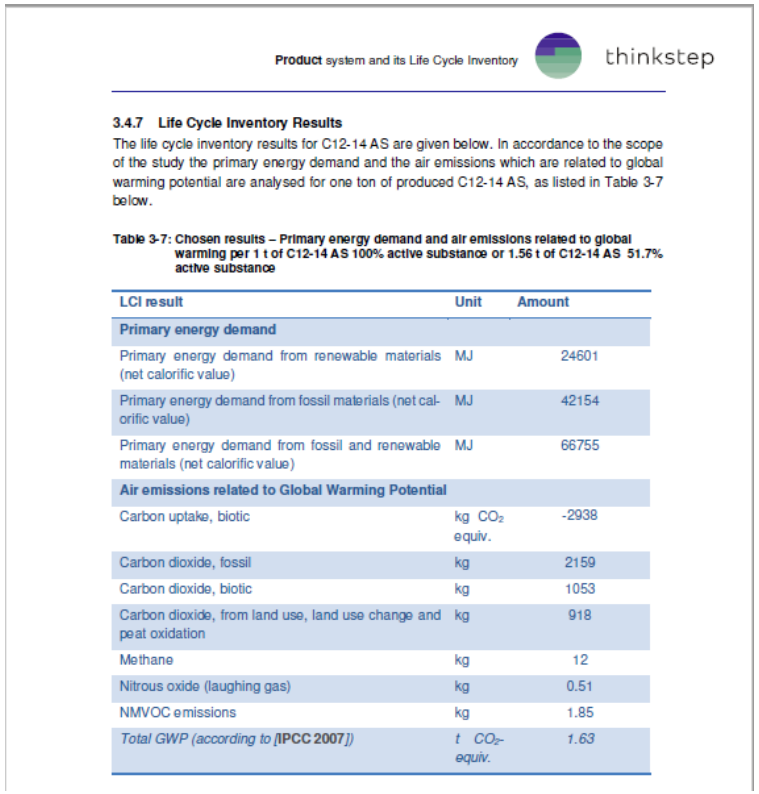






Product system and its Life Cycle Inventory — thinkstep

3.4.7 Life Cycle Inventory Results

The life cycle inventory results for C12-14 AS are given below. In accordance to the scope of the study the primary energy demand and the air emissions which are related to global warming potential are analysed for one ton of produced C12-14 AS, as listed in Table 3-7 below.

Table 3-7: Chosen results – Primary energy demand and air emissions related to global warming per 1 t of C12-14 AS 100% active substance or 1.56 t of C12-14 AS 51.7% active substance

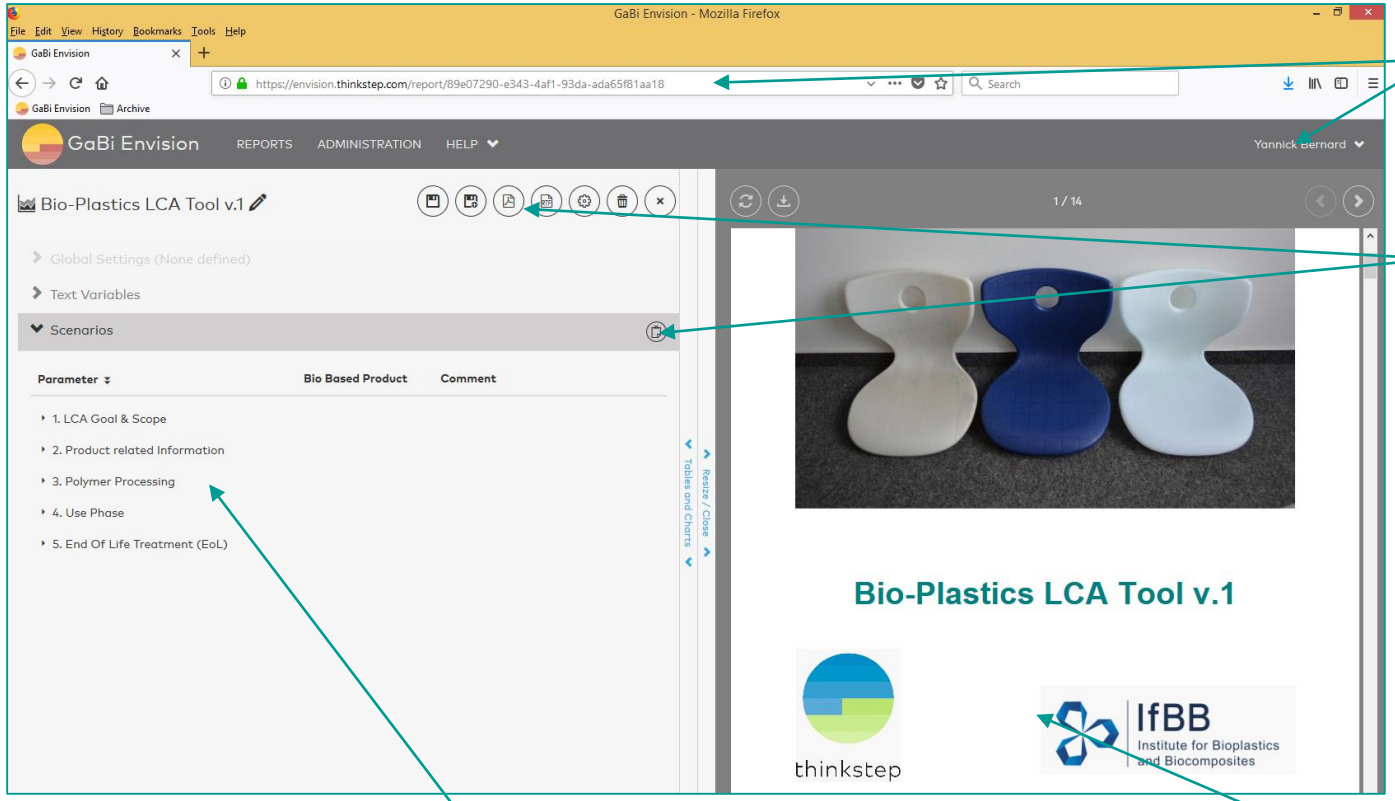
LCI result	Unit	Amount
Primary energy demand		
Primary energy demand from renewable materials (net calorific value)	MJ	24601
Primary energy demand from fossil materials (net calorific value)	MJ	42154
Primary energy demand from fossil and renewable materials (net calorific value)	MJ	66755
Air emissions related to Global Warming Potential		
Carbon uptake, biotic	kg CO_2 equiv.	-2938
Carbon dioxide, fossil	kg	2159
Carbon dioxide, biotic	kg	1053
Carbon dioxide, from land use, land use change and peat oxidation	kg	918
Methane	kg	12
Nitrous oxide (laughing gas)	kg	0.51
NMVOC emissions	kg	1.85
Total GWP (according to [IPCC 2007])	*t CO_2-equiv.*	*1.63*

Functionalities of the tool

The BP Tool in details

The Bioplastics Tool in details

Main window



Web-based tool with personal user login

Export options of results and parameters to pdf, word and clipboard (-> excel)

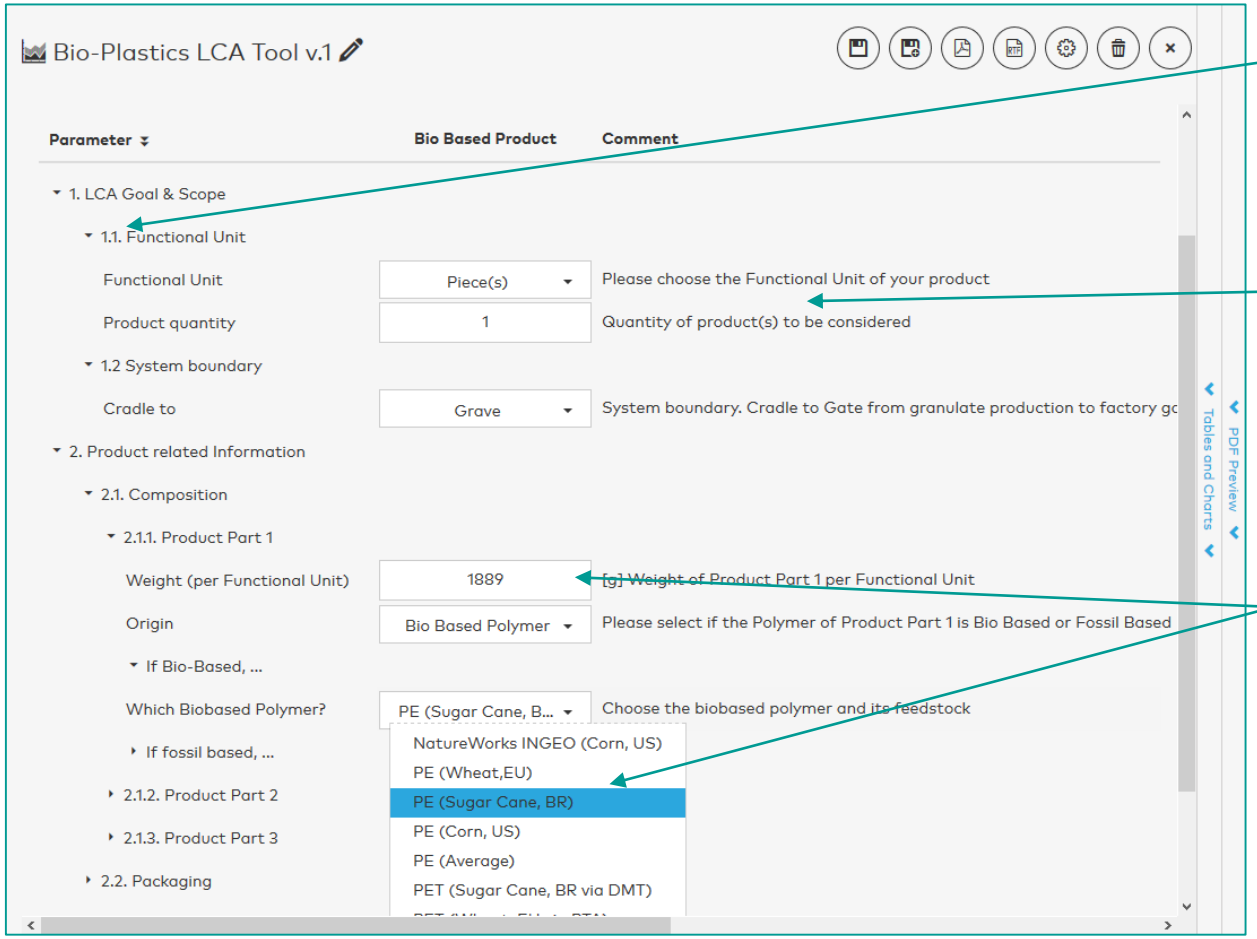
Pre-structured parameter entry section reflecting on a defined base scenario (e.g. bio based product to be analyzed):

- Based on ISO 14040/44
- Following the value chain of Bio-Plastics

Company specific layout and content of report

The Bioplastics Tool in details

Use of parameters



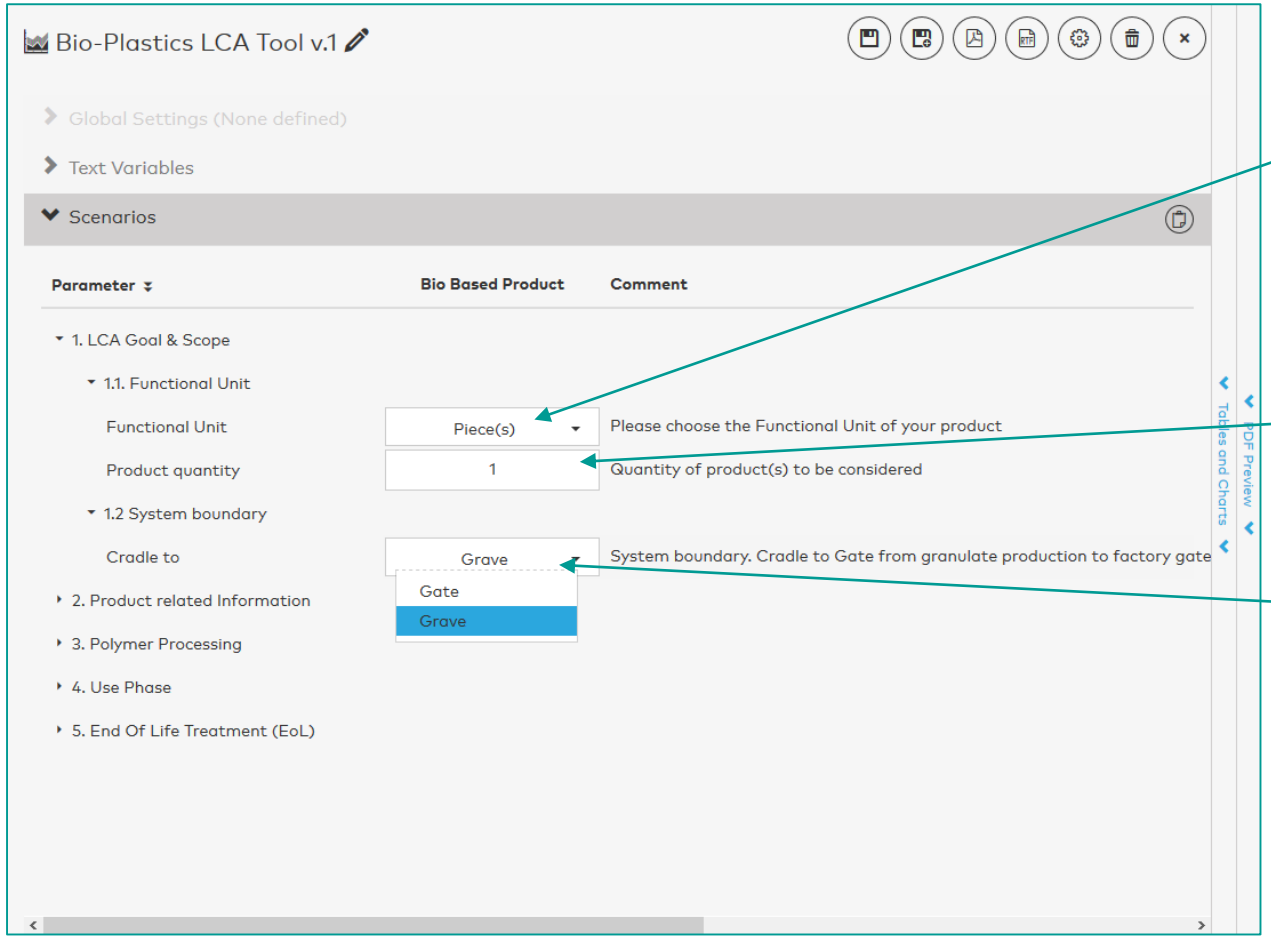
Topic related parameter organization to be unfolded

Comments on each parameter explain and help the user to understand what information to be given (e.g. parameter units)

Parameter entry either by typing of values or selection from pre-defined alternatives

The Bioplastics Tool in details

LCA scope definition



Define functional unit of the product to be assessed:

- Pieces
- Squaremeter
- Cubic Meter
- Kilogramm

Enter amount of functional unit to be calculated

Select the system boundaries:

- Cradle-to-Gate
- Cradle-to-Grave

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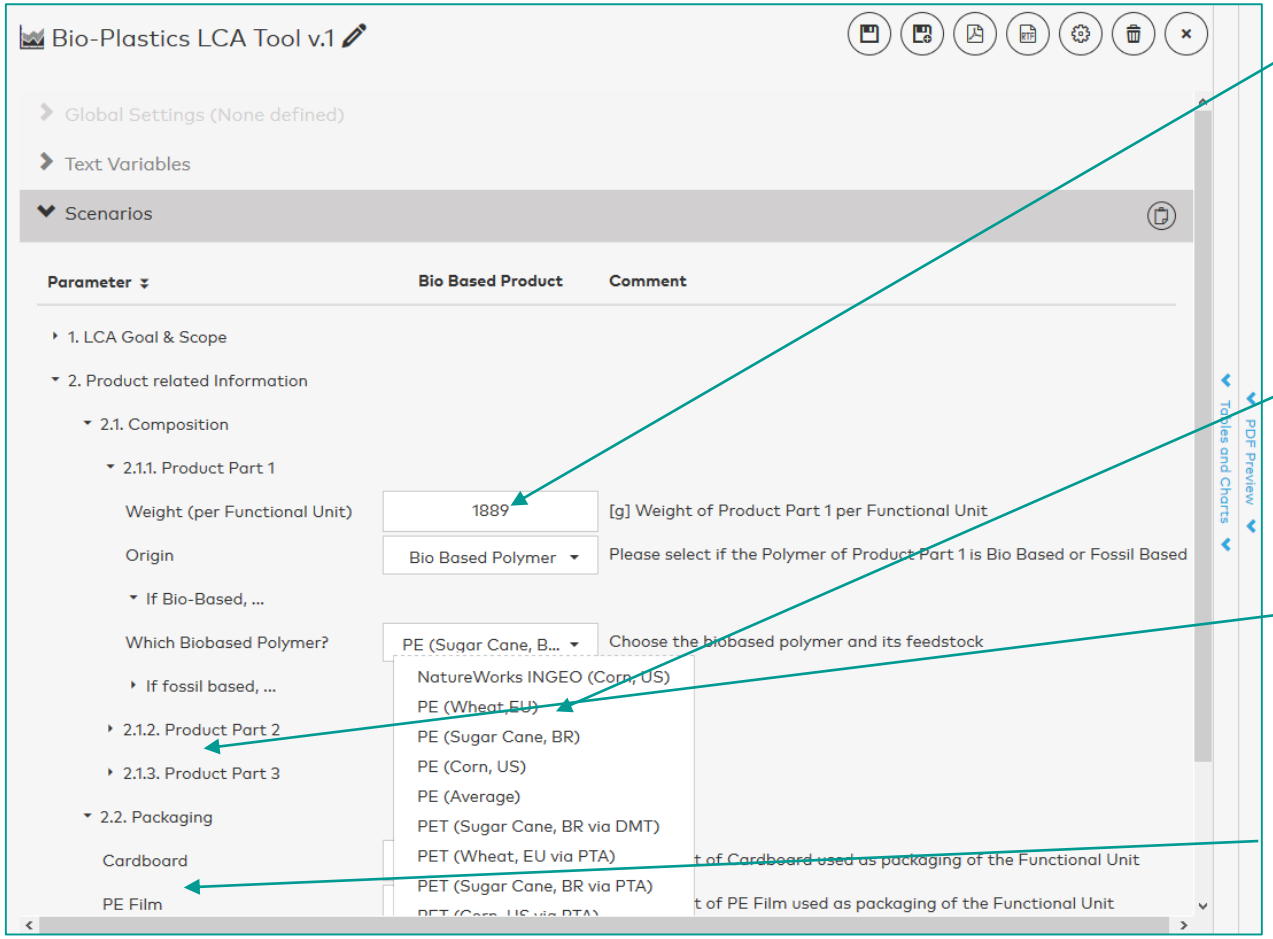
Product definition



Enter the weight (of part 1) of your product.

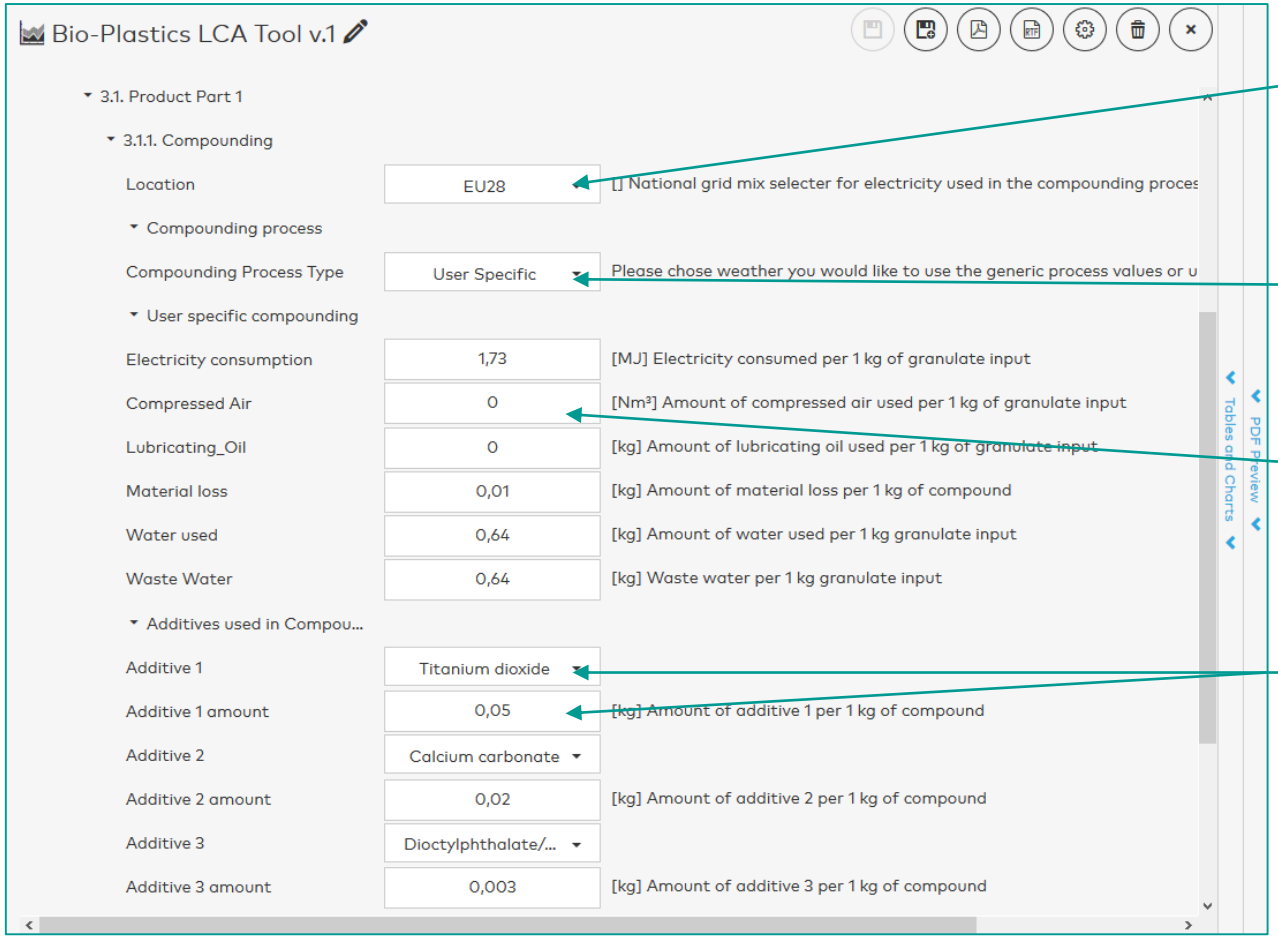
Select the raw polymer of your product (part 1) → PP, PE, PLA, PET, starch blends, etc.

Repeat for product parts 2 + 3 (if applicable to your case)

Choose packaging material for the defined functional unit, if desired

The Bioplastics Tool in details

Specifying production processes



Define location of the granulate compounding -> electricity grid mix

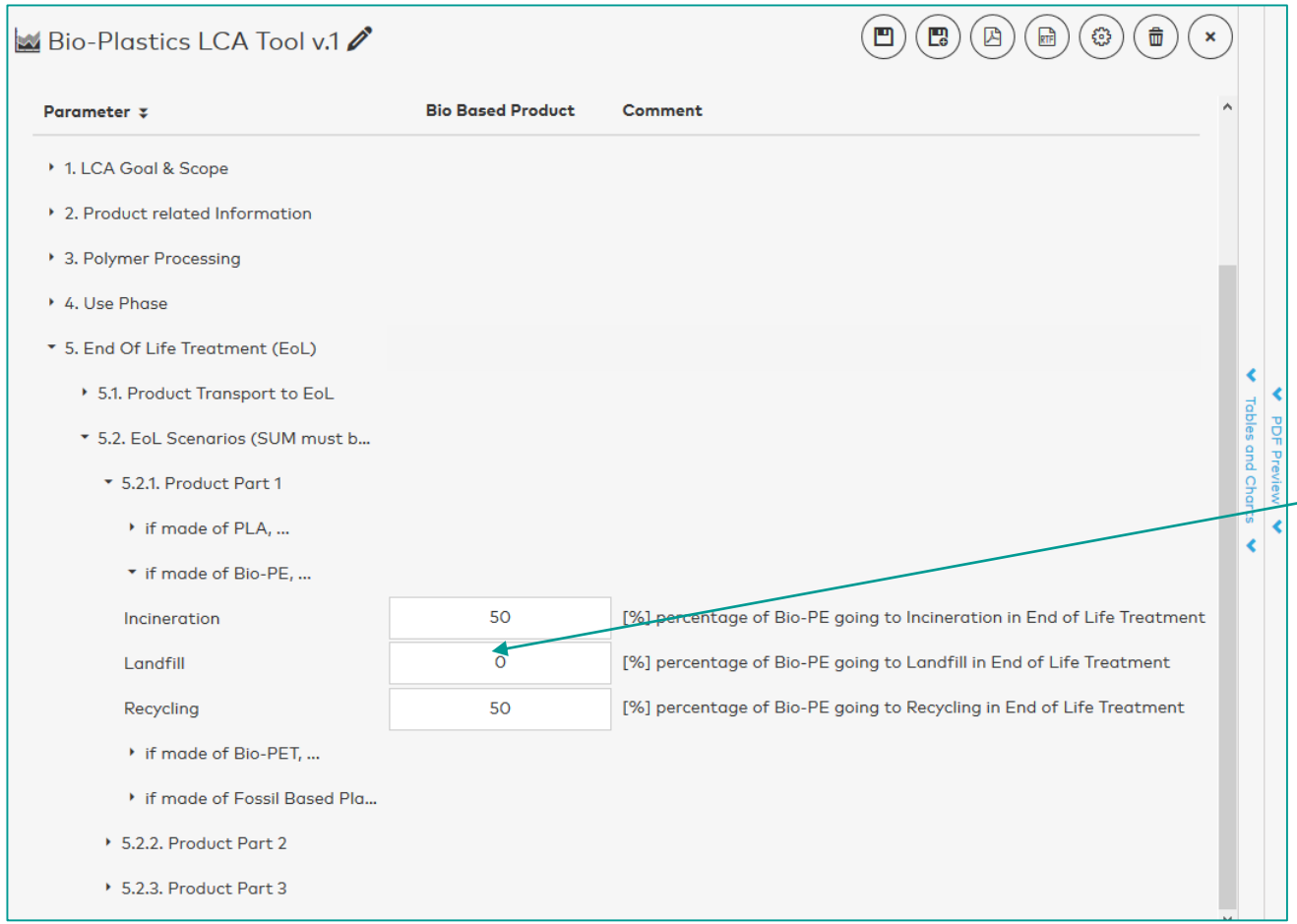
Choose if GaBi compounding process shall be used or if you wish to enter you own process data

Entry of manufacturer specific compounding process data

Define type and amount of additives used in compounding

The Bioplastics Tool in details

End-of-life treatment



Define the share of plastic specific End-of-Life treatment scenarios

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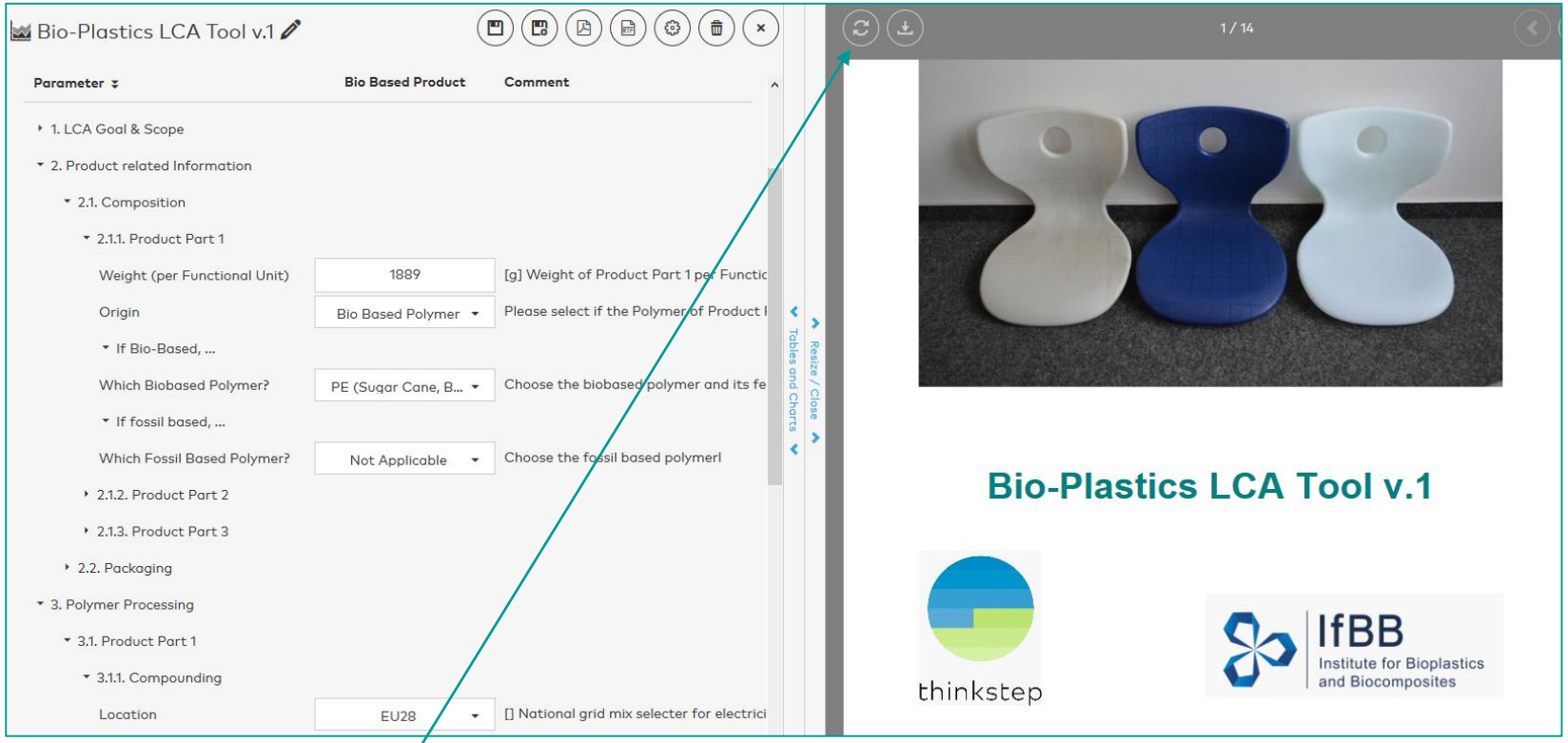
Ready for results calculation



All parameter entries/changes affect the LCA results. (Re-)Calculation is started manually

The Bioplastics Tool in details

Reporting option: ISO 14040/44 compliant report

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2. System Description

This goal of this study is to calculate LCA results for the defined product of 1 Piece(s) of Example Product

First step to do so is calculating the related Life Cycle Inventory (LCI)

Please see the table 2-1 for an executive summary of the most relevant information on the product under study:

Table 2-1: Mass balance product

Information	per Product (as defined in Goal&Scope Section)
Product Related	
Part 1	
Weight Plastic [kg]	1.75
Weight Additives/Composite Materials [kg]	0.138
Weight Product Part 1 [kg]	1.89
Part 2	N.A.
Weight Plastic [kg]	
Weight Additives/Composite Materials [kg]	
Weight Product Part 2 [kg]	
Part 3	N.A.
Weight Plastic [kg]	
Weight Additives/Composite Materials [kg]	
Weight Product Part 2 [kg]	
Packaging	0
Product Weight (total) [kg]	**1.89**

The following table 2-2 shows the amount of post-consumer plastic waste per product for each assumed end-of-life treatment option which has been defined for each single product part independently.

Table 2-2: End-of-life treatment of polymers (excl. additives) in the study

	End of Life Polymers Product Part 1	End of Life Polymers Product Part 2	End of Life Polymers Product Part 3
Plastics incinerated [kg]	0.88		
Plastics composted [kg]			
Plastics put on landfill [kg]			
Plastics recycled [kg]	0.88		

Further information with influence on the LCI of the FU defined, especially regarding materials chosen for the products, process related information (energy, water, waste, etc.) can be taken from the following overview (table 2-3) on all parameter settings of the GaBi LCA model calculated in the background of this report:

Table 2-3: Parameter settings for underlying background GaBi LCA model

2. System Description

Scenario parameters		
	Bio Based Product	
1. LCA Goal & Scope		
1.1. Functional Unit		
Functional Unit	Piece(s)	Please choose the Functional Unit of your product
Product quantity	1	Quantity of product(s) to be considered
1.2 System boundary		
Cradle to	Grave	System boundary. Cradle to Gate from granulate production to factory gate of finished product; Cradle to grave: from granulate production to end of life of product
2. Product related Information		
2.1. Composition		
2.1.1. Product Part 1		
Weight (per Functional Unit)	1889	[g] Weight of Product Part 1 per Functional Unit
Origin	Bio Based Polymer	Please select if the Polymer of Product Part 1 is Bio Based or Fossil Based
If Bio-Based, ...		
Which Biobased Polymer?	PE (Sugar Cane, BR)	Choose the biobased polymer and its feedstock
If fossil based, ...		
Which Fossil Based Polymer?	Not Applicable	Choose the fossil based polymerl
2.1.2. Product Part 2		
2.1.3. Product Part 3		
2.2. Packaging		
Cardboard	0	[kg] Weight of Cardboard used as packaging of the Functional Unit
PE Film	0	[kg] Weight of PE Film used as packaging of the Functional Unit
3. Polymer Processing		
3.1. Product Part 1		
3.1.1. Compounding		
Location	EU28	[] National grid mix selecter for electricity used in the compounding process
Compounding process		
Compounding Process Type	User Specific	Please chose weather you would like to use the generic process values or use your own input values
User specific compounding		
Electricity consumption	1.73	[MJ] Electricity consumed per 1 kg of granulate input

Customizable text and tables: e.g. mass balance of product in scope

Automatic read out of all defined background parameters

Screenshots of GaBi background model can be included as well

The Bioplastics Tool in details

Reporting options: LCA fact sheets

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3. Life Cycle Inventory and Impact Assessment

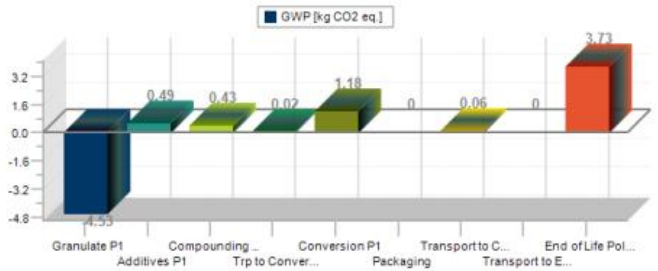
Tabelle 3-1: LCIA results per 1 Piece(s) of Example Product

Impact Indicator	Unit	Cradle -to- Gate	Cradle -to- Grave	Category
GWP *	[kg CO_2 eq]	**-2.41**	**1.38**	Global Warming
AP	[kg SO_2 eq]	**0.08**	**0.045**	Acidification
EP	[kg PO_4 eq]	**0.0583**	**0.0304**	Eutrophication
PERT	[MJ]	**230**	**117**	Primary Energy fr.Renewables
PENRT	[MJ]	**21.4**	**2.69**	Primary Energy fr.Non Renewables
Blue Water Consumption	[kg]	**1.61**	**4.94**	Water

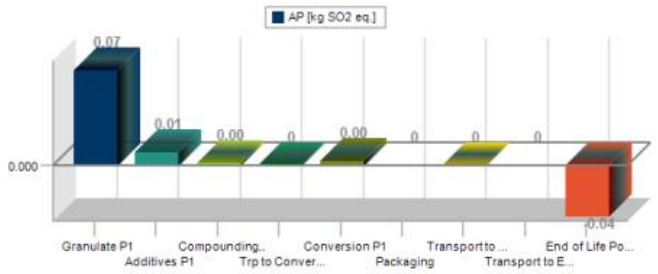
The carbon footprint result (GWP) is: **1.38 kg CO_2 eq.**

* This result includes (!) biogenic Carbon Dioxide (and Methane). Communication of the Cradle-to-Gate result should always additionally inform about the GWP of the End-Of-Life Treatment.

Global Warming Potential for the life cycle stages considered



Acidification potential for the life cycle stages considered



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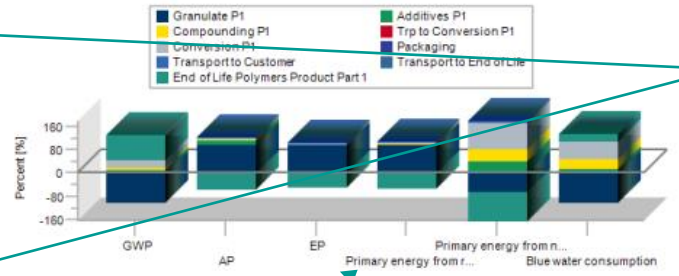
4. Interpretation

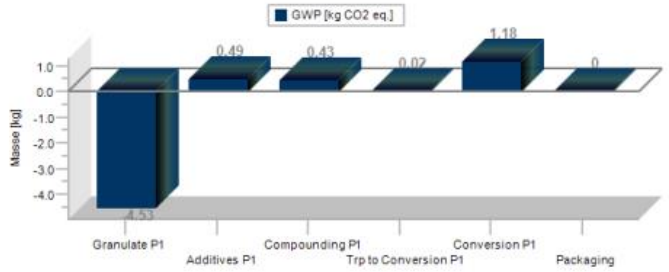
Contribution Analysis of life cycle stages to the LCIA results scaled to 100%



For interpretation of dominant life cycle stages as shwon in the figure above please consider the assumptions and parameter settings of chapter 2.

The following figures show the GWP results just for the cradle-to-gate stage respectively End-Of-Life treatment:

GWP of the Cradle-to-Gate stage



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Automatic read out of LCA results based on parameter entries

Visualization in customizable diagrams

Further diagrams for e.g. results interpretation already integrated

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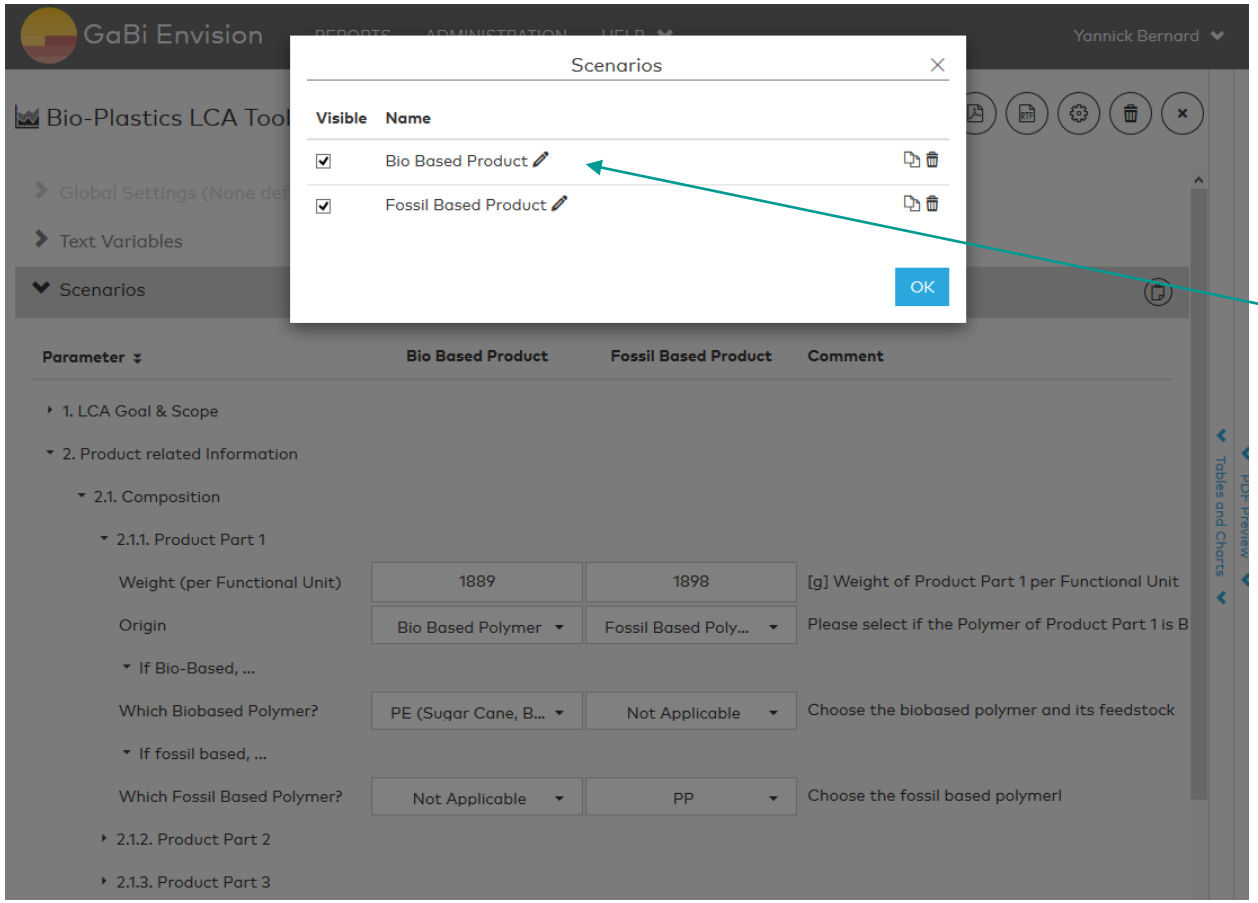
Scenario analysis



Freely create alternative scenarios which can be compared with the previously defined base scenario:

- Alternative materials / additives
- Reduced product weight
- More efficient production process(es) – less energy, less waste
- Alternative transport routes/vehicles
- Different EoL-Options

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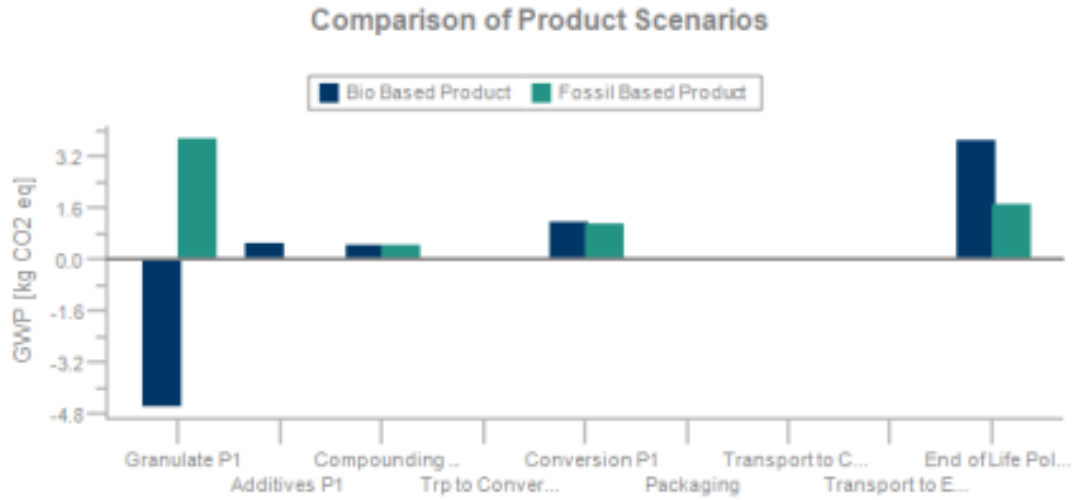
Scenario analysis – Results view

5. Scenario Analysis

Tabelle 5-1: Comparative LCIA results scenarios considered

	Bio Based Product	Fossil Based Product
GWP [kg CO2 eq.]	1.38	7.09
AP [kg SO2 eq.]	0.04	0.01
EP [kg Phosphate eq.]	0.03	0.00
Primary energy from renewable resources (net cal. value) [MJ]	116.63	4.63
Primary energy from non renewable resources (net cal. value) [MJ]	2.69	142.81
Blue water consumption [kg]	4.94	28.19



Derive decisions from the scenario comparison, potential trade offs are shown in a transparent way

Using the Bioplastics Tool

Benefits

Open for company specific customization

ADDITION

- Of **further datasets** – either from GaBi but also based on primary data delivered by owner of the LCA tool:
  - (bio)-plastic granulates (and all included steps: feedstock, fermentation, polymerization)
  - additives / composite materials
  - compounding / conversion processes
  - EoL-treatment options
- Of **further auxiliaries, grid mixes**, etc.

ADAPTATION

- Of **scope / parameter section** to company (department) specific needs
- Of **reporting** to company (department) specific needs:
  - full verifiable ISO 14040/44 report vs.
  - screening quick check GWP fact sheet
  - vs. company specific evaluation methods (e.g. conversion of GWP expressed in kg CO_2 eq into km of driving a car)

Your benefits using this tool

- Bioplastic specific GaBi database
- IfBB as scientific development partner for LCA data
- Tool verification by DEKRA
  - **Base your decisions on consistent, high quality, up-to-date and reliable background data**

- Comparison of scenarios, bio-plastics vs. conventional plastics
  - **Know about the environmental consequences before investing in product and process changes**

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Your benefits using this tool

- Easy-to-use interface, instant result calculation and reporting with customized content
  - **Communicate verifiable LCA results created by your own without being a LCA expert**

- The tool covers all stages of the bio-plastics supply chain
  - **Being prepared to answer questions from your clients and even questions asked to your clients**

Standardized version of the BP Tool:

③

(bio-)plastic materials,
additives
standard converting processes.

Future-proof your business.

thinkstep AG

Hauptstrasse 111-113
70771 Leinfelden-Echterdingen
Germany

Phone: +49 711 341817-0
Fax: +49 711 341817-25

info@thinkstep.com
www.thinkstep.com

Cécile Querleu

Lyon, France

cecile.querleu@thinkstep.com

06 37 54 59 07

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