



# Celanex<sup>®</sup> PBT ECO-B

Helping the Industry Increase Renewable Content  
and  
Reduce Carbon Footprint with Zero Disruption



## Biomass balance **ECO-B: POM, PBT, UHMWPE**

Products derived from biological feedstock like forestry and agricultural waste materials or renewable domestic waste using a mass balance approach

## Recycled content **ECO-R: PA, PBT/PET, PP, TPV**

Products that contain post-industrial or post-consumer recycled materials while still maintaining consistency, quality and performance

## Carbon capture **ECO-CC: POM\***

Products based on CO<sub>2</sub> emissions converted into methanol as building block for downstream products

## End-of-Life: **BioPolymer Solutions**

Products that are biodegradable and compatible with waste streams that go into composting

\* Not operational till end 2023



## Biomass balance **ECO-B**: POM, PBT, UHMWPE

- ▶ Bio-based feedstock using a **biomass balance** approach
- ▶ Independent **3<sup>rd</sup> party audited** mass balance certification (ISCC+, REDcert<sup>2</sup>) \*
- ▶ Significant increase in **renewable content** and reduction of **CO<sub>2</sub> footprint** vs standard fossil equivalents
- ▶ End products in identical quality and properties enable **drop-in replacement**

Material	Available	CO <sub>2</sub> footprint reduction	Renewable content	BioMass Balance feedstock
Hostaform® POM ECO-B	1Q 2021	✓ up to 50%	up to 97%	Bio Methanol
Celanex® PBT ECO-B	2Q 2022	✓ up to 50%	up to 40%	Bio BDO
GUR® UHMWPE ECO-B	3Q 2022	✓ > 100%	up to 99%	Bio Ethylene

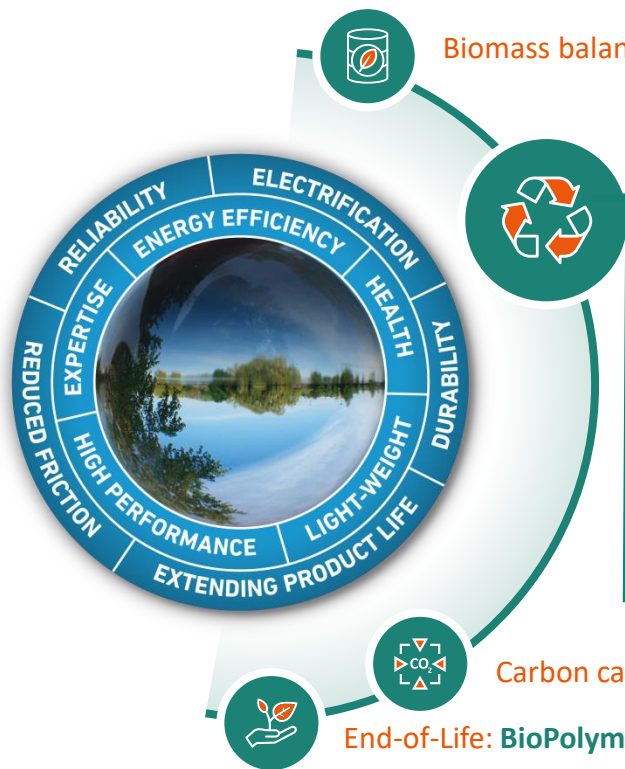
## Recycled content **ECO-R**: PA, PBT/PET, PP, TPV

## Carbon capture **ECO-CC**: POM\*\*

## End-of-Life: BioPolymer Solutions

\* Carbon reduction results based on life cycle analysis and available under non-disclosure agreement.

\*\* Not operational till end 2023



**Biomass balance ECO-B: POM, PBT, UHMWPE**

**Recycled content ECO-R: PA, PBT/PET, PP, TPV**

**Raw materials mixed with Recycled Feedstocks.**

Long-term suppliers to maximize quality, minimize variability and ensure traceability

**Finished products**

- ▶ Compensate performance drop from mechanical recycling step
- ▶ Product very close but not identical to prime (no drop-in)
- ▶ Expanding offer beyond legacy unspecified recycled content to **ECO-R range with specified recycled content**

Material	Recycle Sources	Available	Product Brands
PA	PIR carpet, textile, industrial fiber	✓	Ecomid® PA ECO-R
PBT/PET	PCR beverage bottles, packaging scrap and PIR textile, industrial fiber	✓	Celanex® PBT/PET ECO-R, Impet® PET ECO-R
PP	PIR textile fiber, non-woven	✓	Tecnoprene® PP ECO-R
TPV	PCR	✓	Santoprene® TPV ECO-R

**Carbon capture ECO-CC: POM\***

**End-of-Life: BioPolymer Solutions**

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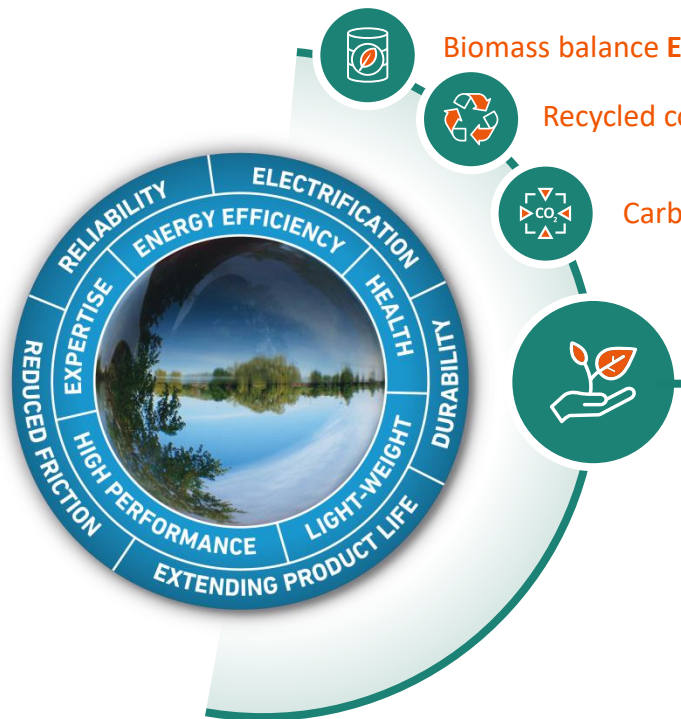


## Carbon capture **ECO-CC: POM\***

- ▶ Leveraging backward integration into methanol production where **industrial waste CO<sub>2</sub>** as byproduct from other plants is used as **feedstock for methanol**
- ▶ Resulting POM polymer estimated to come with >90% **renewable content** and a **CO<sub>2</sub> footprint reduction** in a similar range to biomass balance POM ECO-B
- ▶ Independent **3<sup>rd</sup> party audited** mass balance certification (ISCC+)
- ▶ End products in identical quality and properties enable **drop-in replacement**
- ▶ Flexible commercial model with broad applicability to all grades

Material	Available	CO <sub>2</sub> footprint reduction	Renewable content	Circular feedstock
POM ECO-CC	Late 2023	under evaluation	up to 90%	Circular Methanol

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**Biomass balance ECO-B: POM, PBT, UHMWPE**

**Recycled content ECO-R: PA, PBT/PET, PP, TPV**

**Carbon capture ECO-CC: POM\***

## End-of-Life: BioPolymer Solutions

- ▶ Products that are biodegradable and/or compatible with waste streams that go into composting

### Certifications

- ▶ Biodegradable
- ▶ Suitable for home and industrial composting
- ▶ BPI Industrial Compost Certified

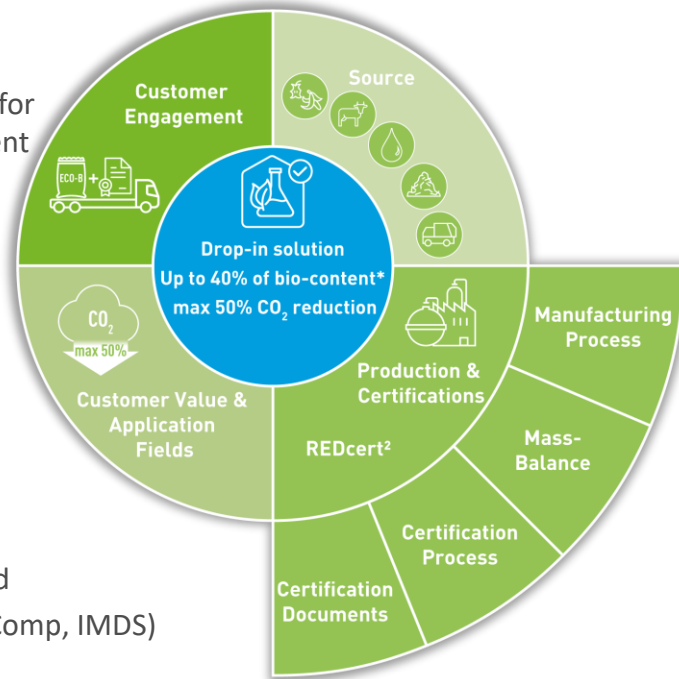
Direct food approved	✓
EN 13432	✓
ASTM D6400	✓
TUV Austria OK Home compost	✓

Material	Available	Circular feedstock
Clarifoil® Cellulosic Film	✓	PEFC Sustainably sourced wood pulp

\* Not operational till end 2023

## Drop-in solution

- ▶ Drop-in sustainable solution
- ▶ Our CAD/CAE supports ECO-Design for further CO<sub>2</sub> reduction and assessment implementing the certification process
- ▶ Success stories in high regulated market



## Drop-in solution

- ▶ Waste converted into Bio-Gas
- ▶ No Palm oil
- ▶ Reduction of fossil-based resources
- ▶ Reduction of waste
- ▶ Bio-based supply chain is supported
- ▶ Global key suppliers

## Drop-in solution

- ▶ Commercially available
- ▶ No product requalification is needed
- ▶ All certifications are kept (FDA, BioComp, IMDS)
- ▶ No performance is sacrificed

## Drop-in solution

- ▶ Manufacturing process remains unchanged.
- ▶ Audited and Certified Process
- ▶ Celanex® PBT ECO-B is a chemically identical product as our standard material.



# Source

Celanese aims to use waste as the only bio-content material approved for its Celanex® PBT ECO-B.

Our Biogas comes from these 5 sources: *crop waste, water treatment waste, manure, food waste and municipal waste sources.\**



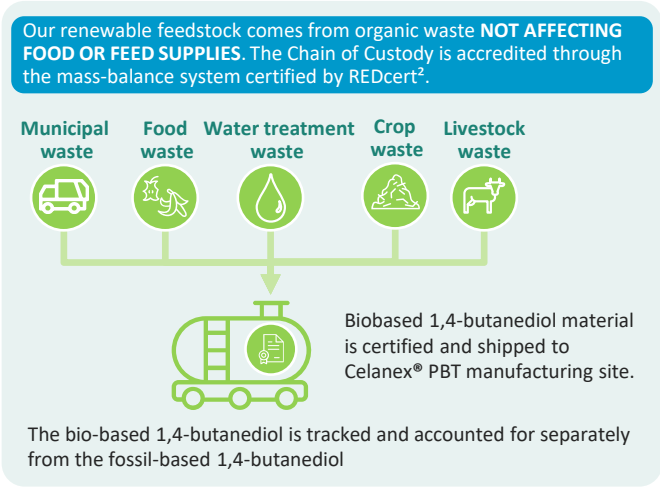
Following the Chain of Custody, our 1,4-butanediol suppliers are REDcert<sup>2</sup> certified. These key global players with sites in every region secure our increasing demand, following the strict quality standards specifications for our PBT manufacturing site

▶ Customer orders a truck load of Celanex® PBT ECO-B



Celanese orders equivalent amount of bio-based 1,4-butanediol

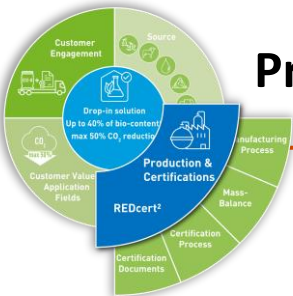
Up to 40% certified biocontent



\*These sources are based on renewable materials according to the definition of waste or residue of the Renewable Energy Directive (RED).



# Production & Certifications



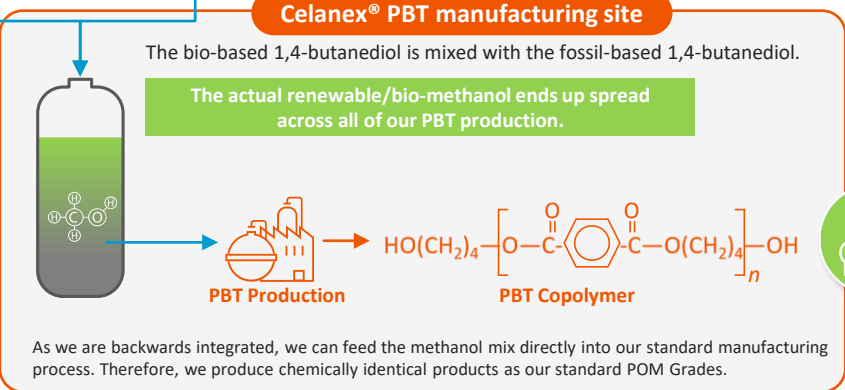
**Drop-in solution**

Celanese has risen to the sustainability challenge developing a sustainable polybutylene terephthalate that is chemically identical to our conventional Celanex® PBT with up to 45% of bio-based content via a *mass-balance approach*, certified by REDcert<sup>2</sup>

**REDcert<sup>2</sup>**  
 This independent company certification audit confirms that we have replaced fossil resources with renewable feedstock. Customer is guaranteed that renewable feedstock is fed into production in equivalent amounts to what is shipped to the customer as Celanex® PBT ECO-B.



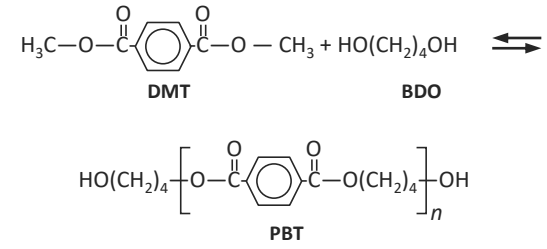
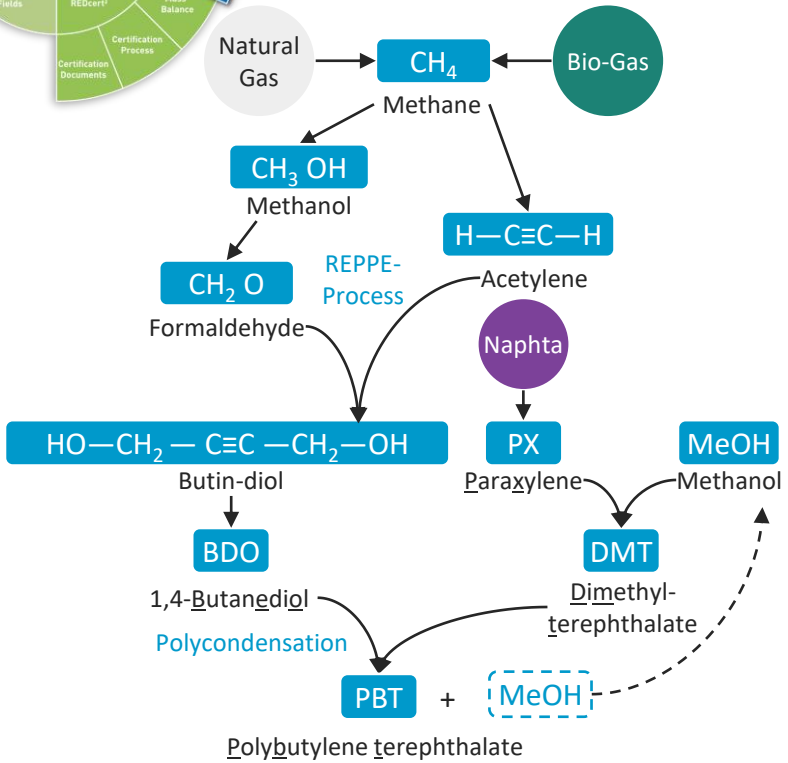
**Celanex® PBT manufacturing site**



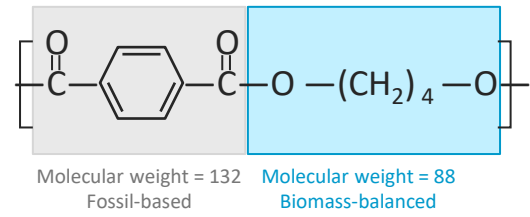
Celanex® PBT ECO-B will be delivered to customer with a sustainability declaration according to REDcert<sup>2</sup>

We can feed the bio 1,4 Butanediol and mix directly into our standard manufacturing process. This allows Celanese to offer our customers Celanex® PBT ECO-B as the sustainable version of most of our Celanex® PBT grades.

# Manufacturing Process

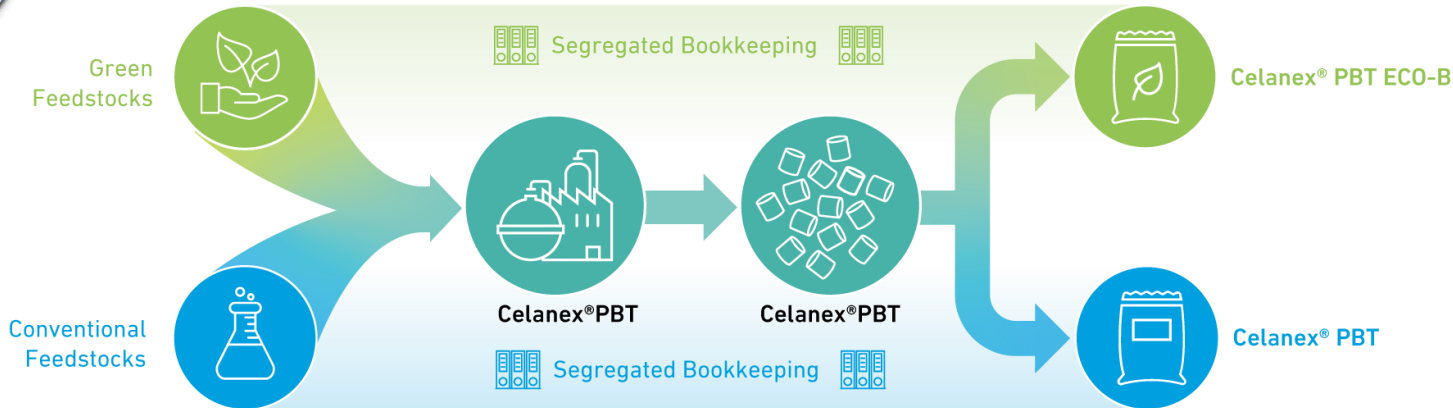
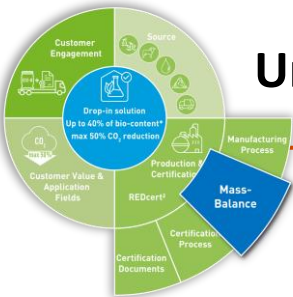


**CELANEX® PBT ECO-B BIO CONTENT**  
 Bio-content = 88 / (132 + 88) \* 100% = 40%



Celanex® PBT ECO-B has bio-content up to 40%, since only the 1,4-butanediol portion is from the biomass-balanced source, which contributes to 40% of PBT polymer.

# Understanding Mass Balance Approach



## Feedstock:

- ▶ Mass balance approach means fossil- and bio-based or recycled feedstocks are mixed in the production but accounted for separately
- ▶ Creates demand for non-fossil feedstocks
- ▶ Maintains efficiency and emissions benefits of large-scale production technologies

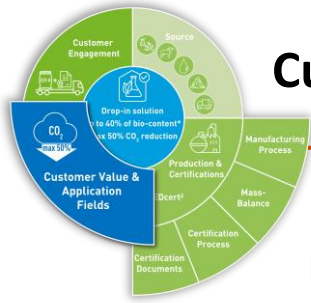
## Bookkeeping:

Celanese system to accurately account and track the feedstocks used to produce equivalent amounts of product

- ▶ Accounting process and data certified by REDcert<sup>2</sup>, a leading and widely recognized certification body



# Customer Value & Application Fields



The versatility of its properties combined with the sustainable benefits are some of the most common reasons for choosing Celanex® PBT ECO-B.



- Drop-in Replacement
- Regulatory consistency
- No requalification needed
- Carbon Footprint reduction
- Renewable content increase
- Identical properties & performance
- Scalability
- Out of kind replacement



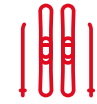
Automotive



Medical



Appliances



Sport & Leisure

## APPLICATION FIELDS



Cosmetics



Industrial



Electronics



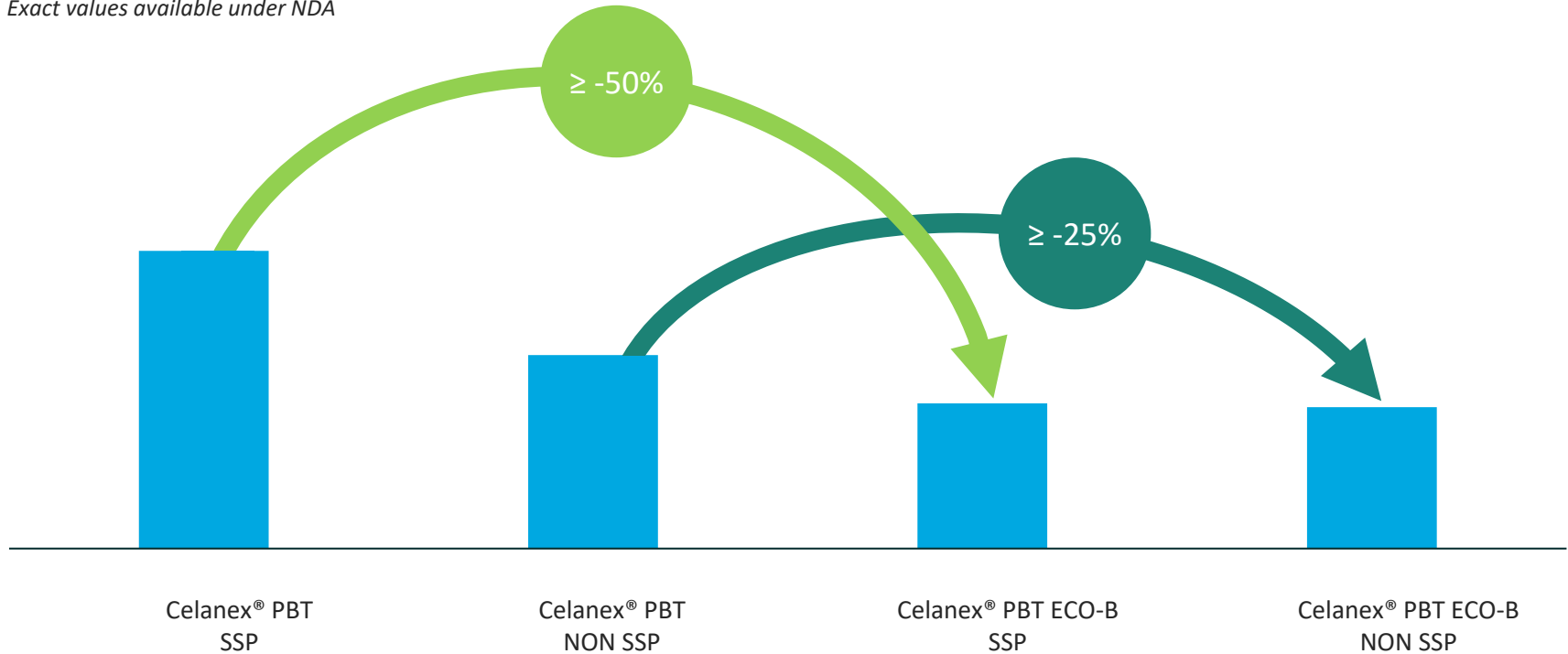
Personal Care



Toys

# Polymer CO<sub>2</sub> Footprint Data

KG CO<sub>2</sub> per KG Polymer  
*Exact values available under NDA*



## Sustainability for Durable Applications

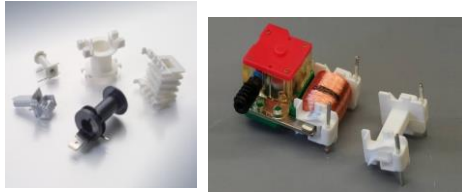
- ▶ High demand for light-weighting, energy efficiency and product life cycle
- ▶ Significantly increased requests for recycled and renewable content in products

*Their impact in industries and applications*

### Industrial



### E & E



### Large & Small Appliances

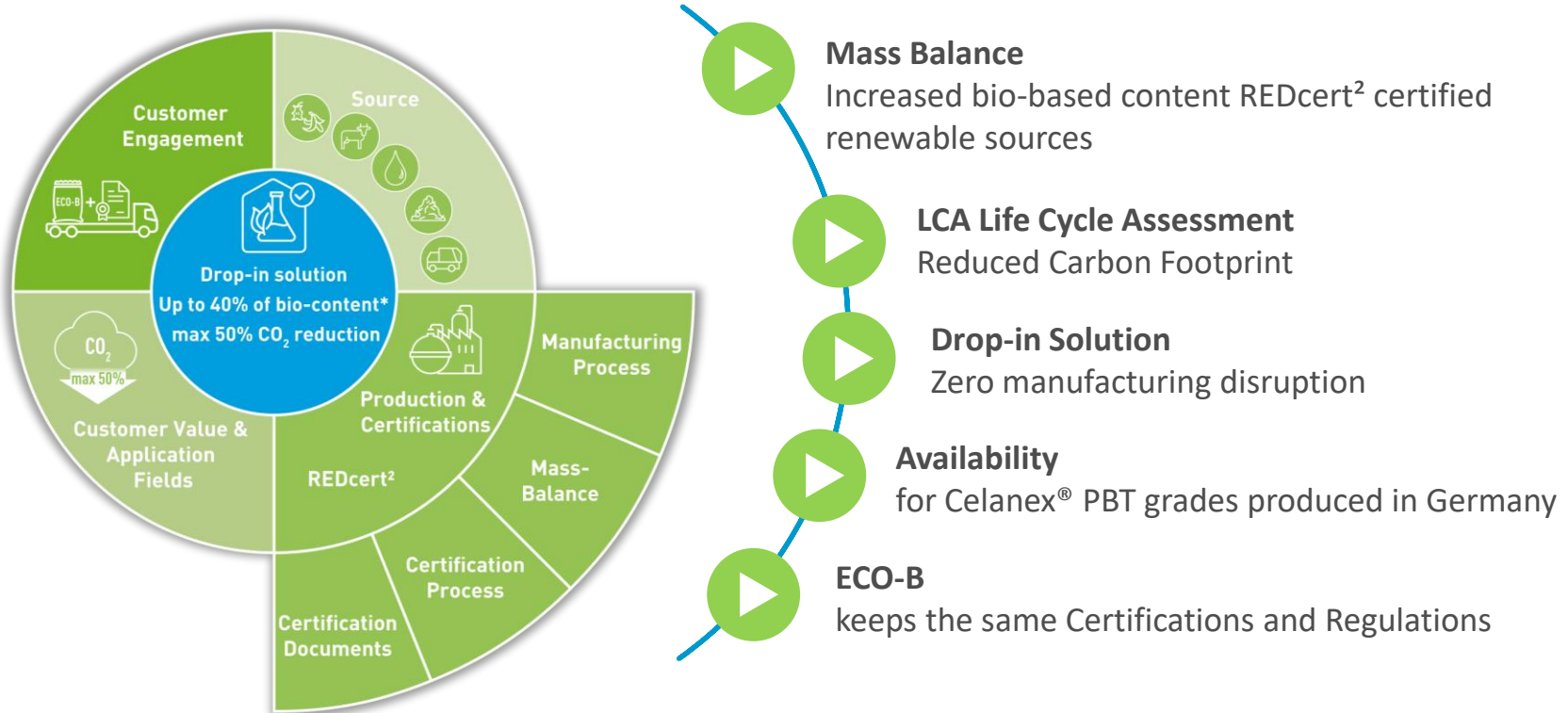


### Medical



### Automotive





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