Celanese

IPAC-RS International Pharmaceutical Aerosol Consortium on Regulation & Science

IPAC-RS Roundtable Part II (2/7/23)

Celanese ECO-B solutions

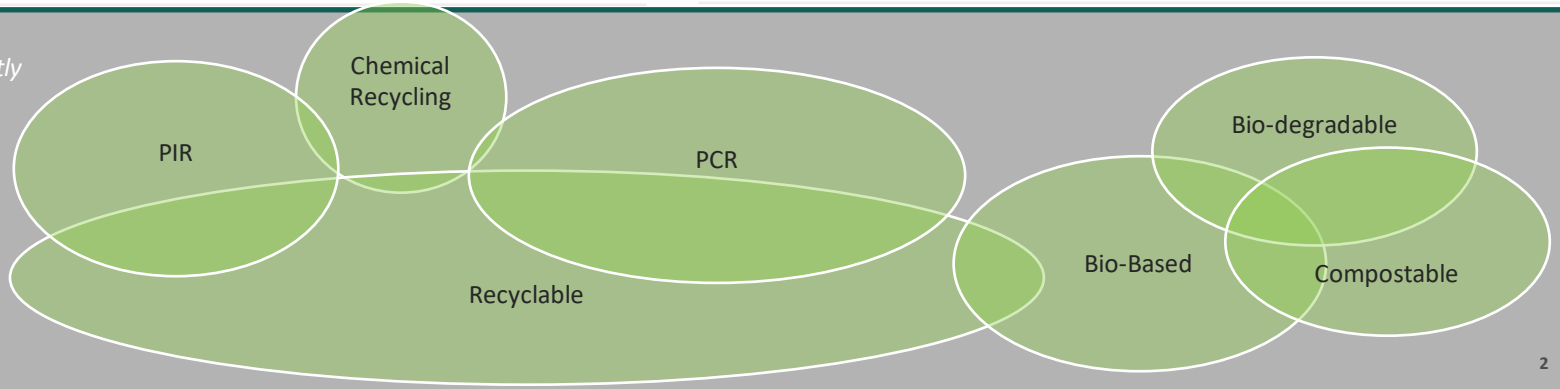
Integrating Sustainability into Medical Device and Combination Products by Helping the Industry Increase Renewable Content
and
Reduce Carbon Footprint with Zero Disruption

Basic Definitions

Term	Definition
PIR Post-Industrial Recycled	Recycled resin from industrial facilities that never reached consumer
PCR Post-Consumer Recycled	Recycled resin from municipal recycling facilities or special collection points that would otherwise have gone to a landfill
Chemically Recycled	Using recycled feedstocks to make chemicals use to produce new polymer
Recyclable	Substantial likelihood that product can be collected, sorted, reprocessed and reused to make another item

Term	Definition
Bio-Based	Made from renewable resources instead of fossil fuels
Mass-balance	Conventional and “green” feedstocks are commingled in production but accounted for separately so that final product can be sold with “green” credentials
Bio-degradable	Capable of being decomposed by bacteria or other living organisms
Compostable	Capable of breaking down in a compost environment

Definitions frequently overlap, creating confusion



EM Sustainable Solutions: Products & Enablers

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_2 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

EM Sustainable Solutions: Products & Enablers

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

- Bio-based feedstock under a **biomass balance** approach, using waste from renewable sources
- Significant increase in **renewable content,** independent **3rd party audited** with a mass balance certification (ISCC+, REDcert²)
- Reduction of **CO_2 footprint** vs standard fossil equivalents *
- End products in identical quality and properties enable **drop-in replacement**

Material	Available		CO_2 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

Source

Celanese

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

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 REDcert² 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

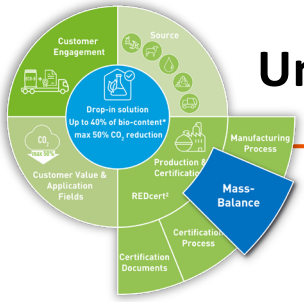
Our renewable feedstock comes from organic waste **NOT AFFECTING FOOD OR FEED SUPPLIES**. The Chain of Custody is accredited through the mass-balance system certified by REDcert².

Municipal waste | Food waste | Water treatment waste | Crop waste | Livestock waste

Biobased 1,4-butanediol material is certified and shipped to Celanex® PBT manufacturing site.

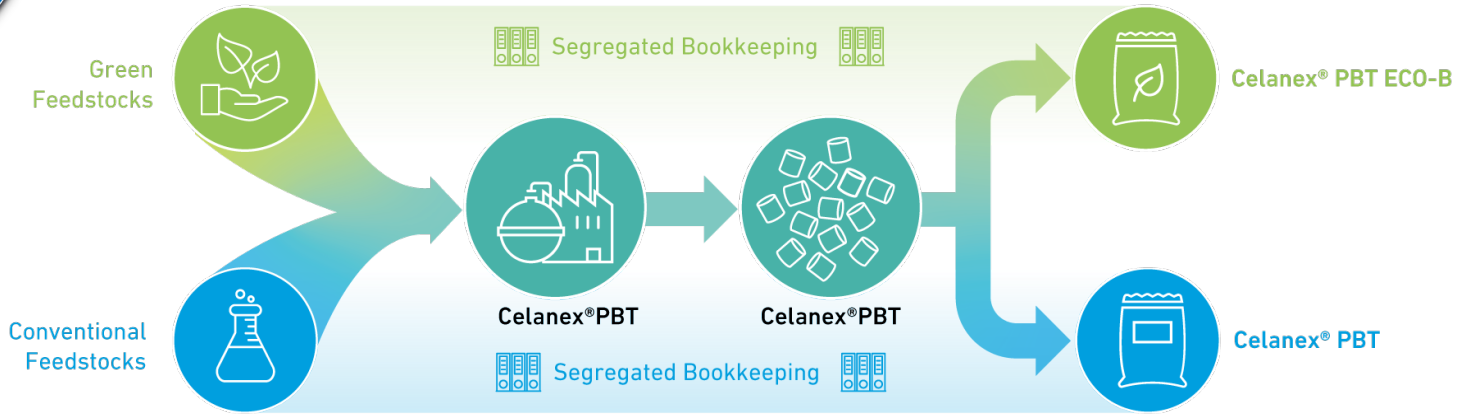
The bio-based 1,4-butanediol is tracked and accounted for separately from the fossil-based 1,4-butanediol

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



Understanding Mass Balance Approach

Celanese



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 REDcert², a leading and widely recognized certification body


DIN CERTCO

REDcert²

Certificate

DIN CERTCO Gesellschaft für Konformitätsbewertung mbH
Alboinstrasse 56, 12103 Berlin, GERMANY

approves that

Celanese US Holdings LLC
222 W. Las Colinas Blvd., Suite 900N, 75039 Irving, Texas United States

complies with the requirements of the certification system

REDcert²

which has been considered equivalent to the Farm Sustainability Assessment (FSA) by the Sustainable Agriculture Initiative (SAI) on 01 September 2016
as scheme for demonstrating compliance with the FSA criteria.

The certified system user is a
supplier (vertical the last interface)

This certificate is valid from 2021-09-23 to 2022-09-22

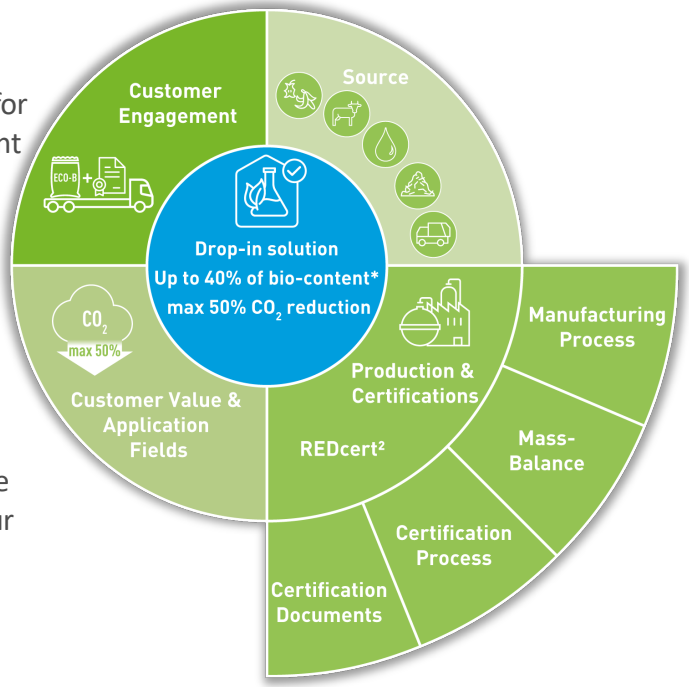
Berlin, 2021-08-23

Benefits of the Sustainable ECO-B Solution

Celanese

Drop-in solution

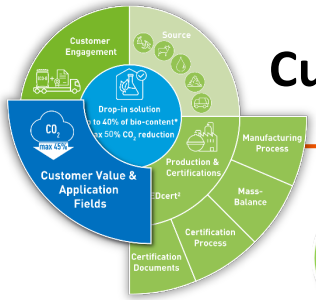
- Drop-in sustainable solution
- Our CAD/CAE supports ECO-Design for further CO_2 reduction and assessment implementing the certification process
- Success stories in high regulated market
- Manufacturing process remains unchanged.
- Audited and Certified Process
- ECO-B products via mass-balance are a chemically identical products to our standard material.



- 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

CO_2 max 50%

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



Customer Value & Application Fields

Celanese

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

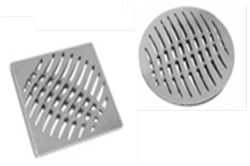
CO_2 max 45%

- Carbon Footprint reduction
- Renewable content increase
- Scalability
- Out of kind replacement

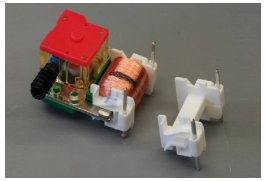
Drop-in solution

- Drop-in Replacement
- Regulatory consistency
- No requalification needed
- Identical properties & performance

Industrial



E & E

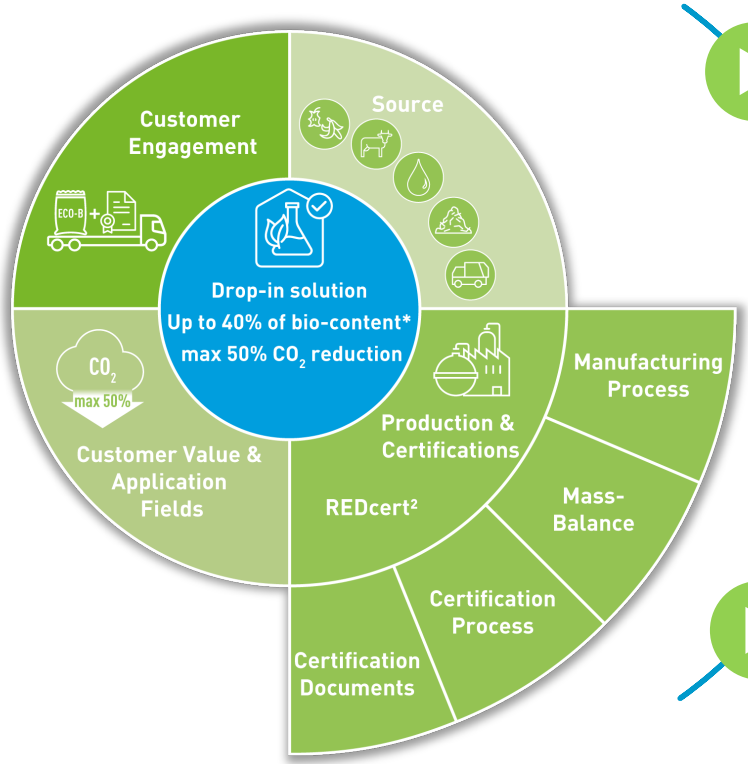


Medical

Large & Small Appliances

Automotive

ECO-B Solutions



Mass Balance
Increased bio-based content REDcert² or ISCC+ certified renewable sources

LCA Life Cycle Assessment
Reduced Carbon Footprint

Drop-in Solution
Zero manufacturing disruption

Availability
For all commercial grades

ECO-B
Keeps the same Certifications and Regulations

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The products mentioned herein are not intended for use in medical or dental implants.

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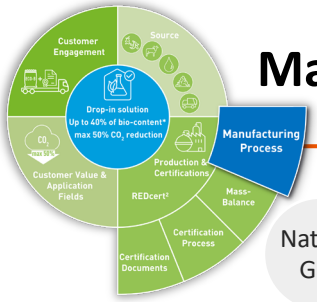
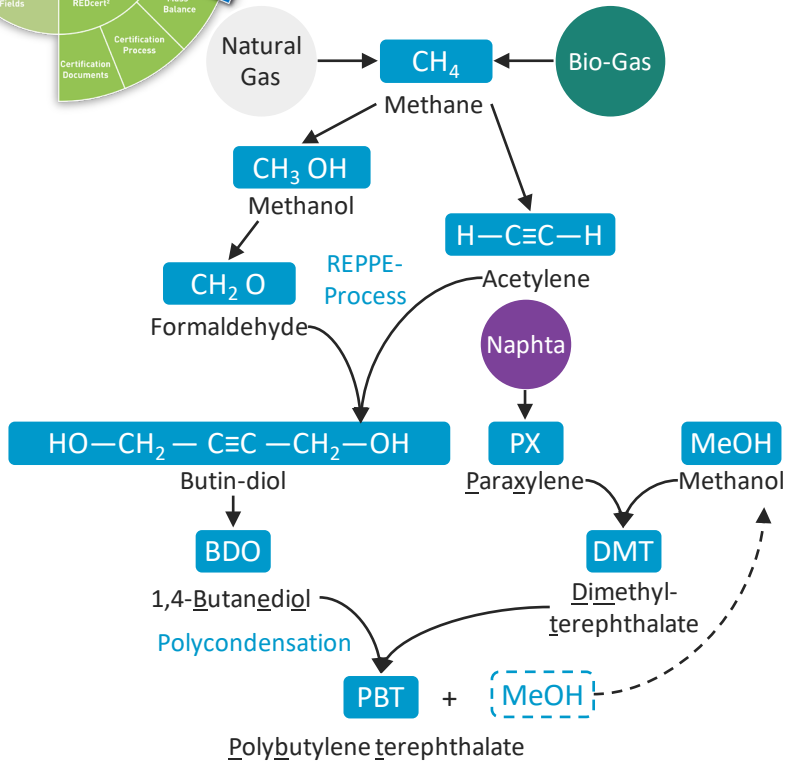
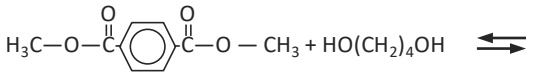
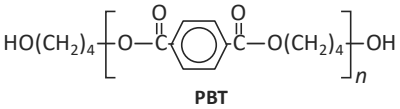
Manufacturing Process



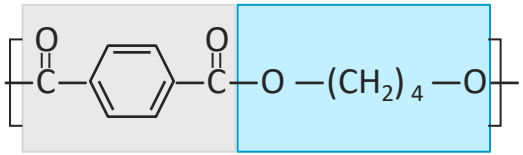






CELANEX® PBT ECO-B BIO CONTENT

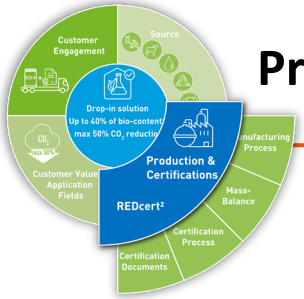
Bio-content = 88 / (132 + 88) * 100% = 40%



Molecular weight = 132
Fossil-based

Molecular weight = 88
Biomass-balanced

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.



Production & Certifications

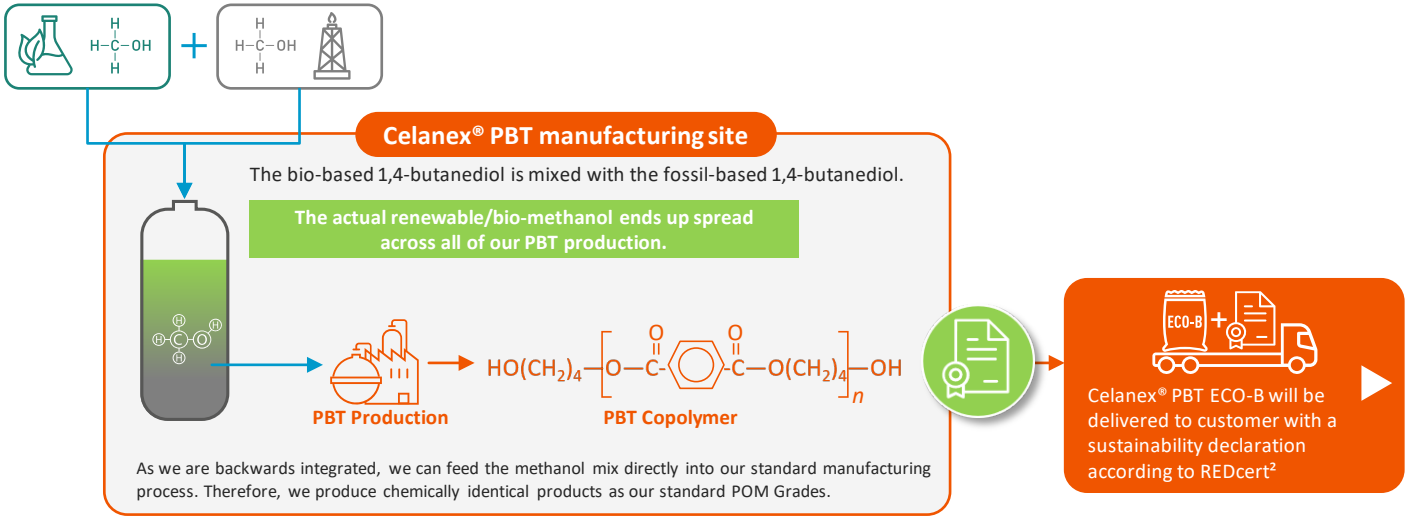
Celanese

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 REDcert²

REDcert²

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.



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.

ISCC+ Certification

- Ideally, Customers, Distributors and OEM's should all get ISCC+ Certification
  - All depends on how our customer wants to market it
- If value chain is broken, they cannot claim ISCC+ Certification
  - Anyone who wants to make claims regarding bio-content in their products needs to be certified

- NO ISCC+ Certificate
  - Customer can talk about bio-content via mass balance and/or lower CO_2 footprint but cannot mention ISCC+ Certification
- With ISCC+ Certificate
  - They can say all of the above and specifically mention ISCC+ certified process


DEKRA

ISCC PLUS Certificate

Certificate Number: ISCC-PLUS-Cert-2247144001

DEKRA Certification B.V.
Meander 1051, NL 4825 MJ Arnhem
certifies that

Celanese Service GmbH
Brüningstr. 50, D-65926 Frankfurt am Main

Processing unit

Celanese Production GmbH
Brüningstr. 50, 65926 Frankfurt am Main

complies with the requirements of the certification system

ISCC PLUS
(International Sustainability and Carbon Certification)

This certificate is valid from 15.10.2020 to 14.10.2021.

The site of the system user is certified as:
Processing unit

The scope of the certificate includes the following chain of custody options:
Mass balance

Arnhem, 15.10.2020
Place and date of issue

B T M Holtus
Stamp, Signature of issuing party

The issuing Certification Body is responsible for the accuracy of this document.
Version / Date 1: 15.10.2020

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