Unlocking the Potential of Bioplastics
Provide an honest product. And think beyond.

Our Bio & Beyond strategy is aligned with Trinseo’s commitment to sustainability and corporate social responsibility. The focus on environmental and social responsibility is intrinsic to who we are as an organization.

As we help our customers meet their most complex materials challenges, we create sustainable solutions designed to enhance and improve people’s lives around the world.

Our commitment to sustainability does not stop with us. It is carried out into the world through the tangible benefits of our materials, which power ideas and innovation.

Learn more about the benefits that our approach and products can provide.
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Trinseo Fast Facts

A strong track record – a bold direction

Trinseo (NYSE: TSE) is a global materials solutions provider and manufacturer of plastics, latex binders, and synthetic rubber.

We are focused on delivering innovative and sustainable solutions to help our customers create products that touch lives every day — products that are intrinsic to how we live our lives — across a wide range of end-markets, including automotive, appliances, consumer electronics, medical devices, electrical, building and construction, carpet, paper and board, footwear and tires.

Global resources

Trinseo delivers an unmatched combination of global reach, operational excellence, expertise, leading intellectual property, world-scale assets, and global R&D presence.

REVENUE IN 2017
$4.4 B

EMPLOYEES IN 25 COUNTRIES
2,200

R&D FACILITIES GLOBALLY
11

MANUFACTURING SITES GLOBALLY
16
Bioplastics: Differentiation is Key

Bioplastics can be divided into bio-based and/or biodegradable plastics.
Specific benefits for many applications

Bio-based Plastics

Bio-based means “from nature to plastic.” Plastic is derived from petroleum or natural gas while bio-based traditional plastics are to a varying degree derived from renewable biomass sources, such as cornstarch, sugarcane, sugar beet, cellulose, or vegetable oils.

Our bio-based thermoplastic product families APILON® S2 BIO and APIGO® BIO can be found in a wide range of applications and can contribute to a reduction in CO₂ and other greenhouse gas emissions compared to fossil-based plastics.

Biodegradable Plastics

Biodegradability stands for the potential degradation of a plastic by the action of microorganisms (such as bacteria, fungi, algae) to carbon dioxide (and/or methane), water, mineral salts and biomass.

In a composting environment, biodegradable bioplastic will degrade into CO₂ and water – caused by bacteria or other biological means. The European standards consider a material to be biodegradable if it degrades by at least 90 percent within six months.

Aerobic and anaerobic biodegradation

Calculation of the bio-based mass content

\[ m_B = \frac{100}{\sum_{i=1}^{n} W_i \cdot m_{B,i}} \]

- \( m_B \) is the bio-based mass content of the product, expressed as a percentage of the total mass of the product
- \( m_{B,i} \) is the bio-based mass content of the constituent (i), expressed as a percentage of the mass of the constituent (i)
- \( W_i \) is the mass of the constituent (i), expressed in grams
- \( W \) is the total mass of the sample, expressed in grams
- \( n \) is the number of constituents of the product

Bio-based or partly bio-based non-biodegradable polymers
- Biodegradable and bio-based plastics
- Biodegradable fossil-based plastics

Source: Material coordinate system of bioplastics, Prof. Dr. Ing. H.-J. Endres, IfBB University of Applied Arts
Life Cycle Assessment (LCA)

A measurement for the advantages of bioplastics partly or fully made of renewable resources

Being committed to save fossil resources for future generations and reduce greenhouse gas emissions, we strive to increase the amount of raw materials partly or totally derived from renewable resources. In addition to the reduced use of fossil-based materials, this facilitates the recycling of materials that cannot be reused.

For the optimization of our bio-based products regarding their entire life cycle, we apply the Life Cycle Assessment (LCA) methodology. This methodology allows for evaluating all the environmental impacts associated with a product.

The LCA considers a product’s entire life cycle from the extraction of raw materials to its final disposal or end-of-life waste management (cradle-to-grave). LCA is an internationally standardized method under ISO 14040 and ISO 14004.

Bio-based plastics can provide environmental advantages

For example, bio-based plastic can reduce the consumption of non-renewable primary energy like oil, coal and natural gas.

Also, bio-based plastic can regulate the global warming potential 100 (GWP 100), a measure of the greenhouse effect, which is calculated over 100 years. It is also known as “carbon footprint”.

The water footprint, which will show in Water Scarcity Index (WSI), is the relationship between total water use (“water footprint”) and water availability. Bio-based plastics can reduce the water footprint, too.

The benefits of having bio-based materials can be:

→ Strategic repositioning of the product
→ Communicate environmental information that can be used to enhance the product reputation
→ Get eco-labeling (e.g. EU Ecolabel, Carbon Footprint)
→ Release Environmental Product Declarations (EPD)
Bioplastics Market

The increasing consumer demand for sustainable products supports the continuous growth of the bioplastics market.
Global Production Capacities of Bioplastics

It is expected that global bioplastics production capacity is set to increase from around 2.05 million tonnes in 2017 to approximately 2.44 million tonnes in 2022.

Global production capacities of bioplastics by market segment (in 2017)

Global production capacities of bioplastics (2017–2022)

Land use estimation for bioplastics 2017 and 2022

In the course of the next few years, there will be no competition between renewable feedstock for food, feed and bioplastic.
Bio & Beyond

Unlocking the Potential of Bioplastics

We embraced the Bio & Beyond strategy when we developed our first biodegradable compound APIINAT™ BIO. Our aim was and still is to reproduce our current products in a bio-based and biodegradable version.

Reproduction of current fossil-based plastic applications in bio-based and biodegradable versions can offer environmental benefits:

- Saving of global fossil resources
- Reduction of Global Warming Potential
- Reduction of water consumption
- Sustainable waste management
Bioplastics: The Natural Choice

Over the last years, we have introduced bioplastics in a growing number of new applications. Our bioplastics portfolio includes advanced biodegradable and bio-based polymers and compounds:

Bio-based and biodegradable TPE solutions

Bio-based non-biodegradable plastics
- APILON™ 52 BIO
  Bio-based TPU Polymers and Compounds
- APIGO™ BIO
  Bio-based TPO Compounds

Biodegradable and bio-based plastics
- APINAT™ BIO
  Biodegradable TPC Compounds
- APINAT™ F BIO
  Biodegradable TPC Compounds

Biodegradable fossil-based plastics
- APINAT™ BIO
  Biodegradable TPC Compounds
**BIO-BASED SOLUTIONS**

**APILON™ 52 BIO**

Bio-based TPU

**Main features**
- High bio-based content with environmental benefits
- Recyclability
- Transparent, translucent
- Soft-touch haptic surface
- Resistant to oil, grease, chemicals
- Resistant to low temperatures
- Good abrasion resistance
- Good processability
- Colorability

**Proactive Product Innovation: APILON™ 52 BIO for footwear and fashion applications**

The broad range of APILON™ 52 BIO grades allows it to use these polymers and compounds in a huge variety of applications, both in footwear and in leather goods.

We developed APILON™ 52 BIO facing the increasing importance of ethical principles in the world of fashion. It is part of an evolution towards an eco-sustainable economy bringing social, economic, and environmental advantages.

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**APIGO™ BIO**

Bio-based TPO

**Main features**
- High environmental benefits
- Soft and hard products
- Special grades: food contact approved (EU 10/2011, FDA)
- Medical grades (biocompatibility in accordance with USP VI and ISO 10993)
- Resistance to low temperatures
- UV stability
- Good processability
- Colorability
- Recyclable

**Proactive Product Innovation: Tampon applicator made with APIGO™ BIO**

Nearly all the tampon applicators on the market are made of polyethylene or polypropylene.

Women are increasingly interested in hygiene products made from natural or sustainable materials.
BIODEGRADABLE SOLUTIONS

APINAT™ BIO
Biodegradable TPC

Main features

→ OK compost certification (EN 13432)
→ Food contact approved (EU 10/2011, FDA)
→ Highly bio-based
→ Resistance to low temperature
→ Transformation technology: film blowing
→ Recyclable
→ Colorability

Proactive Product Innovation: Biodegradable and compostable coffee capsules

→ Biodegradable and compostable
→ Highly bio-based
→ Food contact approved
→ Easy processability
→ High oxygen barrier properties
→ High thermal stability

Oxygen transmission rate (cm² / m² / day) - ASTM F 1927 (thickness 800µm)

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Total biodegradation of APINAT™ BIO

(before illustration purpose only)

Before degradation → During degradation → Compost at the end → Back to Nature
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**Product Stewardship**
Trinseo and its affiliated companies have a fundamental concern for all who make, distribute, and use their products and for the environment in which we live. This concern is the basis for our Product Stewardship philosophy by which we assess the safety, health, and environmental information on our products so that appropriate steps may be taken to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Trinseo products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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