



LIFE15 ENV/SE/000315

LAYMAN'S REPORT

BEYOND FOSSIL PLASTICS

BIODOLOMER FOR LIFE

A PROJECT FOR A SUSTAINABLE FUTURE.



A green revolution in plastics

Conventional plastics are associated with a number of problems, high CO₂ footprint and microplastics in nature causing negative environmental impact. The solution is a highly innovative and renewable material. This report shows how Biodolomer® can replace up to 80% of today's volume plastics. The material can be used for virtually all existing production processes and in all existing machines at the producers.

THE NEW SOLUTION

Biodolomer for LIFE project demonstrates how non-renewable and energy intensive plastic and packaging materials can be substituted with a new material. Biodolomer® is an excellent replacement for 80% of the volume plastics present in the market. Plastics such as PE (polyethylene), PP (polypropylene), PS (polystyrene) and PET (polyethylene terephthalate). Biodolomer® is based on renewable sources and is unique in its concept by demonstrating a list of important characteristics:

- **Renewable**
- **Biodegradable**
- **Compostable**
- **Convertible to renewable energy**
- **Gives virtually no CO₂ emissions, when energy recovered**
- **Does not generate micro plastics**

THE PURPOSE OF THE BIODOLOMER FOR LIFE PROJECT

- To verify the production process (from raw material to end product) for cost-effective production and also demonstrate how Biodolomer® can generate more recyclable waste and renewable energy.
- To secure quality standards in terms of functionality and hygienic standard as well as aesthetics requirements. This is done via demonstrations of four reference products to end-users.
- To present and disseminate the project's results to stakeholders in Europe and other regions.
- To influence environmental legislation in the EU, in particular the Waste Framework directive





Renewable, biodegradable and compostable

Biodolmer® is a result of innovative technology and natural components. It is tested, approved and safe to use.

MADE FROM RENEWABLE RESOURCES

Biodolmer® is made from a unique combination of renewable ingredients

Calcium carbonate

Grain

Sugar cane

Ester

Vegetable oil

- Biodolmer® is fully biodegradable and compostable.

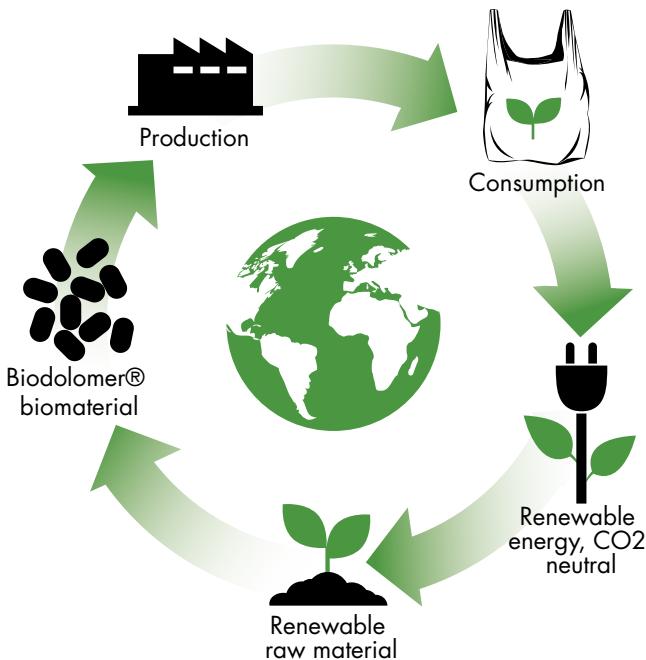
- The material has been tested and approved by the international test institute TÜV Reinland according to the SEEDLING standard complying with the European standard EN 13432.

CERTIFICATES AND APPROVALS

- The recipe for Biodolmer® is patented and Biodolmer® is a registered trademark.



Biodolomer® in the circular economy



Biodolomer® is firmly integrated in the circular economy. It is made from renewable resources and is both biodegradable and compostable. When Biodolomer® is converted to renewable energy, e.g. heat, electricity or biogas, there will be virtually no emission of CO₂.

Advantages with Biodolomer®

- Local and renewable GMO-free raw material
- Biodegradable and compostable
- Will not end up as micro or nano plastics on land or in the ocean
- Significantly reduces CO₂ when energy recovered to renewable energy
- To be used in existing machinery at plastic producers
- More energy efficient production at plastic producers

Positive consumers

To ensure the quality of Biodolomer® a number of tests were performed. The participants were asked to compare the performance of products made in this new material with the same type of products produced in conventional plastic. The overall result was very positive.



THE CARRIER BAG – HIGH QUALITY AND COMFORTABLE GRIP

Customers in a grocery store participated in a blind test. They were asked to try two carrier bags of identical size and filled with the same weight. One made from Biodolomer® and the other made from fossil PE.

FUNCTIONALITY: The participants preferred the quality of carrier bags made from Biodolomer® in general. The grip comfort was considered more comfortable than the bag made by fossil PE.

Something that also influences the perception of biomaterials positively.

AESTHETICS: When asked, the participants didn't find a preference for either carrier bag. How the material feels is considered more important than the look of it.

VALUE FOR MONEY: According to the interviews, people are willing to pay more for carrier bags made from renewable sources, due to the environmental impact. The bag can be reused several times.

Biodolomer® Fiber – a different food tray



In 2020, a new fossil-free food tray will be launched to the market. A great way for food companies to reduce their carbon footprint and reduce the CO₂ emission by up to 80%.

The Biodolomer® Fiber was developed by GAIA with the ambition to look differently from the conventional plastics trays. We added grain to the recipe to get the right look. The food tray has been tested with food companies who have been looking to substitute fossil-based plastics to be able to offer food in more

environmentally friendly packaging. The result of the tests was successful. The food tray has all certificates and approvals needed for food approval and industrial composting. The tray gives fresh products like fish and meat a longer lifespan. This product will be on the European market by 2020.

Surprisingly better cutlery

The test of Biodolomer® cutlery was performed at a sports event and at a hamburger restaurant. The results exceeded participants expectations.

BIODOLOMER FOR LIFE

All participants approved both the function and the grip comfort of the cutlery and the general impression was very good. When informed about Biodolomer®

the majority was surprised that it is possible to make ordinary products from this material and thought it was a very good substitution to fossil-based plastics.

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**“SURPRISED THAT IT IS
MADE OF BIO-MATERIAL”**

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**“POSITIVE – THAT IT HAS
LESS NEGATIVE IMPACT ON
THE ENVIRONMENT”**

“

**“INCREASED MY KNOWLEDGE
OF BIO-MATERIAL”**



Packaging for organic waste

Biodegradable and compostable are key features of Biodolomer®. This test was to verify the potential of recycling Biodolomer® as organic waste, for biogas production. The result showed low biogas production meaning further development is needed. The project foresees that with better pre-treatment technology and that Biodolomer® digests at lower temperature thus the biogas potential will increase.

TEST PROCEDURE

15 tons of food waste was collected using Biodolomer® food waste bags and run through the pre-treatment plant at Kristianstad Biogas to get samples for laboratory tests. RISE, Research Institutes of Sweden, performed laboratory tests with samples of Biodolomer® bags and from the slurry made from food waste.

The result showed that the production of biogas from the slurry was in line with acknowledge literature values. The production of biogas from the Biodolomer® bags showed that the bags used that had been in contact with food waste had a higher



contribution to biogas production than not used bags. However, the production of biogas was in average only 10% compared to the slurry, and with a high standard deviation. Regarding visible impurities the result showed that the slurry examined had a higher value than allowed according to SPCR 120.

20% MORE FOOD WASTE FOR BIOGAS

During the project an independent study of food waste bags; paper bags compared to Biodolomer® bags, was conducted among a group of tenants in Helsingborg. The study wanted to understand what influenced the willingness to increase the sorting degree of food waste mostly, the material itself or additional verbal information. The main finding was that tenants using the Biodolomer® food waste bags increased the amount of food waste with up to 20%, at the same time as they also appreciated the bag more than the paper bag, since the bag was dense, easy to tie and kept the waste bin fresh.



1.

Collection of food waste in Biodolomer waste bags.



2.

Slurry sample, testing for visible impurities and biogas potential.

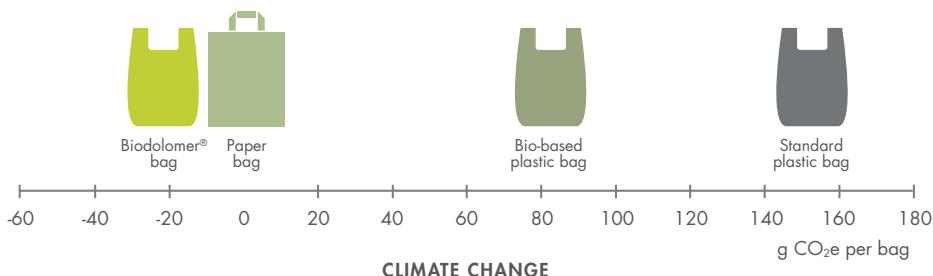


3.

Collection of food waste bag samples for biogas potential.

Life Cycle Assessment

The LCA study aims to give a complete overview of how the material flows assignable to the product affects the environment. The Life Cycle Assessment study of Biodolomer® shows that the material has a low global warming potential and cumulative energy demand.



The Life Cycle Assessment study shows that Biodolomer® has the lowest impact in the impact category GWP (Global Warming Potential) when studied in the cradle to gate perspective as granulate compared to bio PE and fossil PE alternatives and in a cradle-to-grave perspective in the form of a carrier bag compared to bio PE, fossil PE and paper alternatives. Source: Profu AB

BIO PE - Polyethylene made of sugar cane, Bio-based plastic bag

FOSSIL PE - Polyethylene made of crude oil, Standard plastic bag

PLA - Polylactic acid

PBAT - Biodegradable aliphatic-aromatic copolyester

The LCA study took place during 2019. Three impact categories deemed most relevant were selected.

- Global warming potential (GWP).
- Cumulative energy demand (CED, both renewable and non-renewable).
- Water consumption (WC).

LOW GLOBAL WARMING POTENTIAL

The LCA study showed that Biodolomer® had the lowest impact in the impact categories GWP and non-renewable CED, both when studied in a cradle-to-gate perspective (as granulate, compared to bio PE and fossil PE alternatives) and in a cradle-to-grave perspective (in the form of a carrier bag, compared to bio PE, fossil PE and paper alternatives). In the categories renewable CED and WC, the fossil PE and paper alternatives performed slightly better.

CARRIER BAG REPLACES OTHER PRODUCTS

The material production phase and secondary use phase were identified as those with the largest contribution to the overall life cycle impact of the Biodolomer® carrier bag. PLA and PBAT were the material components which contributed the most to

THE BIODOLOMER® LCA

The time horizon of the impacts in this study was 100 years, and the temporal scope was 2019. The geographical scope differs with the different material since they are produced in different locations. For all materials, however, the use phase and end-of-life phase were set to occur in Sweden. We used the available data in the EcoInvent database for inventories for the other materials. The data quality is thus quite different and significantly higher for the Biodolomer® life cycle than for the other materials.

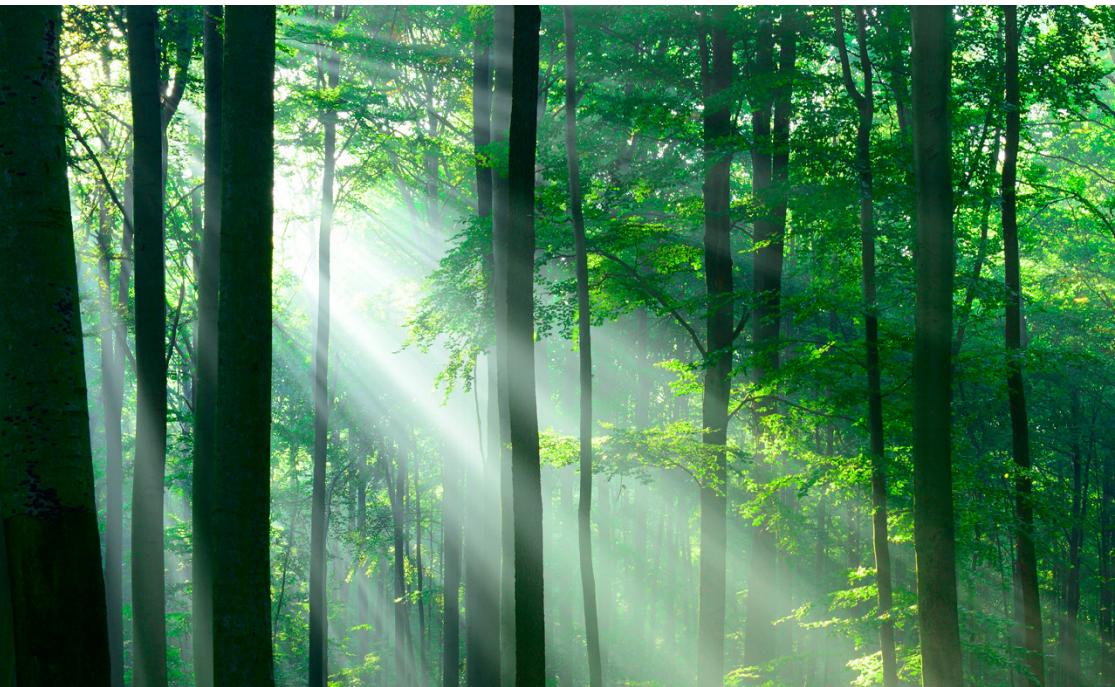
the material production phase of Biodolomer® where PBAT had the largest impact per unit mass. Out of the likely secondary use activities identified, the reuse as carrier bag proved to have the most important impact by displacing other products, thus saving resources and reducing emissions.

WELL SUITED FOR END-OF-LIFE DISPOSAL

Because of the material properties of Biodolomer® and the fact that it is made up of mostly biogenic and inert

materials, it is theoretically well suited for a number of different end-of-life disposal options, like material recycling, biological treatment (anaerobic digestion with bio-methane recovery) and energy recovery. The physical properties make the material easy to re-process. The mostly biogenic components mean that carbon dioxide emissions from combustion, either in a waste to energy plant or in cement kilns, can be considered to have a low global warming impact.

For complete LCA please visit www.gaiabiomaterials.com



COMPARING ENVIRONMENTAL EFFECTS

The goal of LCA is to compare the full range of environmental effects assignable to products and services by quantifying all inputs and outputs of material flows and assessing how these material flows affect the environment. This information is used to improve processes, support policy and provide a sound basis for informed decisions.



Åke Rosén, presenting products made of Biodolomer® for EU organizations in Brussels, 25 April 2019

Transferability - spreading the word

Bio-based material and plastic alternatives are relatively new concepts. They require explanation and education. An important part of Biodolomer for LIFE is to communicate with stakeholders.

ENGAGING DIALOGUE

During the project we have informed stakeholders about Biodolomer® and its potential to substitute fossil plastics. We have connected with politicians, the business sector, plastics producers and consumers. We have so far reached more than two million people, directly and indirectly and the dissemination will continue.

POLICY INFLUENCE

To be able to launch the Biodolomer® as a substitute to fossil plastics we have engaged in discussion with

the EU Commission and the Swedish Environmental department. Since bio-based material is relatively new on the market the project has taken on the role to educate and make sure that decisionmakers have the right knowledge.

Åke Rosén is founder and head of research and development at GAIA Biomaterials. In June 2019 he became a member of the technical working group at SIS, the Swedish Institute for Standards. At SIS bio-based materials will be part of the standardization of plastics in Europe and in the long term, possibly influence international standards.

European added value

The demand for plastic is high in Europe. But the many negative aspects of fossil-based plastics make a substitute necessary. Biodolomer® is a superior alternative to conventional plastics – rapidly cutting CO₂ emissions.



There are many reasons for the high interest in bio-based materials today. The main reasons are the negative impact from CO₂ emissions on the climate and the ambition to take responsibility for the environment. Many countries have banned fossil plastics already and companies are looking for substitutes. Today Biodolomer® has a higher market price than fossil plastics. But adding the actual cost for the negative climate/environmental impact makes Biodolomer® competitive. Biodolomer® can replace up to 80% of fossil volume plastics like PE (polyethylene),

PP (polypropylene), PS (polystyrene) and PET (polyethylene terephthalate). GAIA BioMaterials produces the granulate and producers of applications can easily use the granulate in existing machines. This makes the transformation cost-efficient. Biodolomer® can be produced close-to-market with high percentage of locally sourced raw material throughout the world.

The Biodolomer for LIFE project has demonstrated that the highly innovative bio-based Biodolomer® is the new solution in creating a more sustainable world for generations to come.



The partners of Biodolomer for LIFE

GAIA BIOMATERIALS - THE COMPANY BEHIND BIODOLOMER®

GAIA BioMaterials develops and produces biodegradable biomaterials for a wide variety of applications. The vision is to replace fossil based plastics with a renewable, biodegradable and compostable alternative without sacrificing quality. One of GAIA BioMaterials products is the revolutionary Biodolmer®.

NSR - THE MUNICIPAL WASTE COMPANY

The local waste handling company providing service to the residents in the six municipalities in northwestern Scania. The objective is to be part of creating a long-term sustainable and cyclical society. NSR manage waste and recycle materials in the best possible way, taking into account the environment, work environment, technology and economy. NSR supports the residents with carrier bags for food waste and wants to utilize the full potential of the material for biogas production and biofertilizer.

ÖRESUNDSKRAFT - THE MUNICIPAL ENERGY COMPANY

The local energy company, providing electricity and district heating to 125 000 households in northwestern Scania, the ambition is to move away from burning fossil-based plastics and work towards bio-based material. When using bio-based material instead of fossil-based in the production of electricity and heat there is no CO₂ emissions emitted that will affect the climate.

EU LIFE PROGRAMME

The LIFE programme is the EU's funding instrument for the environment and climate action. The general objective is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value. LIFE started in 1992 and has co-financed more than 4 500 projects in the member countries with more than €6 billion to protection of the environment.

ec.europa.eu/easme/en/life

Follow the interesting story in how to save our planet on www.gaiabiomaterials.com.

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