Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

Rethinking Plastics

Opportunities in Bioplastics – A Strategic Approach

January 2017

Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

Contents

Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

Introduction

With increasing concerns over the use of plastics, sustainable alternatives to plastics are increasingly in demand. Biopolymers in general and bioplastics in particular, present one such sustainable alternative.

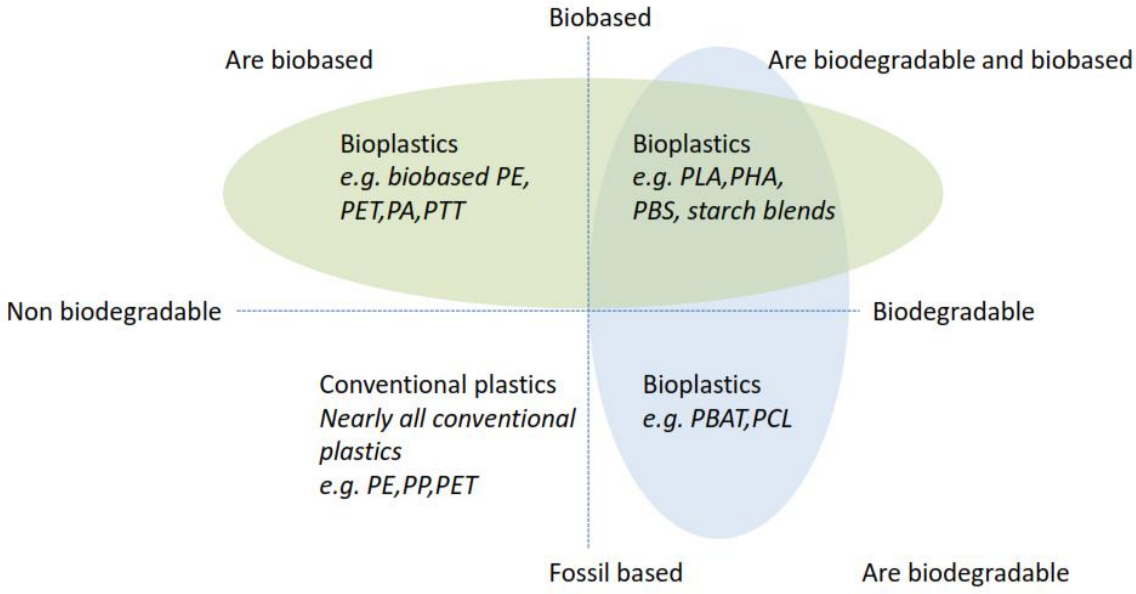
In this context, bioplastics have attained much prominence as they are one of the very few commercially feasible alternatives to plastics. Products and solutions based on bioplastics/biopolymers present interesting opportunities globally, and in India. Opportunities are present across a variety of industrial sectors that include packaging, water, beverages, insulation materials, specialty materials and more.

A number of entrepreneurs are keen to know the key characteristics of this exciting new sector to evaluate entry into one or more of the bioplastics segments. The following document attempts to give an overview of the bioplastics market in India and worldwide and is developed to provide some intelligence on the untapped opportunities available in this nascent sector.

What are Bioplastics?

Bioplastics are plastics in which all carbon is derived from renewable feedstocks. They may or may not be biodegradable. The term 'bioplastics' covers several groups of plastics – on the one hand are biobased plastics (made from renewable resources) and on the other hand biodegradable plastics.

Here's a well-known chart that puts bioplastics in the context of conventional plastics, as well as in the contexts of biodegradability and the lack of it.



As you can see from the above chart:

It is a general misconception that all biobased plastics are biodegradable and vice versa. They are not – there are enough bioplastics that are durable.

What's even more interesting is that there are petro-based plastics that are biodegradable. This again runs contrary to popular perception that all conventional plastics are non-biodegradable.

Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

Biodegradable Plastics

Main Biodegradable Plastics from Natural Sources

- Starch-based Polymers – Plant based
- Polylactides (PLA) – Lactic acid by fermentation
- Polyhydroxyalkonates (Polyhydroxybutyrate) (PHB) – Microbial source
- Cellulose: Cellulose esters, cellulose ethers, cellophane (cellulose pulp from trees or cotton

Main Biodegradable Plastics from Synthetic Sources

These are man-made polymers that are biodegradable but not from renewable resources.

- Polybutyrate adipate terephthalate (PBAT)
- Polybutylene succinate (PBS)
- Polycaprolactone (PCL)
- Polyvinyl alcohol (PVOH, PVA)

Properties of Key Biodegradable Bioplastics

Biopolymer	Renewable feedstock	Properties	Substitute for
Polylactic acid (PLA)	Corn (Major), sugar beet, potatoes, wheat, maize, tapioca	High tensile strength and modulus. However, its brittleness and low crystallinity led to low thermal stability and limited applications.	Low-density and high-density polyethylene (LDPE and HDPE), Polystyrene (PS) and polyethylene terephthalate (PET), Polypropylene (PP)
Polyhydroxy alkanoates (PHA) and (PHB)	Corn, potatoes, maize, tapioca, vegetable oils	The materials properties exhibited by **PHAs**, ranging from stiff, brittle to semi rubber-like makes it a close substitute for the synthetic plastic and gives wide range of final products. **Melting points from 40-180C** **PHB** has better oxygen barrier properties than both PP and PET, better water vapor barrier properties than PP, and fat and odor barrier properties that are Sufficient for use in food packaging.	Polypropylene (PP) Polyethylene (PE)

Bioplastic Blends

When virgin biopolymer is used to manufacture the end product, they can cater to only limited set of products due to the limitations in its properties. However, the drawbacks can be overcome by blending two biopolymers such that they complement each other resulting in enhanced property of the resin to cater to numerous end products.

For example, the brittleness of PLA can be overcome by blending it with PBAT, a petroleum based biodegradable polymer, enabling the blend to be used in a wide range of applications thanks to their mechanical, thermal and other properties. (BASF is in commercial production of this blend with the brand name ECOVIO)

The Bioplastics Market

Bioplastics still constitute a very small percentage of the total plastics market. Of the total 300 million tons of plastics consumed in 2015, only about 2.1 million tons (0.7%) was bioplastics. Of this, only about 0.8 million tons (0.3% of total) was biodegradable bioplastics – that is, bioplastics which degrade naturally within a short period of time.

The above share however is expected to rise significantly owing to some key drivers.

Drivers for the Bioplastics Market Growth

A number of key drivers are accelerating the growth of the bioplastics market

- ⇨ Mandates & regulations
- ⇨ Increasing eco-awareness among consumers
- ⇨ Corporates becoming more focused on sustainability
- ⇨ Technology stabilization
- ⇨ Cost reduction

Challenges for Bioplastics

At the same time, bioplastics face critical challenges before they achieve large scale market penetration.

- ⇨ **They are much more costly** than conventional plastics (could be 2-4 times as costly, depending on product)
- ⇨ **Upstream technology is still evolving**, and hence there are uncertainties in technologies and processes
- ⇨ **Uncertainties present in post-use processing** and end of life options for bioplastics
- ⇨ **Threat of substitutes** – a number of substitutes, some of them authentic and some not-so authentic, present competitive challenges to the adoption of bioplastics in many mainstream markets
- ⇨ **Customer awareness** - a number of misconceptions result in a poor and sometime faulty understanding of the market, resulting in delays in investment decision-making

Strategic Market Approach

Given the Opportunity and Challenges, how does an entrepreneur approach the bioplastics business opportunity?

The following are the steps/stages we suggest:

Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

Identify the Right Market

- ⇨ In order to decide which of the business models and products to go with, an entrepreneur first needs to have a good idea of which market he will be targeting.
- ⇨ Here, one can consider four types of market segments

	Currently Available	**Emerging Market**
Commodity	Unsophisticated, Low risk, Low margins	Unsophisticated, Low Risk, Medium margins
Premium	Sophisticated, Medium Risk, Medium-high margins	Uncertain, Sophisticated, Medium-high risk, High margins

- ⇨ The matrix above provides a perspective of the type of market segment opportunities present for an entrepreneur.
- ⇨ Each of the four combinations presents a specific Opportunity-Challenge profile.
- ⇨ It is recommended that an entrepreneur starts with a clear understanding of each of the four cells, and based on the combination that is best aligned to his aspirations and constraints, select the optimal combination

Let us look at each of the four combinations in brief.

Currently Available - Commodity – this cell represents the most obvious market segments for bioplastic products; one can readily imagine what comes in this – *disposable carry bags, for instance.* These market segments already exist with some amount of competition. While a new entrepreneur might be tempted to enter this, he/she should take note that owing to the commoditized nature and extent of competition, it might result in a pretty painful existence.

Currently Available – Premium – this cell represents the more premium bioplastic market segments. Similar to the cell above, these markets are already being catered to with varying levels of competition, but these are more specialized than the commodity segment, and could hence provide good margins to the producer. *An example of a product in this cell is biodegradable medical implants.*

Emerging – Commodity – this cell represents those market segments that are fairly new or are just emerging, but would be requiring commoditized and unspecialized products. An example of a product that belongs to this category could be punnets/small boxes used for take-aways and for shipping specific food products. Currently made of plastic, these are used by a number of premium hotels as well as by online shopping firms, and there is a reasonable need for them to switch over to biodegradable plastics.

Emerging – Premium – this cell represents an exciting, though relatively uncertain set of market segments. These are segments in which the needs require fairly specialized bioplastic products, and these segments could also be willing to pay top dollar prices for these. An example of a product in this segment could be bioplastic, biodegradable microbeads to be used in cosmetics, now that some developed countries have started banning use of plastics microbeads in cosmetics.

Identify the Right Product

Bioplastics Product Categories

At first sight, bioplastics appears to be a rather homogeneous product category, but it is not.

For one, all bioplastics are not biodegradable. This comes as a surprise to many, as the common wisdom is that the whole point of going for bioplastics is to have a biodegradable product. Not so. Some bioplastics are not biodegradable, and they are used as a renewably sourced substitute for durable plastics.

In addition to bioplastics being biodegradable or not, a bioplastic product can come in the following categories:

- ***Homogeneous bioplastics*** – these are bioplastics made with a single, homogeneous resin (PLA, for instance)
- ***Bioplastic blends/compounds*** – these are pure bioplastics too, but having more than one rein. An example is PLA/PHA blend.
- ***Bioplastic blends with petro-plastics*** – a variation of the above, these are blends that contain both bioplastic and petro-plastic resins. An example of this is PLA/PBAT.
- ***Bioplastic laminates with metal/paper*** – Typically for films, these are bioplastic films that are laminated with thin layers of metallic foil or paper.
- ***Composites of bioplastics with wood and fiber*** – Finally, bioplastc products can also be in the form of composites, where they are blended with wood or fiber.

Identify the Right Business Models

An entrepreneur has the choice of starting at different levels on the bioplastics value chain. Here are the business models available for an entrepreneur in this context.

- Starting upstream with the biomass
- Starting with an intermediate product (such as Lactic Acid)
- Starting with resins but doing the compounding of multiple resins
- Starting with the compounded resins and doing only the moulding of end product
- Purchasing the end product and only involved in trading

Each model above has a specific risk-return profile, and an entrepreneur has to choose the business model based on his/her profile and the business assets brought to the table.

Taking it Forward

As we have seen in the earlier sections, the decision-making process for investing in a bioplastics venture can be quite intricate.

There are multiple market segments and product categories that an entrepreneur can operate in. In addition, the entrepreneur also has the option of starting at various points along the business value chain.

Given these combinations and the opportunity-challenge canvas, how does an entrepreneur or startup decide which way to go?

The right or optimal strategy should start with identifying who will be the customer (market segment) and what needs would be satisfied for the customer. This would determine the product categories. The right business model depends to a large extent on the profile of the entrepreneur, his/her current business assets and also the capital that can be brought in for the venture.

Hence, our recommended steps for the way forward are as follows:

First: Select the market you wish to enter. Then -

➔ Identify the products that are most attractive for the market segments selected

➔ Identify the business model that will be the best for you

➔Identify technical and marketing partners required for the product and the business model

➔Firm up business plans and start the business

How Can Bioplastics Guide Help?

With its focus and prior work in bioplastics, Bioplastics Guide has an excellent understanding of all the strategic steps listed above and can assist an entrepreneur in making the optimal decisions for each stage of the decision making process.

Interested in taking Bioplastics Guide consulting assistance for entering the bioplastics industry? Send a note to hello@bioplastics.guide with brief details about your profile and needs.

About Bioplastics Guide

Bioplastics is a domain with enormous potential, but it is also an intricate one, with a number of dimensions and challenges.

While there are excellent information sources available online that provides information on the technical aspects, properties and end uses of bioplastics, there is hardly any resource that takes all these inputs, synthesises them and provides strategic and practical directions to aspiring entrepreneurs and businesses keen on investing in this sector.

We wanted to fill this gap. The **Bioplastics Guide** provides, through its site, blog and other resources strategic, market-focussed guidance for prospective investors in bioplastics. Our consulting division extends this strategic guidance further by providing strategic and market analyses of the bioplastics industry, customised for their aspirations and context.

The **Bioplastics Guide** is part of **Energy Alternatives India (EAI),** a leader in renewable energy and cleantech research and consulting, with a focus on India. The Bioplastics Guide however provides research and consulting assistance for regions outside India as well.

Bioplastics.guide

EAI
Catalyzing Cleantech & Sustainability

About EAI

Energy Alternatives India (EAI) was formed in 2008 to provide Consulting, Research, Promotion and Marketing support to the fast growing Renewable Energy and Cleantech industry in India. Started by a team of professionals from IITs and IIMs having prior experience in the alternative energy industry, we have had the opportunity to work in most of the diverse Renewable energy sectors such as Bioplastics, Algae bio-fuels and products, castor oil, Solar, Wind, Biomass, Waste-to-energy etc.

We also operate the country's largest renewable energy portal (www.eai.in) and the solar energy portal (www.solarmango.com). In addition, we run a popular renewable energy community the EAI Club (www.eai.in/club) , and India's largest renewable energy newsletter, EAI Daily (www.eai.in/newsletter) .

Consulting

EAI provides consulting assistance for all the major renewable energy sectors with a major focus on Solar (PV and thermal), Bio-energy, Bioplastics, Wind, Energy Efficiency and Sustainable heating for industries.

We work for industrial and commercial companies, public and private utilities, governments, investors, developers, banks, financial institutions, private equity companies, venture capitalists and private entrepreneurs.

Consulting / Research work related to Bio and Other Cleantech domains

Our team has extensive acquaintance with the entire spectrum of renewable energy and cleantech domains and has provided end-to-end services to clients looking for assistance in Bio and other Cleantech sectors.

EAI has done biomass, bioplastics and biofuels related projects for globally reputed companies & organizations such as Huber, General Electric, GSK, Bill & Melinda Gates Foundation, Pepsi Co., etc.

Simply put: There are few, if any companies, in India as good as EAI who can provide the specialized, high quality intelligence, strategic guidance, market research support and business contacts for the bio-energy market.

All the Best!