D. Market projection

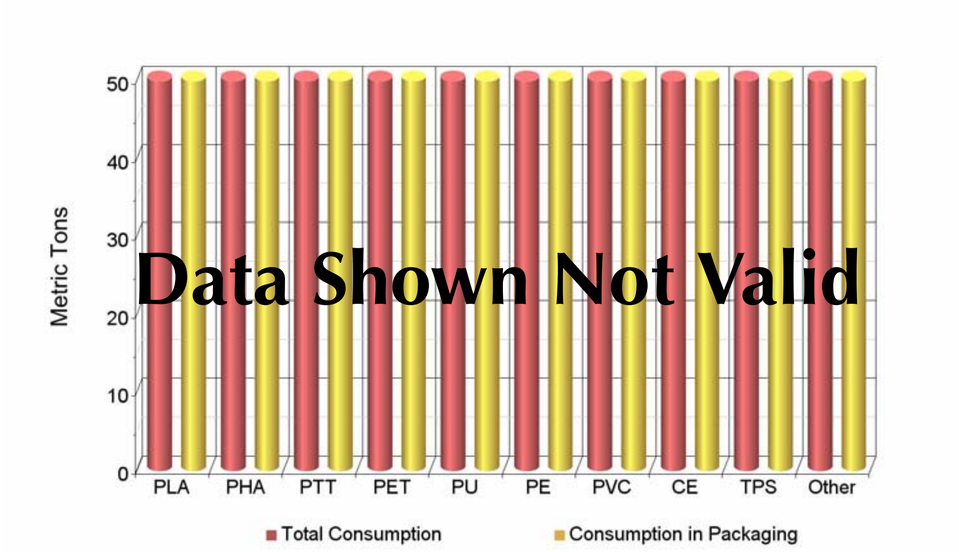
The market projection begins with a summary of global biopolymer consumption and progresses logically to a variety of more detailed analyses including segmentations by raw material type, end-use, package type, and geographic region.

1. Global biopolymer resin consumption

The first set of market data provides global biopolymer consumption for each biopolymer family. It also shows the amount of consumption in the packaging market.

Figure 4 provides the quantitative comparison. for 2009

Figure 4
Total Consumption versus Consumption in Packaging
2009 global consumption



Source: Allied Development Corp.

One of the important reasons for presenting this data (Figure 4) is to examine the relationship between total bio-polymer consumption and

2. Polyhydroxyalkanoates (PHA)

There are currently only small and pilot plant scale suppliers of PHA resins; however, the nature of this market will change dramatically with the start up of the Telles plant in Clinton, Iowa, U.S.A. in early 2010. Other suppliers are also planning to build production scale plants.

Table 11 provides the quantitative projections.

Table 11
PHA Global Production Capacity
(metric tons)

COMPANY	2004	2009	CAGR	2014	CAGR
BioMatera					
Biomer					
Kaneka					
Meredian					
PHB Industrial		**Data Removed**			
Telles					
Tianan					
Tianjin Green					
Others					
Total					

Source: Allied Development Corp.

After the early 2010 start up of its new production facility, Telles will have over 90% of global PHA production capacity; however, several other companies will enter this market or expand with significant capacity by 2014. Tianan of China, PHB Industrial of Brazil, and Meredian of Bainbridge, Georgia, U.S.A will install three of the largest facilities. The Telles expansion will be completed well before the announced expansions of these three companies, leaving sufficient time for them to change their plans. Based on this timing and our expectations for market demand, we have scaled back the projected

Greenhouse gas releases

Table 19 provides a comparison of the greenhouse gas releases during manufacture of select polymers.

Table 19
Greenhouse Gas Releases during Manufacture
(weight CO_2 per weight polymer)

POLYMER	GREENHOUSE GAS RELEASES	GREENHOUSE GAS RELEASES
	(kilograms CO_2 per kilogram polymer)	(pounds CO_2 per pound polymer)
BIOPOLYMER		
Polylactic acid		
Polyhydroxyalkonates		
Polyethylene terephthalate		
Polytrimethylene terephthalate		
Polyethylene		
Polyols		
Thermoplastic starch		
SYNTHETIC POLYMER		
Polytrimethylene terephthalate		
Polyethylene		
Polyethylene terephthalate		

Data Removed

Source: Allied Development Corp.

Bio-PTT and bio-PET both provide a moderate reduction in greenhouse gas releases compared to their synthetic counterparts (Table 19). However, bio-PE provides a huge advantage compared to synthetic PE, even greater than the energy savings examined previously. In fact, the negative value for greenhouse gas releases means the manufacture of bio-PE actually removes greenhouse gases from the atmosphere. At first this may not seem possible, but the life cycle

C. Polylactic Acid (PLA)

Global capacity for PLA (and the other biopolymers) was examined in detail in the Technology section, so comments in the Marketing section will be focused on consumption, pricing, package type, and other market related issues.

1. Current status

Table 21 provides the quantitative projection for PLA capacity, total consumption, and consumption in packaging.

Table 21
PLA Global Consumption
(volume)

	2004	2009	CAGR	2014	CAGR
METRIC TONS					
Global capacity					
Capacity utilization (%)					
Total consumption					
Packaging market share (%)					
Consumption in packaging		**Data Removed**			
MILLION POUNDS					
Global capacity					
Capacity utilization (%)					
Total consumption					
Packaging market share (%)					
Consumption in packaging					

Source: Allied Development Corp.

Large scale production of PLA resin began in 2002 when NatureWorks started its plant in Blair, Nebraska USA. At that time, the