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BRINGING PLA TO MARKET

The market for second generation PLA

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BIOPLASTICS PROCESSING & PROPERTIES
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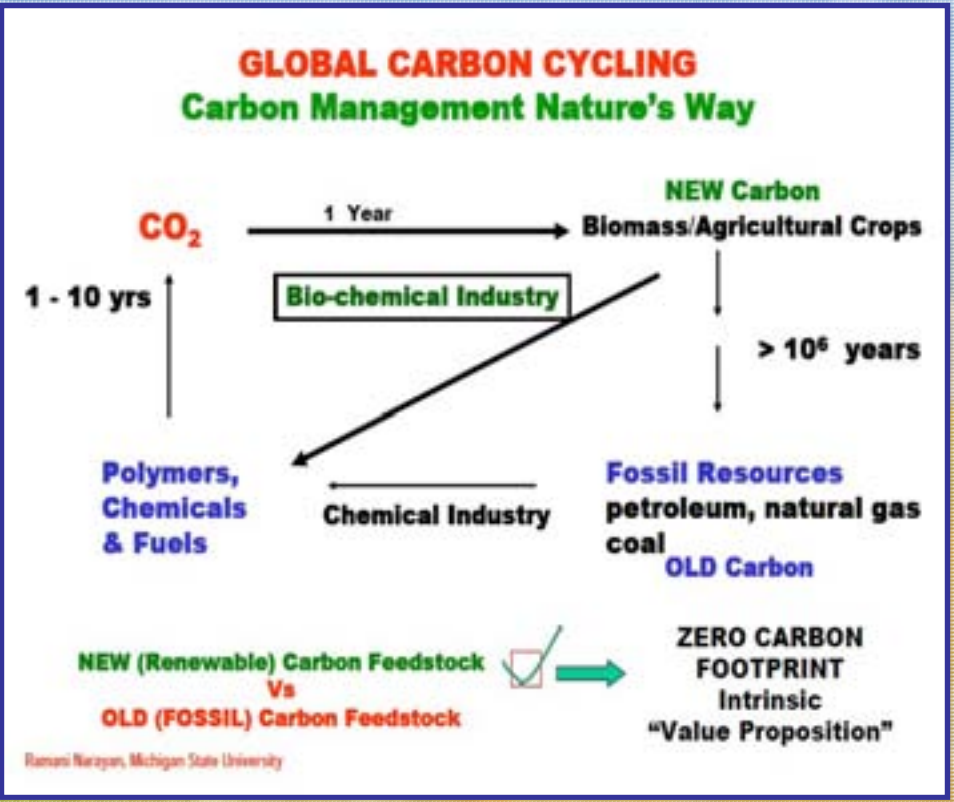
Market Driver – Replace Oil-Based Plastics

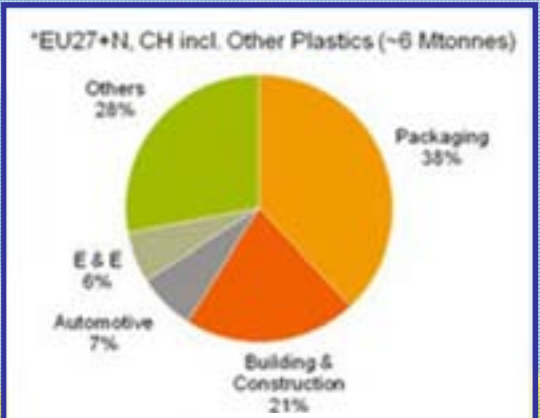
- Plastics growing with global GDP growth
- Packaging growing at above GDP rates
- Oil supply can't keep pace with demand for oil-based plastics and fuels, and disruptions affect competitive position relative to bio
- Oil-based plastics have large carbon footprint
- Need to future-proof the supply chain

- Consumer awareness and government concerns put pressure on
  - Retailers and brand owners to replace oil-based plastics to reduce carbon footprint
  - Manufacturers to secure the supply chain
- In response, we expect the European Commission will set targets for adoption of bio-renewable products



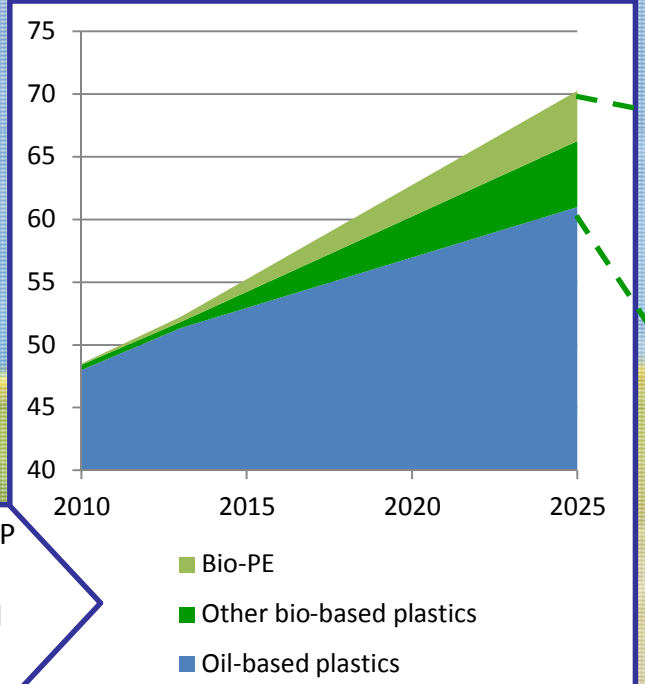
Market Opportunity – Bio-Based Plastics Market

European Plastics Market (million tons)

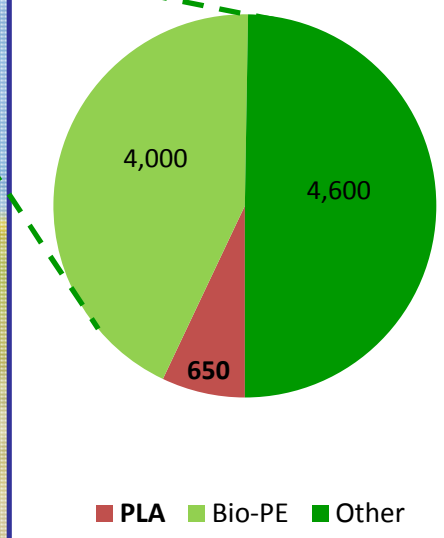


48.5 million tons

- Total plastics projected to grow at GDP rate of 2.5% pa to 70.2 Mt in 2025
- Forecast 13% bio-based share of total plastics market by 2025 = 9.25 Mt



EU Bio-based Plastics Market 2025 (thousand tons)



- Bio-PE forecast to supply 43% = 4 Mt of bio-based plastic demand

- Bio-PP, Bio-PET and other bioplastics forecast to supply the remaining 5.25 Mt including 650 kt PLA

- Packaging forecast to consume over 38% or 3.5 Mt of bio-based plastics

Market Driver – Energy Recovery at End of Life

- In future, bio-based plastics will be valued higher than oil-based plastics through energy recovery at end of life
- No net gain of CO_2 for bio-based plastics (unlike oil-based plastics)
- Renewable Obligation Certificates (ROCs) already exist

- Preferred option for disposal after use is recycling, but….
- Recycling contaminated packaging such as this yogurt pot is not practical or economic

- Best option at end of life is energy recovery
- Favours bio-based materials such as PLA

Market Opportunity – Biorenewable Energy

Replace oil-based plastics in packaging with bio-based plastic to

- Save limited fossil carbon resources
- Reduce carbon footprint
- Enable energy from waste by maximising biorenewable waste

Increase biorenewable energy yield by adopting bio-based plastics for packaging

- Target high value food packaging which can't be recycled
  - Convenience food
  - Hospitality / Food Service
- Increase bio-based (C^{14}) content in waste stream

Bio-Based Plastics Value Proposition

DROP-IN BIOPLASTICS

Bio-PET is functionally identical with oil-based PET and ~30% bio-based

Coca Cola introduced PlantBottle™ in 2009

Heinz committed to PlantBottle™ in 2011

In March 2011 PepsiCo announced world's first PET bottle made 100% from plants

- Bio-PE is functionally identical with oil-based PE and 100% bio-based
- Braskem sold out its first 200 kt pa bio-PE plant in year 1
- Bio-PE forecast to be largest bio-based commodity plastic

P&G's announced bio-PE shampoo bottle in April 2011

Plastics Development Cycle 1900 - 2010

- Trend from oil-based to bio-based (bio-renewable) plastics in the past 10 years

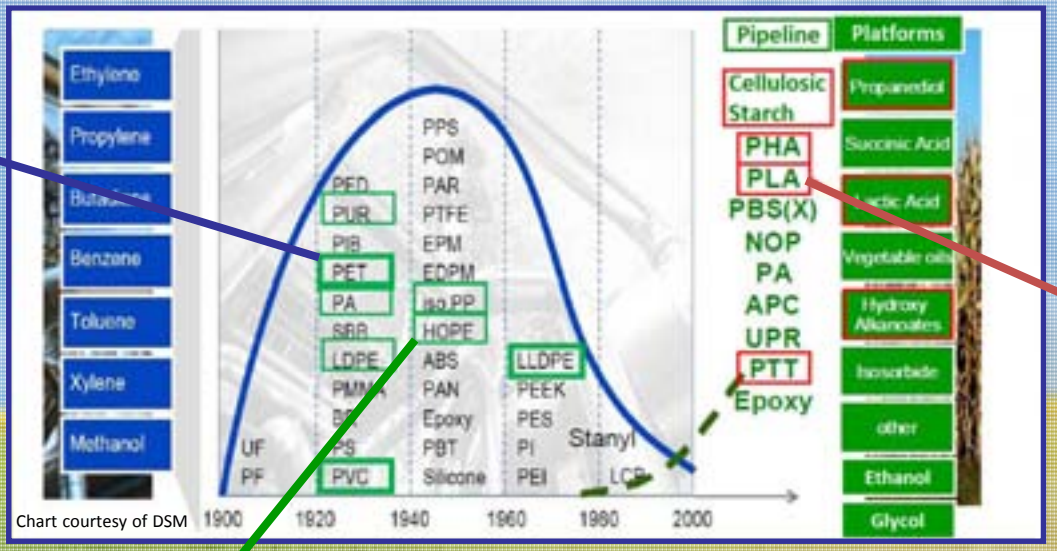


Chart courtesy of DSM

Value Proposition

- Brands whose values include sustainability, are adopting bio-based packaging to increase appeal to consumers
- Choice of bio-based plastic depends on functionality required for the particular application
- In each case, bio-based packaging enhances the value proposition of these brands

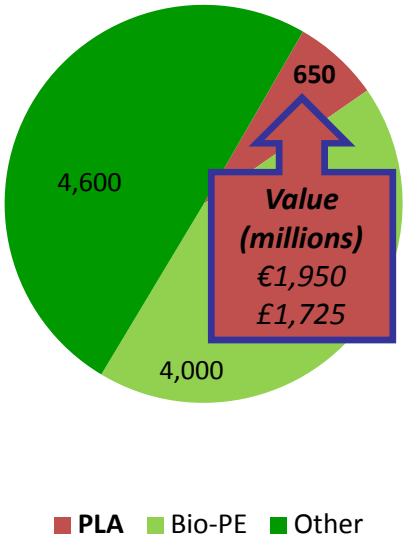
NICHE BIOPLASTICS

- PLA is 100% bio-based and offers unique functionality
- With global sales of 100 kt pa, PLA likely to remain world's leading niche bioplastic

Danone launched Activia Yogurt in Germany in PLA cup in May 2011

Market Opportunity – PLA

EU Bio-based Plastics Market 2025 (thousand tons)



European PLA Market (thousand tons) (kt)

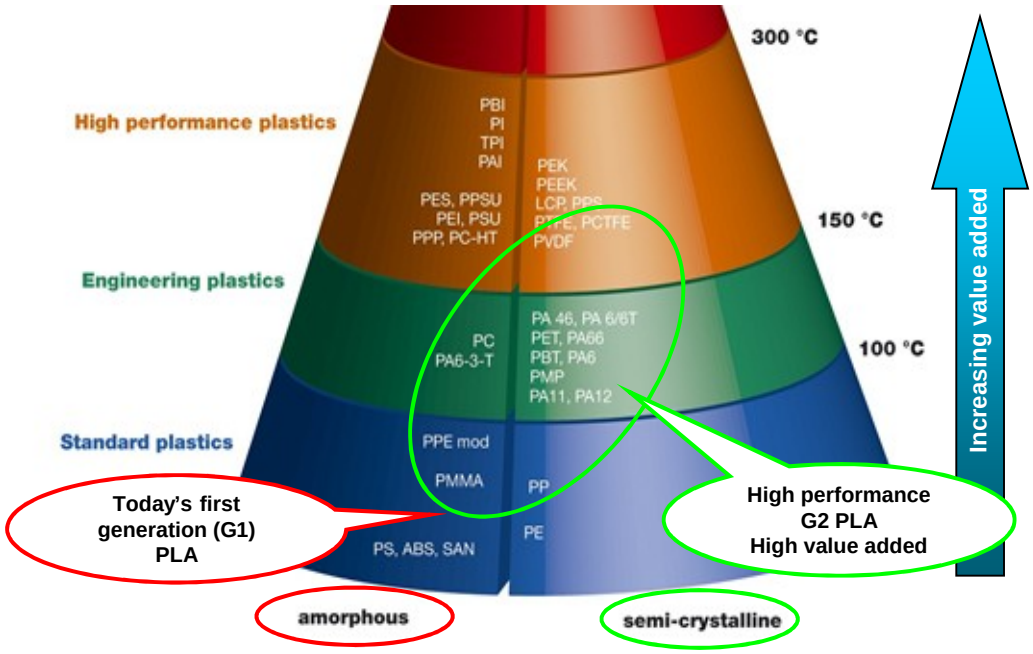
EU PLA Market (thousand tons)		2011	2015	2020	2025
McKinsey ~2/3 packaging, ~1/3 Europe				670	
NNFCC studies			184	346	650
- Value @ €3.0/kg (£ millions)			*£478*	*£918*	*£1725*
Estimated Supply	- G1 PLA	40	60	90	100
	- G2 PLA	2	25	70-110	200-340
Market Gap		-	100	160	280

- McKinsey forecast global PLA market of 3000 kt pa in 2020
  - 1/3 = ~1000 kt fibre – the rest is plastic for packaging etc.
  - 1/3 of plastic = ~670 kt in Europe
- NNFCC studies forecast strong growth for G2 PLA from EU (non-GM) source
- Current G1 PLA global sales of 120 kt pa (~1/3 in Europe) will grow with increased capacity through 2020, but growth will slow as G2 PLA supply increases
- 3 other G2 PLA plants in Europe by 2015 (including Synbra)

How does PLA compare with oil based plastics?

Second generation (G2) PLA has the properties required to replace oil-based plastics such as PP and PET in high value packaging applications

PLA has functionality which is not available from oil-based plastics:
- bio-based thermoplastic with added performance and functionality
- added value and benefit



Cone chart courtesy of Purac

- For example, high moisture vapour transmission makes PLA a good option for packaging cucumbers

- Shelf-life:
  - 2 days with no wrap
  - 4 days with PE film wrap
  - 8 days with PLA film wrap
- Value:
  - Increased customer satisfaction
  - Reduced spoilage
  - Reduced cost of waste removal & disposal

Market Opportunity – Packaging

Target segments where PLA can replace oil-based plastics and add value

- Packaging applications where energy recovery is a better option than recycling
  - Fresh produce, short-shelf-life products and convenience foods
  - Film wrap
  - Microwavable and dual-ovenable rigid packaging

Injection-moulded microwavable ready-soup pot - replaces PP

Note: Image of M&S soup pot for illustration only

Thermoformed tray for oven-ready meal pack – G2 PLA replaces cPET

High performance technical flex pack

Projected EU PLA Market 184kt in 2015 Target Segments
Rigid packaging - injection moulded
Rigid packaging - thermoformed sheet
Co-Blended Polymer - mainly film
Clear film
Coated paperboard
Composites
Fibre
Non-packaging injection moulding