

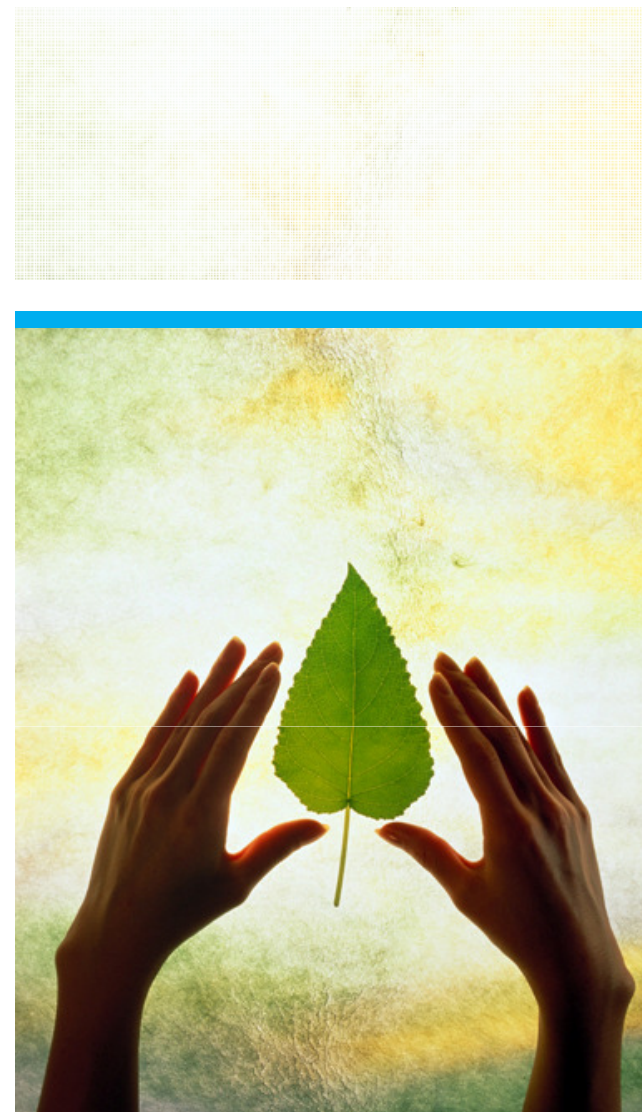


## Green Chemistry as a promising way

*J.C. Bogaert*

*8th Congress of the ECRN*  
7th October 2010

[www.lactic.com](http://www.lactic.com)



# Green Chemistry

## GREEN CHEMISTRY Sustainable Chemistry

“Green chemistry consists of chemicals and chemical processes designed to reduce or eliminate negative environmental (and health) impacts.”

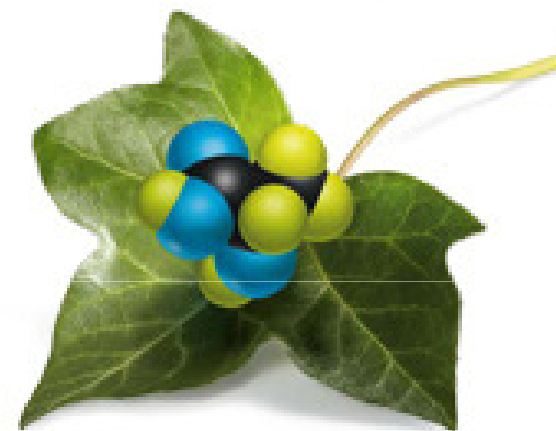


# 12 principles

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## In short:

1. Prevent wastes
2. **Save carbon**
3. Reduce toxicity
4. Be efficient
5. Avoid auxiliary substances
6. Reduce energy requirements
7. Use **renewable materials**
8. Reduce derivatives
9. Use catalysts
10. Think « **end-of-life** » (LCA)
11. Follow reactions in real-time
12. Improve safety



Adapted from: P. Anastas & J. Warner, Green Chemistry: Theory and practice, New York, Oxford University Press, 1998

## 3 fields

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### Energy

Bio fuels

### Chemistry

Commodities

Specialties

Fine chemicals

### Materials

Biopolymers

Fibres

Composites

### Bio-based products

- existing products , same as oil-based products
- new products with new functionalities

### Already a REALITY

European chemical industry is estimated to use 8-10% renewable raw materials to produce various chemical substances



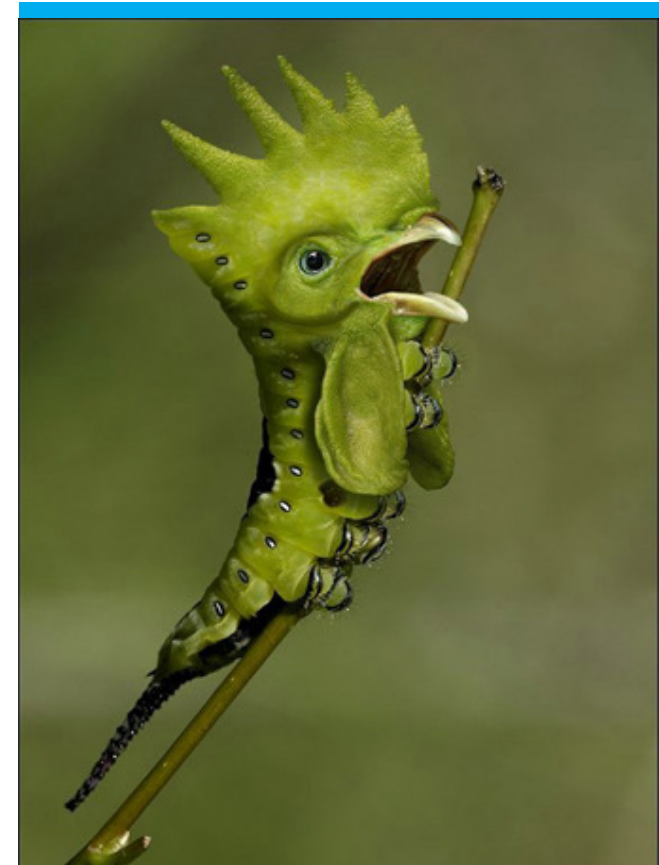
# Walloon Region as an example

European Commission's Lead Market Initiative  
(COM(2007)860):

Bio-based products identified as innovative market  
with strong growth potential

Bio-based products could become a lead market for  
Europe

Green Chemistry can help transforming Walloon  
Region



# Walloon Region: Assets (strengths)

## § Existing resources

- § Biomass (wood, agriculture)
- § Wastes

## § Strong chemical industry & biotechnology

- § Chemistry & Life Sciences = 2<sup>nd</sup> industrial activity in Wallonia
- § Chemistry & Life Sciences = 25% of Walloon manufacturing industry's global turnover
- § Chemistry & life Sciences = very high level of specialization in Wallonia

## § High research potential & education (agronomy, chemistry, biotechnology)

- § 6 universities, 17 high schools, 13 research centres, >1000 research fellows and scientists

## § Already existing projects & networking initiatives

- § TECHNOSE, SINOPLISS,...
- § GREENWIN

## § Already existing industrial projects

- § NEOCHIM (biodiesel), BIOWANZE (bio-ethanol), GALACTIC/FUTERRO (lactic acid/PLA)

Probably true for all  
regions in Europe

Adapted from: ValBiom communication - 10<sup>th</sup> May 2010

# Walloon Region: Challenges

(weaknesses)

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- § **Need to organize supply chain for renewable raw materials**
  - § Collection, logistics & storage infrastructures
- § **Distortion of competition between bio-energy & bio-based products**
  - § Fiscal incentives, green certificates... for bio-energy
  - § None for bio-based products
- § **Need for clear communication to consumers**
  - § To identify bio-based products
  - § To understand the benefits of using bio-based products
- § **Need for “systemic approach”**
  - § Integration of agriculture & industrial development
- § **Need to focus on high added-value bio-based products**
  - § Competition with BRIC countries on commodities
  - § Lack of resources for production of commodities
  - § Higher market penetration predicted for specialties & fine chemicals (50% by 2025) & polymers (18% by 2025) [only 8% for commodities]

Probably true for all  
regions in Europe

Adapted from: ValBiom communication - 10<sup>th</sup> May 2010 and European Commission - report 3<sup>rd</sup> November 2009

# GALACTIC as a showcase

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## Mission

### LEADING LACTOCHEMISTRY

“ The chemistry of nature is what inspires **Galactic** to imagine **a world in which chemistry meets nature**. Today, this world opens up countless possibilities to replace expensive petrol based solutions with sophisticated **lactic acid** alternatives. They are equal in performance to say the least, and far more superior in respect to the environment. Handed to us by nature, our products are completely natural themselves. Therefore they hold a promise for future challenges. We are proud to be part of **the next nature**. ”





# GALACTIC in the World

**USA**  
**GALACTIC Inc.**

- ±10 employees
- Production of lactates & blends

**PLARCO**

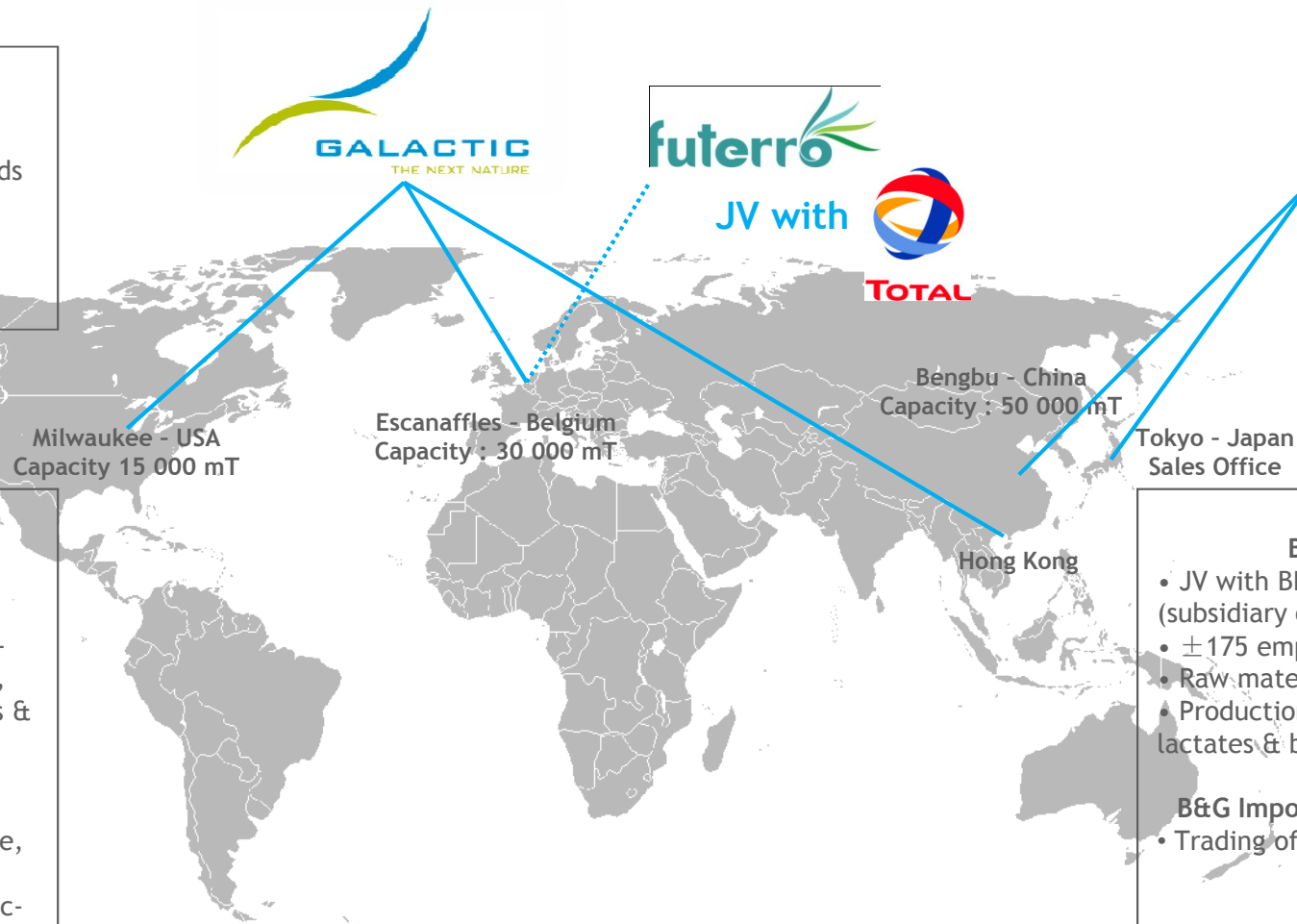
- JV with WRR
- Recycling of PLA

**Belgium**  
**GALACTIC SA**

- ±110 employees
- Raw material: sugar
- Production of L-lactic acid, D-lactic acid, lactates (solid salts, liquid salts and esters), lactides & PLA

**FUTERRO SA**

- Demonstration unit for PLA
- Production & sales of L-Lactide, D-Lactide, (functionalized) oligomers, P(L)LA, P(D)LA and sc-PLA



**China**  
**B&G Ltd**

- JV with BBKA Biochemicals (subsidiary of COFCO)
- ±175 employees
- Raw material: corn glucose
- Production of L-lactic acid, lactates & blends

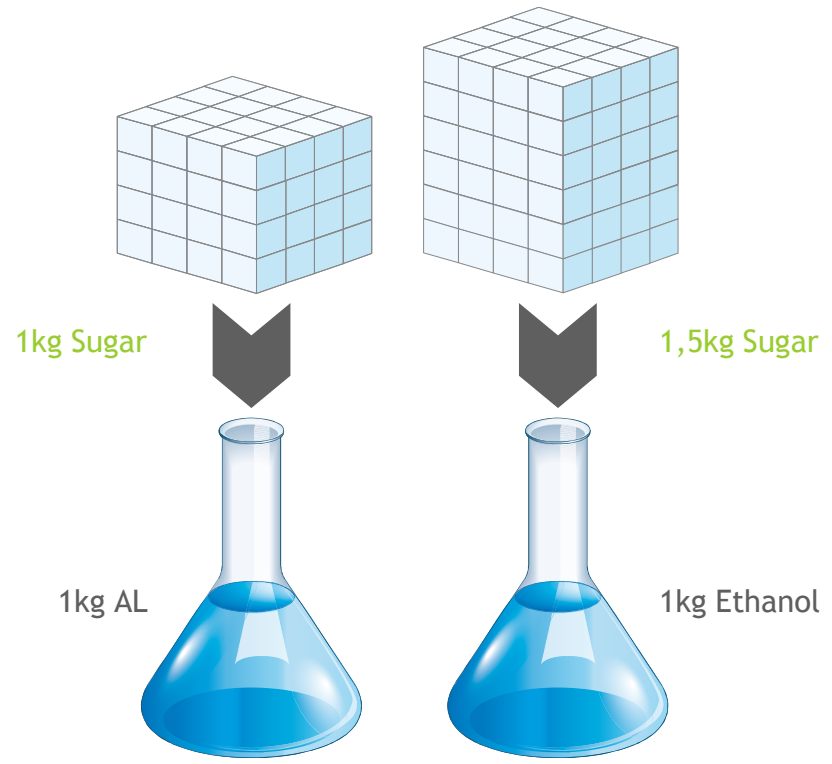
**B&G Import & Export Ltd.**

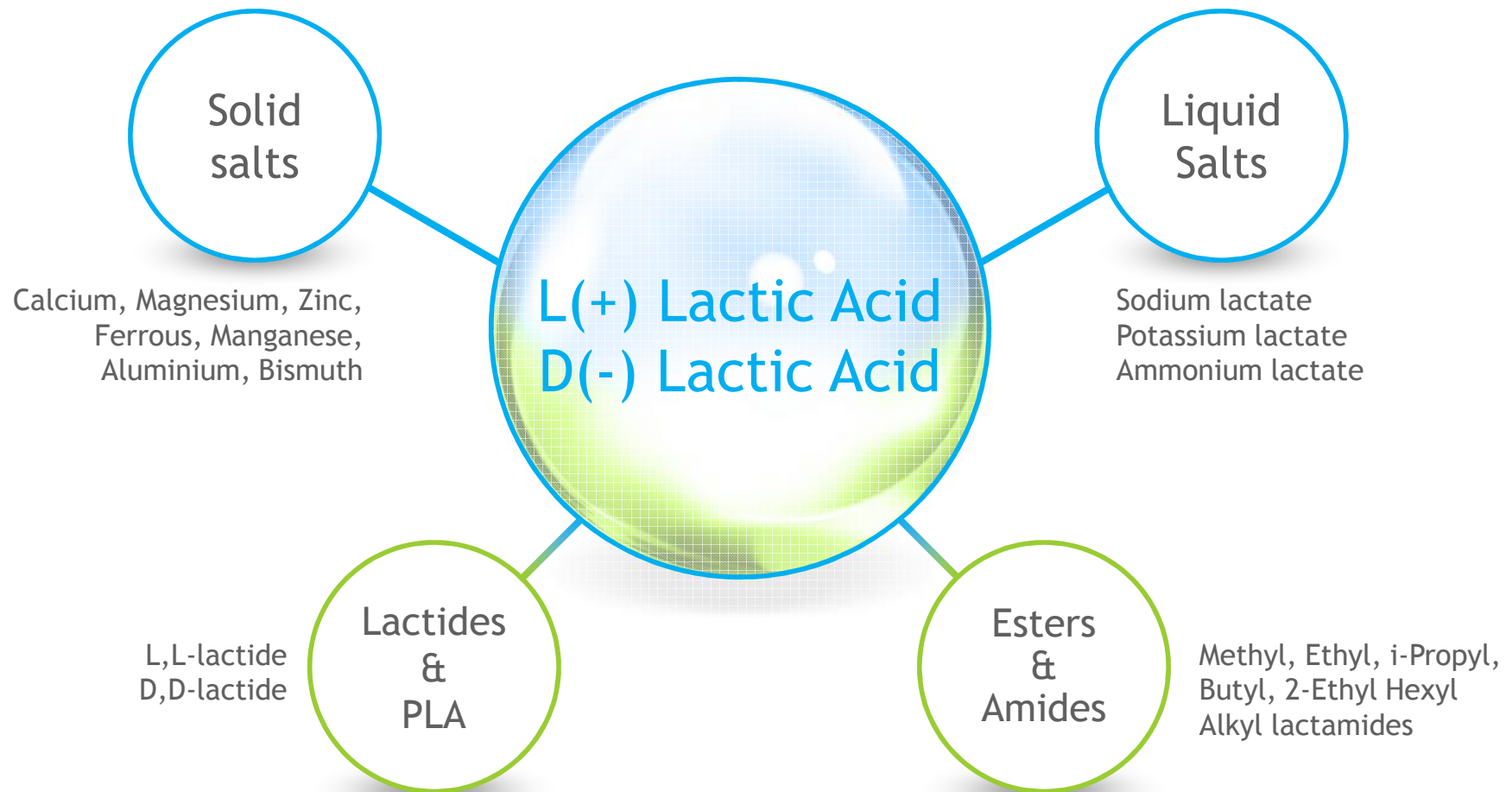
- Trading of chemicals

**Japan**  
**B&G Japan KK**

# Why Lactic Acid?

- § **Natural:** most widely occurring hydroxy-carboxylic acid
- § **Biocompatible:** naturally present in human body (Cori cycle)
- § **Biodegradable**
- § **Sustainable:** derived from renewable carbohydrates (sugar, corn, wheat or cellulose) by anaerobic homo-fermentation
- § Its production generates **no CO<sub>2</sub>**
- § Carbon yield > 95%





# FOOD applications



## Bakery

- - preserving agent
- - elasticity of the dough
- - production of emulsifier: SSL/CSL, etc



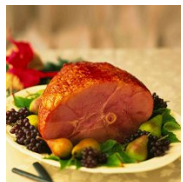
## Beverages

- - drinks fortification
- - pH in brewing process
- - flavor profiles, etc



## Fruits & vegetables

- - pH adjustment in canned vegetables
- - « cement » between cells
- - taste enhancer, etc



## Meat & poultry

- - bacteriostatic agent (*E. Coli*, *Listeria*, *C. Botulinum*)
- - natural decontamination of carcasses
- - mild flavor enhancer & color stabilizer, etc



## Fish & shrimps

- - inhibition of melanosis
- - inhibition of *Listeria*
- - pH lowering, etc



## Sauces & dressings

- - natural preservation effect
- - mild acidification
- - etc



## Confectionery

- - mild acid flavor taste
- - prevent sugar inversion
- - improves the gel matrix, etc



## Dairy

- - control of lactic fermentation
- - direct acidification
- - taste, etc

# NON FOOD applications



## Cosmetic

- - skin humectant & moisturiser
- - Skin rejuvenaing & whitening
- - Antimicrobial
- - pH control



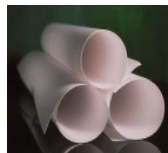
## Industry

- - chemical nickeling
- - synthesis of resins
- - pH control



## Paintings, coatings & inks

- - used for the synthesis



## Paper & textile

- - silk: brightening & finishing
- - paper & textile: humectants
- - leather: pH control



## Detergent

- - anti-microbial properties
- - compatible with metals & plastics
- - « skin protective »



## Pharmaceutic

- - treatment of dermatological disorder
- - dialysis solution
- - oral care



## Fertilizers

- - oligoelements chelating agent
- - growth stimulator



## De-icer

- - avoids re-freezing
- - compatible with metals & plastics
- - environmentally friendly

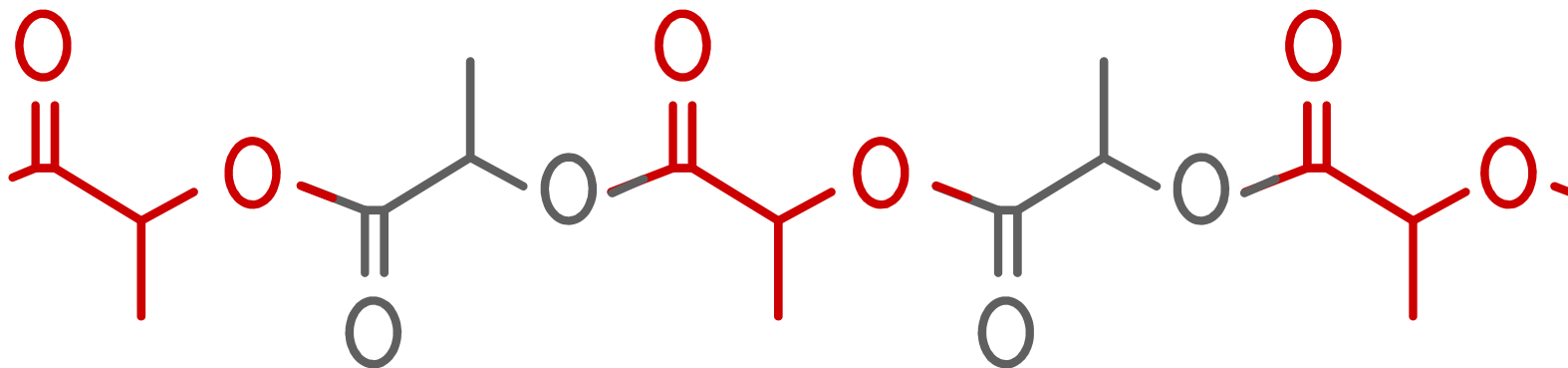
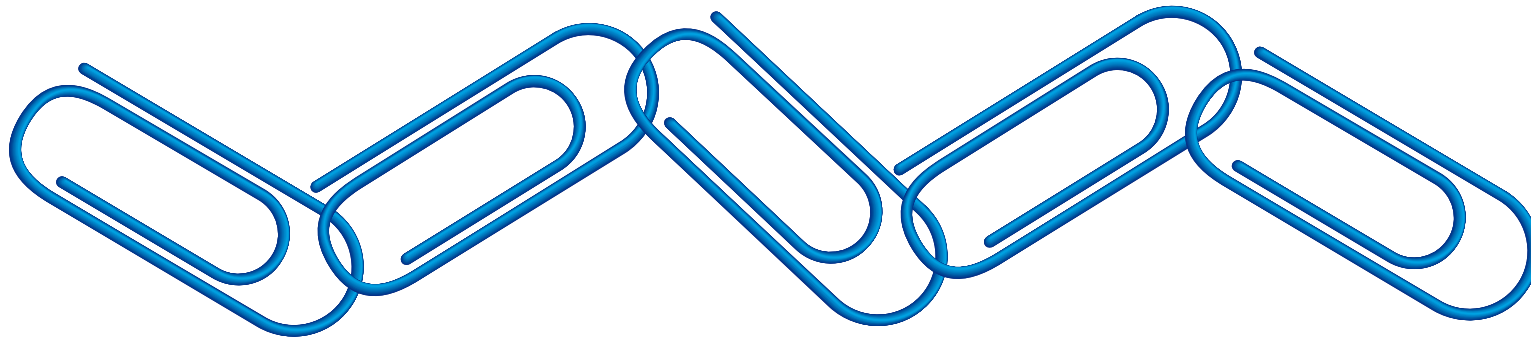


## Tobacco

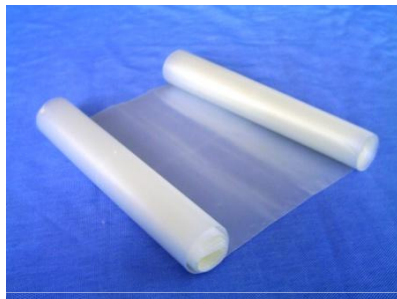
- - Improves taste & bleaching

# Poly Lactic Acid (PLA)

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# PLA

## Renewable Plastic for Durable and Biodegradable Applications

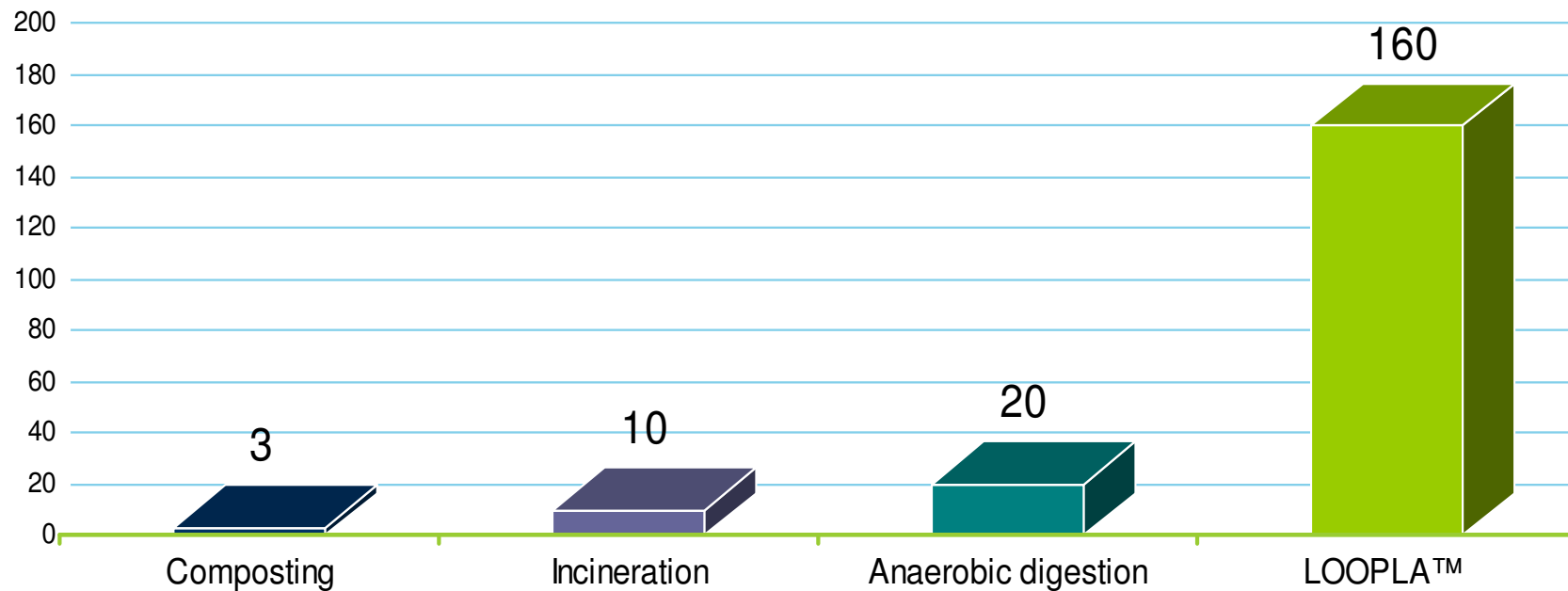






# LOOPLA® provides the best environmental protection for end of life of PLA

ECO-Benefits (points)



- ECO-Benefits are based on the standard eco-indicator 99 scores (Taking in account elements such as ecotoxicity, fossil fuels, climate change,...)

*Study by VITO(Be), based on datas from Natureworks and Galactic*



# Value chain

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Short movie about the whole value chain