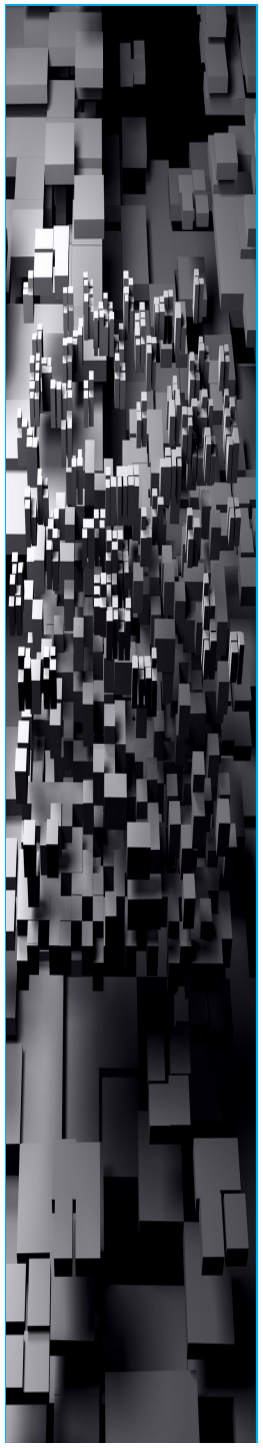


CIRMAP
Center of Innovation and Research in Materials and Polymers

UMONS
Université de Mons

materials
UMONS RESEARCH INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING

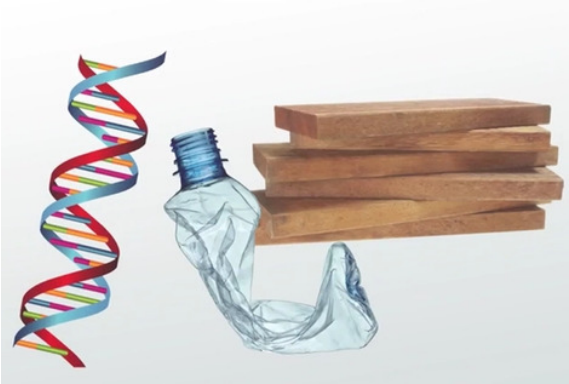
FOOD PACKAGING

CHALLENGES IN BIOSOURCED POLYMERS

Outline

- **Introduction**
- **Who are we?**
  - A Polymer Research laboratory
  - Polymer characterization
- **The plastic's demand in Europe**
  - Some global figures...
  - Pros & Cons
- **Focus 1 : Food packaging**
  - What was a **good** food packaging?
  - What will be a **good** food packaging?
- **Focus 2 : Biobased and/or biodegradable food packaging**
  - Definition
  - Interest and challenges

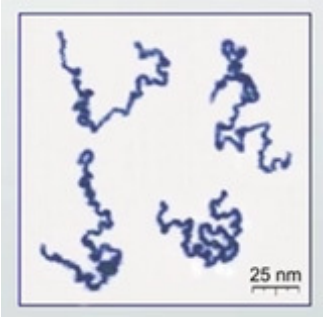
INTRODUCTION



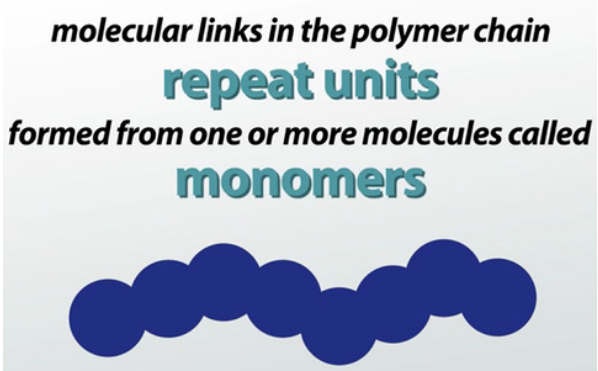
What do DNA, plastic bottle or wooden have in common?

Polymer from Grec 'Poly'=Many + 'Meros'=Part

Polymers are very large molecules that are made up of thousand - even millions - of atoms that are bonded together in a repeating pattern

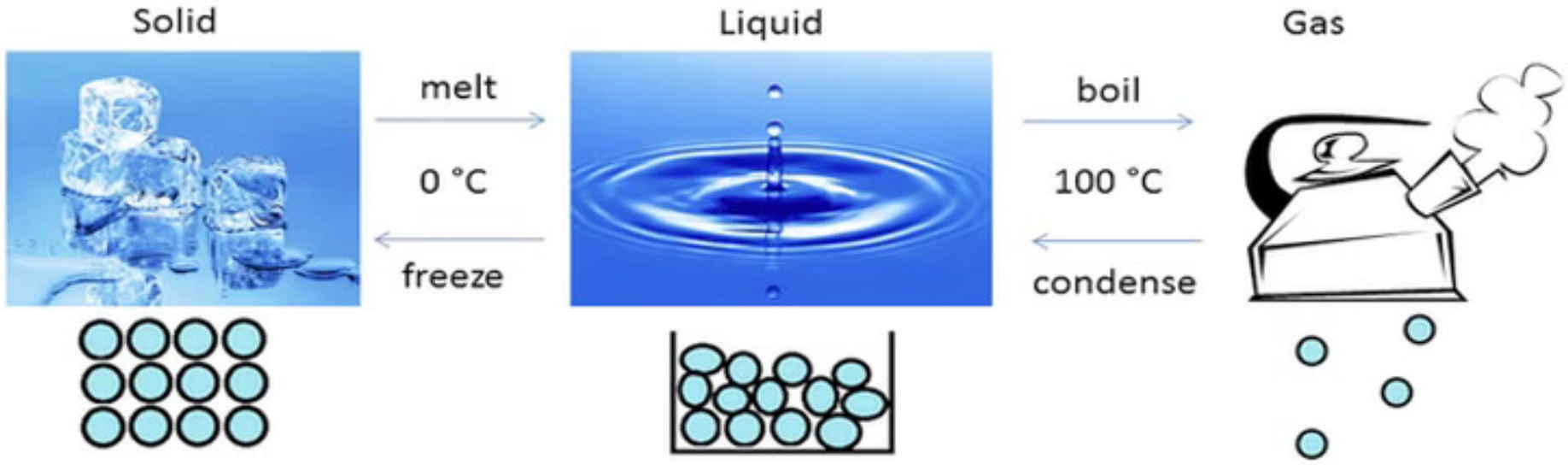


A polymer is easily visualized by imagining a chain



INTRODUCTION

Plastic from Grec 'Plasticos'= Able to be molded



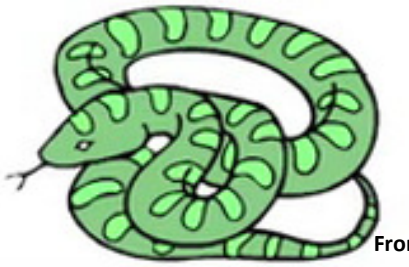
Polymers:

Glass transition

Solid glassy → Solid Rubbery

Melt

Solid Rubbery → Highly viscous liquid



From Dr Rachel Platel

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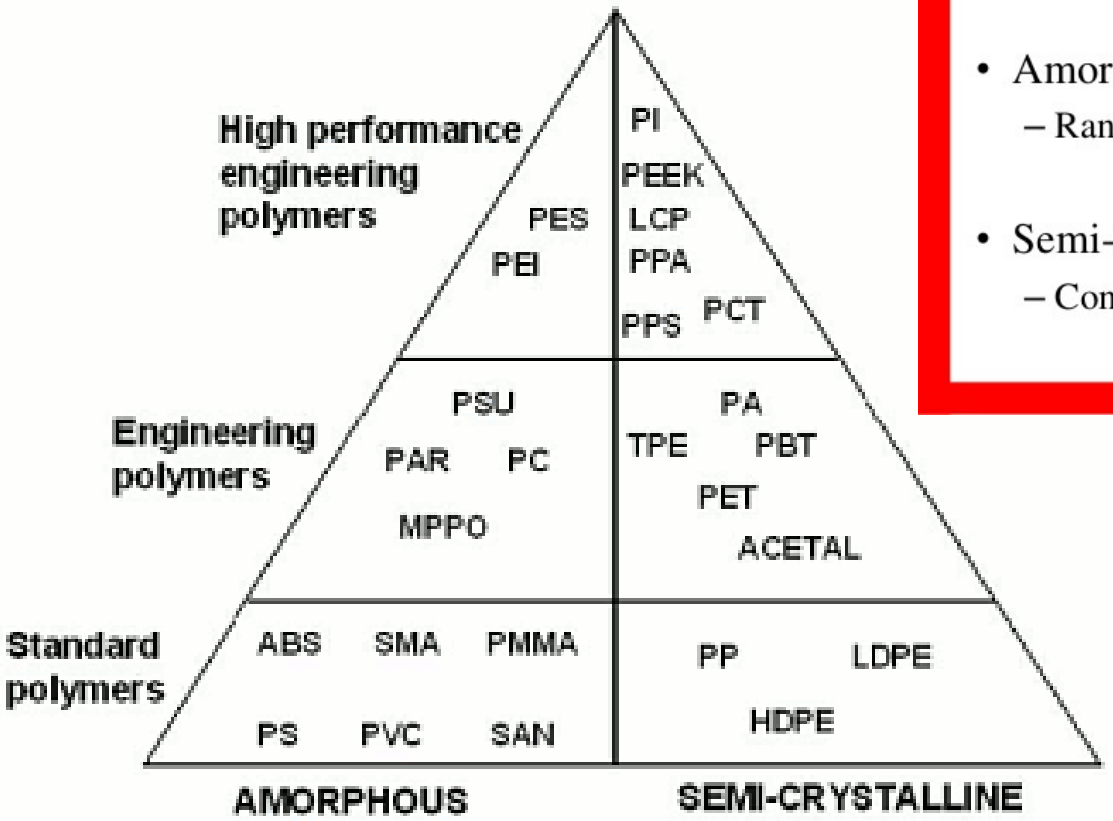
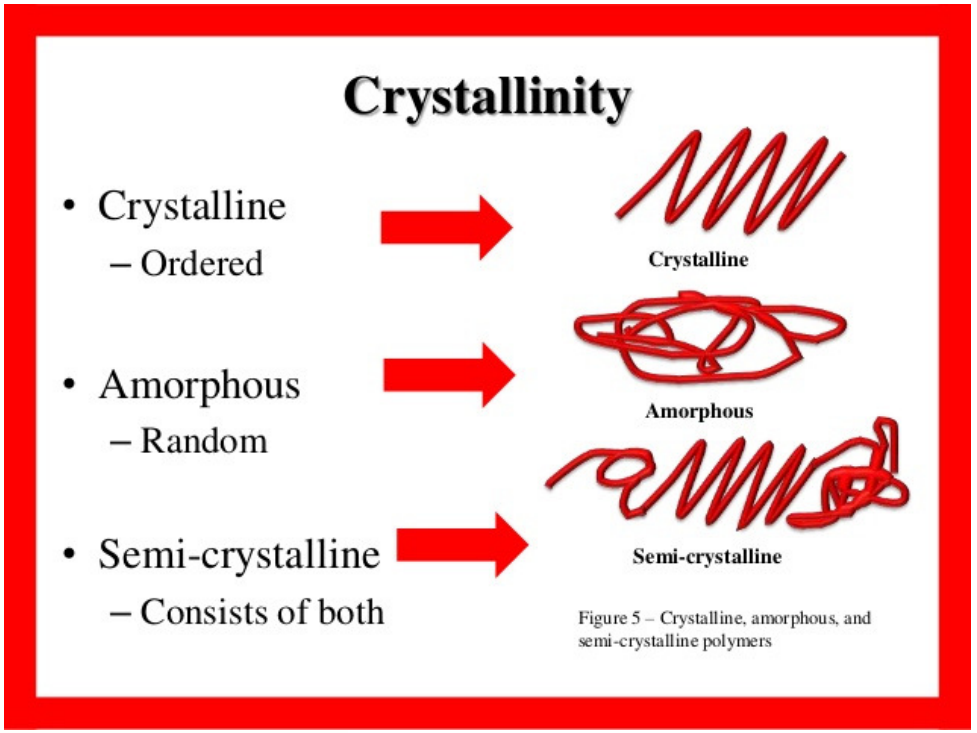




INTRODUCTION

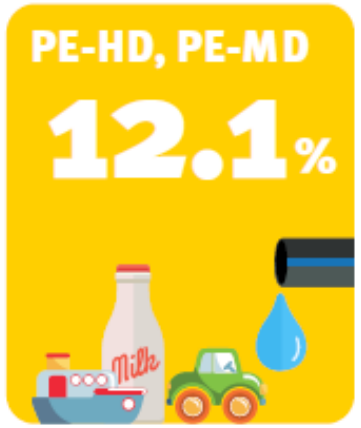
A variety of plastics for different needs

Bottles, etc.

Spectacle frames and plastic cups (PS), packaging (PS-E), etc.

Mattresses and insulation panels, etc.

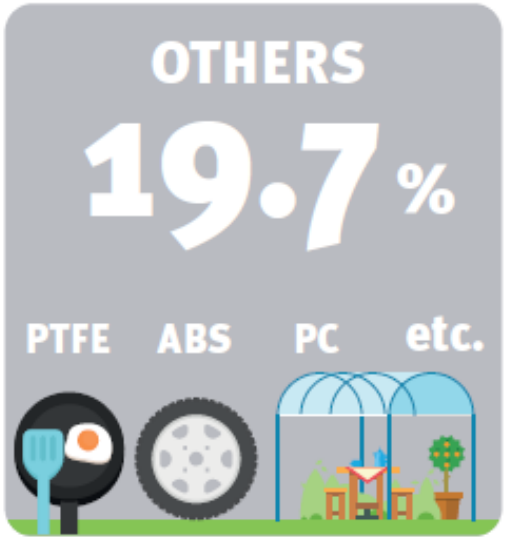
Window frames, flooring and pipes, etc.



Toys (PE-HD, PE-MD), milk bottles and pipes (PE-HD), etc.

Films for food packaging (PE-LLD), reusable bags (PE-LD), etc.

Folders, food packaging hinged caps, car bumper, etc.



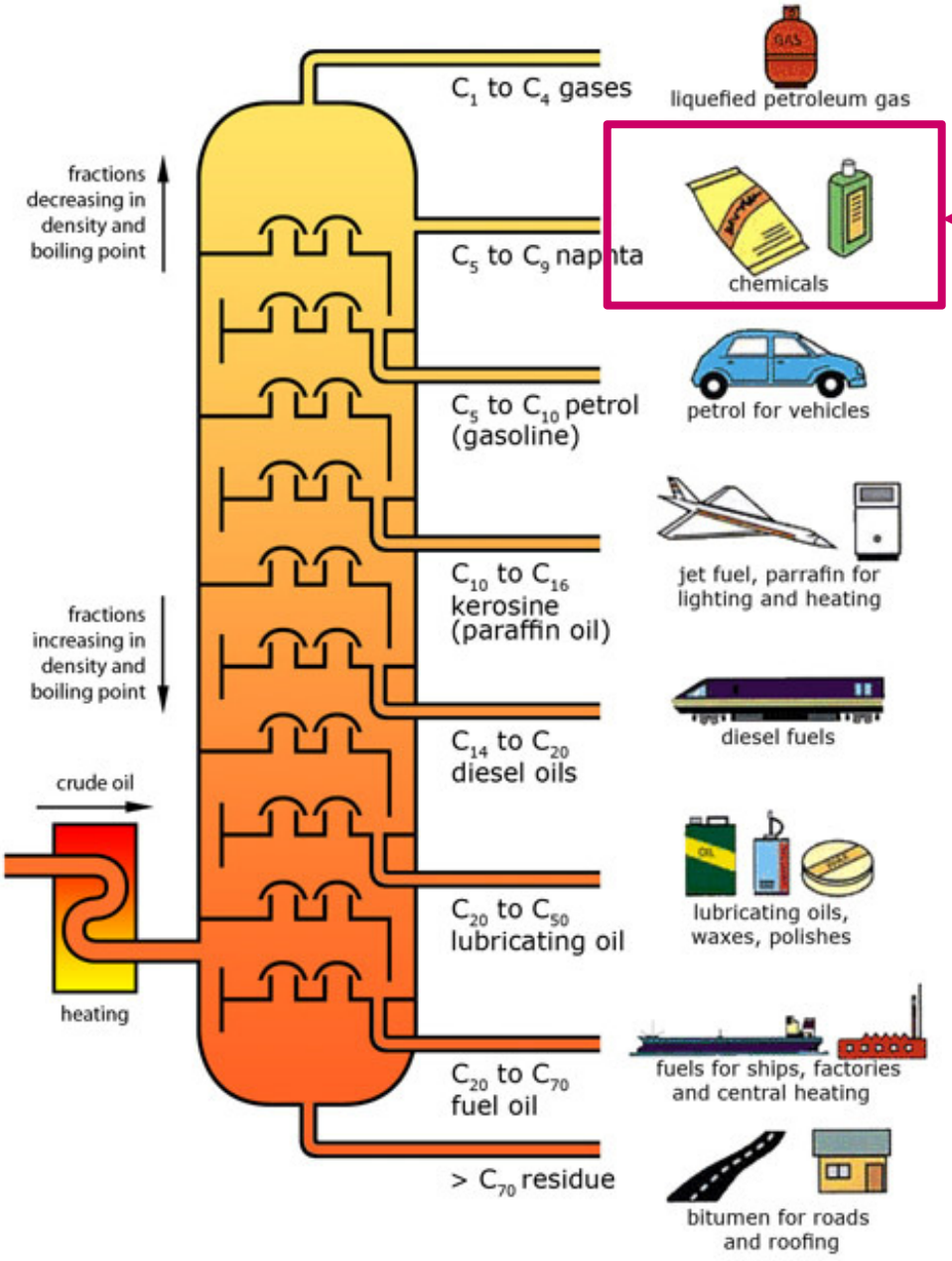
Teflon coated pans (PTFE), hub caps (ABS), roofing sheets (PC), etc.

European plastics demand* by polymer type 2014

Source: PlasticsEurope (PEMRG) / Consultic / myCeppi

* EU-28+NO/CH

INTRODUCTION



crude oil 100%

Only 4% from crude oil

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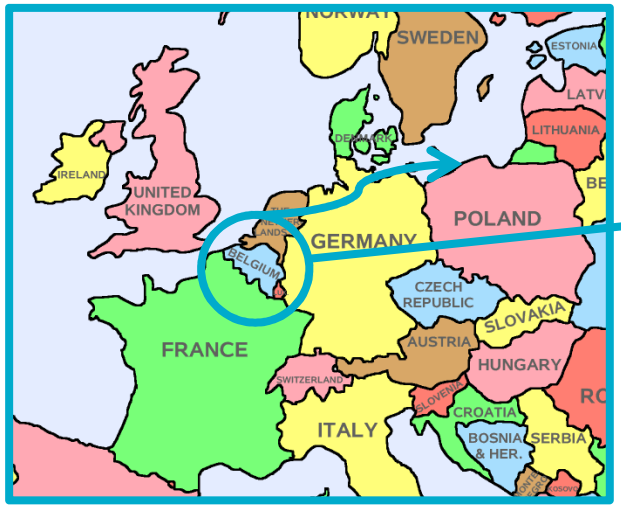
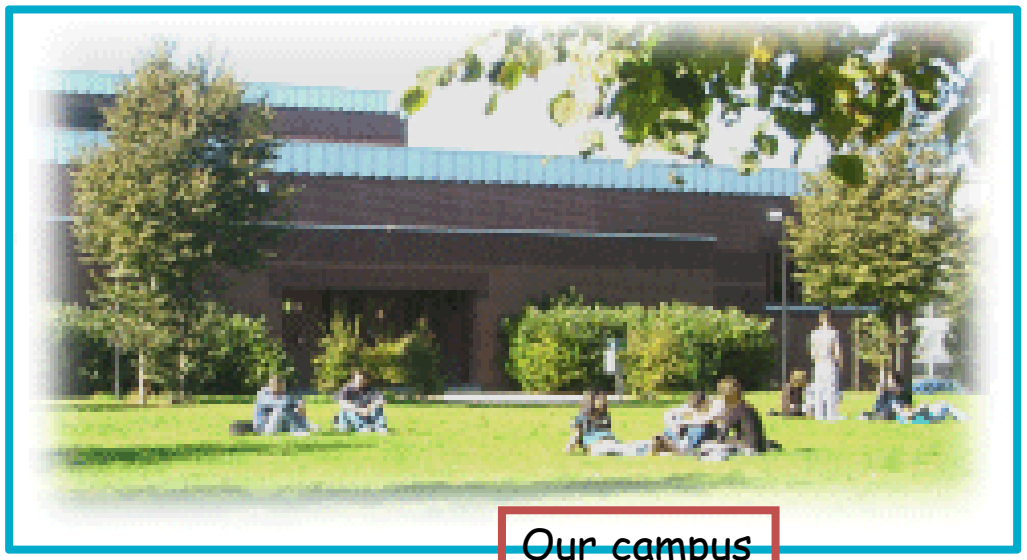
UMONS - SMPC



Belgium -Mons

The Grand-Place



Our campus

The Doudou

LABORATORY OF POLYMERIC AND COMPOSITE MATERIALS

ENVIRONMENTALLY FRIENDLY, BIO-BASED

&

HIGH PERFORMANCE POLYMERIC MATERIALS

THE KEY-ROLE OF SUSTAINABLE CHEMISTRY IN NANOTECHNOLOGY AND MATERIALS SCIENCE

- *Founded by Prof. Philippe Dubois in 1997*
- *About 55 people :*
  - *4 professors (UMONS & FNRS)*
  - *25 scientists & postdocs*
  - *15 PhD students*
  - *8 technicians*

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health
UMONS RESEARCH INSTITUTE FOR HEALTH SCIENCES AND TECHNOLOGY

CIRMAP
Center of Innovation and Research in Materials and Polymers

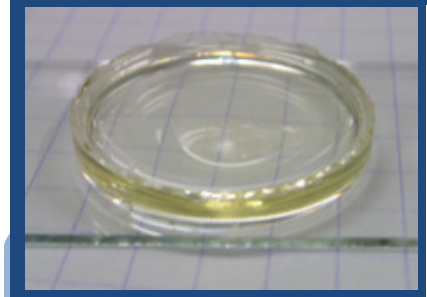
MateriaNova
MATERIALS R&D CENTRE

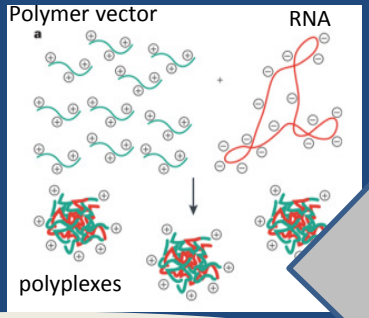
nano4

- *Member of 2 research Institutes*
- *Member of 2 research Centers*
- *Founder of 1 spin off*

Controlled synthesis and Biomedical applications

- Design of biocompatible polymer vectors for gene therapy or drug delivery,
- Synthesis of biodegradable soft hydrogels for tissue engineering or drug delivery,
- Development of molecularly imprinted polymers
- Surface functionalization of biomaterials.





materials
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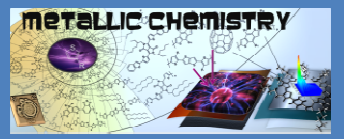
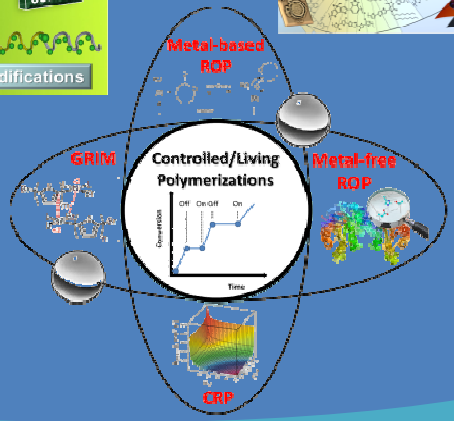
health
UMONS RESEARCH INSTITUTE FOR HEALTH SCIENCES AND TECHNOLOGY

Macromolecular Engineering and Energy

- Design of new monomers/initiators and catalysts,
- Development of controlled/living polymerizations,
- Application of quantitative organic transformations.

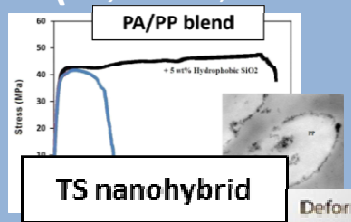


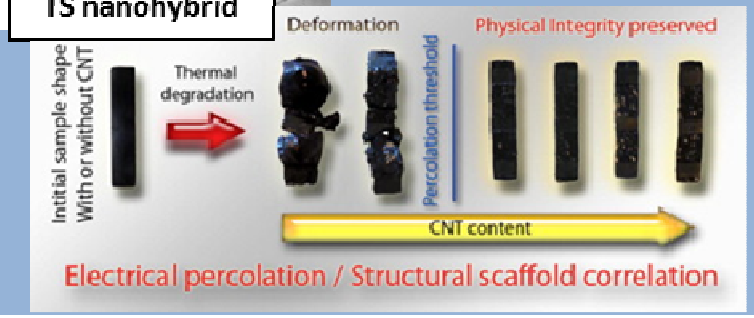


Polymer blends and nanocomposites

- Confinement of particles within polymeric phases;
- (Nano)structuration of polymeric materials;
- Structure/properties relationship

(fire, thermal, electrical, mechanical, barrier … properties)

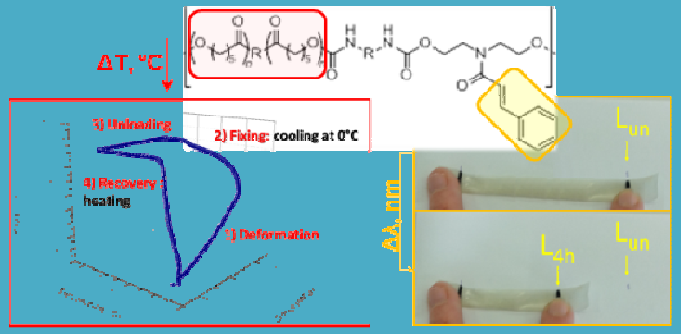




Biopolymers and Reactive Extrusion

- Development of renewable polymeric materials/nanocomposites;
- Reactive (melt-)processing through blending, polymerization, etc.;
- Smart properties including shape-memory properties.

Dual-stimuli-responsive shape-memory polymers



PROCESSING LAB

Lab reactor

Few mg

Horizontal screw extrusion

~ 7 g

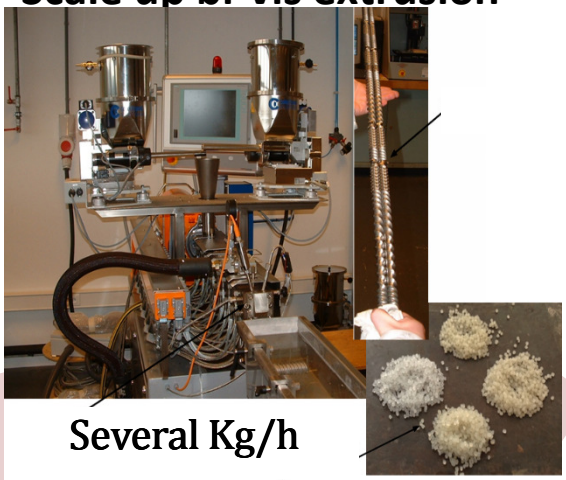
Vertical screw extrusion

~15 g

Internal mixer

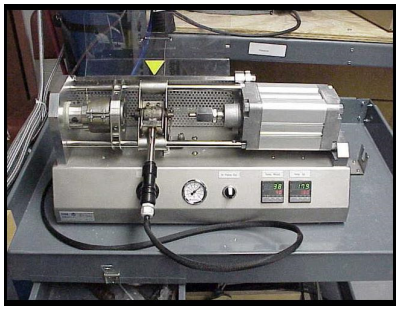
~ 80 g

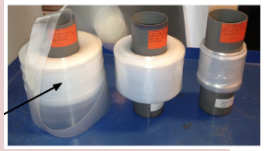
Scale up bi-vis extrusion



Several Kg/h

PROCESSING LAB

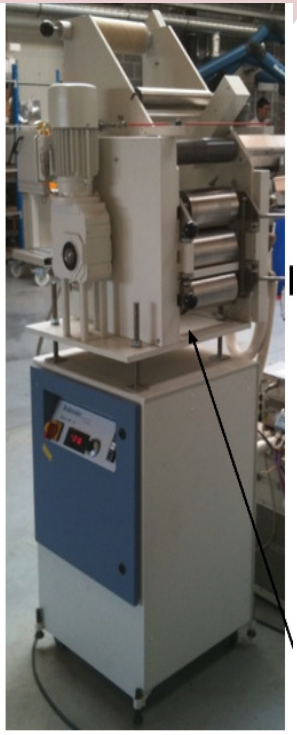




Small film casting

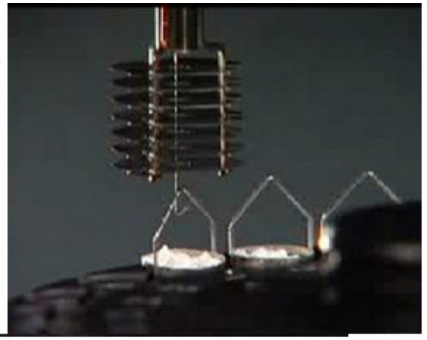
Injection Molding

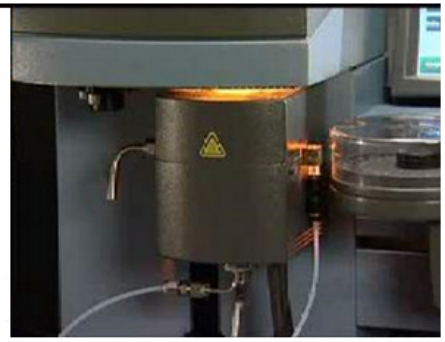
Press high pressure



film casting

CHARACTERIZATION : THERMAL ANALYSIS

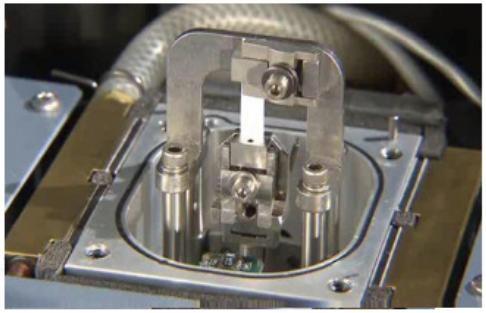


Thermogravimetric analysis ou TGA



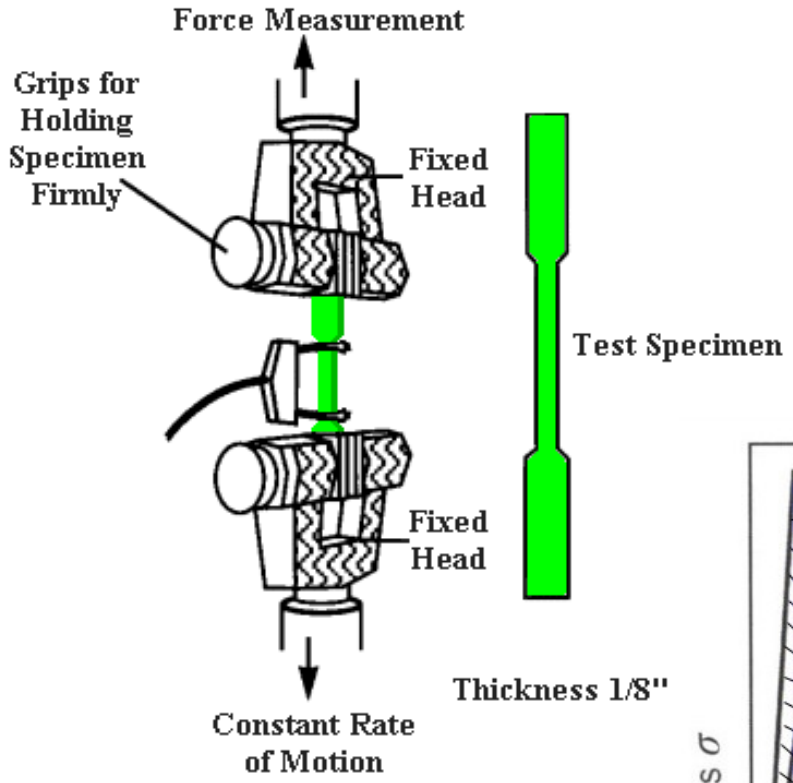

Differential scanning calorimetry ou DSC

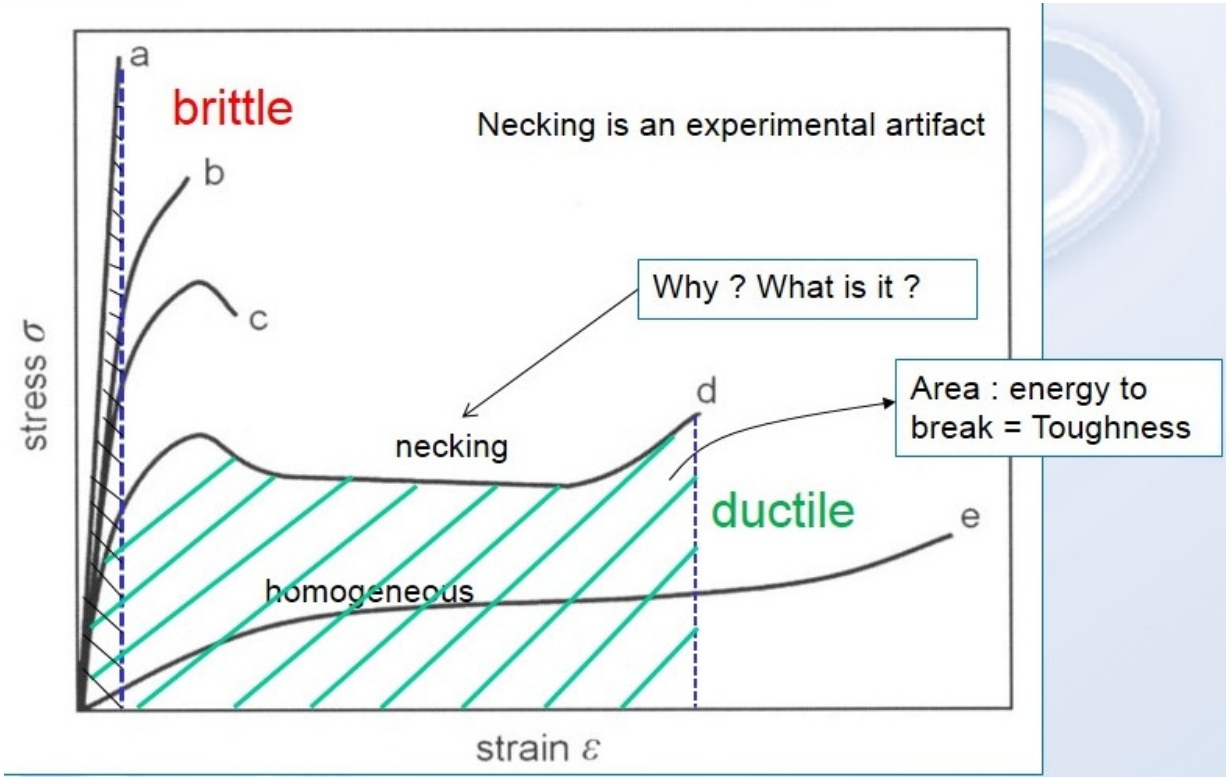


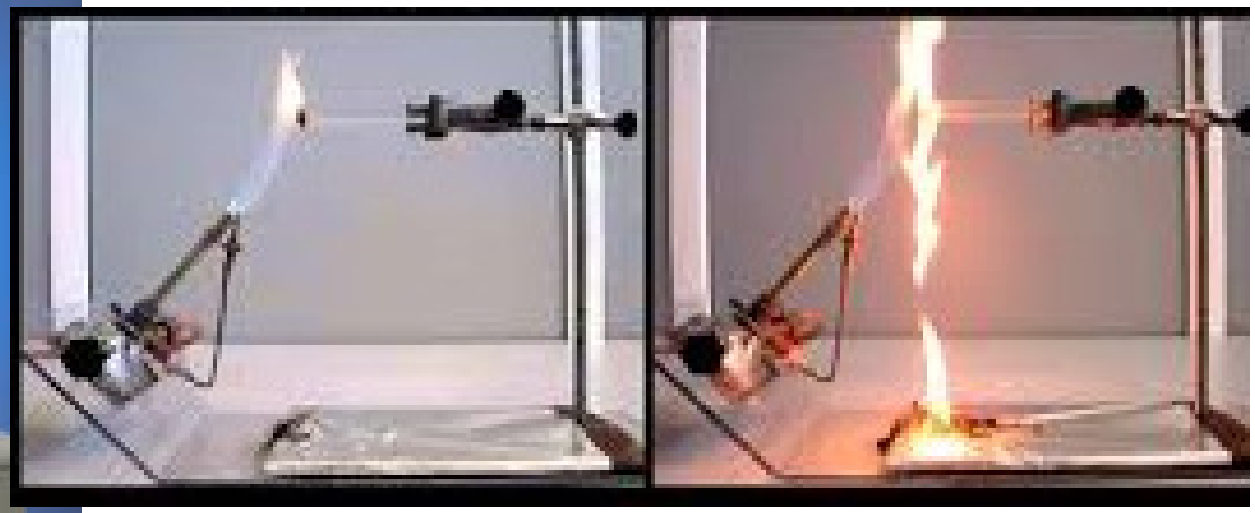
Dynamic mechanical thermal analysis ou DMTA

CHARACTERIZATION : MECHANICAL PROPERTIES

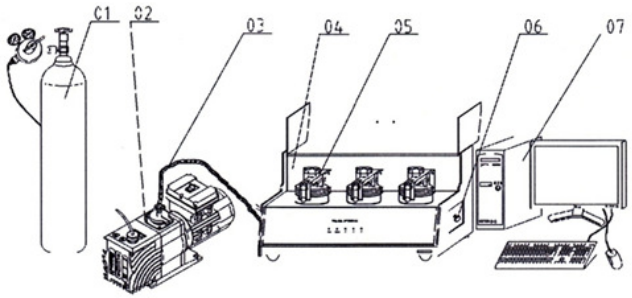




CHARACTERIZATION : FIRE RETARDANCY PROPERTIES

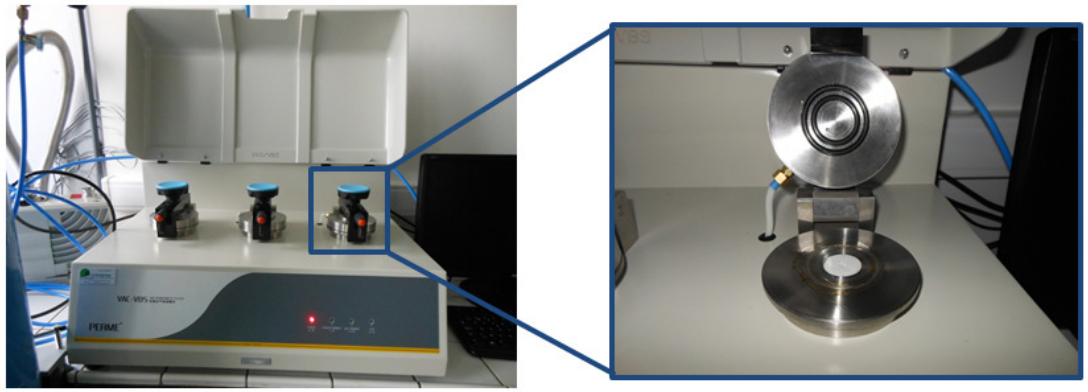


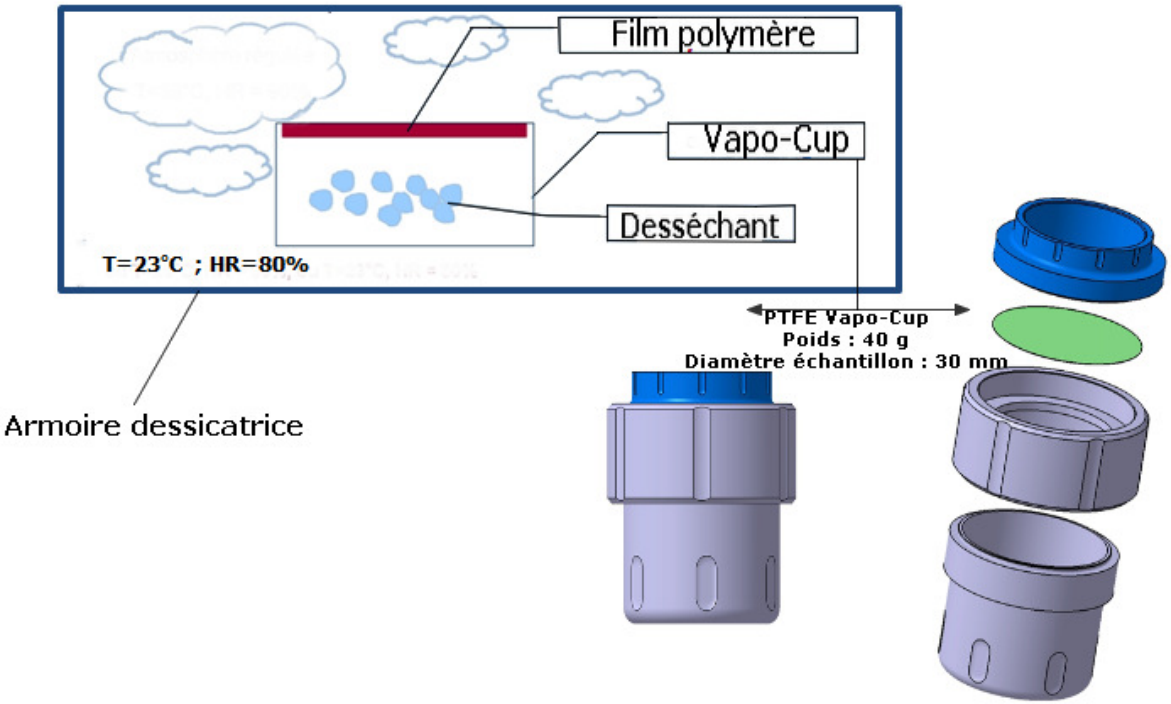
CHARACTERIZATION : TRANSPORT ANALYSIS



01 Bouteille de gaz; **02** Pompe à vide; **03** Tuyau de la pompe à vide; **04** Appareil de mesure

05 Cellule de mesure; **06** Valve du vide; **07** Ordinateur et imprimante





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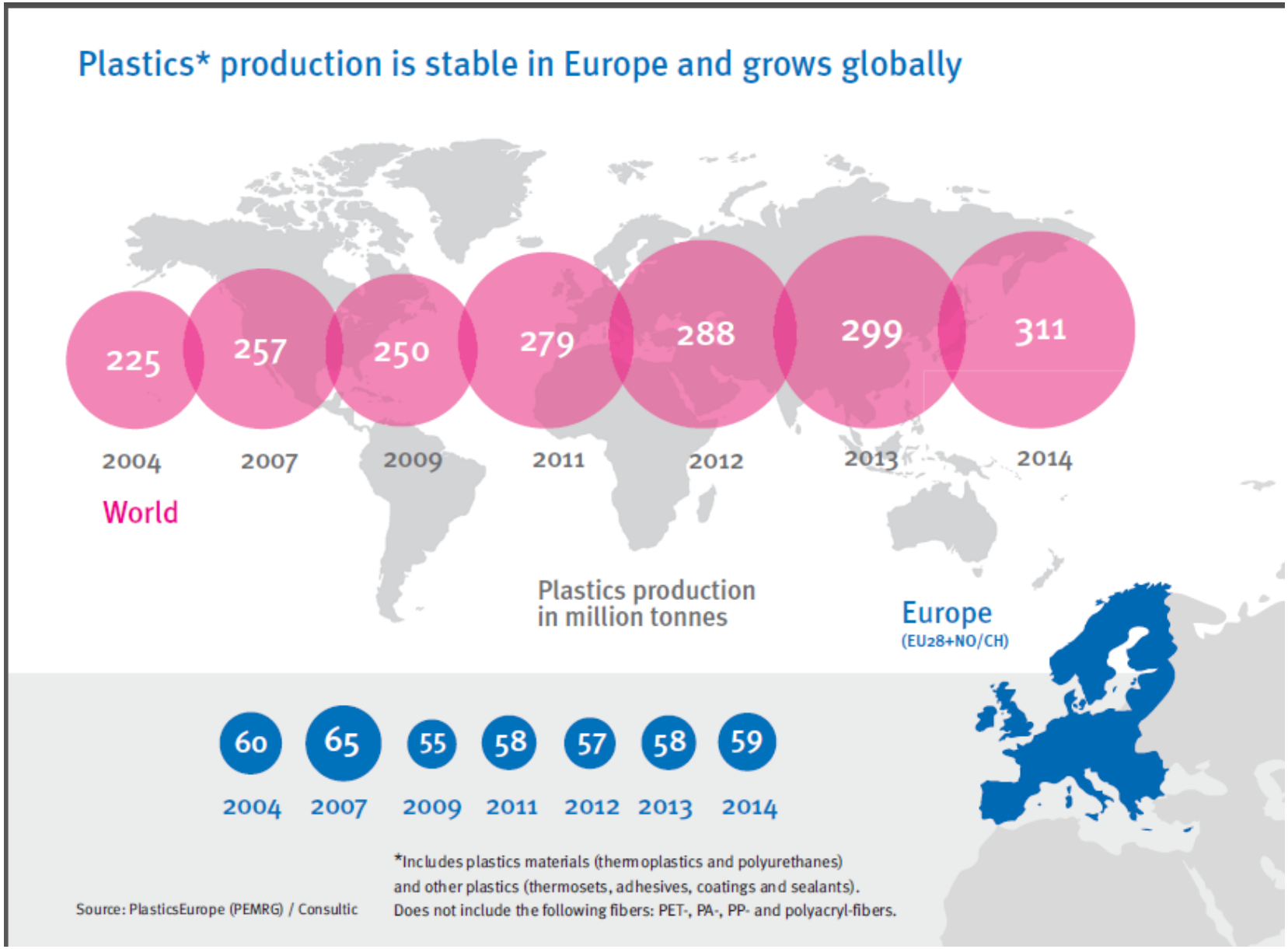
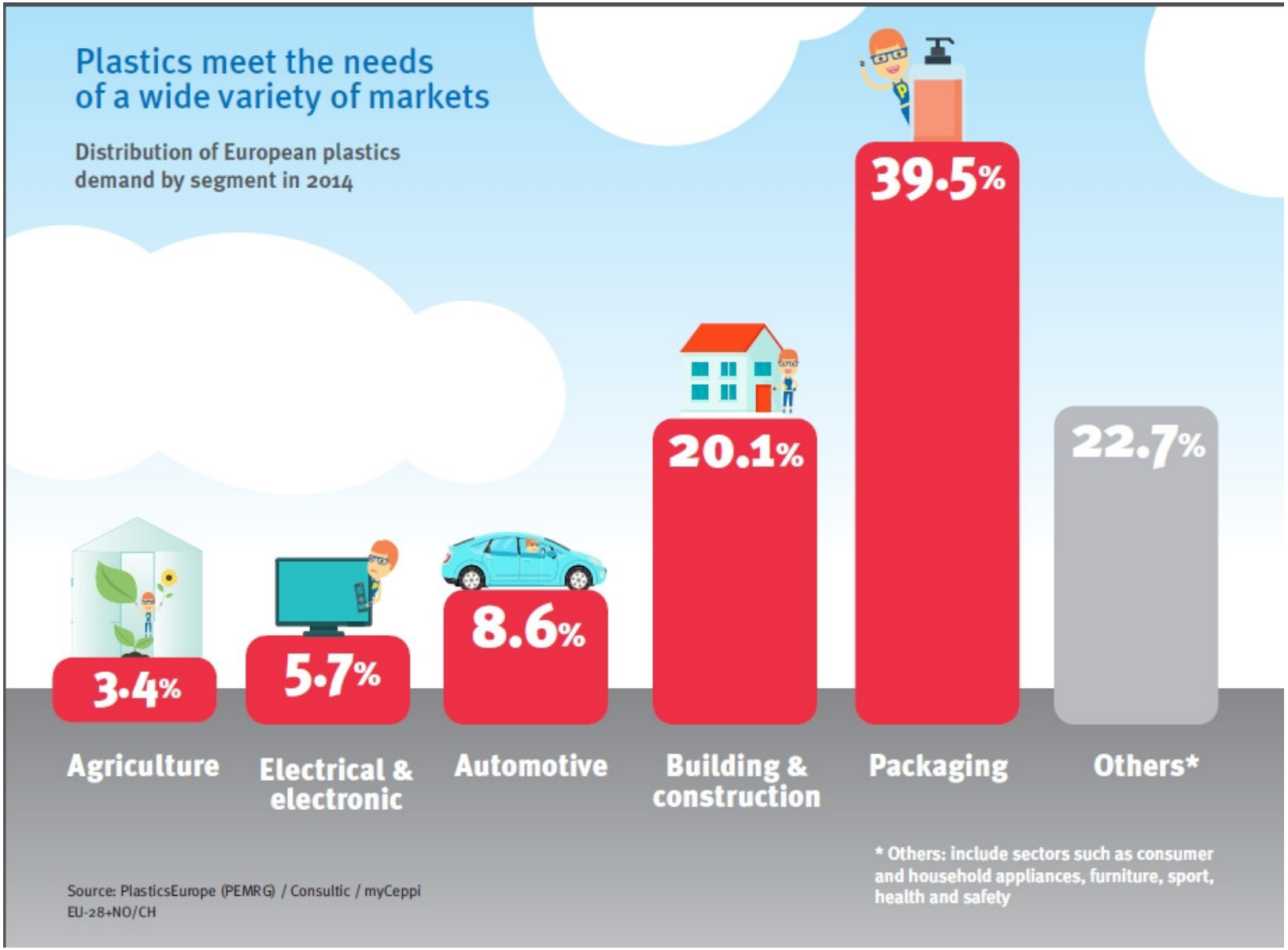
- Specific strategy with polylactide
  - Nanoreinforced polymers
  - Functional polymers

EUROPE PLASTICS DEMAND

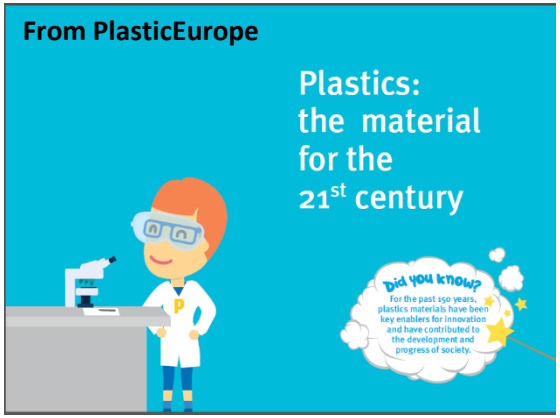


EUROPE PLASTICS DEMAND



When you think of plastic for food packaging, what springs to mind?

Positif



Négatif

- http://www.plasticseurope.org/Document/how-plastics-help-protect-the-planet.aspx?Page=MEDIA&FolID=3

- http://www.plasticseurope.org/Document/plasticstoo-valuable-to-be-thrown-away---english.aspx?Page=MEDIA&FolID=3

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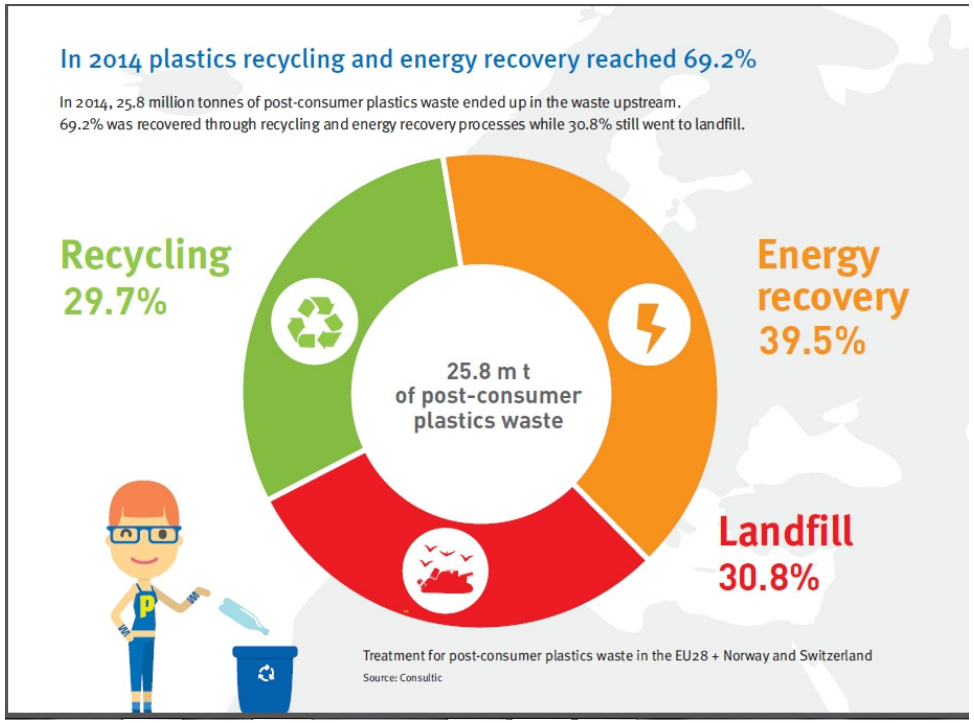
Positif



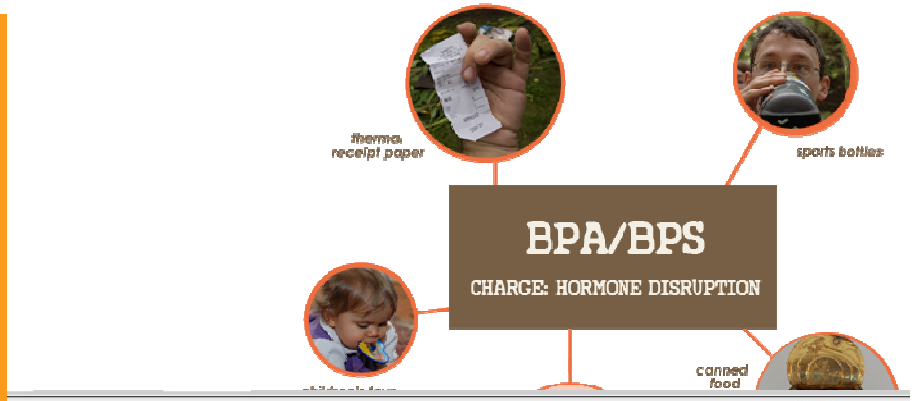
Négatif

When you think of plastic for food packaging, what springs to mind?

Positif

From PlasticEurope

Négatif



Phthalates in soft PVC products used in food production equipment and in other food contact materials on the Danish and the Nordic Market 2013-2014

Jens Højslev Petersen and Lisbeth Krüger Jensen

Abstract

Background: Food contact materials (FCM) containing phthalates can be a source of food contamination when used in plastics for food production equipment, in utensils for food contact and in packaging. Since 2008 several of the phthalates used for FCM were regulated in the EU; some of them because they were well-known endocrine disruptors. Results of the Danish Food Authorities control in 2008 and 2009 showed 23 % non-compliant samples. Critical FCMs turned out to be those made from plasticised PVC and sold as suitable for contact with fatty foodstuffs. Targeted follow up control campaigns were therefore arranged by the Danish food authorities (latest in 2013) and by the Nordic food authorities in a common campaign in 2014.

Findings: FCM plastics were analysed for phthalate content and when needed additionally tested for migration of phthalates according to the declared area of use with respect to food type, contact temperature and time in contact with food. In both recent control campaigns about 1/3 of the samples analysed exceeded the current maximum limits for phthalates (especially DBP and DEHP) in plastics or showed migration into the fatty food simulant above the specific migration limits. Critical sample types were conveyor belts, hoses and gloves.

Conclusions: Legal limits for phthalates were exceeded in many of the samples analysed in recent tests, including a large proportion of conveyor belts and gloves. The proportion of non-compliant conveyor belts, hoses and gaskets was lower in 2013 and 2014 than in 2008-2009, whereas the proportion of non-compliant gloves increased

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WHAT WAS A **GOOD** FOOD PACKAGING?

- **Less food waste from production to shelf :** In its 2011 report, the FAO stressed that one of the reasons behind food losses and waste in developing countries is the lack of appropriate packaging solutions. In Europe, only 3% of all products delivered to customers are spoilt between production and transport thanks to packaging, compared to 40% in developing countries.
- From pre-baked bread rolls packed **under nitrogen**, to meat protected **by oxygen-barrier plastic films**, food is kept fresher for longer thanks to plastic packaging. The more plastic packaging is used to extend shelf-life, the more food is saved

WHAT WILL BE A **GOOD** FOOD PACKAGING?

- **Less Pollutant, of course…. reducing again the environmental footprint**
- **Solid protection inspired by nature** Just like a nut is protected by a shell, plastic packaging provides unequalled physical protection for many foods. For instance, egg breakage is reduced by 80% when using plastic egg packs instead of alternative materials

- **Avoid a bad impact on health…using natural additifs…**
- **A glimpse of the future :** Plastic packaging can already triple shelf life thanks to its unique properties that allow for resealable portioned films and packs, anti-microbial agents, humidity control systems and modified atmosphere packaging solutions. In the near future, innovations will become available such as printable RFID tags (Radio-frequency identification) that provide warnings of changes in **temperature and humidity levels** that might affect the integrity of the product. **Absorbers and emitters of natural occurring gaseous substances** that prolong shelf life are already entering the market. In the future, **biosensors that detect bacteria and viruses** will pave the way to safeguard the quality and safety of food for consumers whilst further reducing food waste.

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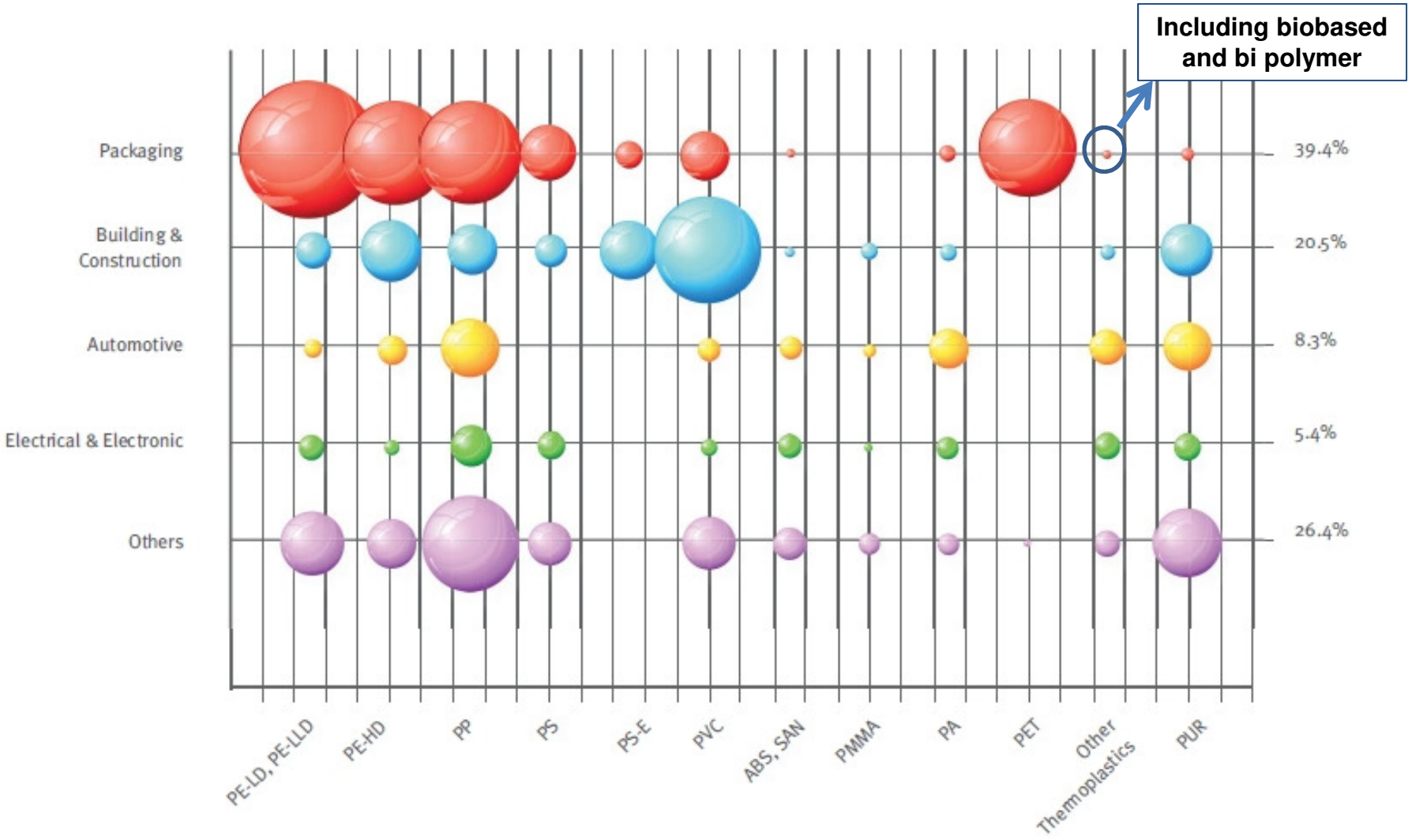
PACKAGING : FROM POLLUTANT POLYMER…

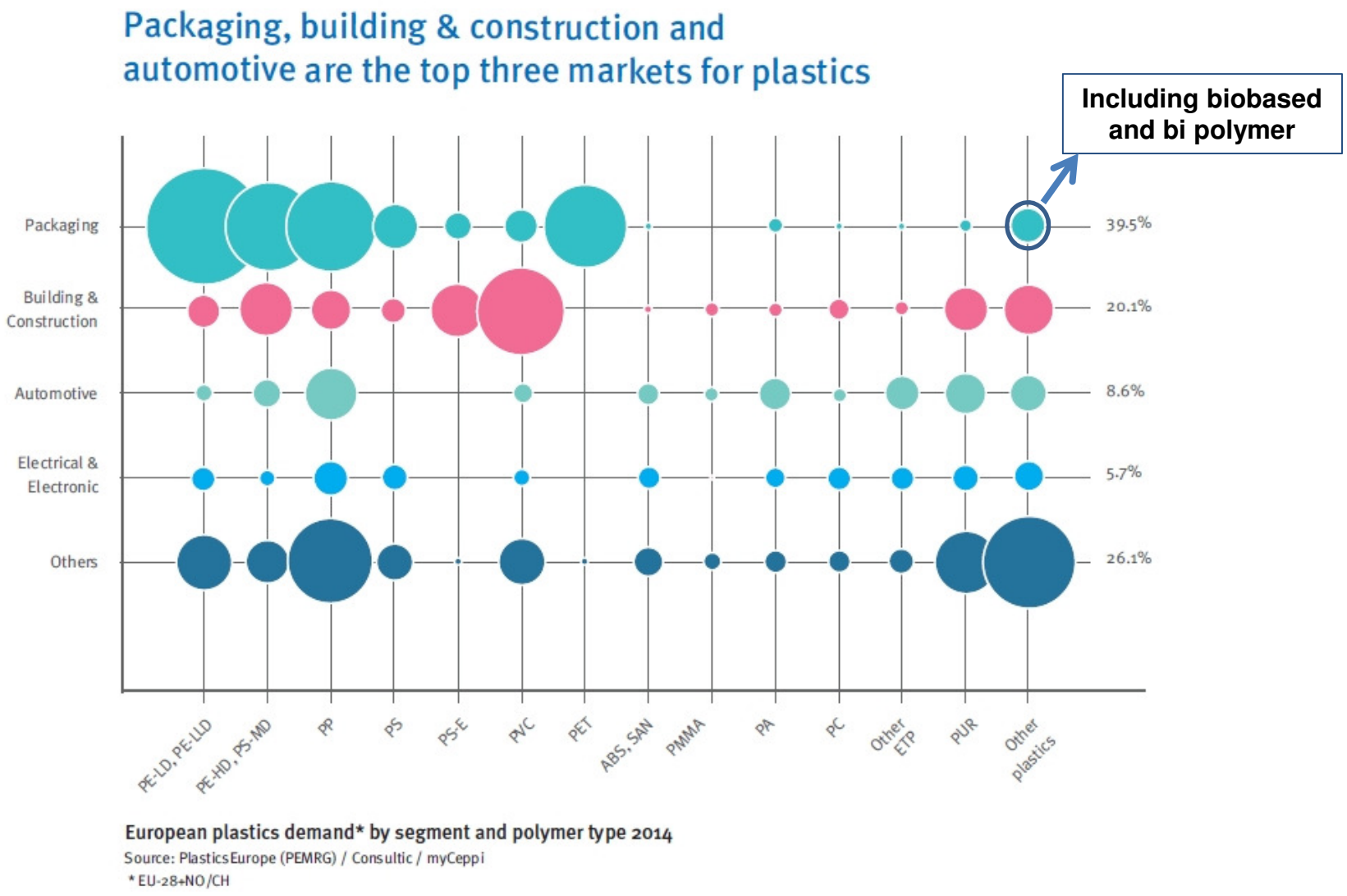


European Plastics Demand* by Segment and Resin Type 2011

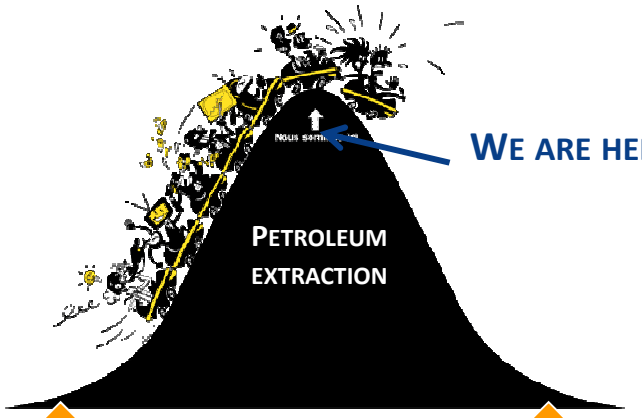
Source: PlasticsEurope Market Research Group (PEMRG)

* EU-27+N/CH incl. Other Plastics (~5.7 Mtonne)

...To Biobased And Biodegradable Polymer



CHALLENGES FOR FOOD PACKAGING

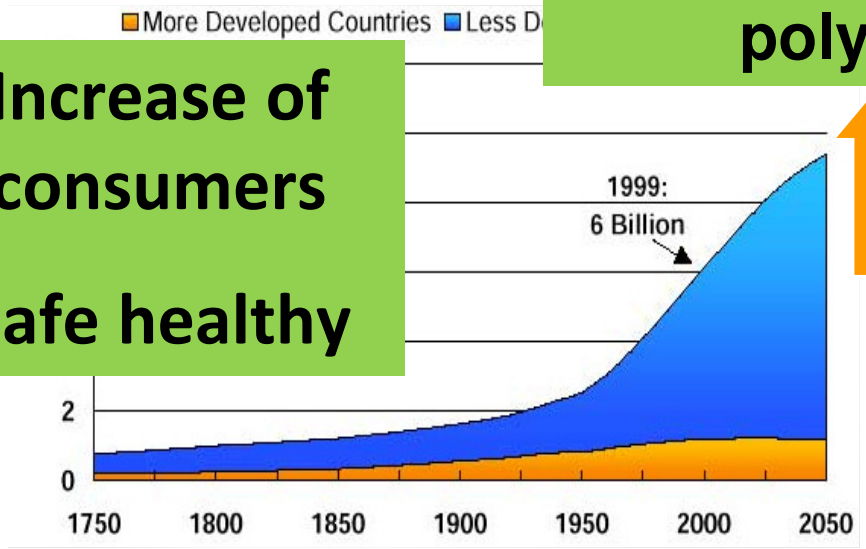


Reduction of oil ressources

Biobased and biodegradables polymers

Increase of consumers

Safe healthy



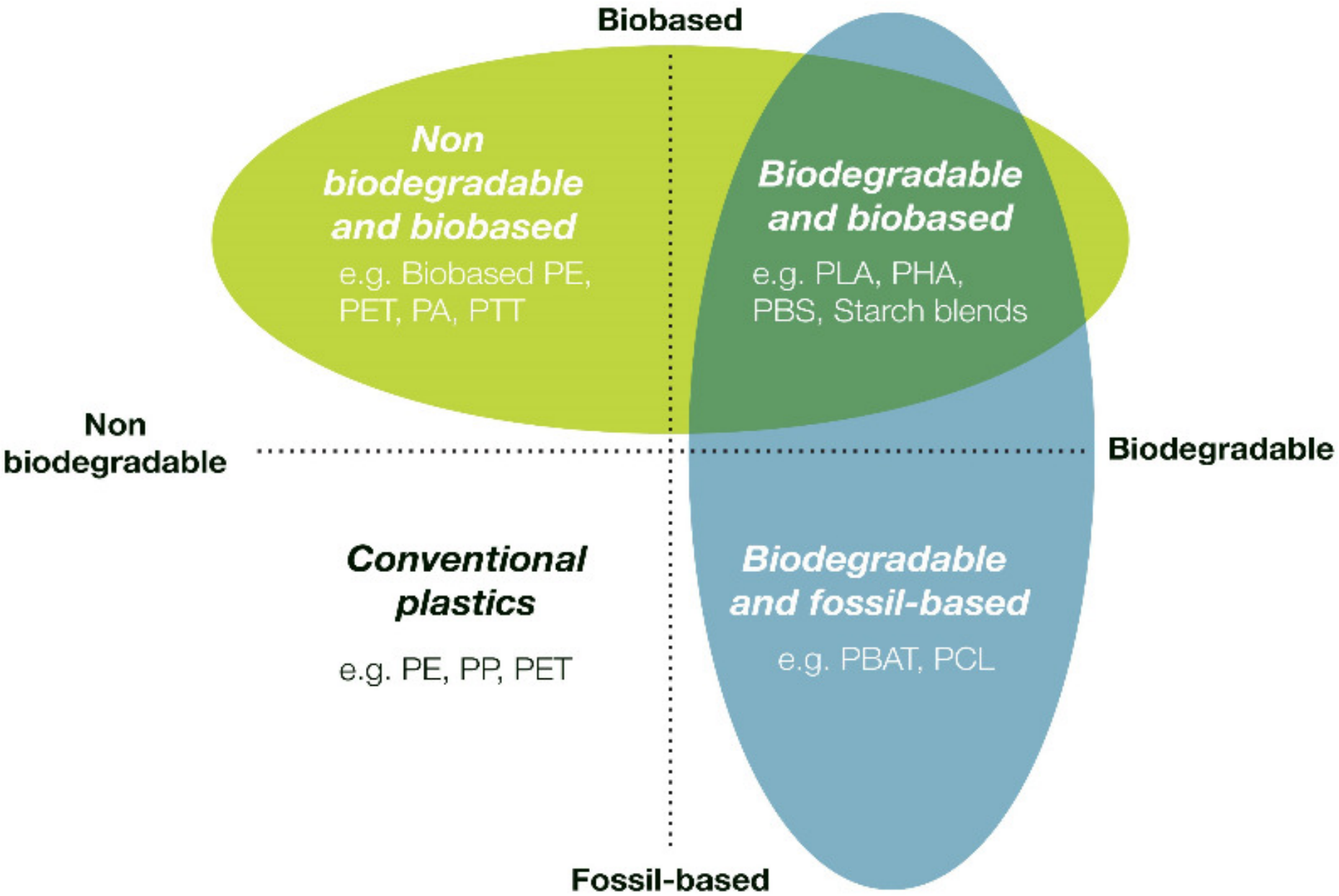
Waste gestion

DEFINITIONS

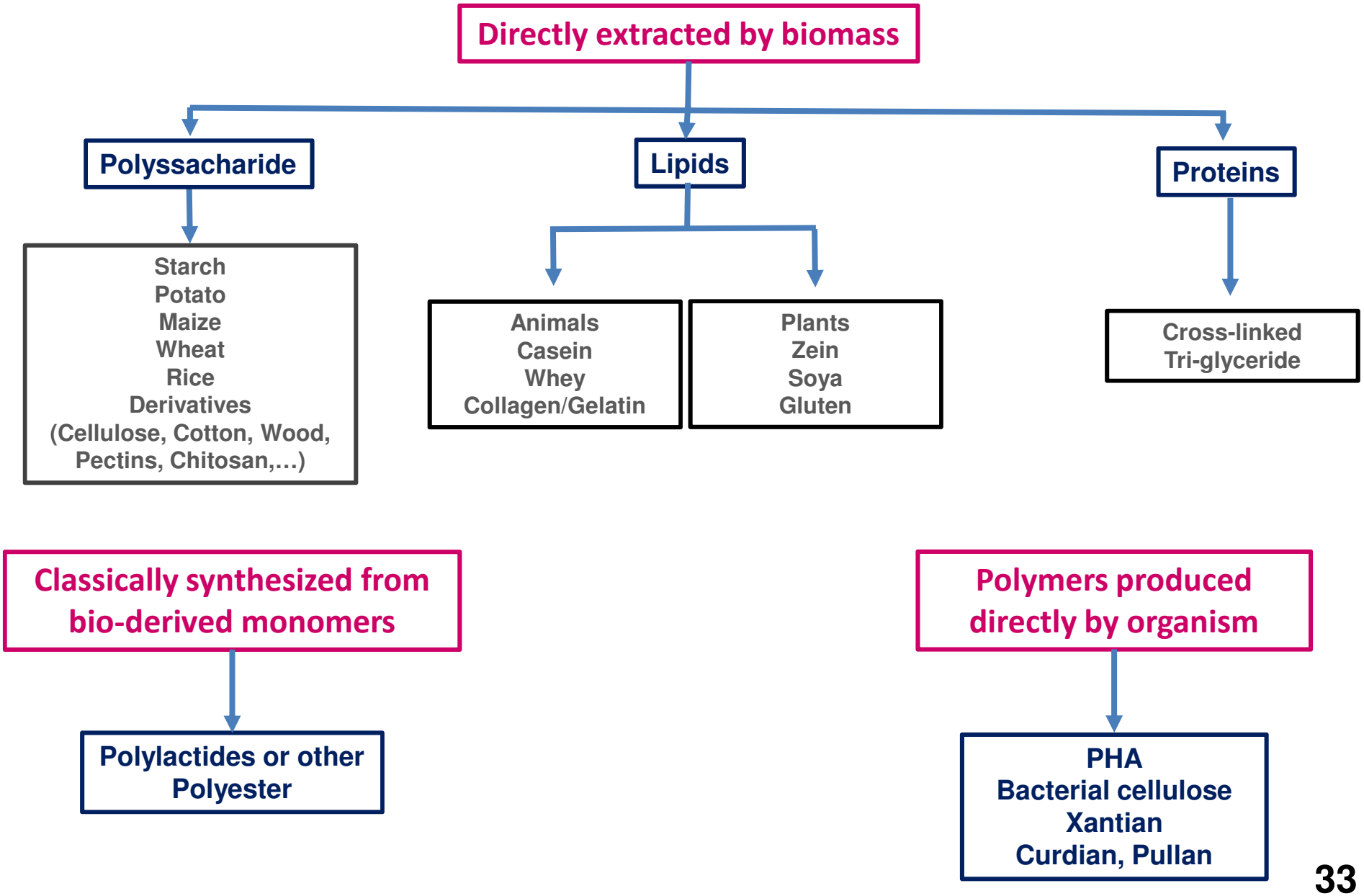
- **What is a "biobased" plastic?** A biobased plastic is made from renewable resources instead of fossil fuels. Examples of renewable carbon resources include corn, potatoes, rice, soy, sugarcane, wheat, and vegetable oil. A biobased plastic can be partly or entirely biobased.

- **What is a "biodegradable" plastic?** A biodegradable plastic can degrade by naturally occurring microorganisms such as bacteria, fungi, and algae to yield water (H2O), carbon dioxide (CO2) and/or methane (CH4), biomass, and inorganic compounds. However, the environment and timeframe must be specified in which biodegradation is expected to occur, otherwise the claim is meaningless.

DEFINITIONS

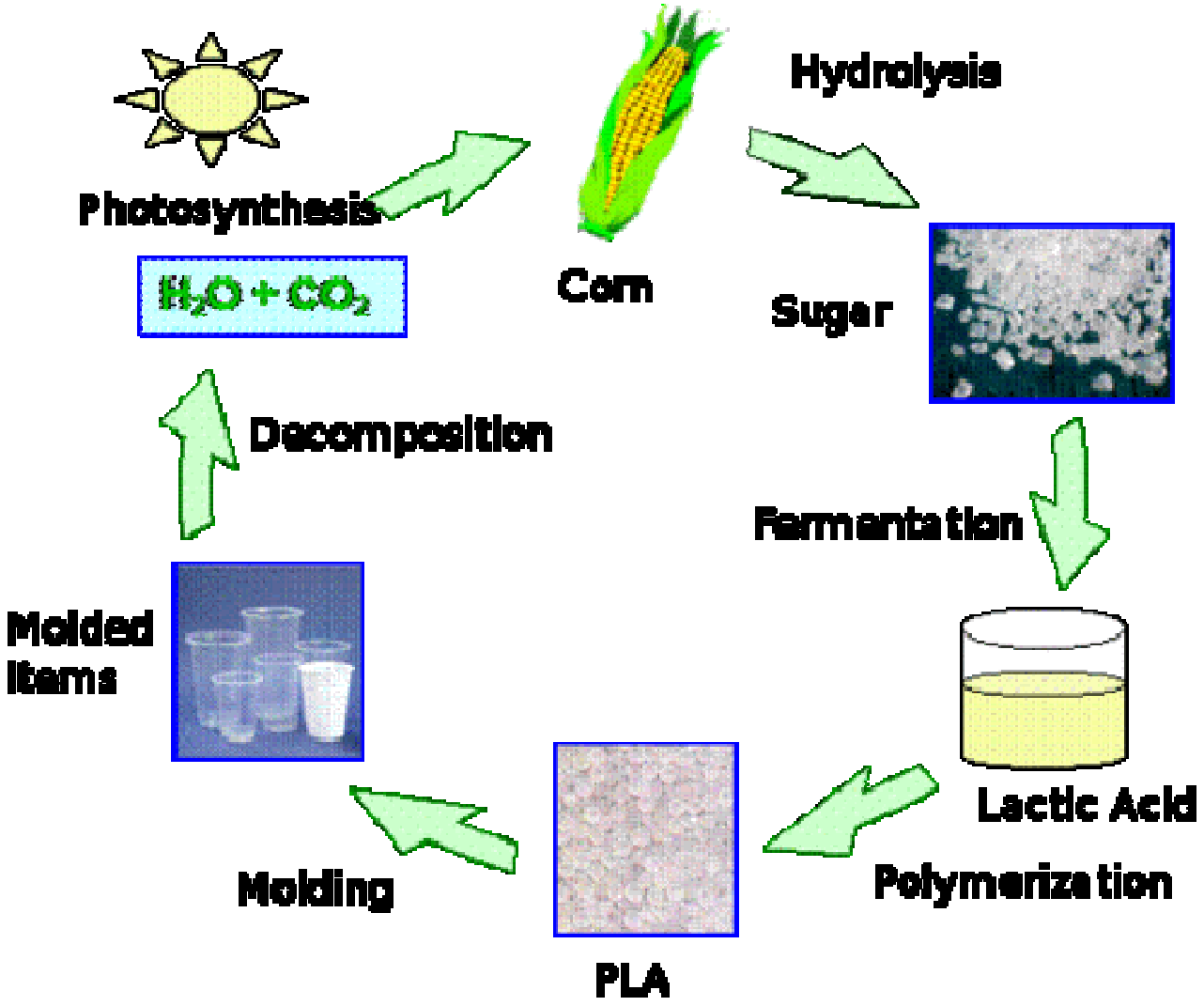


BIOBASED POLYMER

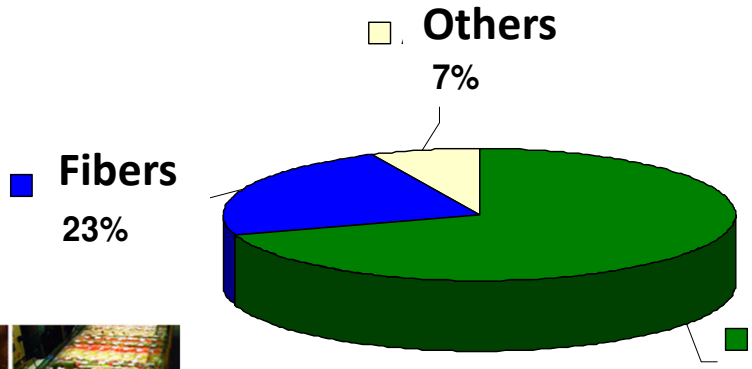


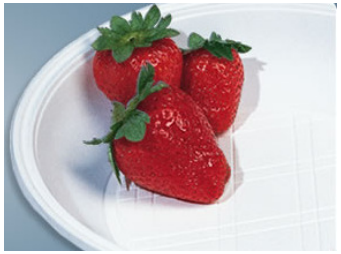
POLYLACTIDE

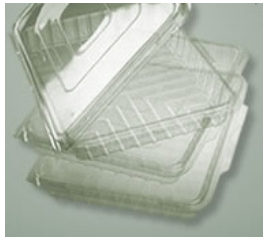
A MOST PROMISING BIOBASED AND BIODEGRADABLE POLYMER FOR FOOD PACKAGING



CURRENT APPLICATION FOR PLA







POLYLACTIDE

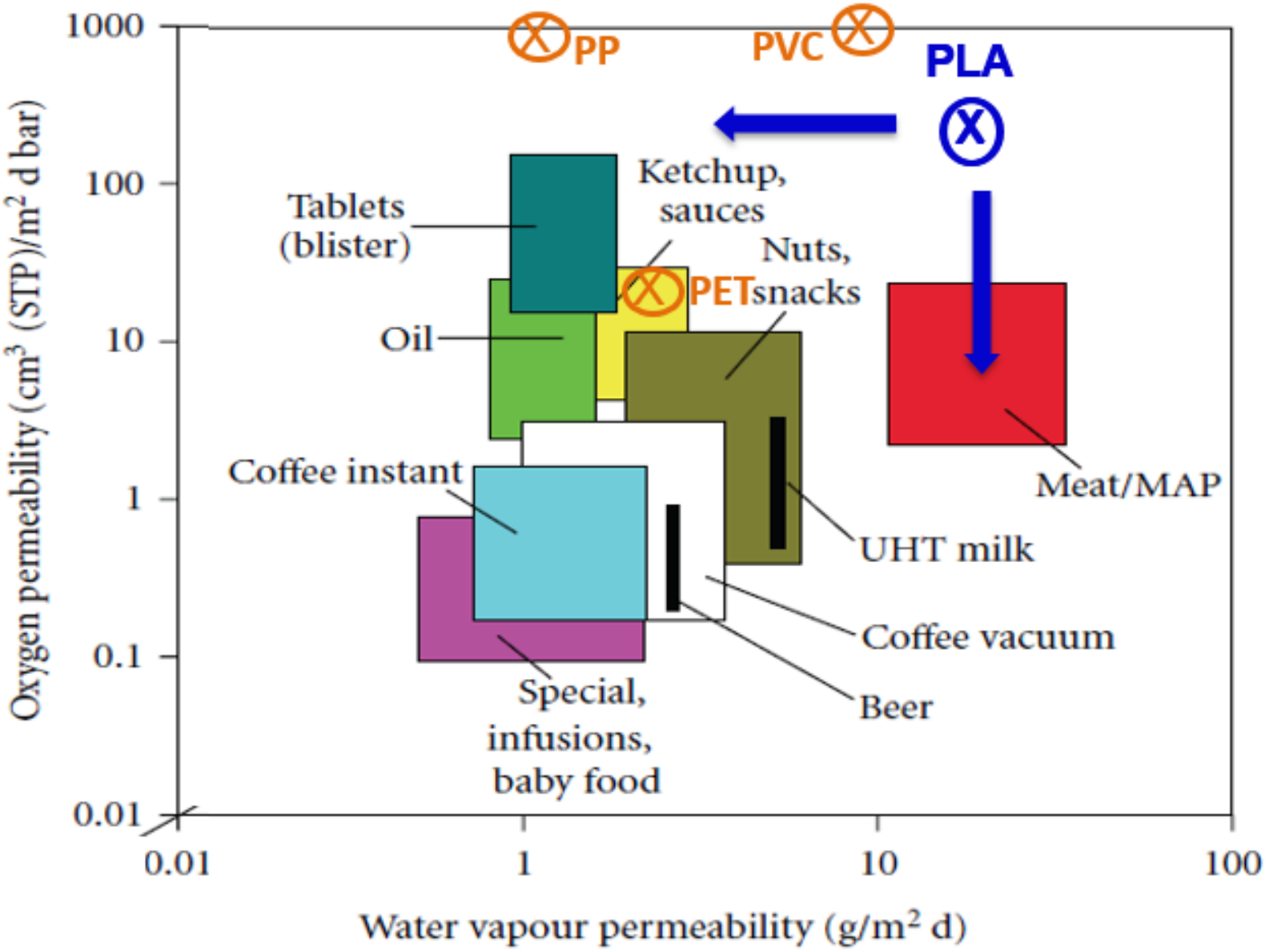
A MOST PROMISING BIOBASED AND BIODEGRADABLE POLYMER FOR FOOD PACKAGING

- ✓ **Drawbacks of PLA include low gas barrier properties or a low resistance to conditions of humidity**
- ✓ **Challenge :**

1. **Improve the barrier properties for food packaging application**
2. **Improve the durability of packaging, with given storage conditions, while maintaining its biodegradability, when no longer used**

[1] Siracusa V. et al., 2008. (19):p.634-43, Trends in Food Science & Technology.

TRANSPORT PROPERTIES OF PLA



[1] Siracusa V. et al., 2008. (19):p.634-43, Trends in Food Science & Technology.

ACKNOWLEDGEMENTS

Thank you for your attention!

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UMONS RESEARCH INSTITUTE
FOR MATERIALS SCIENCE
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UMONS
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CIRMAP
Center of Innovation and Research
in Materials and Polymers