# Future of Plastics

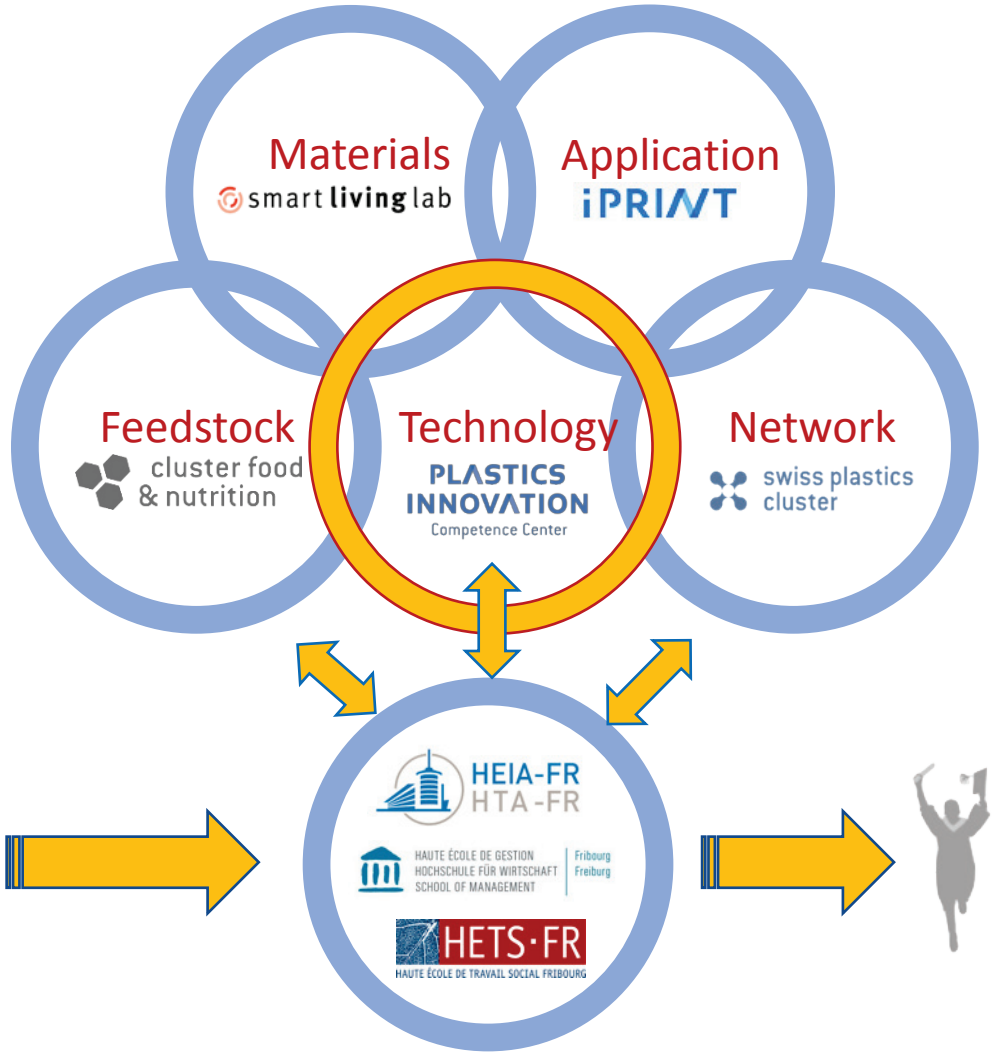
by Maria Stewart

https://envisiontec.com

# Plastics Innovation Competence Center

PLASTICS INNOVATION Competence Center

## Research & Innovation




Marry
**Societal**
**Economic**
**Environmental**
Needs

# Demand for plastics

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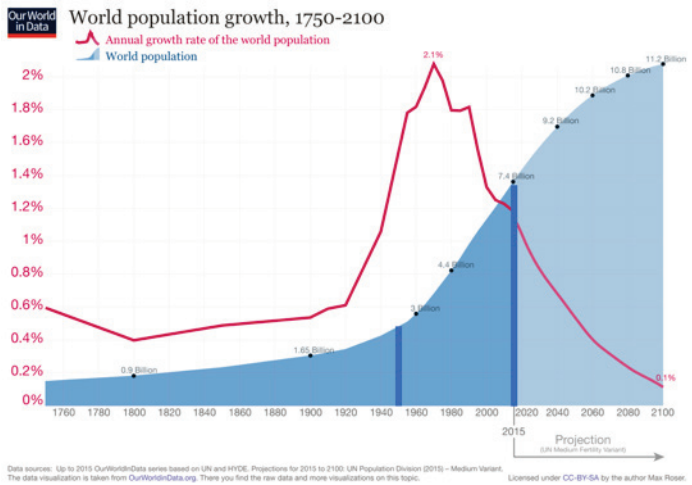
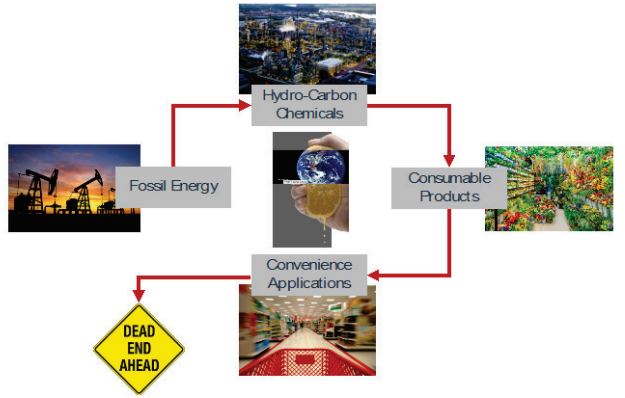
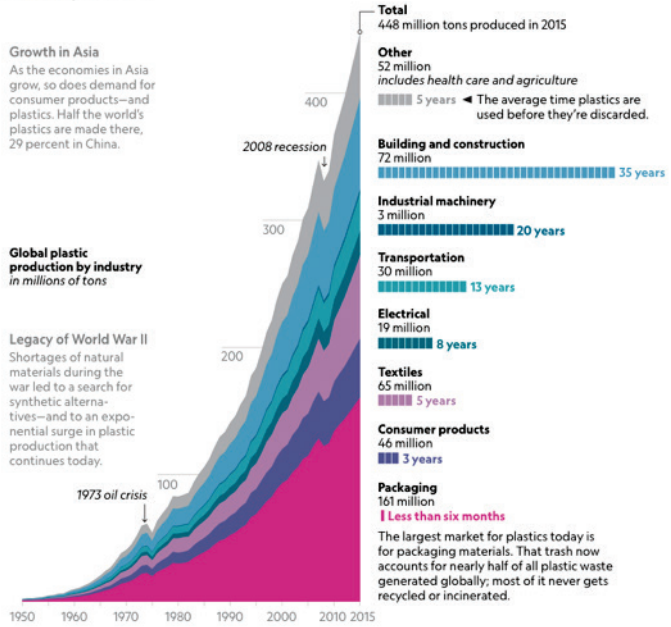



**Plastics represent 5-7% of non-renewable fossil energy**

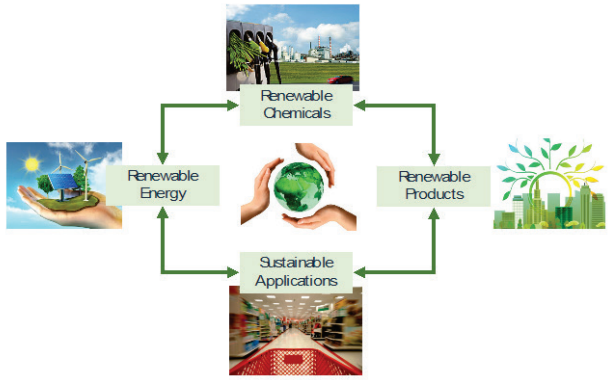



**Global Plastics Volume Growth**




JASON TREAT AND RYAN WILLIAMS, NGM STAFF
SOURCE: ROLAND GEYER, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

**The World moves Towards a Renewable & Circular Plastics Industry**



# From Fossil to Renewable

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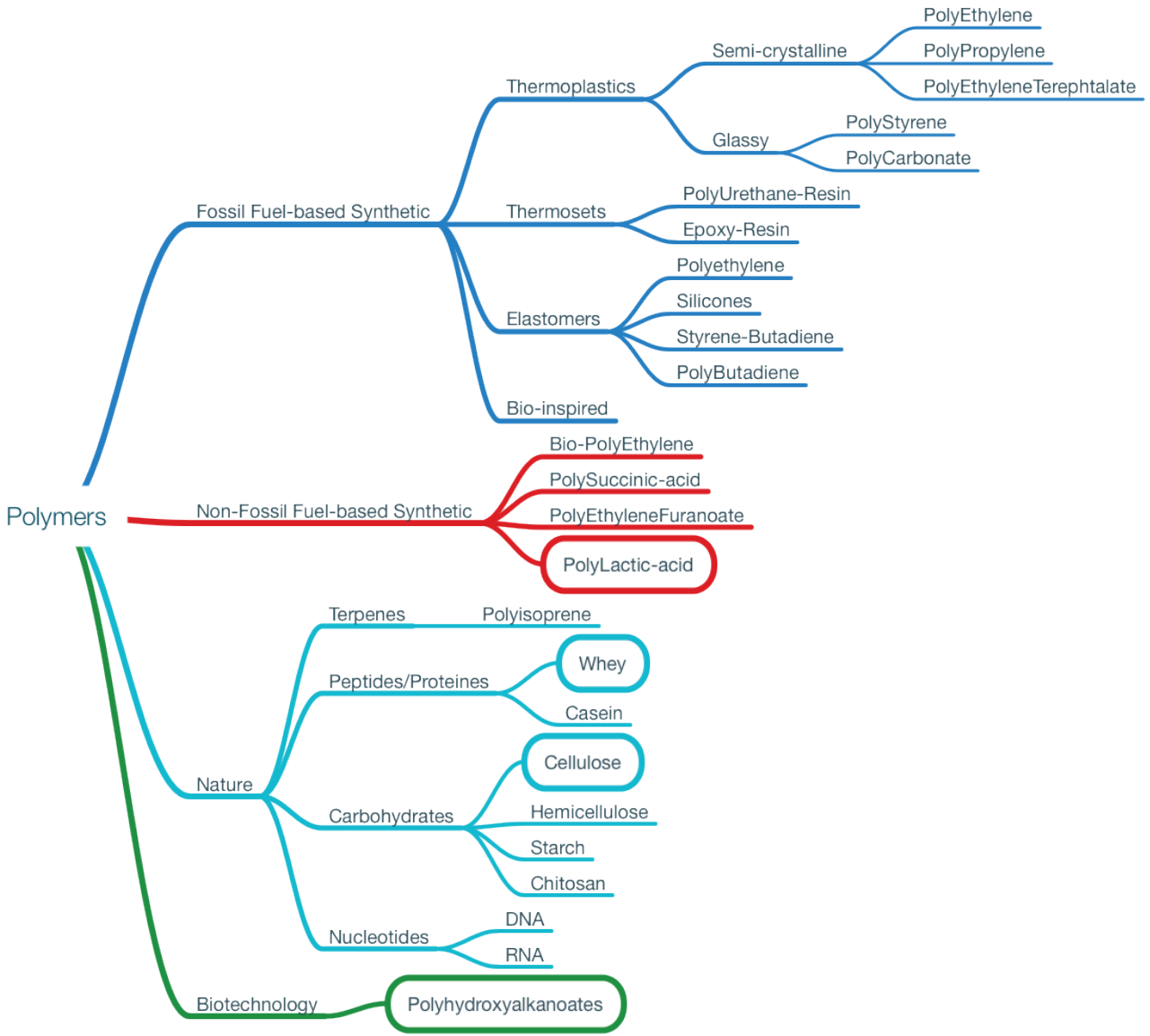


~ 400 MM Ton

~ 2 MM Ton

~ 3’000 MM Ton

~ 0.0001 MM Ton

# Evolution of Plastics

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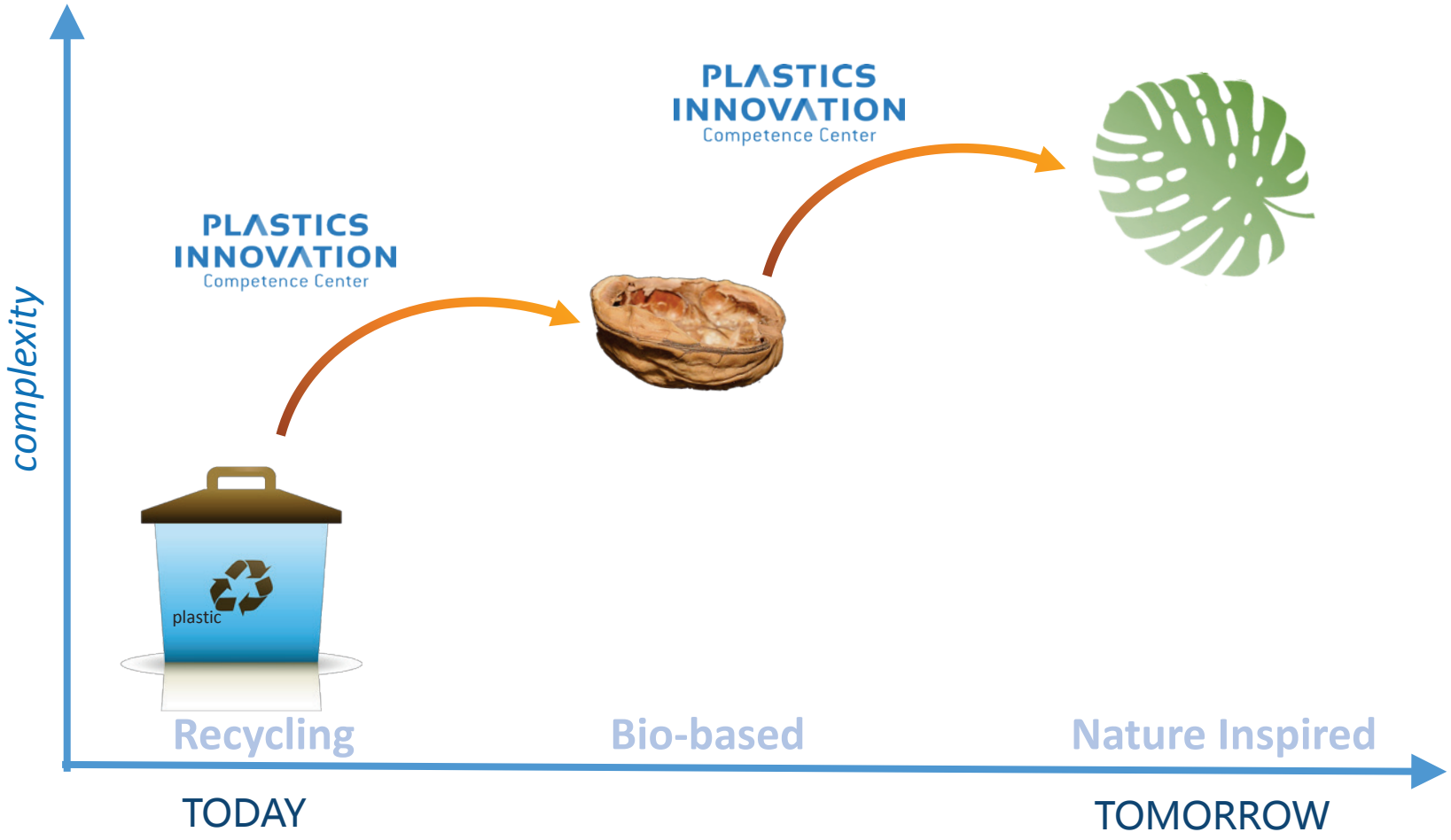

# Recycling technologies & challenges

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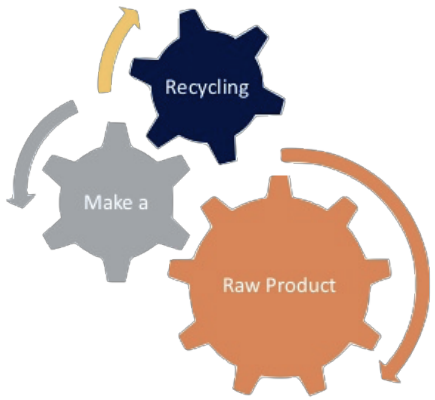
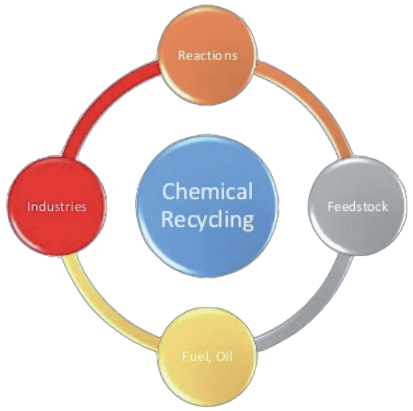
## Mechanical Recycling




## Chemical Recycling




## Pyrolysis

## Thermal “recycling”

Recycling usually starts with collection and identification of plastics. These processes are challenging since most of the products are not designed for recycling: multi-material hard or impossible to separate, composites, unnecessary additives, combinations with non-plastic materials like metals, paper of fibers. Most of the plastics today are not recycled for the stated reasons.

Recycling should rather start with the design, capable to integrate not only high performance and functionality but also end-of-life solution, recycling and not only energy recovery. The material should stay as long as possible in the loop. Design to recycling must help keeping plastics away from landfills or incineration plants, decreasing the use of natural resources and contributing to the circular economy practices.

# Design for recycling

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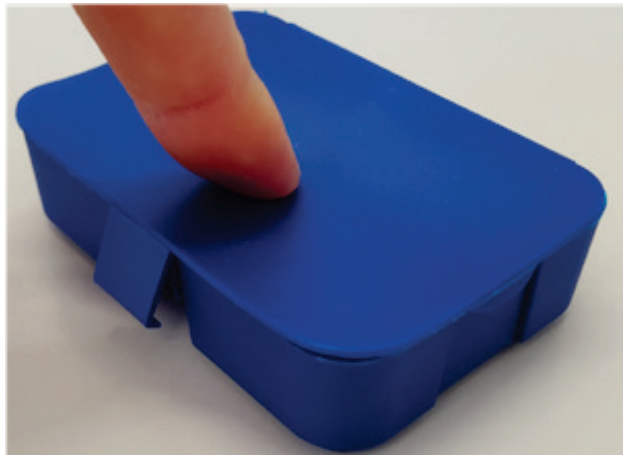
**Single material concept with integrated lid**

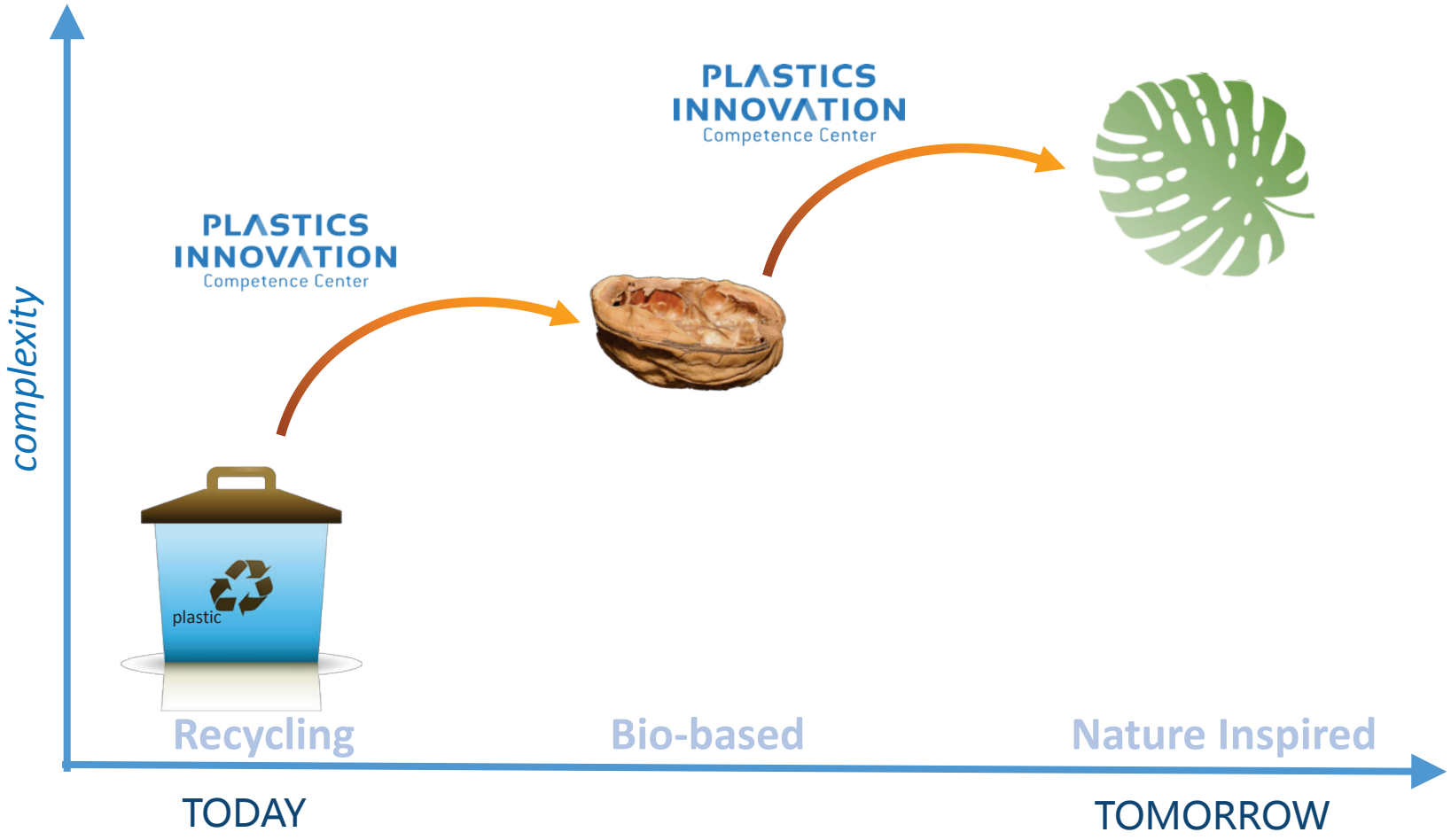
We developed and produced a plastic box (PP) with an innovative opening and closing system, based on the same principle as the "click-clack" boxes on the market. The box is therefore designed with a bistable opening and closing system.

**Easy to identify and recycle**

The mechanism is presented for packages produced by injection moulding and exploits a physical effect known as bi-stable behaviour and allows to open and close the box with just one hand. It is made in one piece thanks to a hinged connection of the cover, easy to identify and recycle.




# Evolution of Plastics



# Biomass in Europe

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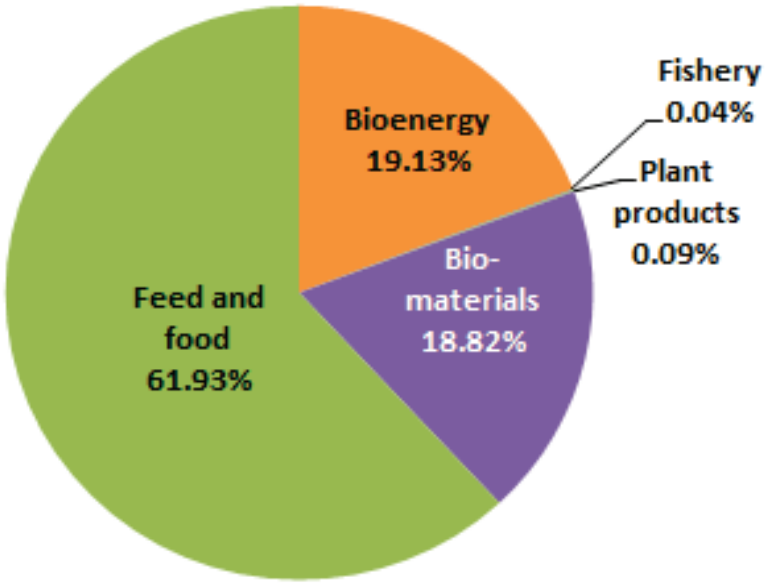
## EU 28 + CH, NO
## Annual Production = 1’466 Million Tons

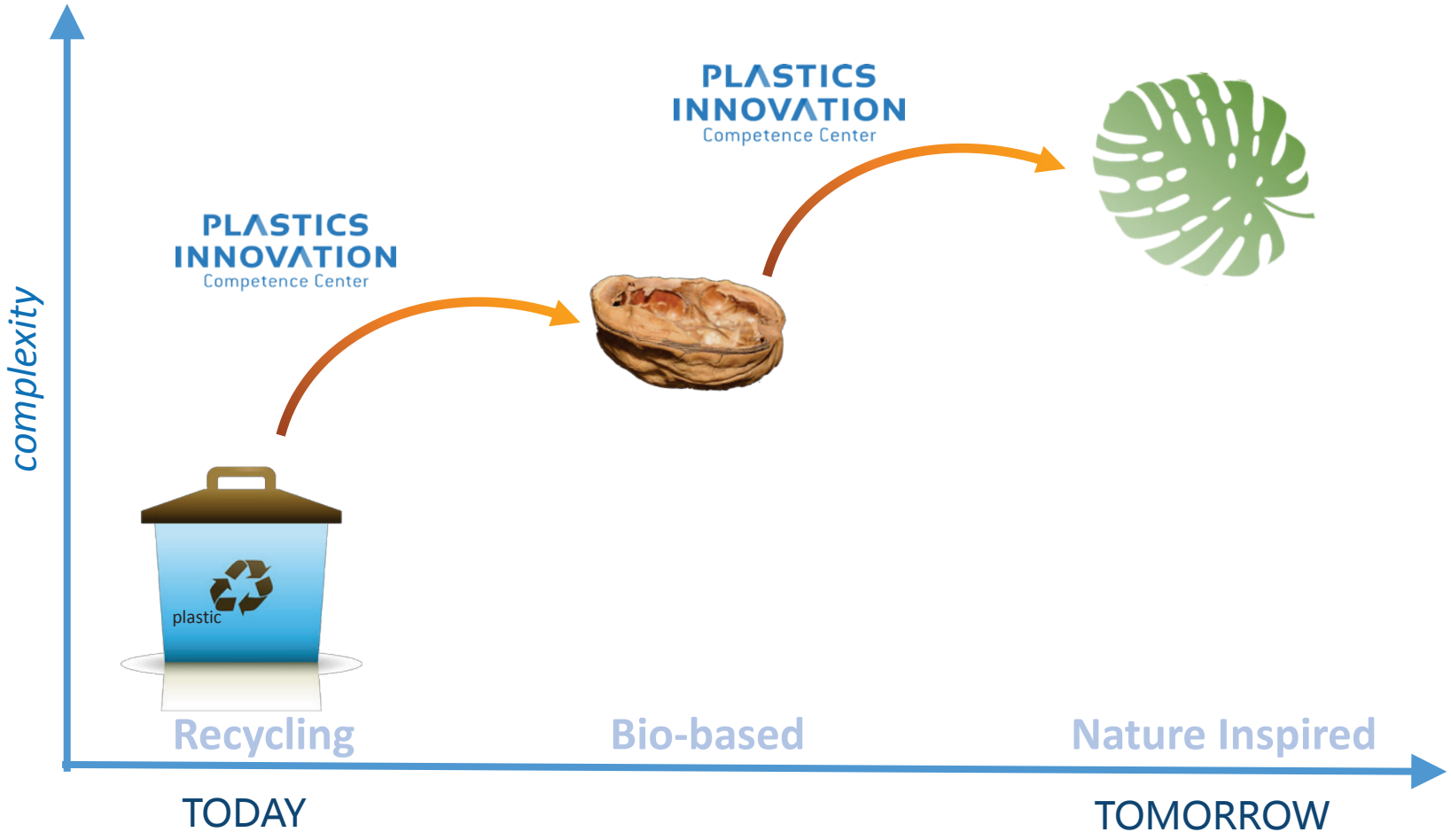



## Actual use = 805 Million Tons !



Biomass production, supply, uses and flows in the European Union - EUR 28993 EN – 2018 (2013 estimates) https://ec.europa.eu/jrc

# Evolution of Plastics



# Self-healing elastomers

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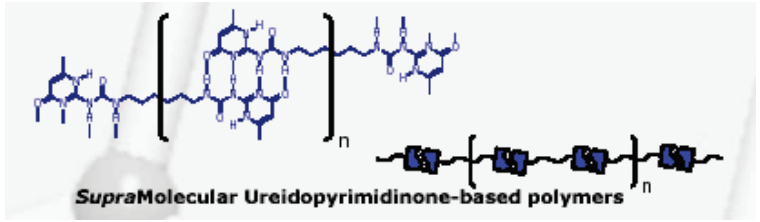



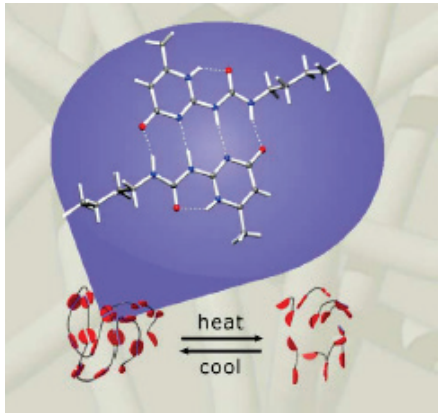


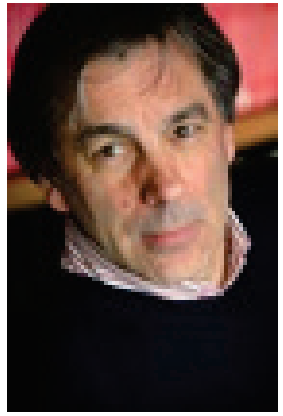

Bert Meyer


https://vimeo.com/60593534 http://www.suprapolix.com

# Vitrimers – reversible thermosets

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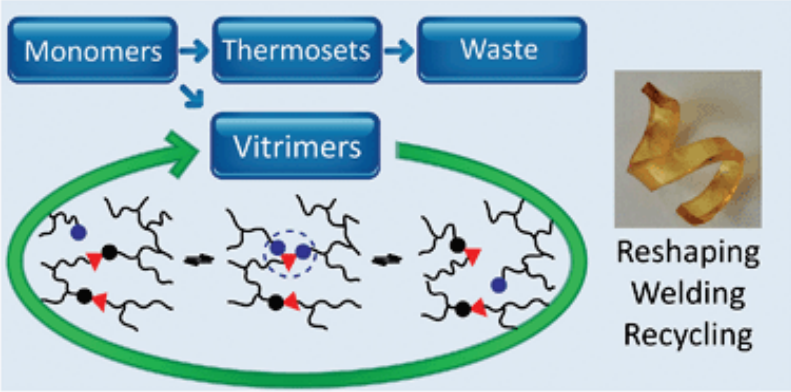
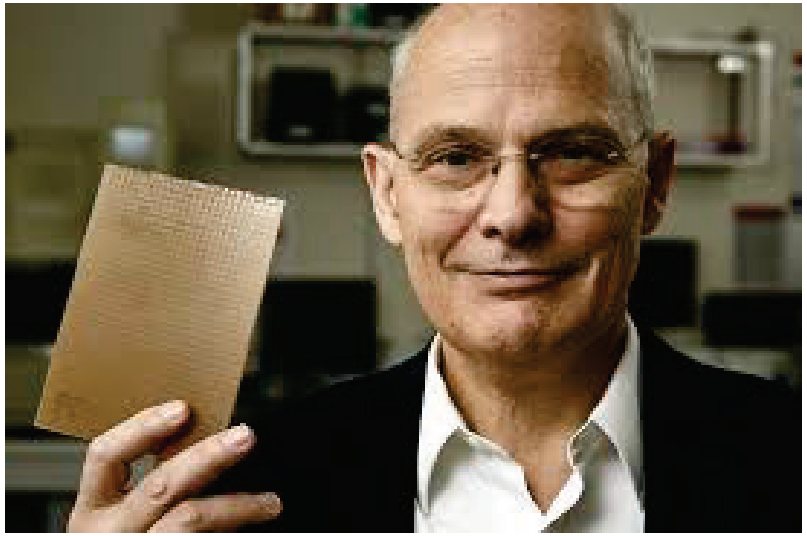
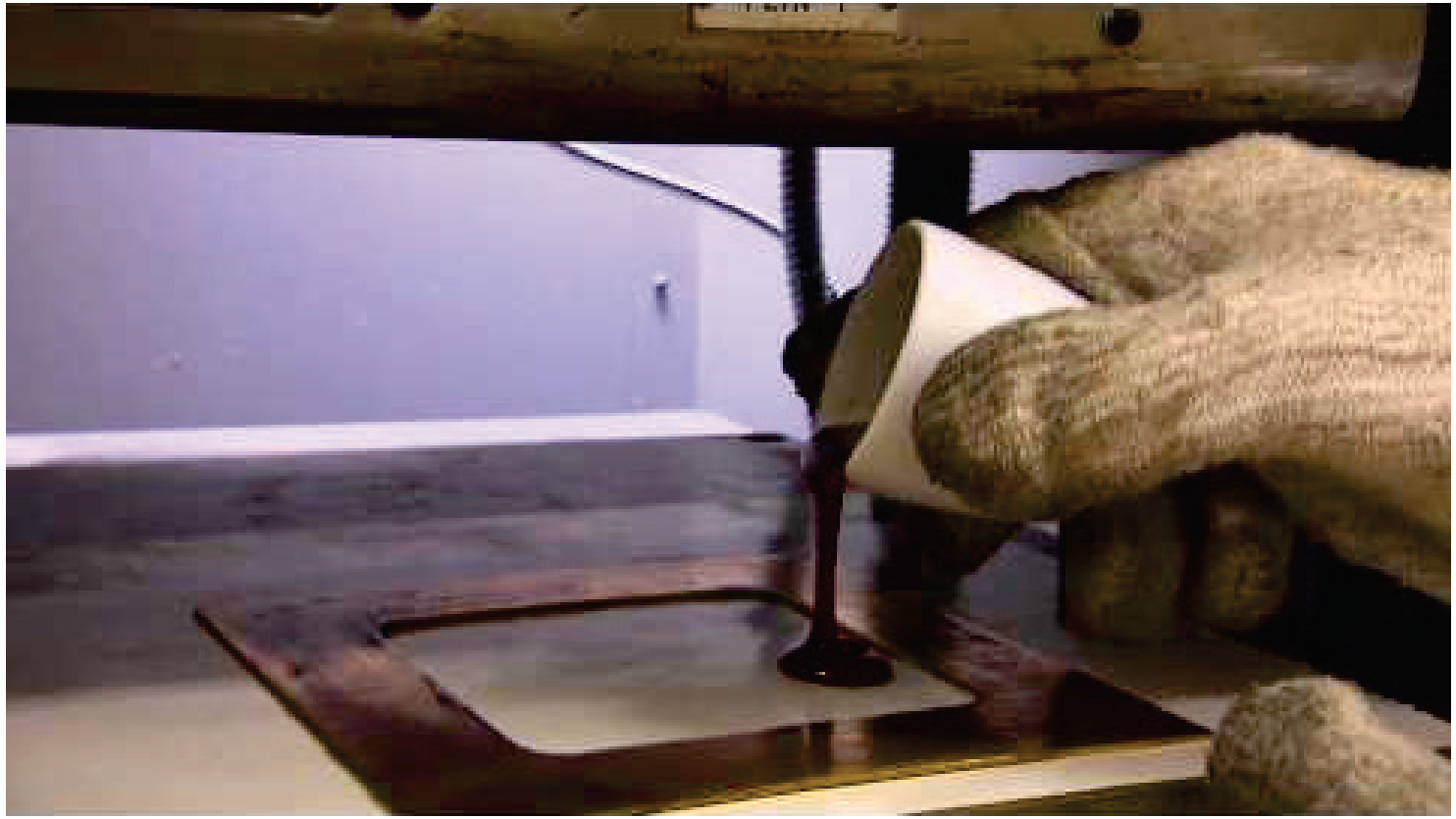
W. Denissen et al., Chem. Sci., 2016, 7, 30





https://www.espci.fr/en/directory?recherche=leibler&r_en_cours=on&type=recherche&unique_id=CgRcAjAeBDw%3D&lang=en

# Benefits for 3D Printing

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Challenges for 3D printing :

**No CAD design > no 3D print**

**Too expensive, does not scale**

**Rough surface, single color**

**Strength of materials**

**Limited set of plastics**

Opportunities for 3D printing :

**Different CAD design**

**Reduce cost, faster operation**

**Smooth surface**

**Tailored strength**

**Versatile set of plastics**

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