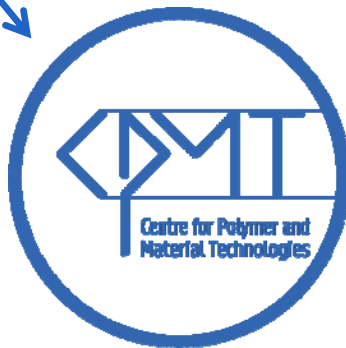
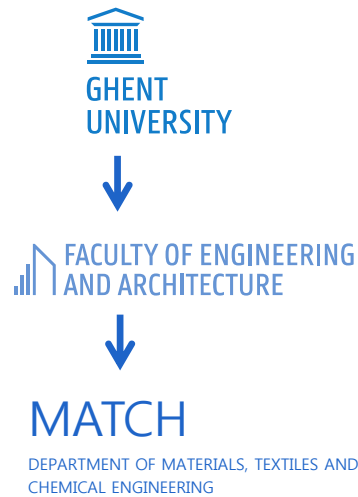


Design from Recycling for post-consumer WEEE plastics

G. Vyncke, J. Onnekink, T. Feenstra, K. Ragaert

6th International Conference on Sustainable Solid Waste Management
Naxos, June 2018

CPMT group & team recycling



3D Printing

- Extrusion based 3D Printing
- 3D Printing of composites
- Printhead development
- Development of new materials for 3D Printing
- 3D Printing build strategies
- Fablab UGent

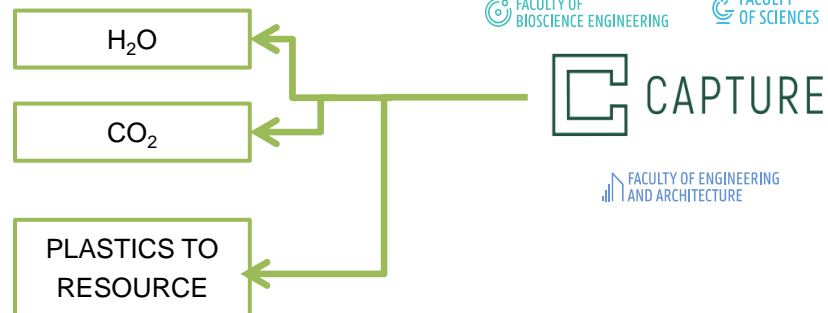
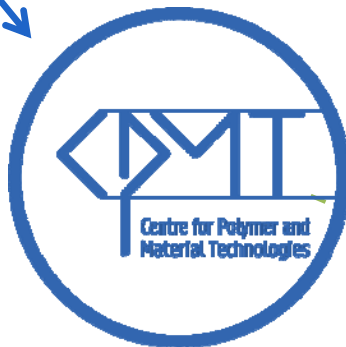
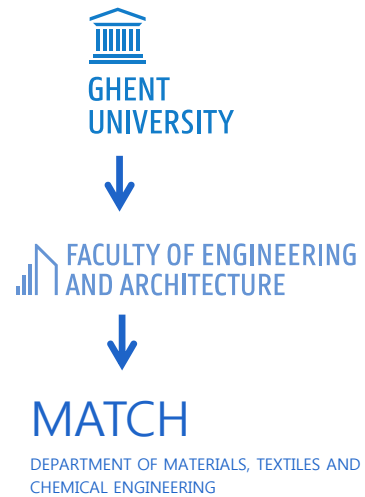
Advanced Polymer Processing

- Injection Mould Engineering
- Conductive polymers
- Hybrid Moulds
- Process simulation

Recycling and Sustainable Use

- Mechanical recycling
- Mixed plastic waste
- Multilayer packaging
- WEEE recycling
- Compounding
- Microfibrillar composites
- Design for Recycling
- Design from Recycling
- Degradation effects

CPMT group & team recycling



TEAM RECYCLING

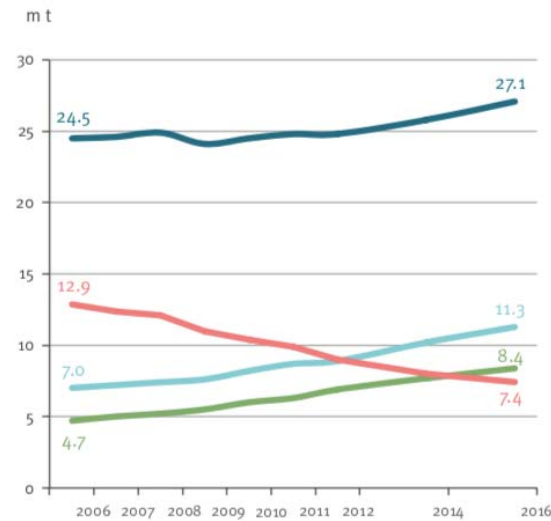
Our **mission** is to contribute to the circular economy by **demonstrating the sustainable potential of plastics**.

This is achieved by transferring fundamental materials science to **improved industrial processing of recycled plastics**.

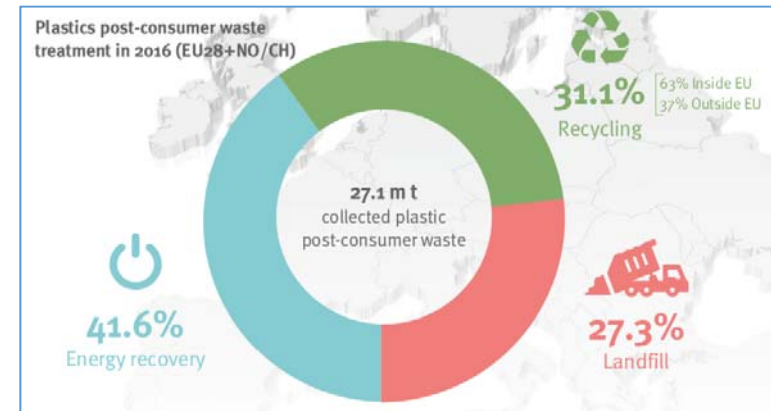
Solid plastic waste in EU

In ten years, plastic waste recycling has increased by almost 80%

From 2006 to 2016 the volumes of plastic waste collected for recycling increased by 79%, energy recovery increased by 61% and landfill decreased by 43%.



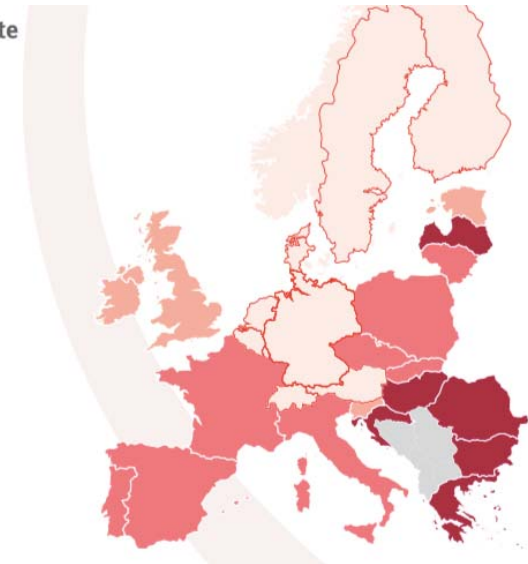
Source: Plastics The Facts 2017, PlasticsEurope



Plastics post-consumer waste landfill rate across Europe

- 10% or less
- up to 30%
- up to 50%
- more than 50%
- Countries with landfill restrictions implemented

Plastics waste going to landfill in 2016



EU Strategy for Plastics in a circular economy

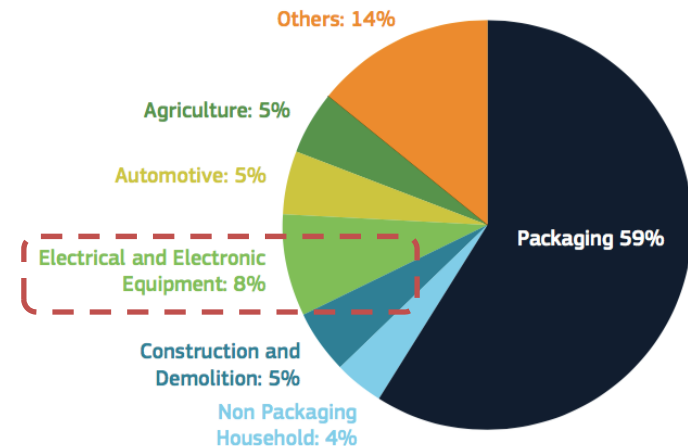
- Released January 18
- Includes overview of planned EU measures to implement Strategy



Goals:

- 2025: recycle 55% of plastics packaging
- 2030: all plastics packaging recyclable
- 2030: over 50% of ALL plastics are recycled

EU PLASTIC WASTE GENERATION IN 2015



Source: Eunomia (2017)

Plastics in WEEE

- Dominated by ABS, HIPS and PC
- Challenges for effective recycling:
 - *Flame retardants*
 - *Stable supply*
 - A sufficient ,feel' for the properties
 - Specific design guidelines

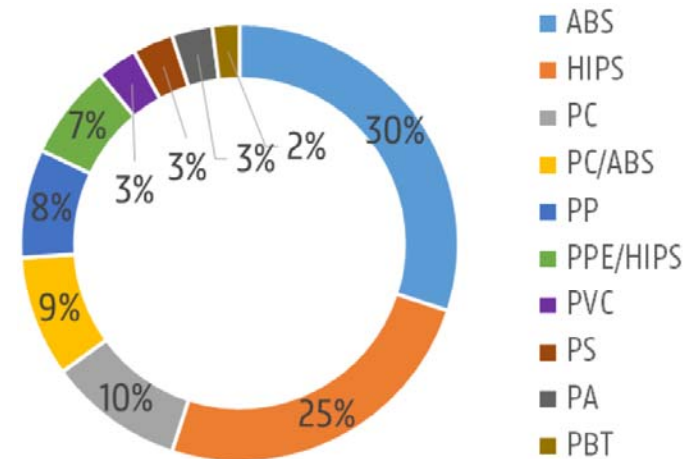


Figure 1: Typical composition of the plastics fraction within WEEE (Achilias and Antonakou 2015)

Design for Recycling



*'As a first step, and under the framework of the Ecodesign directive, the Commission has developed and will propose shortly to Member **States mandatory product design** and marking requirements to make it **easier and safer to dismantle, reuse and recycle** electronic displays'*

*'The Commission is also proposing to **encourage better product design** by differentiating the financial contribution paid by producers under **extended producer responsibility** schemes **on the basis of the end-of-life costs** of their products. This should create a **direct economic incentive to design products that can be more easily recycled or reused.**'*

'The designed-for-recycling method incorporates recycling and recyclability criteria into the design phase of products, with the aim of obtaining recycled and/or recyclable products.'

Julio Rodrigo and Francesc Castells, Rovira i Virgili University

Design for Recycling relates to:

- design for disassembly
- eco-design (*EU Ecodesign directive*)

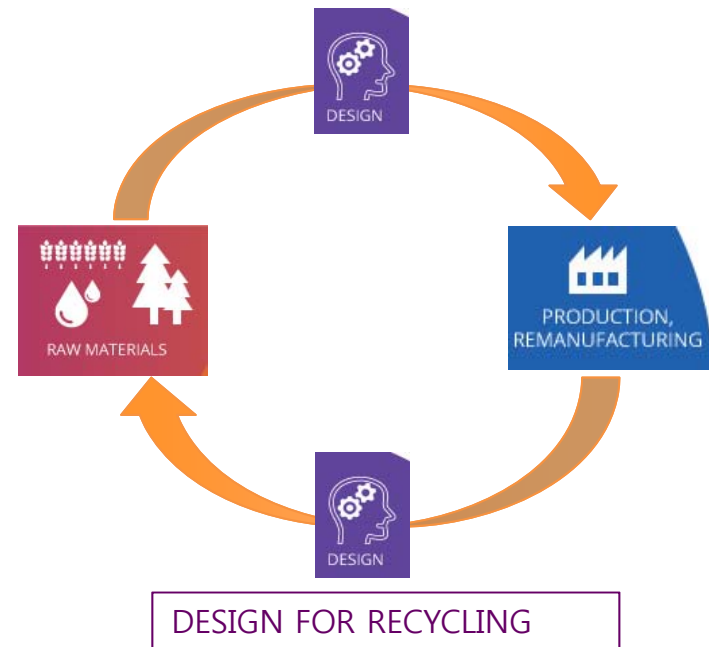
= designing a product to make it easier to recycle into the individual composing **materials** at its **end-of life**

Design for Recycling

making it easier to recycle the individual **materials** making up the product at its **end-of life**



Source: EU Parliament, 2015, Circular economy: the importance of re-using products and materials

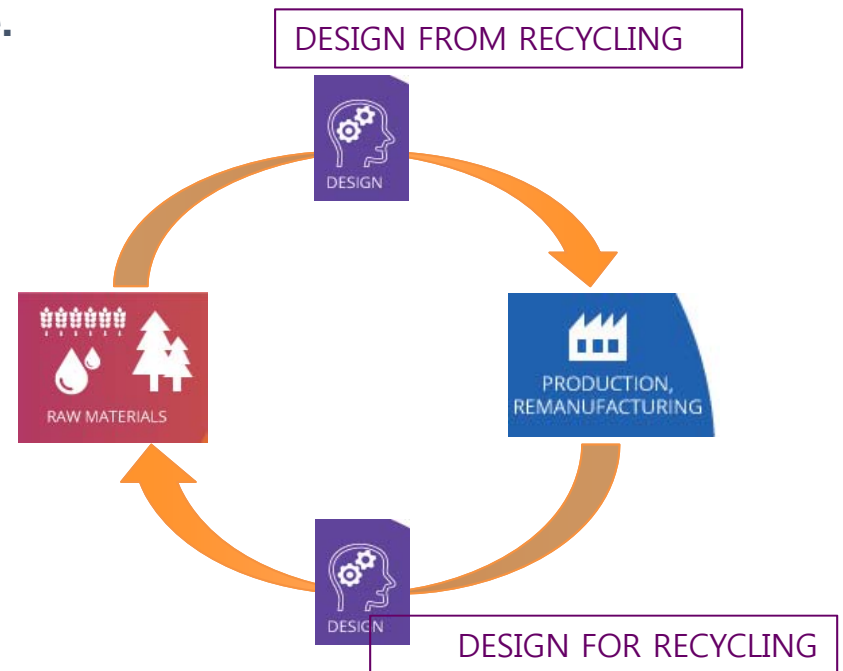


Design from Recycling

Developing new products, based on available recycled materials,
at start-of life.

Material-driven design approach

1. Knowing the possibilities and properties of the available r-polymers
2. Matchmaking between products and available r-polymers
3. 'tweaking' r-polymers if you have to (remain cost-effective)
4. Adapted product design for r-polymers
 - *This includes mould design*



Making it easier to recycle the individual **materials** making up the
product at its **end-of life**.

Design from Recycling

Developing new **products**, based on available recycled materials, at **start-of life**.

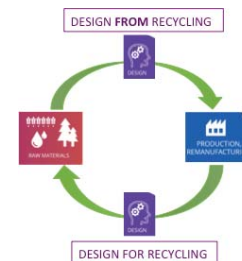
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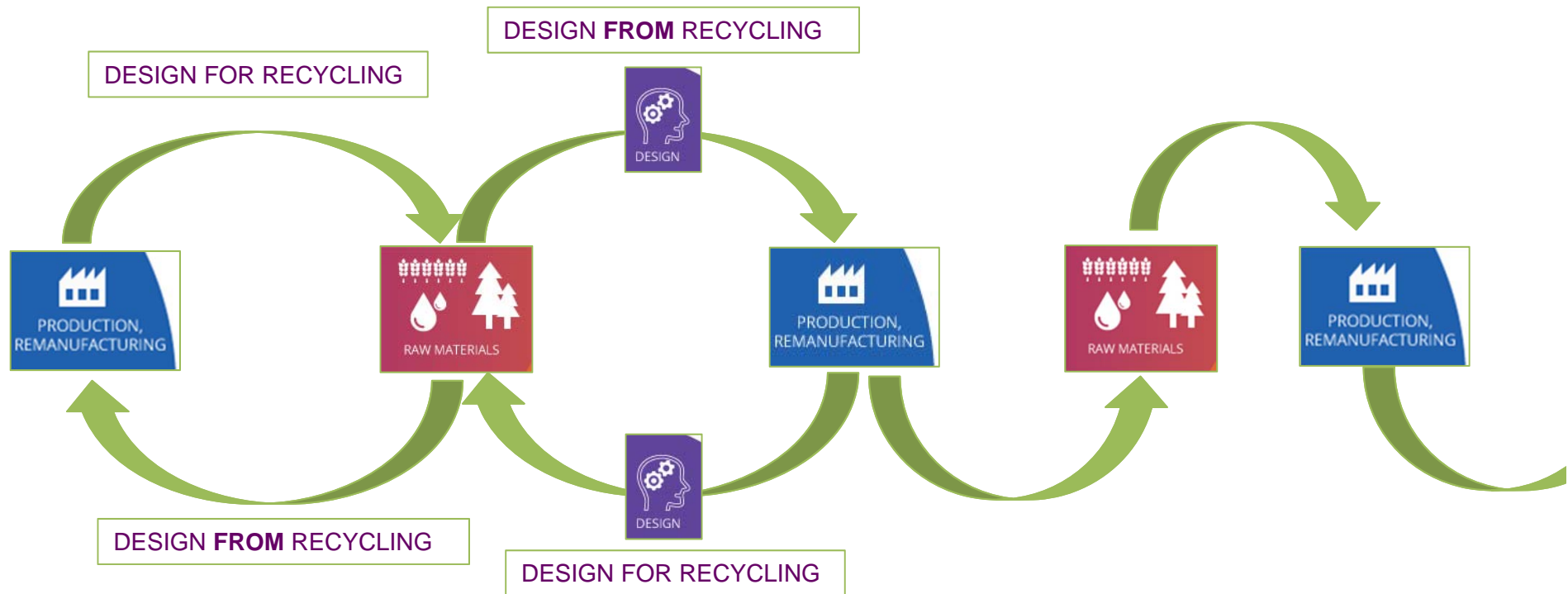
challenges

- Engineer-speak vs designer-speak
- Recycling the recycled
 - *Retained functionality of additives*
- Industrial inertia
 - *Prices of virgin feedstock*

Design from Recycling requires a close symbiosis between designers and engineers



Design from Recycling

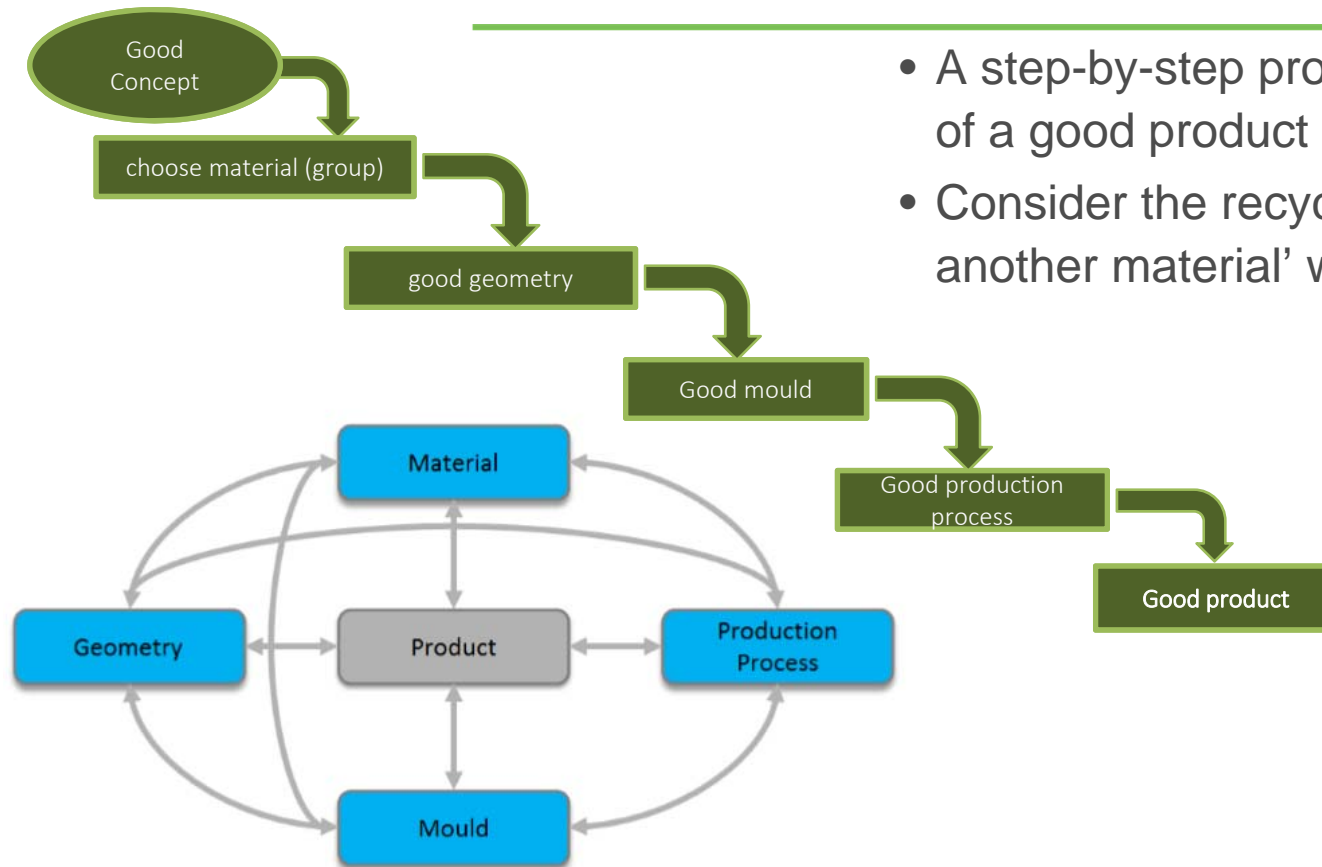


Presentation outline

- Framework: (WEEE) plastics in the EU
- Design from Recycling
- Tools for Design from Recycling
- Outlook



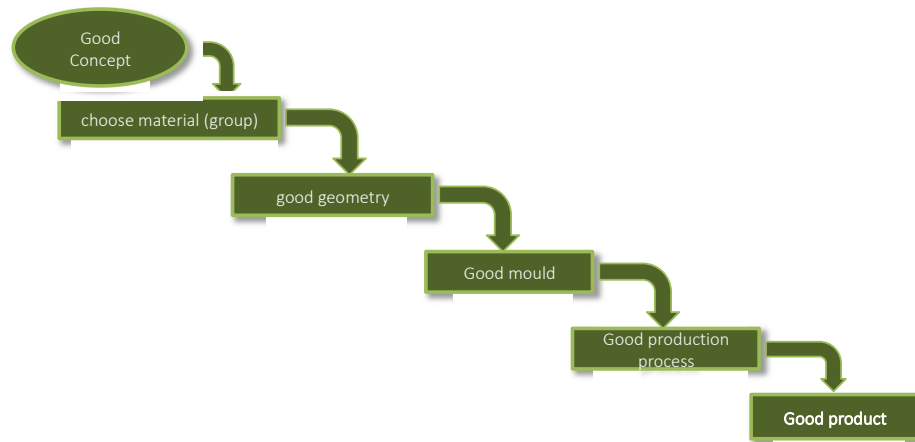
Design strategy – new product

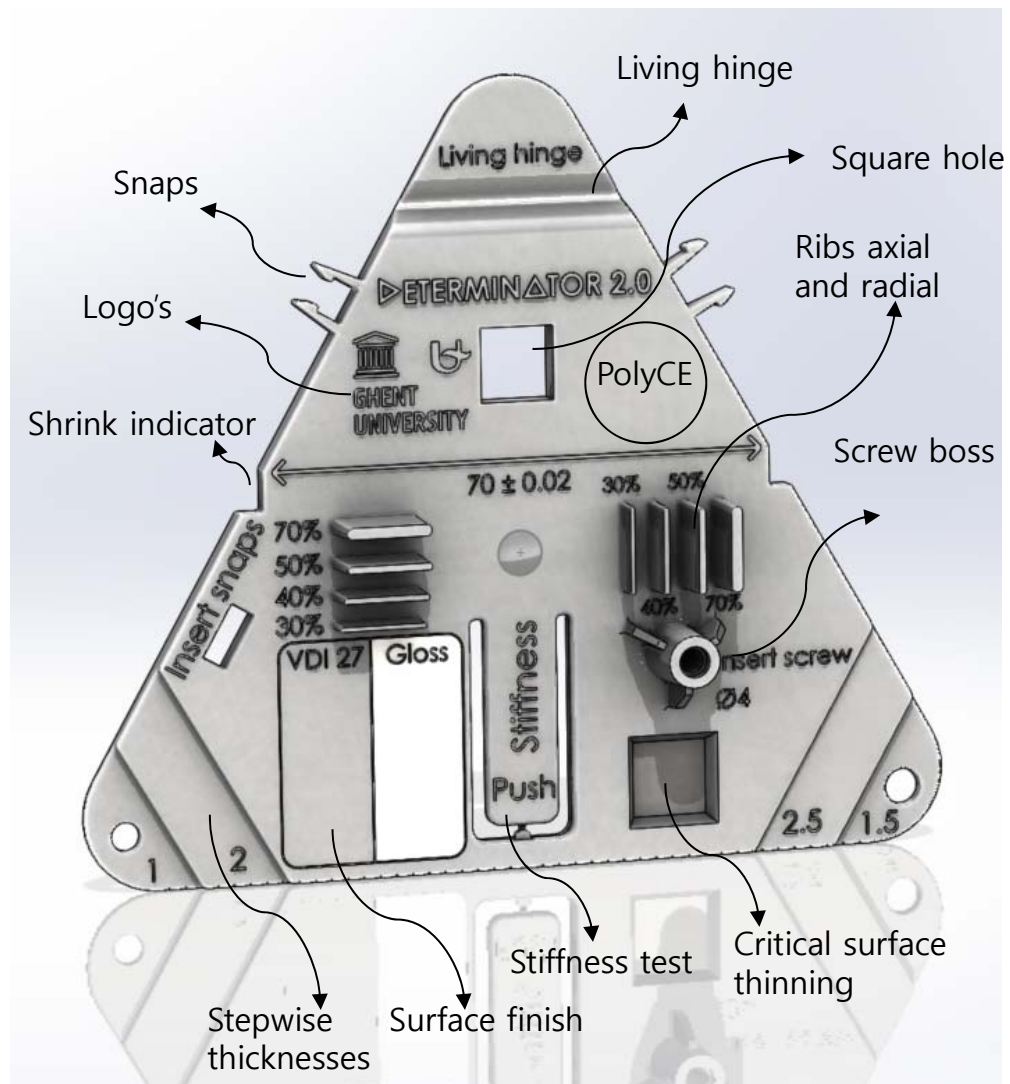


- A step-by-step process for the development of a good product
- Consider the recycled material as ‘just another material’ with its given properties

Design strategy – recycled content drop-in

- All steps have already been taken. Moulding tool is in place and must be used with minimum adjustment
- Aim to bring recycled materials as much as possible to the same properties as the virgin material, both in terms of mechanical properties and processing.
- --> blending, use of additives, adapted processing conditions





the dEEEterminator

- A tactile tool for the hands-on evaluation of material properties
- Supplement to TDS
- Allows to bring out aspects, specific to EEE products like gloss, snaps, living hinge, screw boss, surface thinning...

Outlook



- Application of Design from Recycling strategy and tools to effective products in large-scale demonstrator project PolyCE
- Expected to market from 2019 onwards



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Prof. Dr. Kim Ragaert
*Sustainable Use and Recycling of
Polymers*

kim.ragaert@ugent.be
+32 9 331 03 91

Ghent University
Faculty of Engineering and Architecture
MATCH – CPMT

Tech Lane Ghent Science Park – campus A
Technologiepark 915
9052 Zwijnaarde, BE

