CAPTURE

The state of Plastics Recycling in Europe

Prof. Kim Ragaert

Ghent University – Circular Plastics

GHENT UNIVERSITY

PURESMART workshop – May 31st 2021

PUReSmart

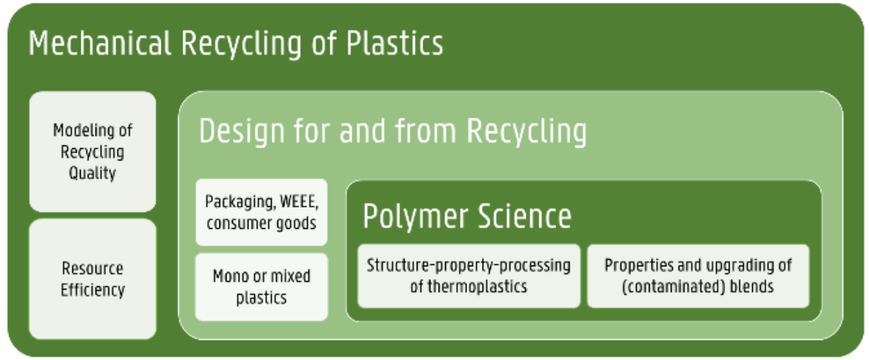
Speaker background - Kim Ragaert

Prof. Kim Ragaert - Circular Plastics

- Materials scientist, PhD in polymer processing (2011)
- Associate professor in 'Circular Plastics' at Ghent University -CPMT
- Chair of the Plastics to Resource pipeline within CAPTURE:
  - 15 professors, 4 institutes, value chain collaboration
  - Lead of the Mechanical recycling programme
- 2020 Plastics Recycling Ambassador

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 and increased recycling of plastics.



State of Plastics Recycling in Europe

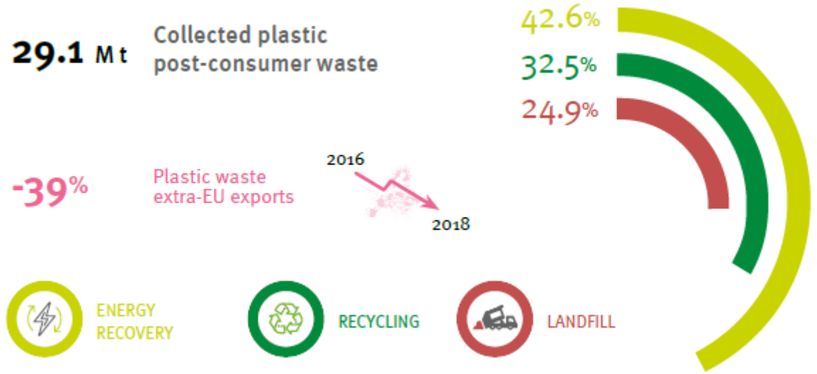
CAPTURE

- The numbers
- The misunderstandings
- The way forward

THE NUMBERS

The numbers

- **Over 30% are *collected for recycling inside & outside EU***
  - *Varies between states, e.g.:*
    - *24% France*
    - *39% Germany*
  - *for plastic packaging waste: typically 10-20% higher*



(Plastics The Facts 2020, Plastics Europe)

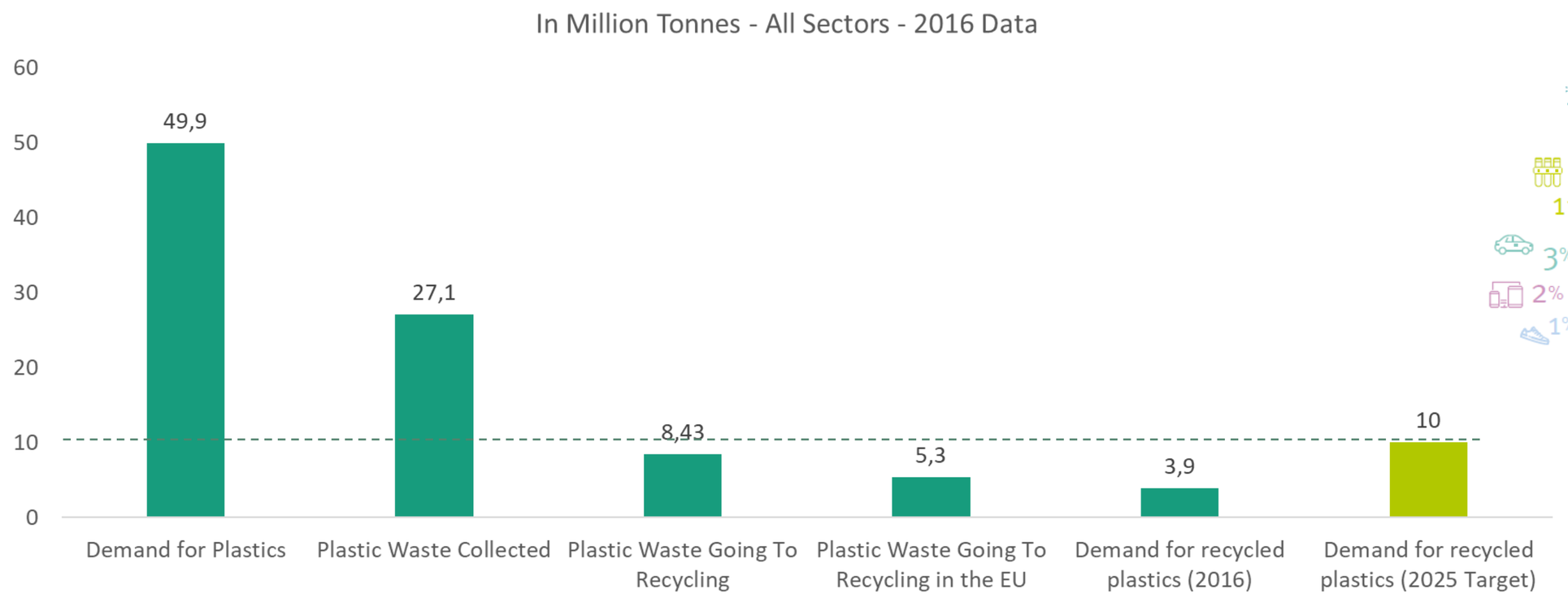
Calculated effective rates from studies:

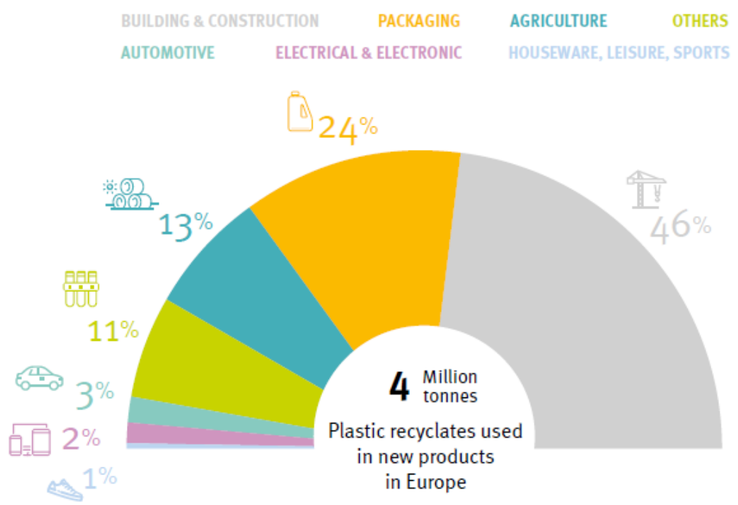
- (NL) 26% of post consumer packaging waste is effectively recycled
  - Source: The impact of collection portfolio expansion on key performance indicators of the Dutch recycling system for Post-Consumer Plastic Packaging Waste, a comparison between 2014 and 2017. Brouwer, Picuno, van velzen, Kuchta, De Meester and Ragaert. Waste Management, 2019.

EU Goals:

- 2025: recycle 55% of plastics packaging
- 2030: all plastics packaging recyclable
- 2030: recycle 50% of all plastics

The numbers





(Plastics The Facts 2020, Plastics Europe)

Graph by Anton Berwald, Fraunhofer IZM, PolyCE consortium.

Data Source: European Commission, Assessment report of the voluntary pledges under Annex III of the European Strategy for Plastics in a Circular Economy, 2019

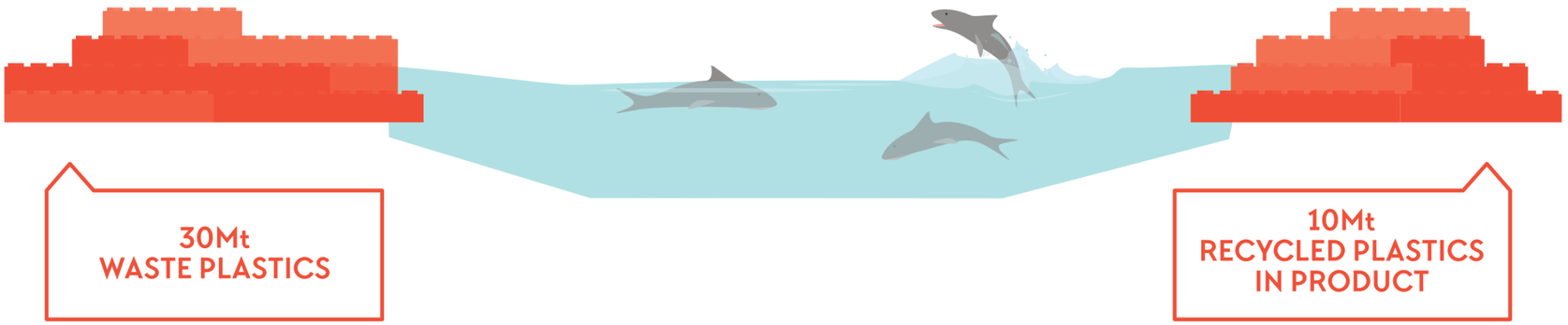
Circular Plastics Alliance:

'We commit to increase the uptake of recycled plastics up to at least 10 million tonnes, in all plastic products, whilst ensuring product quality and safety'

EU Goals:

'The objective is to ensure that by 2025 ten million tonnes of recycled plastics find their way into new products on the EU market'

The 2025 challenge



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THE MISUNDERSTANDINGS

THE MISUNDERSTANDINGS-

‘mechanical recycling is at its limit’

CAPTURE

‘High quality in mechanical recycling is only achieved with clean mono streams’

THE MISUNDERSTANDINGS-
‘mechanical recycling is at its limit’

CAPTURE

Holy Grail 2.0
Intelligent Sorting

Improved & innovative sorting

‘High quality in mechanical recycling is only achieved with clean mono streams’

Design for recyclability

https://www.polyce-project.eu/results/

Open Access Brief Report

sustainability

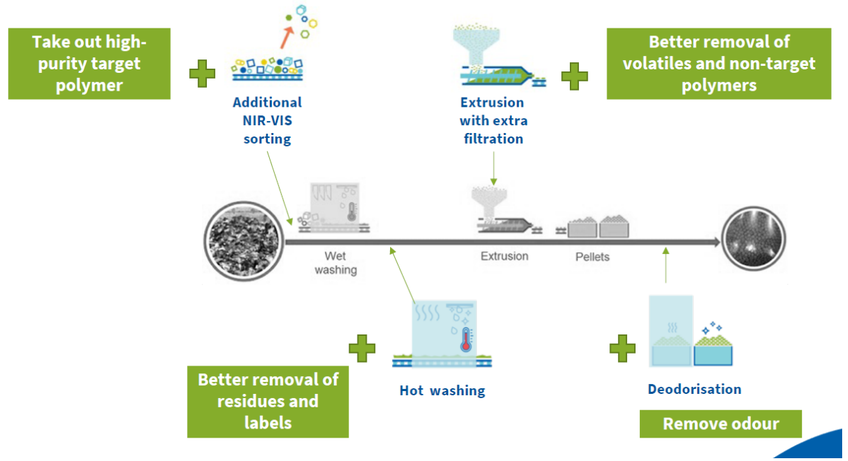
Design for Circularity Guidelines for the EEE Sector

by Anton Berwald [1,*], Gergana Dimitrova [1], Thijs Feenstra [2], Joop Onnekink [2], Harm Peters [2], Gianni Vyncke [3] and Kim Ragaert [3]

Targeted pretreatment

CEFLEX

QRP: Increasing quality with 4 extra steps



ChemSusChem
Chemistry–Sustainability–Energy–Materials
Chemistry Europe
European Chemical Societies Publishing

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Towards a Better Understanding of Delamination of Multilayer Flexible Packaging Films by Carboxylic Acids

Sibel Ügdüler, Tobias De Somer, Prof. Kevin M. Van Geem, Martijn Roosen, Dr. Andreas Kulawig, Dr. Ralf Leineweber, Prof. Steven De Meester

ELSEVIER

Resources, Conservation and Recycling
Volume 161, October 2020, 104907

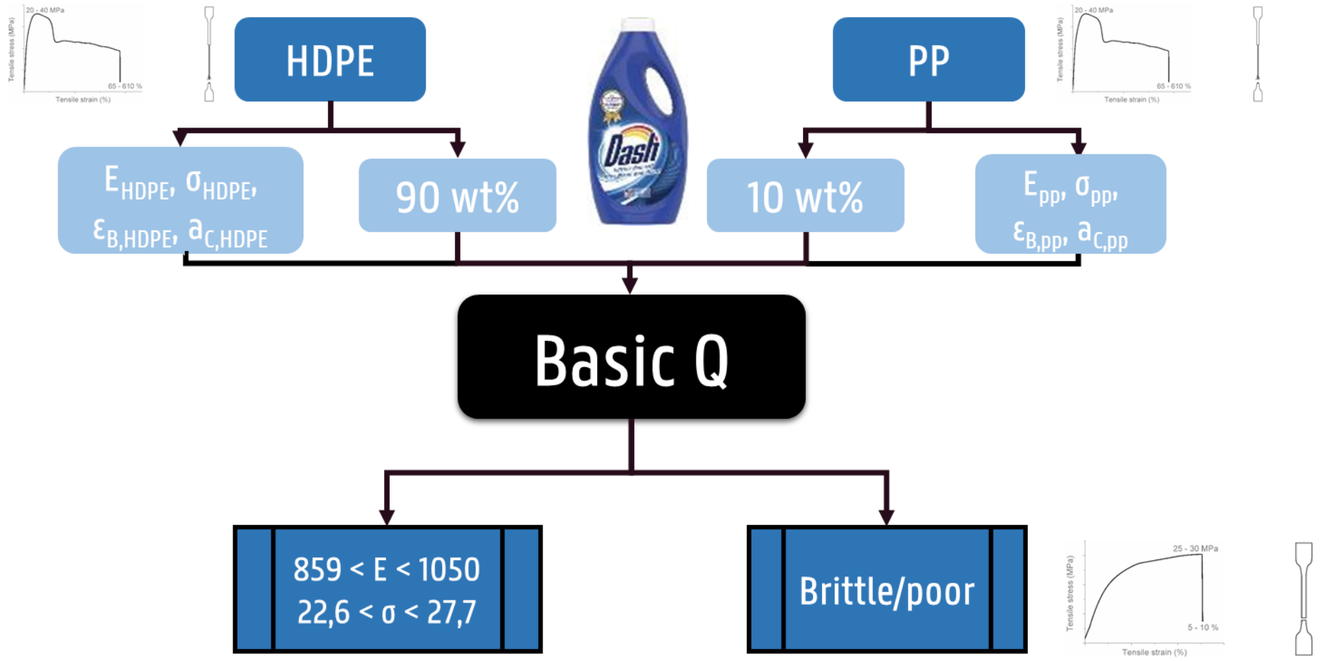
Full length article

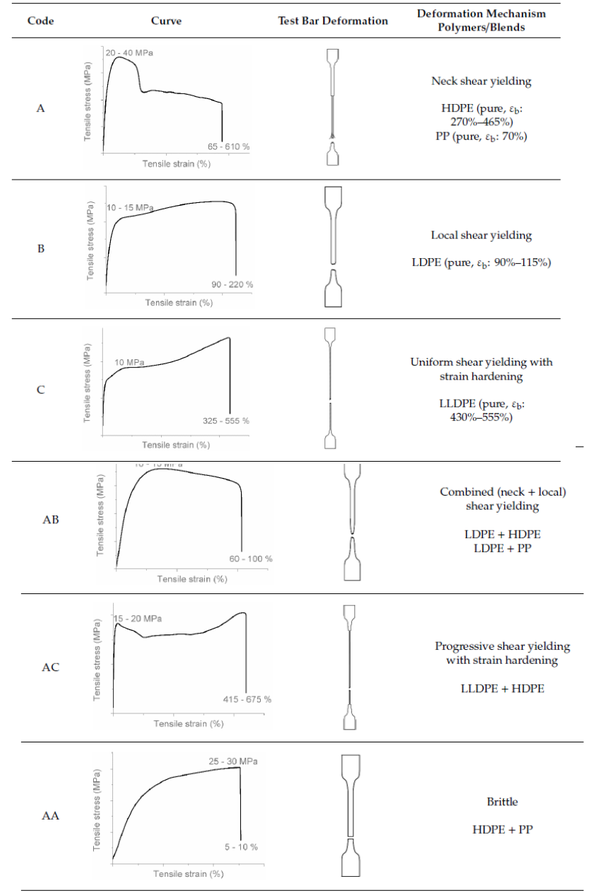
Development and application of an analytical method to quantify odour removal in plastic waste recycling processes

Ruben Demets [a, b], Martijn Roosen [a], Lore Vandermeersch [c], Kim Ragaert [b], Christophe Walgraeve [c], Steven De Meester [a]

THE MISUNDERSTANDINGS-
‘mixing polyolefines is fine’

‘if we can reduce the products/resulting waste streams to a mix of polyolefins, we will be fine’





polymers

Open Access Article

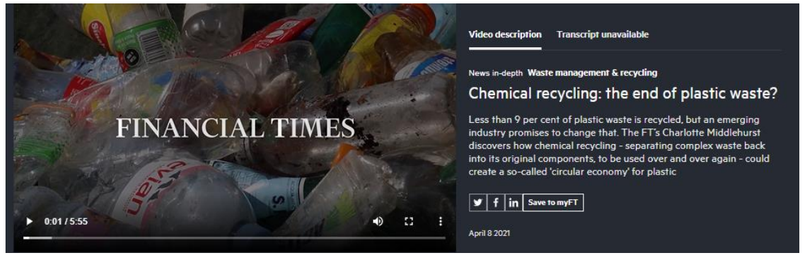
Microstructural Contributions of Different Polyolefins to the Deformation Mechanisms of Their Binary Blends

by Astrid Van Belle [1,†], Ruben Demets [1,2,†], Nicolas Mys [1,2], Karen Van Kets [1], Jo Dewulf [3], Kevin Van Geem [4], Steven De Meester [2] and Kim Ragaert [1,*]

THE MISUNDERSTANDINGS-
‘chemical recycling = a silver bullet’

CAPTURE

‘pyrolysis (and similar) will transform all complex and contaminated plastic waste to clean resources, to be returned to the cracker’



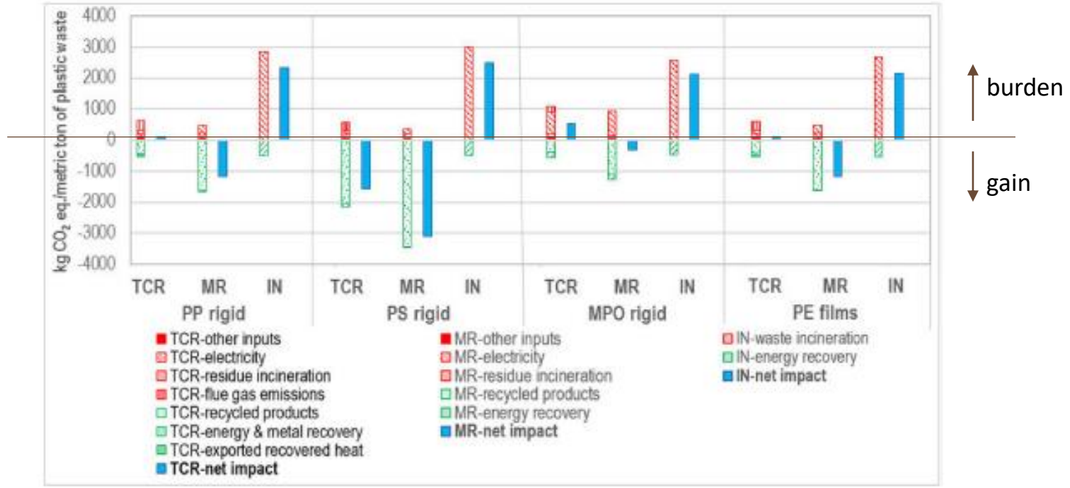


Fig. 2. Potential environmental impacts: (a) resource consumption and (b) global warming impact of the three analysed treatment options: thermochemical recycling (TCR), mechanical recycling (MR) and incineration (IN) for the four plastic fractions: *PP, PS, MPO rigids* and *PE films*. Positive values on the y-as represent burdens, while negative values represent savings. Other inputs (TCR/MR): the burdens of sorting inputs, chemicals, water and heat, except electricity which is presented separately.

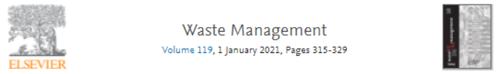
Like with all conversion processes: output quality is dependent on input quality

But: high potential for food contact and/or MPO

Resources, Conservation and Recycling
Volume 171, August 2021, 105633

Moving from linear to circular household plastic packaging in Belgium: Prospective life cycle assessment of mechanical and thermochemical recycling

Didem Civancik-Uslu [a, 1], T.T. Nhu [a, 1], Bart Van Gorp [b], Uros Kresovic [c], Macarena Larrain [d, e], Pieter Billen [d], Kim Ragaert [f], Steven De Meester [g], Jo Dewulf [a], Sophie Huysveld [a]



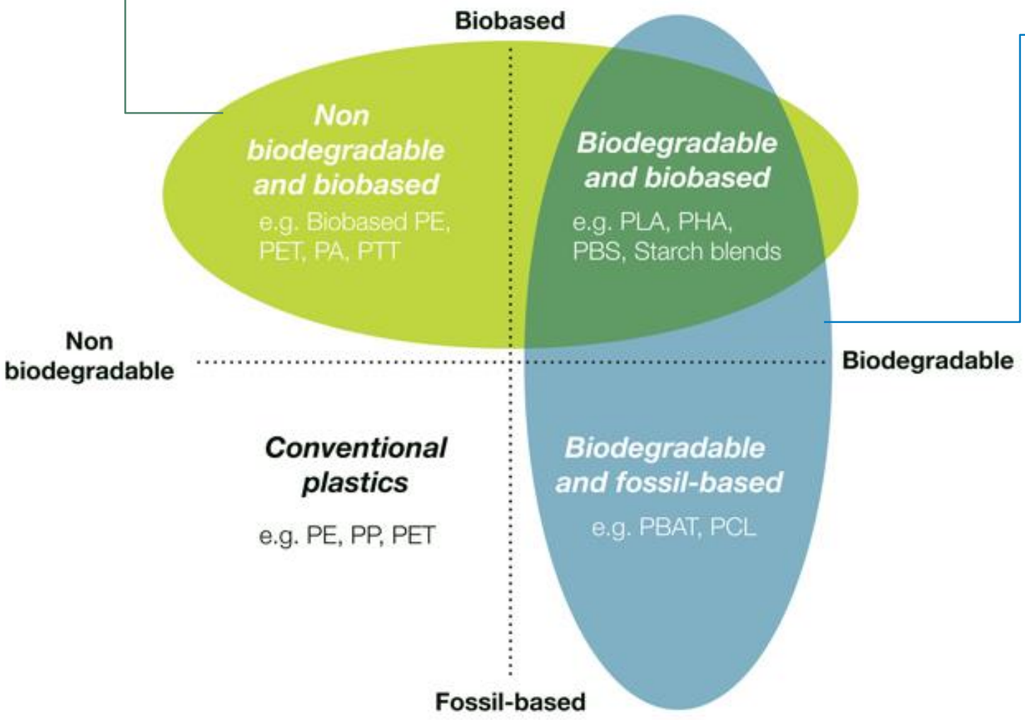
Waste Management
Volume 119, 1 January 2021, Pages 315-329

A recycler’s perspective on the implications of REACH and food contact material (FCM) regulations for the mechanical recycling of FCM plastics

Ellen De Tandt [a], Cody Demuytere [a], Elke Van Asbroeck [d], Hiram Moerman [d], Nicolas Mys [b, c], Gianni Vyncke [a], Laurens Delva [a], An Vermeulen [e], Peter Ragaert [b, c], Steven De Meester [c], Kim Ragaert [a]

THE MISUNDERSTANDINGS-
‘biobased = a silver bullet’

These are fine, will recycle as conventional



Effective circularity is extremely low

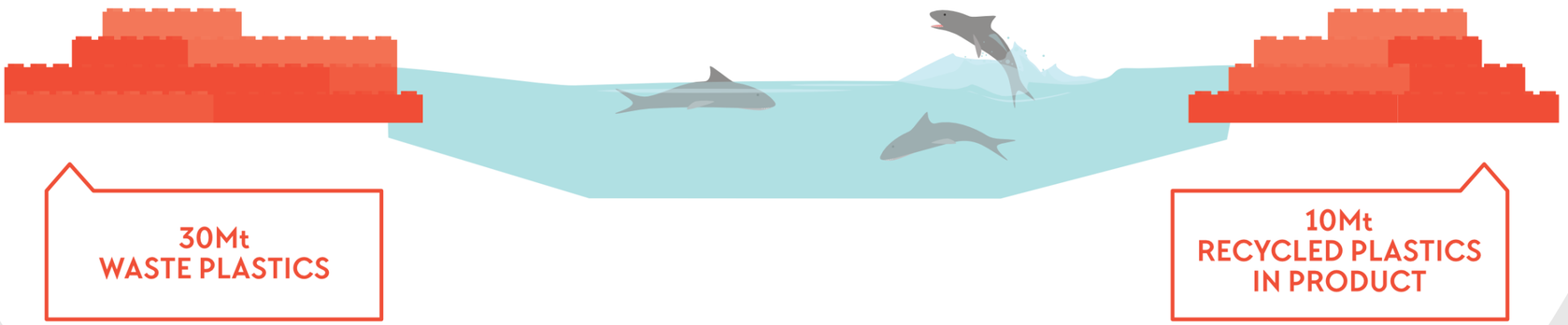
- In most countries: not allowed to put in ‘compostable’ waste
- None of these are targeted in recycling, given their low %
- Within current waste management, they are **incinerated at best**
  - (exceptions: mulch films, home composting)

THE MISUNDERSTANDINGS-

So many others…

- **‘dissolution based recycling is just another form of chemical recycling’**
- **‘plastic litter it is the sole responsibility of the producers’**
- **‘plastic litter is the sole responsibility of the consumer’**
- **‘PS cannot be recycled’**
- **‘PVC is a bad material’**
- **‘replacement of plastic with other materials is always more sustainable’**
- **…**

THE WAY FORWARD



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The thing about plastics…

…is that there are (still) too many minority streams.

And the emerging biobased plastics only make it more complex.

What if

- Industry continues the ongoing simplification trend, so that we create larger volumes of less contaminated plastic waste per sector? (= systemic Design for Recyclability)

- Packaging industry were to jointly pick one biobased plastic and allow it to mature into the 6th ‘big plastic’?

The thing about recycling…

…is that we have one technology in place and one strongly emerging.

And we have no idea how they will balance out.

We should

- realise that there are no silver bullets and output quality ≈ input quality. We must develop science to improve those input qualities from all angles.
    - Delamination/de-inking
    - Decontamination
    - Material/component/additive design for recycling

- build a dynamic model to evaluate how the balance between mechanical and chemical recycling will develop in the EU.
    - Will they cannibalize each other's feedstock?
    - Will they be fully complimentary?
    - What will it mean for the overal recycling rates?

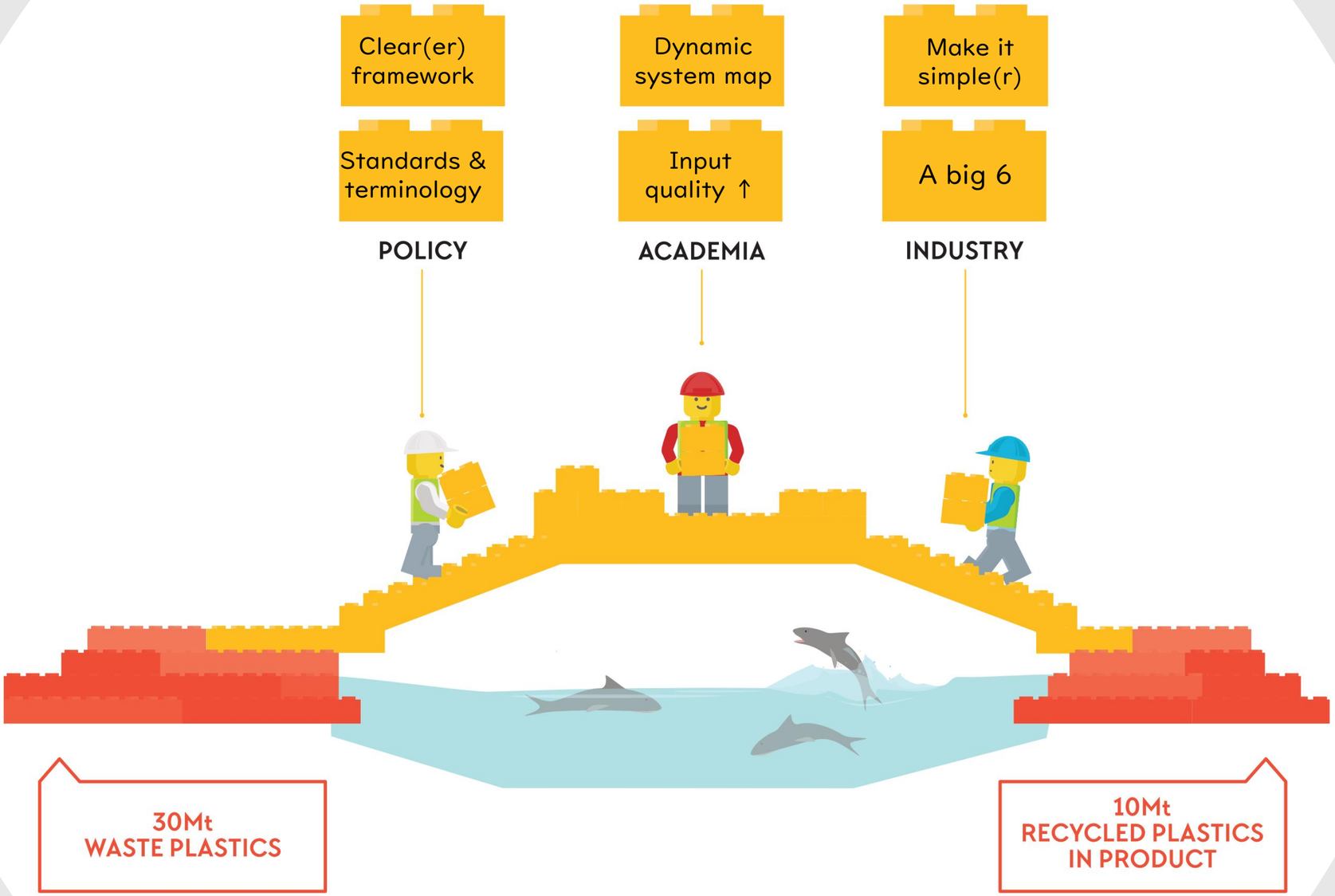
The thing about legislation and policy making…

…is that it needs to give everyone else a clear framework to work within.

And too often we can't see the forest for the trees.

We need

- Clear and unambigious terminology (e.g. 'recyclable')
- Standards, today rather than tomorrow
- Understanding that plastics are complex (and you can't just do things like make 'minimum criteria for PE')
- Clear-cut, to-the-point guidelines on 'what we must do' to be compliant
    - REACH vs end-of-waste, FCM



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PLASTICS RECYCLING AWARDS EUROPE 2020 WINNER
Plastics Recycling Ambassador of the Year

Prof. Dr. Kim Ragaert
Circular Plastics

2020 Plastics Recycling Ambassador

Chair of CAPTURE-Plastics to Resource
Mechanical Recycling program lead

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Ghent University
Faculty of Engineering and Architecture
MATCH – CPMT

Key publications:

- De Tandt, …, and Kim Ragaert. A recycler's perspective on the implications of REACH and Food Contact materials (FCM) regulation for the mechanical recycling of FCM plastics. (2020) Waste Management.
- Roosen, Martijn… Ragaert, Kim; De Meester, Steven. A detailed analysis of the composition of selected plastic packaging waste products and its implications for mechanical and thermochemical recycling. (2020) Environmental Science & Technology.
- Astrid Van Belle , …, Seven de Meester and Kim Ragaert. Microstructural contributions of different polyolefins to the deformation mechanisms of their binary blends. (2020) Polymers.
- Kim Ragaert, Sophie Huysveld, Gianni Vyncke, Sara Hubo, Lore Veelaert, Jo Dewulf and Els Du Bois. Design from recycling: A complex mixed plastic waste case study. (2019) Resources, Conservation and Recycling. 155.
- Sophie Huysveld,Sara Hubo; Kim Ragaert; Jo Dewulf. Advancing circular economy benefit indicators and application on open-loop recycling of mixed and contaminated plastic waste fractions, Journal of Cleaner Production 211 (2019) .
- Thoden van Velzen U., Brouwer M., Augustinus A., Soethoudt I., De Meester S. and Ragaert K. Predictive model for the Dutch post-consumer plastic packaging recycling system. Waste Management 71 (2018), 62–854.
- Ragaert K.,Delva L. And Van Geem K. (2017). Mechanical and Chemical Recycling of Solid Plastic Waste. Waste Management 69 (2017) 24–58.

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