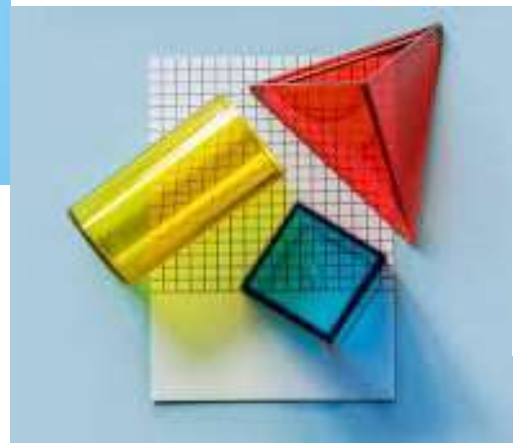
Project code:
2019-1-EL01-KA201-062914

Erasmus+ Call: 2019 - KA2 -



Erasmus+
This project is funded by the European Union.
ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ
ΙΚΥ

UNIVERSITY OF THE AEGEAN
2nd Primary School of Chios
ISA 13 Serzana
AEM
QmLab
Waste Management Laboratory
PrivaSI

3D printing technology aims students understanding maths and recycling procedure

Intellectual Output 4 (IO4) – Curricula for Recycling

Part C: Recycling technologies

Waste Management Laboratory

DEPARTMENT OF ENVIRONMENT

UNIVERSITY OF THE AEGEAN

Erasmus+

This project is funded by the European Union.

ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

Aim of the course

To introduce the main concepts of recycling technologies, especially the treatment of recyclable materials and at the same time to emphasize on the contribution of recycling to the environmental protection.

Students will be taught the recycling methods and the procedure of plastics' transformation into filament.

Learning outcomes

- Be familiar with the different recycling technologies
- Knowledge of the economy of plastic packaging
- Be familiar with the types of plastic that can be used for filament
- Knowledge of projects and companies which use 3D printers with plastic filament and recycle plastic

Suggested sessions

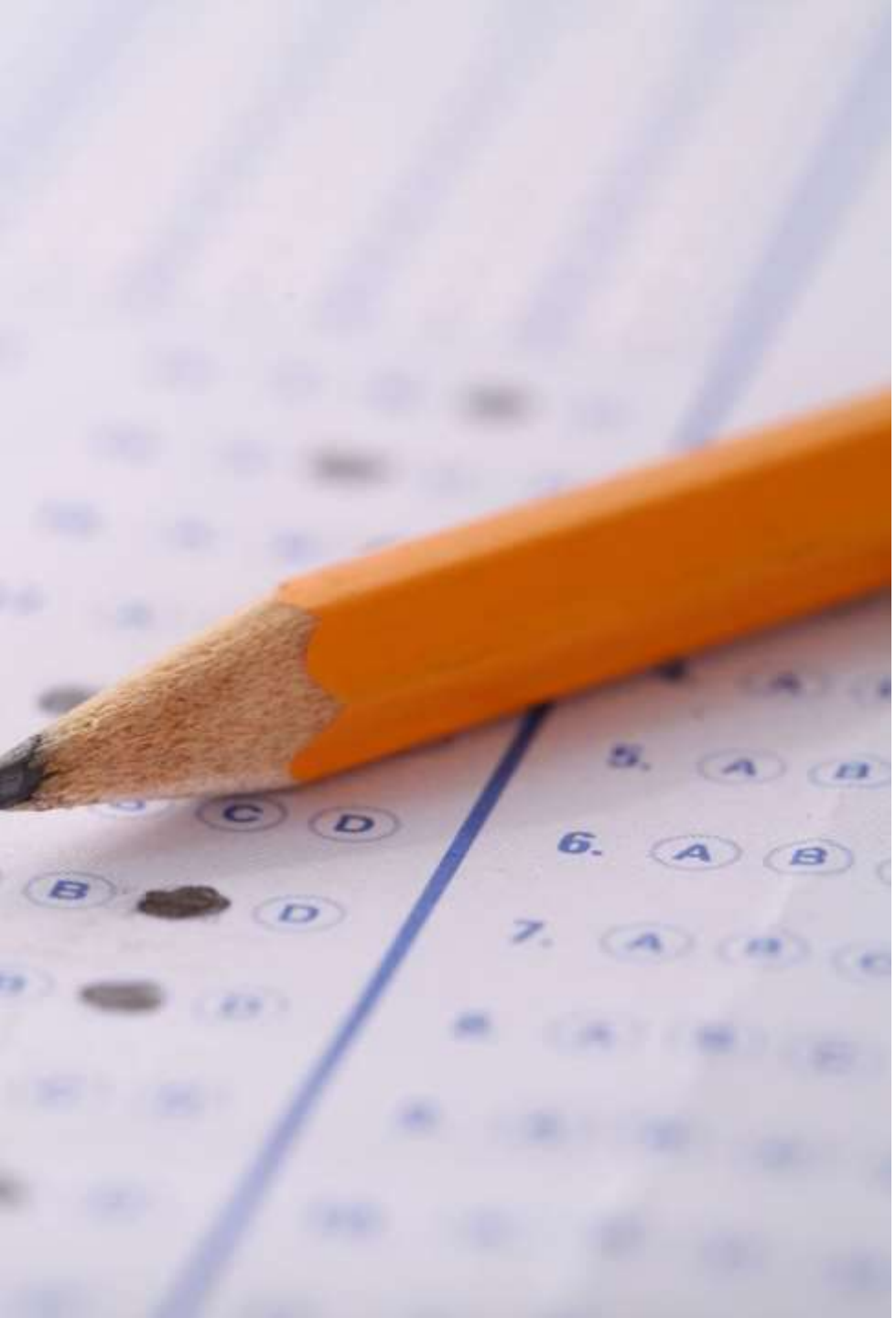
1. Life cycle of plastic
2. Circular economy of plastic packaging
3. Mechanical recycling
4. Chemical recycling
5. Secondary materials and recycled products
6. Plastic to filament
7. Projects on recycling
8. Activity

Educational material

Course description

Handbook

Presentation (example)



Course Description Structure

a) Aim of the course

b) Learning outcomes

c) Teaching and Learning Methods

   i. Teaching approach

   ii. Delivery method

   iii. Sessions

d) Educational material (materials / sources / resources required to complete the course)

   i. Keywords

   ii. "Flow Chart of Teaching"

Handbook Structure (I)

a) General

b) Life cycle of plastic

c) Circular economy of plastic packaging

d) Mechanical recycling

e) Chemical recycling

f) Secondary material and Recycled products

g) Plastic to Filament

Handbook Structure (II)

h) Projects/Companies

i. Ekocycle – Coca Cola
ii. Print your city : Greece
iii. Precious Plastics
iv. BLUECYCLE LAB- Greece
v. Coronavirus: 3D printers save hospitals with valves (Italian company)
vi. Marchesini Group (Italy)
vii. Gogliot Italian Packaging company

i) Activity

j) References

Presentation Structure (example)

a) Waste collection
b) What is happening after the truck
c) Recycling Technologies
d) Mechanical recycling
e) How does it work?
f) Mechanical recycling step by step
g) What are the benefits?
h) Challenges

The total volume of recyclable materials collected from the beginning of this year until end of September, 2019.

Plastic post consumer waste rates of recycling, energy recovery and landfill per country in 2018

https://docs.european-bioplastics.org/publications/bp/EUBP_BP_Mechanical_recycling.pdf

Collection of recyclables

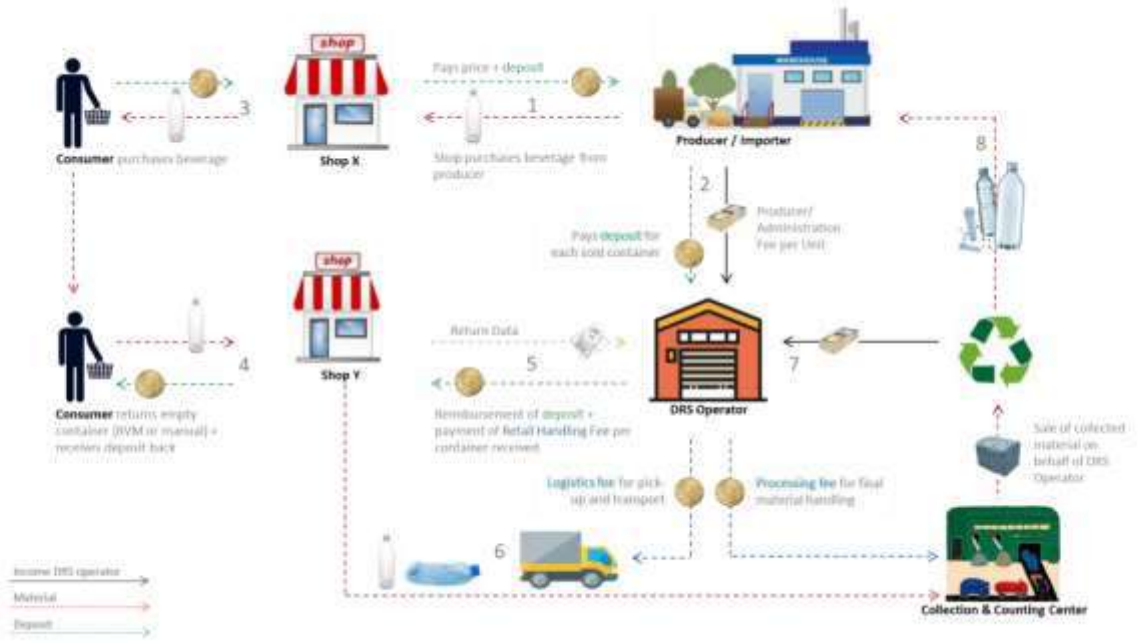
❖**Door to door collection**

https://greenbestpractice.jrc.ec.europa.eu/node/50

❖**Municipal collection**

https://www.municipalwasteeurope.eu/

Deposit Return Schemes

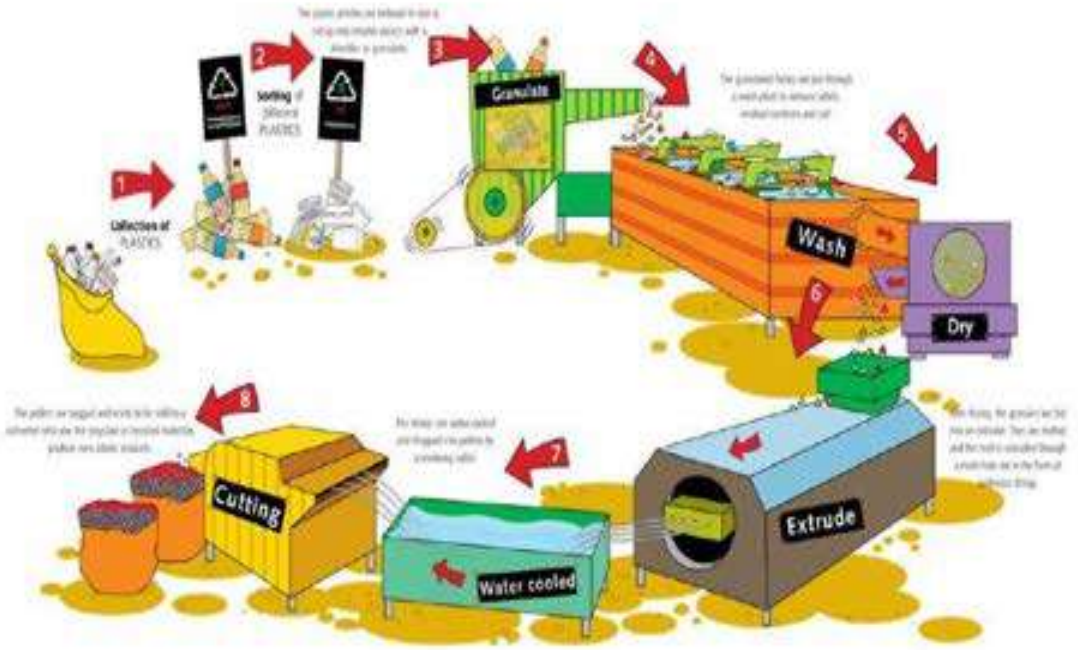


https://www.oecd.org/stories/ocean/deposit-refund-schemes-58baff8c

What is happening after the truck?

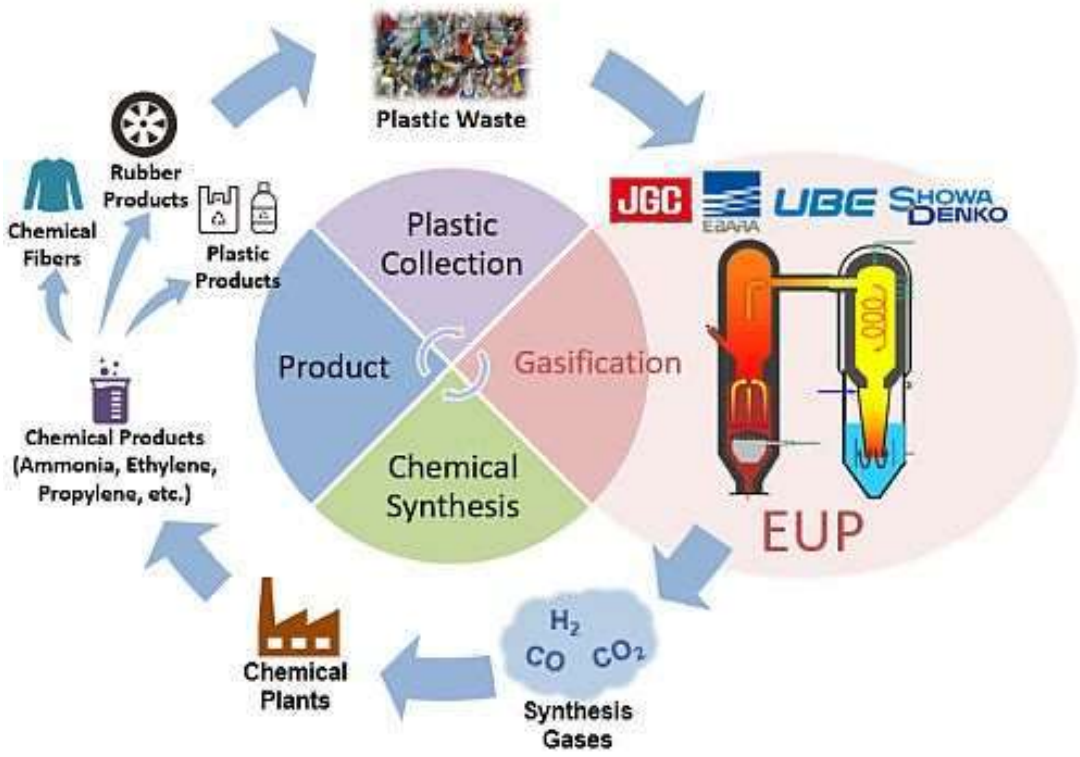
Recycling Technologies

- Mechanical recycling



Source: GRID Arendal, 2019

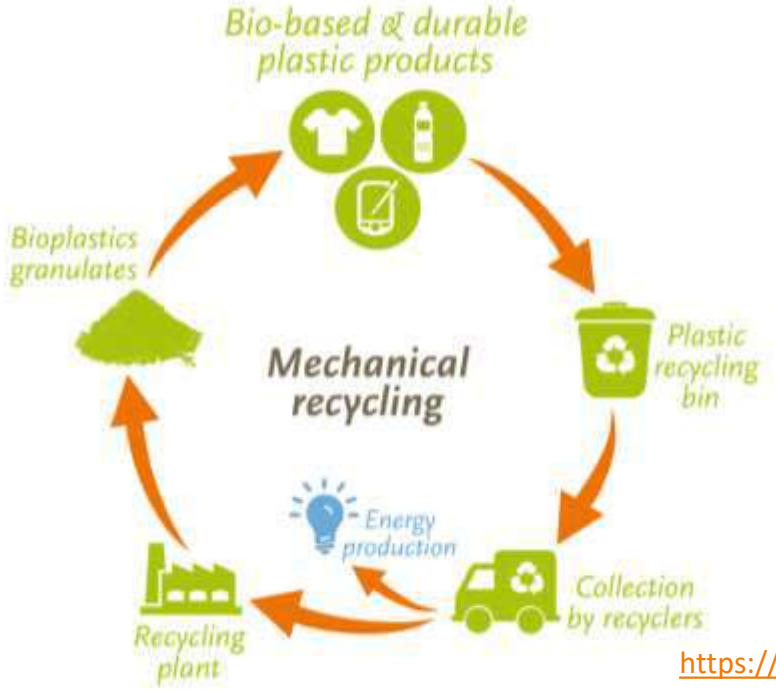
- Chemical recycling



https://scoopasia.com/jgc-ebara-environmental-plant-ube-industries-showa-denko-start-study-on-collaboration-for-promotion-of-gasification-chemical-recycling-of-plastic-waste/

Mechanical recycling

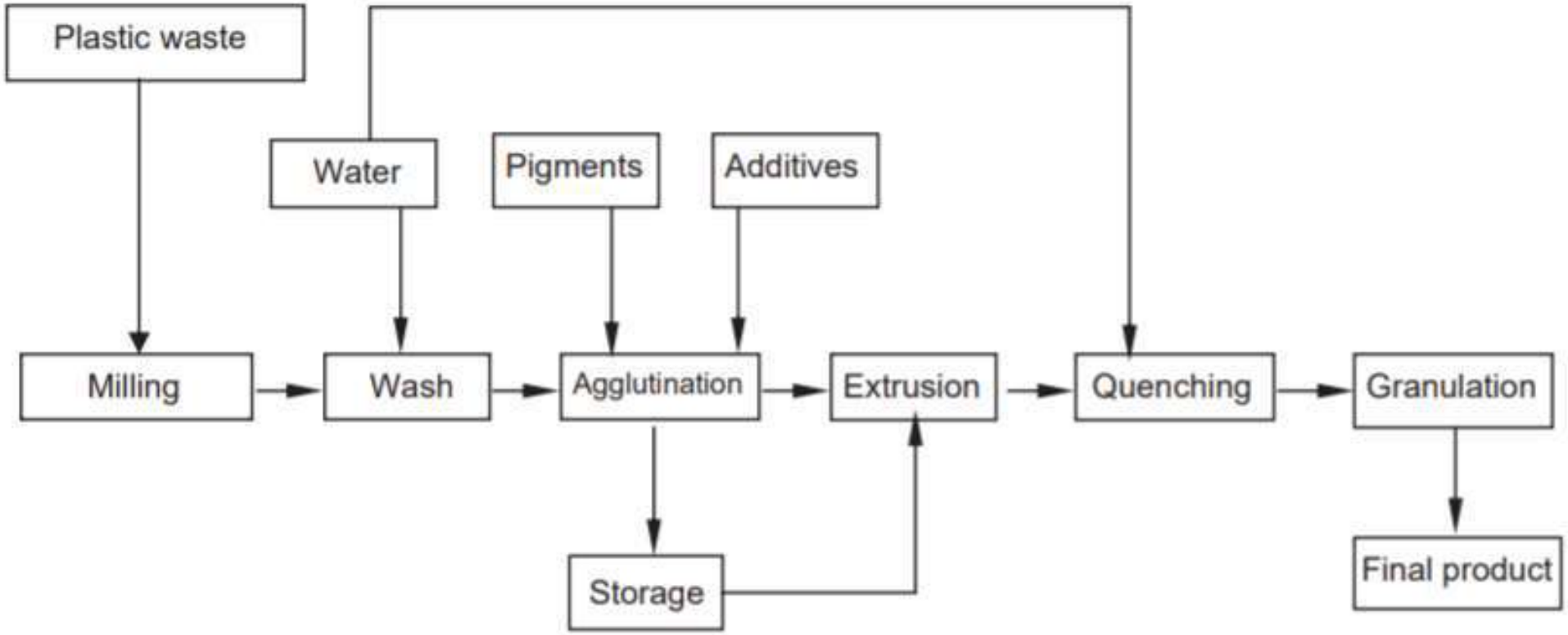
Mechanical recycling of plastics refers to the process of transforming plastic waste into secondary raw material or products without significantly change in the chemical structure of the material.



https://www.european-bioplastics.org/bioplastics/waste-management/recycling/

How does mechanical recycling work?

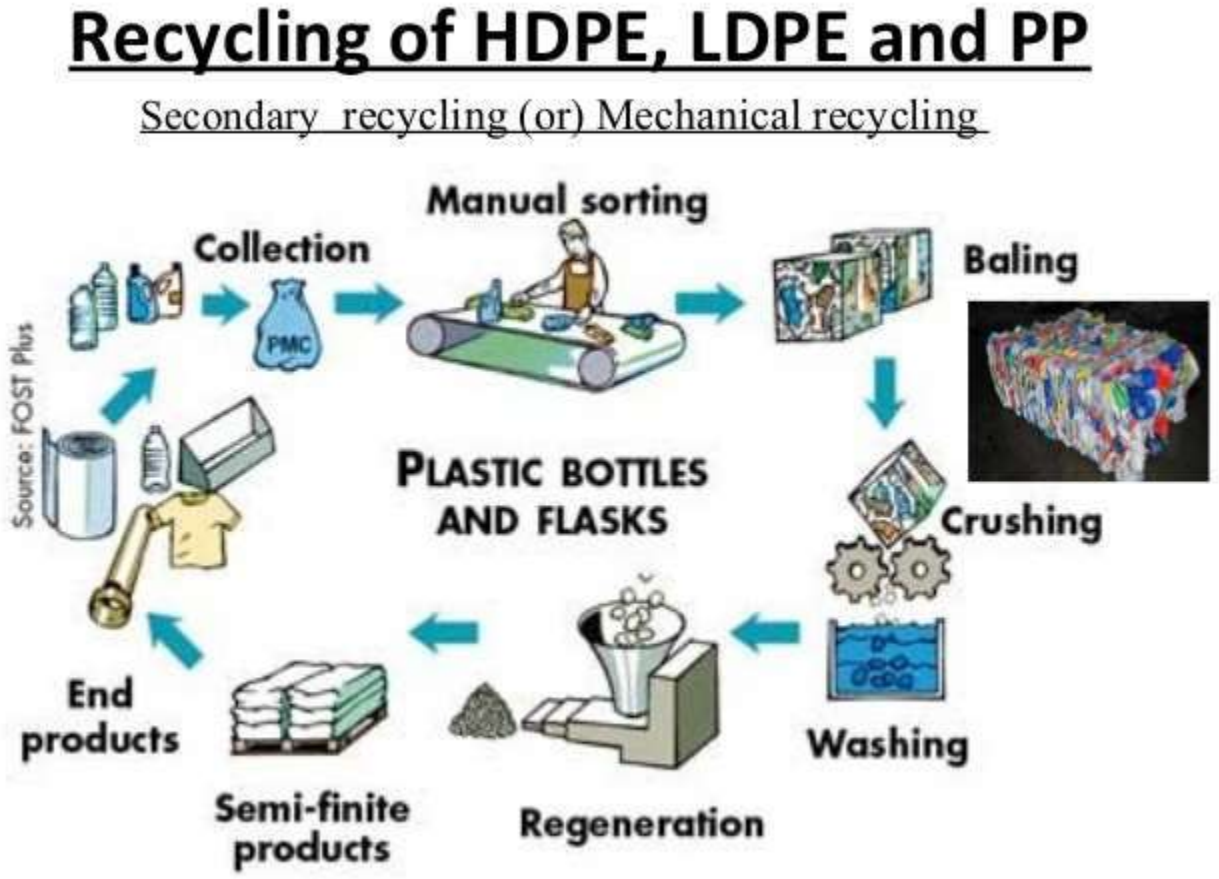
Mechanical recycling step by step



Source: Aznar, M. et.al, 2006

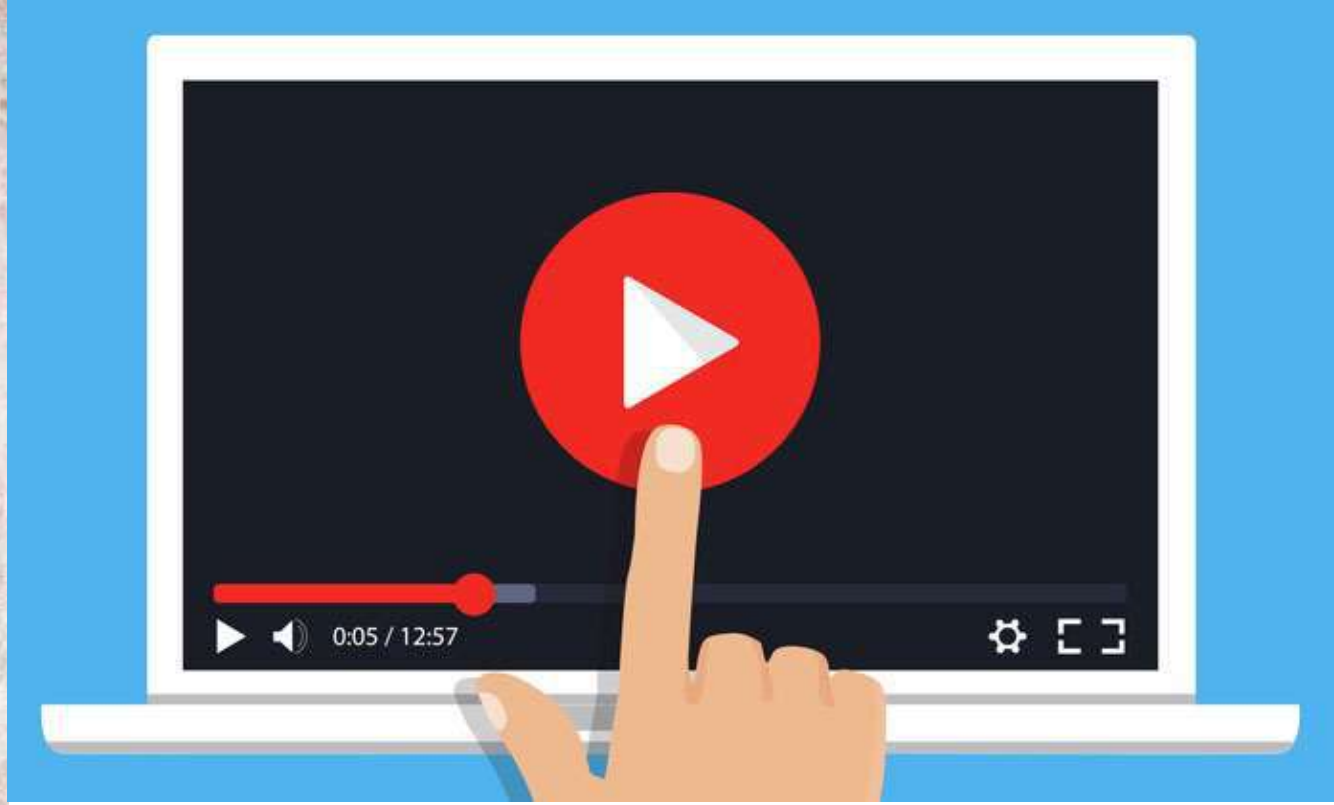
Stages of mechanical recycling

- Sorting
- Cutting/shredding
- Contaminant separation
- Floating
- Milling
- Washing and drying
- Chemical washing
- Agglutination
- Extrusion
- Quenching



https://www.slideshare.net/nagarajansel/plastic-wast-management

KEEP CALM AND It's Video Time



https://www.youtube.com/watch?v=zyF9MxlcItw

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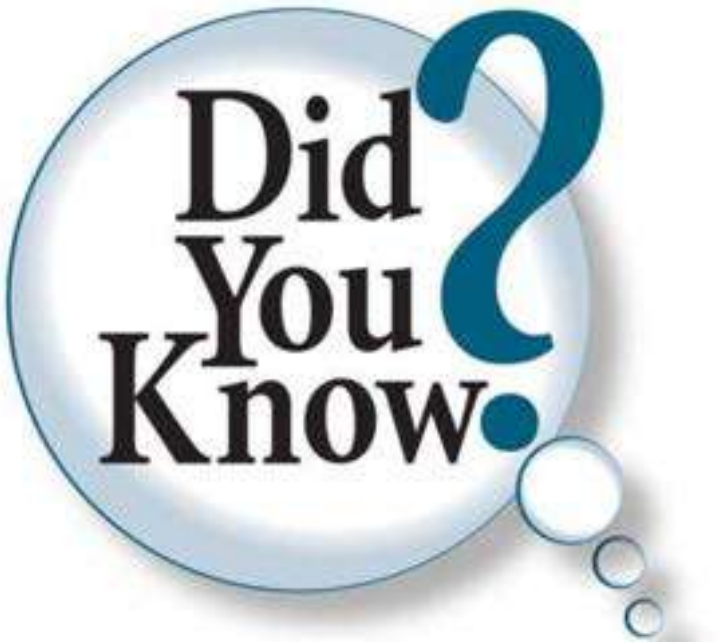
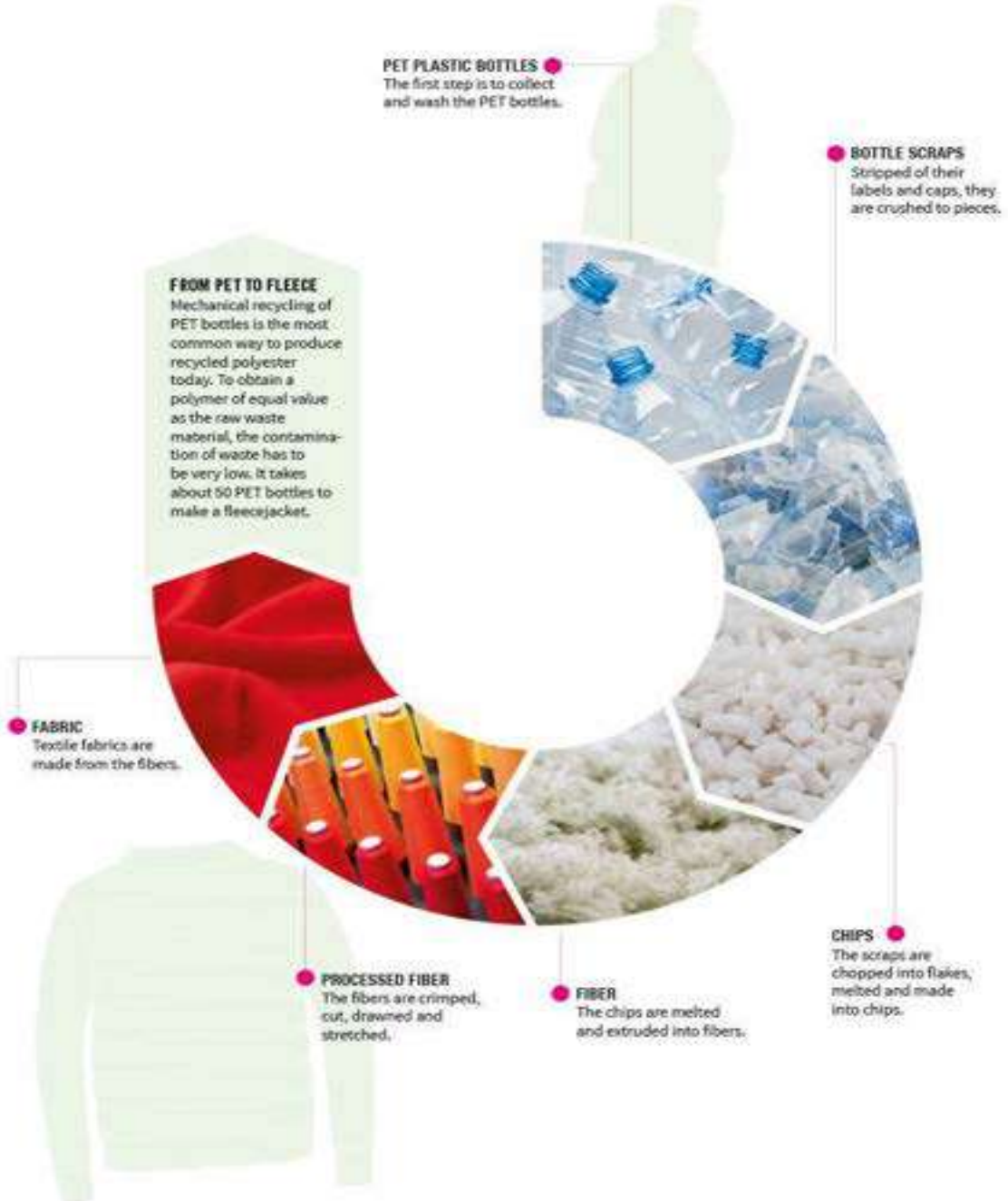
https://www.youtube.com/watch?v=zO3jFKiqmHo&feature=emb_logo



Mechanical recycling is used for the recovery of pre-consumer (post-industrial) material as well as for post-consumer plastic waste. It is currently the most used method of recycling post-consumer plastic waste in Europe

https://docs.european-bioplastics.org/publications/bp/EUBP_BP_Mechanical_recycling.pdf

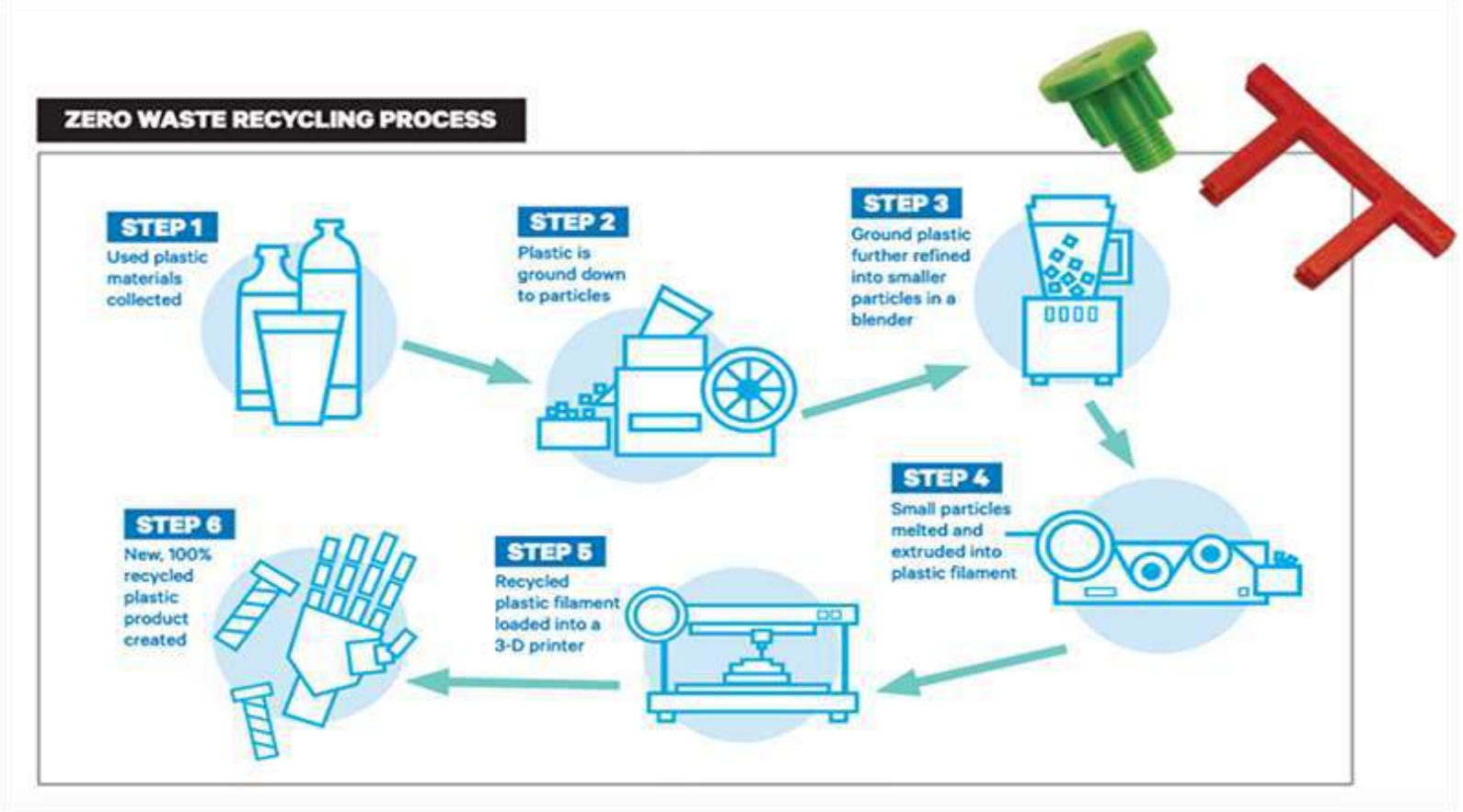


http://sustonmagazine.com/2017/06/05/facts-you-should-know-about-recycled-polyester/

What are the benefits of mechanical recycling?

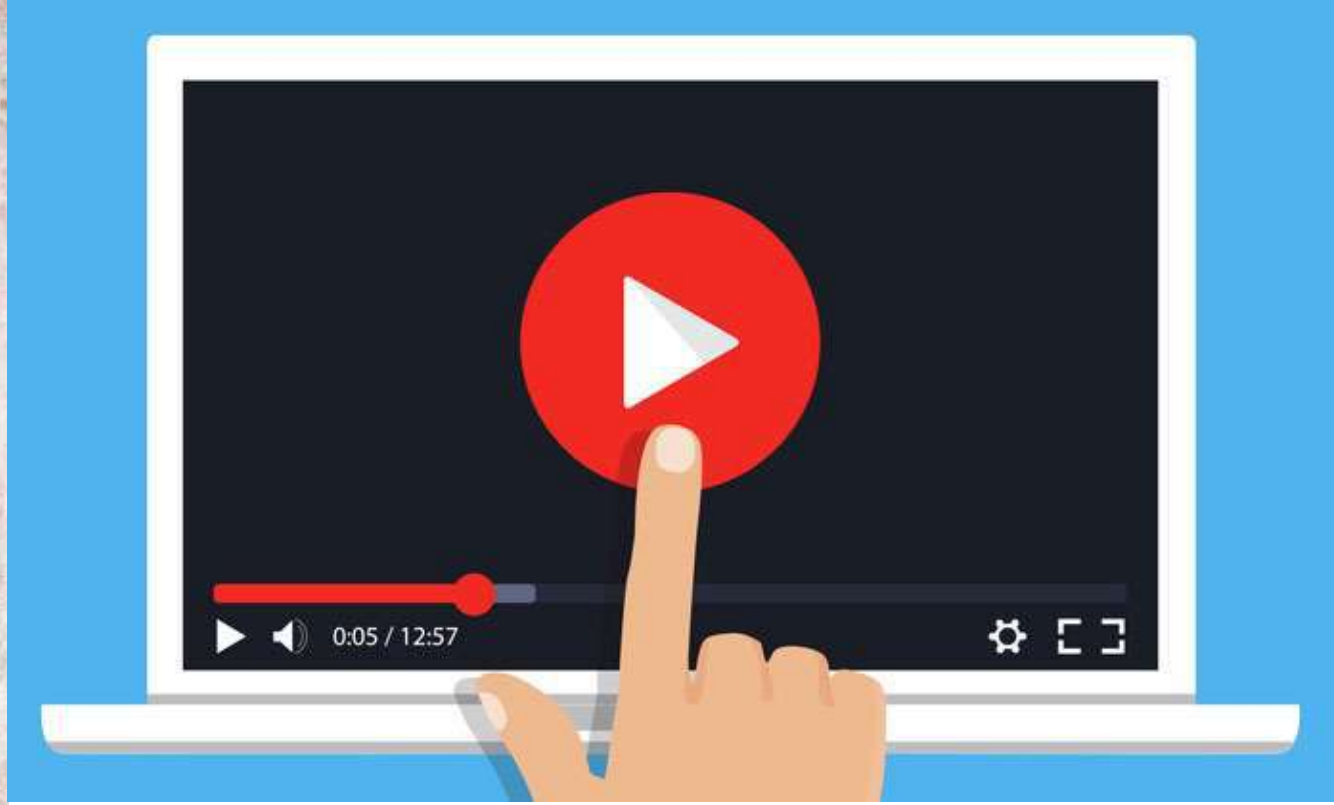
- Conservation of natural resources and energy → production of virgin plastic
- Reduction of plastic waste that ends up in landfills
- Increase the efficiency of new plastic products → the reduction of greenhouse gas emissions and energy savings in recycled versus virgin content product manufacturing

Plastic to filament



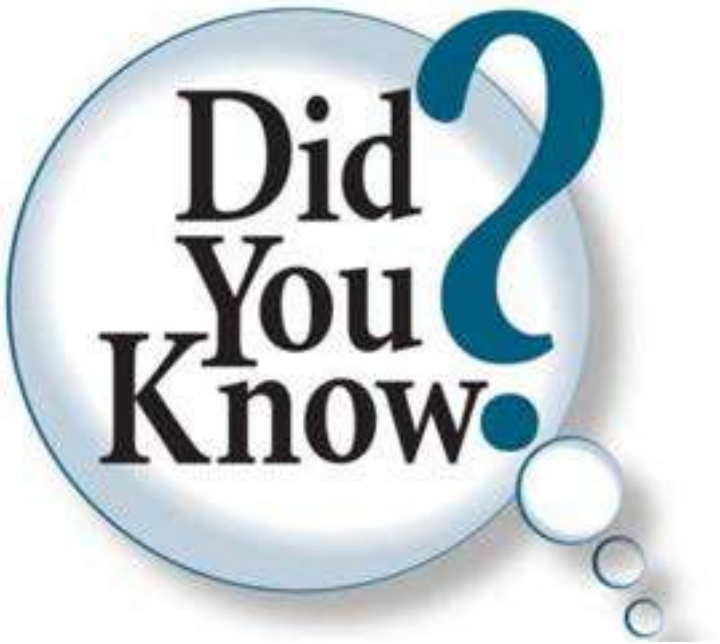
https://www.duq.edu/news/featured-stories/zero-waste-recycling-solutions

KEEP CALM AND It's Video Time



https://www.youtube.com/watch?v=4mtf1cx0PLc

https://www.youtube.com/watch?v=vqWwUx8l_Io



The proper identification of the materials is essential for achieving a maximized purity of recyclates

https://docs.european-bioplastics.org/publications/bp/EUBP_BP_Mechanical_recycling.pdf

Challenges

http://www.circulareconomyasia.org/mechanical-recycling/

- The quality of plastics collected is usually inconsistent and contaminated → downcycling into lower value items
- Many plastic recycling companies have insufficient standardization, industrialization and operational excellence in their operations
- Only a fraction of 'recyclable' used plastic is recycled into the products for which they were originally produced → colorants, additives, and fillers used during plastic production, contamination from consumer use, and yield losses during the recycling process

Challenges

- Recycling process shortens the length of polymer chains, resulting in decrease their quality and, eventually, the need of disposal of the material
- Lower-grade plastic waste, including post-consumer and multi-layered plastic packaging is particularly difficult to separate and treat

http://www.circulareconomyasia.org/mechanical-recycling/

Challenges

- Plastic recyclers tend to specialize in one or a limited number of plastic types such as HDPE, LDPE and PP etc.

- In order to guarantee product quality and quantity, plastic recyclers seek plastic waste bales with specific criteria. These often need to be sourced from various countries, which can be challenging due to the different collection schemes and sales methods for plastic waste

http://www.circulareconomyasia.org/mechanical-recycling/

References

- Tsakona, M., 2019. *Global scrap plastic recycling: Technical Assessment report*. GRID Arendal
- Aznar, M. P., Caballero, M. A., Sancho, J. A., & Francés, E. 2006. *Plastic waste elimination by co-gasification with coal and biomass in fluidized bed with air in pilot plant. Fuel Processing Technology, 87(5), 409–420.*
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- https://sustainablepackaging.org/mechanical-recycling-options/
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- http://sustonmagazine.com/2017/06/05/facts-you-should-know-about-recycled-polyester/


Thank you for your time!