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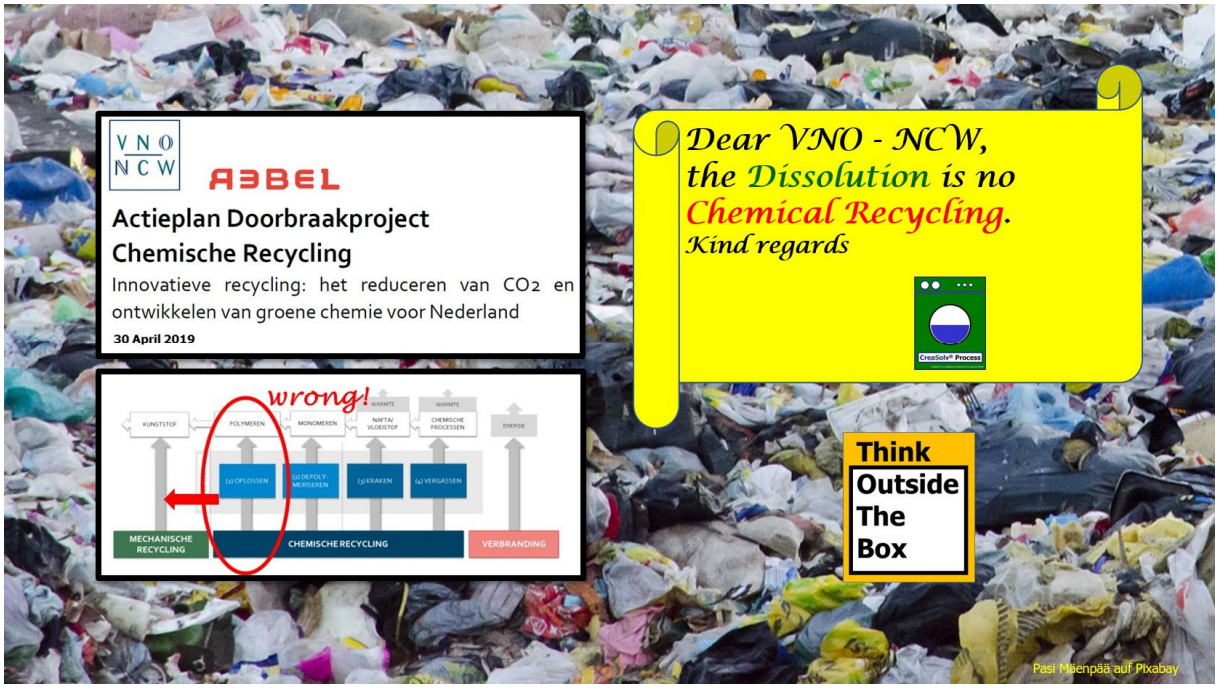
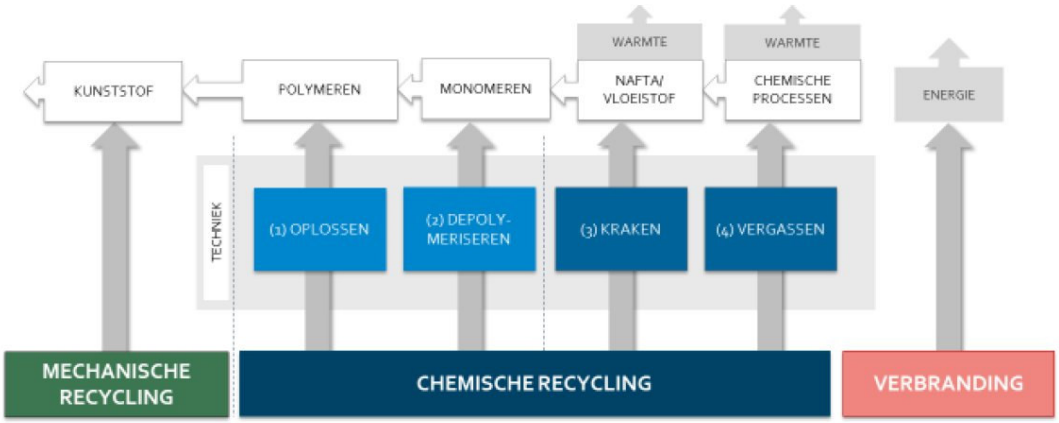
The Dissolution is no Chemical Recycling for Plastic Waste

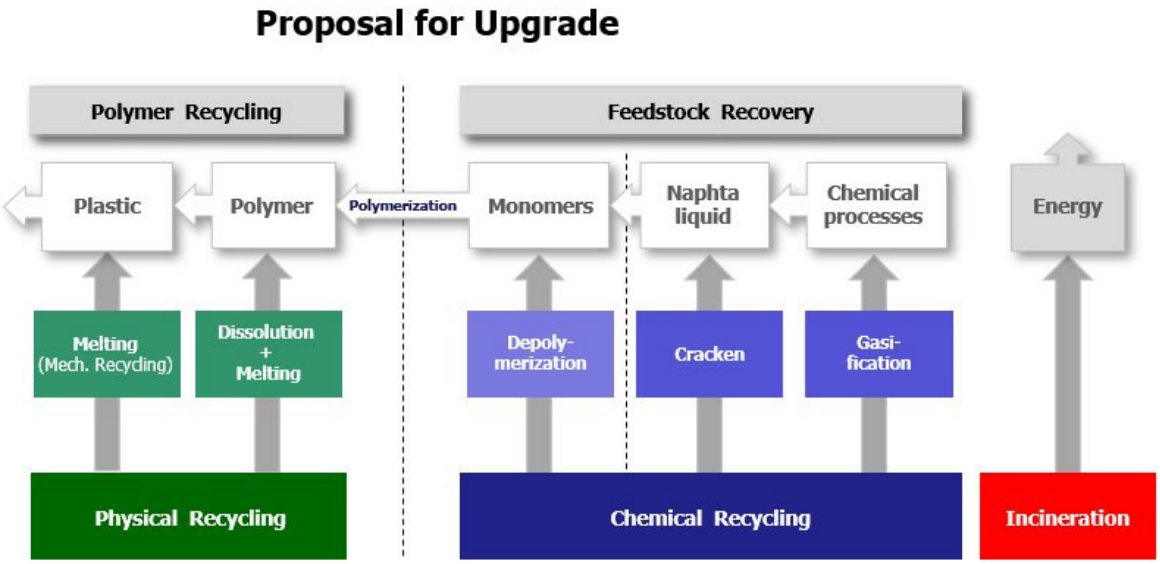


On behalf of the Dutch Ministry of Infrastructure and the Environment, Rebel supported VNO-NCW (*Confederation of Netherlands Industry and Employers*) in the implementation of phase 1 of the chemical recycling breakthrough project. The "Actieplan Doorbraakproject Chemische Recycling" (Innovatieve recycling: het reduceren van CO2 en ontwikkelen van groene chemie voor Nederland)" has been prepared by VNO-NCW on the basis of the underlying chapters, which have been prepared by Rebel, with input from many stakeholders[1)].

On page 7 of this report a graphic shows the overview of different recycling technologies for plastic waste including mechanical recycling, chemical recycling and incineration with energy recovery.



The positive thing is that this report is one of the rare cases that includes the "Dissolution" (oplossen) as a recycling technology for plastic waste. This is a progress.
The graphic should better look as follows:



On the other side it is unfortunate but obvioulsly a common actual misconception or intended false information in the industry that a dissolution is considered as a chemical reaction and classifies therefore as Chemical Recycling.

Physical or Chemical Reaction?

Basics

A chemical reaction produces new substances, while a physical reaction does not.

A material may change shapes of forms while undergoing a physical change, but no chemical reactions occure and no new compounds are produced.

Physical Change

- ***No new substance is formed***
- ***No composition change***
- ***The change is reversible***

Examples

- ***Boiling water, melting ice***
- ***Shredding paper (or plastic film)***
- ***Dissolving sugar in water***
- ***Melting a polymer*** *(e.g. extrusion)*
- ***Dissolving a substance in a liquid***

Chemical Change

- ***New substances are formed***
- ***Composition is changed***
- ***The change is irreversible***

Examples

- ***Burning wood***
- ***Rusting of iron***
- ***Polymerization & de-polymerization***
- ***Pyrrolysis of polymers***

Please check:
Bozeman Science - "Chemical and physical changes":
https://www.youtube.com/watch?v=ziQtpXVDpn0&feature=youtu.be

Chemistry for Kids – "Chemical and physical changes":
https://www.youtube.com/watch?v=x49BtB5dOwg&feature=youtu.be

ISO 15270/2008 Plastics - Guidelines for the recovery and recycling of plastics waste[2)] definitions:

1. mechanical recycling - processing of plastics waste into secondary raw material or products without significantly changing the chemical structure of the material

2. chemical recycling - conversion to monomer or production of new raw materials by changing the chemical structure of plastics waste through cracking, gasification or depolymerization, excluding energy recovery and incineration
   Feedstock recycling and chemical recycling are synonyms.

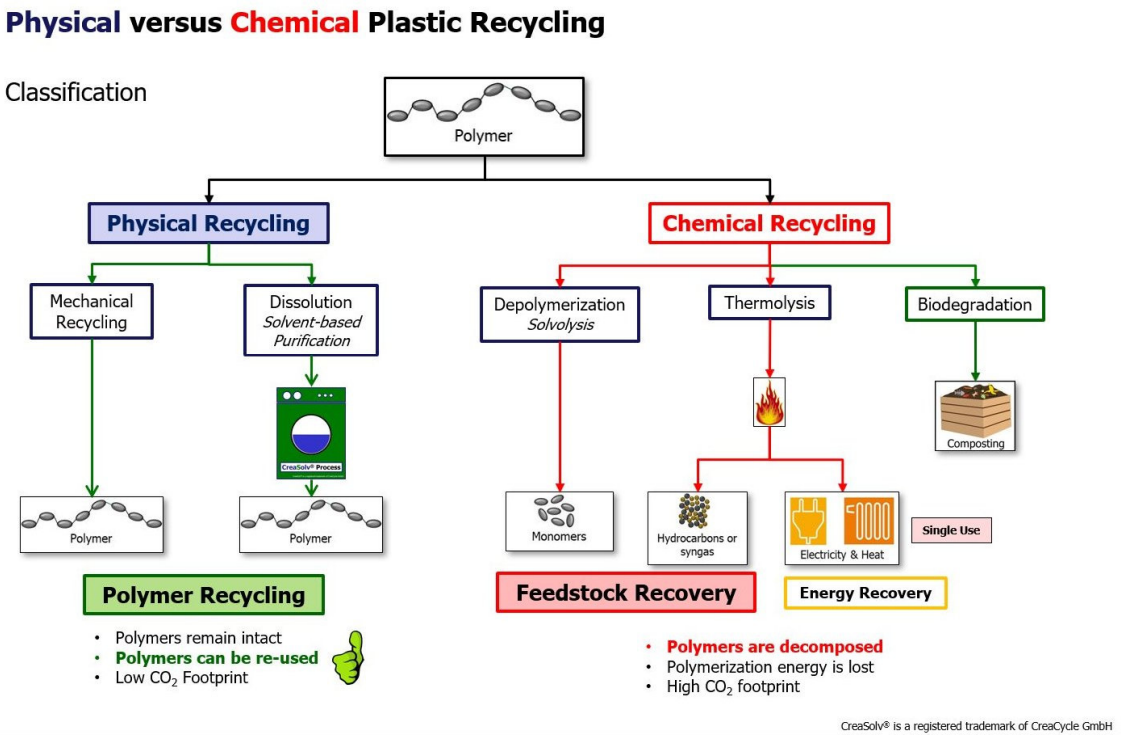
3. energy recovery - production of useful energy through direct and controlled combustion
   Solid-waste incinerators producing hot water, steam and/or electricity are a common form of energy recovery.

Without doubt one can conclude from above Guideline that Chemical Recycling of plastic waste always goes in line with the destruction of the chemical composition/structure of the polymer(s).

Solvent-based Purification (dissolution) is based on physical and not on chemical reactions or changes and only the physical state of the polymer changes from solid to liquid and then back to solid. The polymer chains remain unchanged in contrary to Chemical Recycling and can be **re-used** in the original or similar applications.

Therefore, it is no surprise that the Solvent-based Purification (dissolution) meets the criteria of mechanical recycling (ISO 15270/2008 Plastics) but not the ones of chemical recycling, what leads to the conclusion that the actual descriptions, definitions and classifications of plastic recycling processes are no longer up-to-date and lead to confusion.
Whether this is intended or done unknowingly is up for individual judgement.

Mechanical recycling and solvent-based purification belong both to the category **Physical Recycling** and both enable the "re-use" of the polymer without down-cycling to raw-materials or feedstock (e.g. fuel, syngas, hydrocarbons) or building blocks of polymers, which have to be polymerized again to bring them back into the cycle.

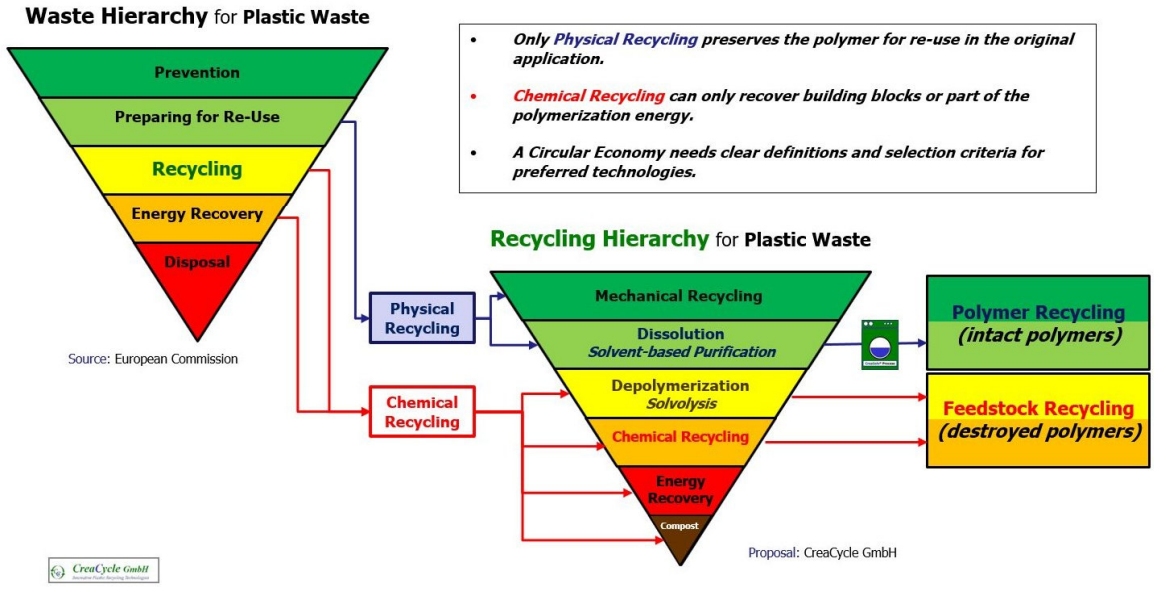


When mechanical recycling needs a high sorting purity of waste streams and fails on imbedded additives and impurities (including hazardous and toxic ones) or multilayer packaging, the CreaSolv® Process based on a Solvent-based Purification works like a washing machine on a molecular level[3)].

We can only urge authorities and ministries to come up with clear definitions and data like life cycles analyses (LCAs) for all available plastic recycling processes so that a fair comparison is possible in order to develop a Plastic Recycling Hierarchy.

No Waste Hierarchy without Recycling Hierarchy for Plastic Waste

Selection Criteria for a Circular Economy



Conclusion

Mechanical recycling, solvent-based purification (dissolution) and chemical recycling will be needed to cope with the huge plastic waste pollution we are confronted with.
It makes no sense to try to hide certain technologies or classify them incorrectly, hoping to achieve an economical advantage. Here is more at stake than just money.

We need clear leadership from authorities and ministries on

- what kind of technologies are available
- how are plastic recycling technologies defined and classified?
- which parameters will be applied in order to give guidance on how certain plastic waste streams should be treated
- which technologies will get a recycling quota
- etc

If this area stays as is and recycling is the same as recovery and chemical recycling is promoted as the only solution available by ignoring all others and pointing out their limitations or deficiencies without naming the ones for chemical recycling as well or making it difficult to find LCAs (life cycle analyses) for pyrolysis or gasification, we better stop immediately talking about Circular Economy.
Without definitions there is no plan or procedure.
And without a plan or procedure it will be difficult to achieve an improvement.

Literature

1. VNO-NCW - "Actieplan Doorbraakproject Chemische Recycling" - Innovatieve recycling: het reduceren van CO2 en ontwikkelen van groene chemie voor Nederland. Published 30 April 2019.
2. ISO 15270:2008 Plastics - Guidelines for the recovery and recycling of plastics waste – Link https://www.iso.org/obp/ui/#iso:std:iso:15270:ed-2:v1:en
3. CreaCycle GmbH "The CreaSolv® Process is neither a Solvolysis nor Chemical Recycling." Published on Linkedin 2020.01.16 – Link https://www.creacycle.de/de/presse-news/185-2020-01-16-the-creasolv-process-is-neither-a-solvolysis-nor-chemical-recycling.html

In order to protect resources and our environment, high-quality recycling technologies for plastic waste are required, which allow the reuse of polymers without breaking up the polymer chains.
CreaCycle GmbH and the Fraunhofer Institute for Process Engineering and Packaging (IVV) in Freising, Germany combined their competencies in a cooperation aimed at "Plastic/Raw-Material Recycling with a Solvent-based Purification Technology" (selective extraction) and developed the CreaSolv® Process that is based on physical changes and leaves the polymer composition intact.
Proprietary CreaSolv® Formulations from CreaCycle with the lowest risk potential possible for user and environment dissolve selectively a target polymer. This reduces besides the hazard also the cost for the equipment. After the separation of imbedded impurities or undesired polymers the recycled polymer can be reused in its original application.

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