

PERSPECTIVES IN BOOSTING VALUE AND KEEPING MATERIALS IN THE ECONOMY

A Quality Recycling Process for Flexible Packaging

Foreword

A lot can be delivered today with existing sorting and recycling technologies – if only the required infrastructure was in place to unlock its full environmental and economic potential.

Collaborating together in the New Sustainable End Markets workstream, CEFLEX stakeholders are aiming to bring to the market a Quality Recycling Process – delivering recycled polymers for higher-value end market applications than what is currently commercially available.

Through the power of their value chain collaboration and expertise in the waste management of flexible packaging, today they are able to prove the concept of **‘Recycling of household collected post-consumer flexible packaging back to non-food flexible packaging through mechanical recycling via the Quality Recycling Process’**.

With this milestone reached, the CEFLEX workstream is moving forward into industrial trials to build the business case for investment in the infrastructure which can leverage this Quality Recycling Process into a mainstream solution to keep the materials in the economy at the highest value possible.

This booklet is designed to explore and profile the Quality Recycling Process from several perspectives and give insights from those who have rigorously tested its potential.

We run the technical ‘proof of concept’ for household collected post-consumer flexible packaging Post-Consumer Waste (PCR) which demonstrates:

- ▶ **Recycling back to a wider range of non-food flexible packaging is possible - including more demanding applications through mechanical recycling via the Quality Recycling Process.**
- ▶ **The Quality Recycling Process produces film grade quality rPE and rPP polymers appropriate for non-food flexible packaging by applying near infrared (NIR) sorting by polymer and color, followed by hot washing and extrusion with extra filtration and deodorization.**
- ▶ **As a real breakthrough, film grade recyclates for natural rPE and all color rPP can be obtained at good product yield and quality and with mechanical and processing properties (i.e. film extrusion process) which make these materials suitable for replacement of virgin polymer grades.**

Data from industrial trials running in 2020-21 will assess the economic viability of the process and a business case for investment in necessary infrastructure.

November 2020

The Action Team ▾

Table of Contents

Foreword	1
The Action Team	2
Table of Contents	3
About CEFLEX	4
Key Questions Answered	6
Sorting out recycled polypropylene from flexible plastic waste	6
Increasing the amount of polyethylene (PE) and polypropylene (PP) put on the market as flexible packaging	6
The role of existing technologies in value creation	7
Ensuring the maximum amount of recycled polymers fit for packaging applications	7
End markets for recycled polyethylene and polypropylene from flexible packaging waste ..	8
The Process	9
Boosting value and keeping materials in the loop	13
Interviews with CEFLEX stakeholders in the action team	15
Michael Langen, HTP Engineers	15
Berry Bellert, Atterro	16
Clemens Kitzberger, Erema Group	17
Valentina Betto, Plastotecnica, S.P.A.	18
Florian Egner, RKW Group	20
Dr. Gottfried Weyhe, Polifilm Extrusion	21
Monica Battistella, Taghleef Industries	21
Reactions from CEFLEX stakeholders in the value chain	23
Gareth Callen, PepsiCo	23
Jesús Maza Lisa, Danone	23
Conclusion	25
Annex: further resources	26



About CEFLEX

The Circular Economy for Flexible Packaging (CEFLEX) initiative is a collaboration of over 160 European companies, associations and organisations representing the entire value chain of flexible packaging. Together, we work to make all flexible packaging in Europe circular by 2025.

The initiative is committed to avoiding waste and pollution by redesigning consumer flexible packaging and ensuring an appropriate collection and recycling infrastructure in all European countries. This will enable used flexible packaging to be cost effectively collected and recycled with valuable new markets and applications created so the recycled packaging can be used again and again.

Committed to achieving a circular economy

CEFLEX stakeholders represent the full flexible packaging value chain including: raw material producers (plastics, paper and aluminium foil), ink, coating and adhesive suppliers, film producers and flexible packaging converters, brand owners, waste management companies, recyclers, extended producer responsibility organisations and technology suppliers.

All contributors are committed to making flexible packaging circular, so it remains and is increasingly recognised as a responsible and relevant packaging format for the future.

Together, they collaborate to identify opportunities to increase recycling, develop sustainable end markets for these recycled materials and work to stop leakage into the natural environment.

Mission Circular

CEFLEX's 'Mission Circular' commits to collection of **all flexible packaging and over 80% of the recycled materials** channelled into valuable new markets and applications to substitute virgin materials

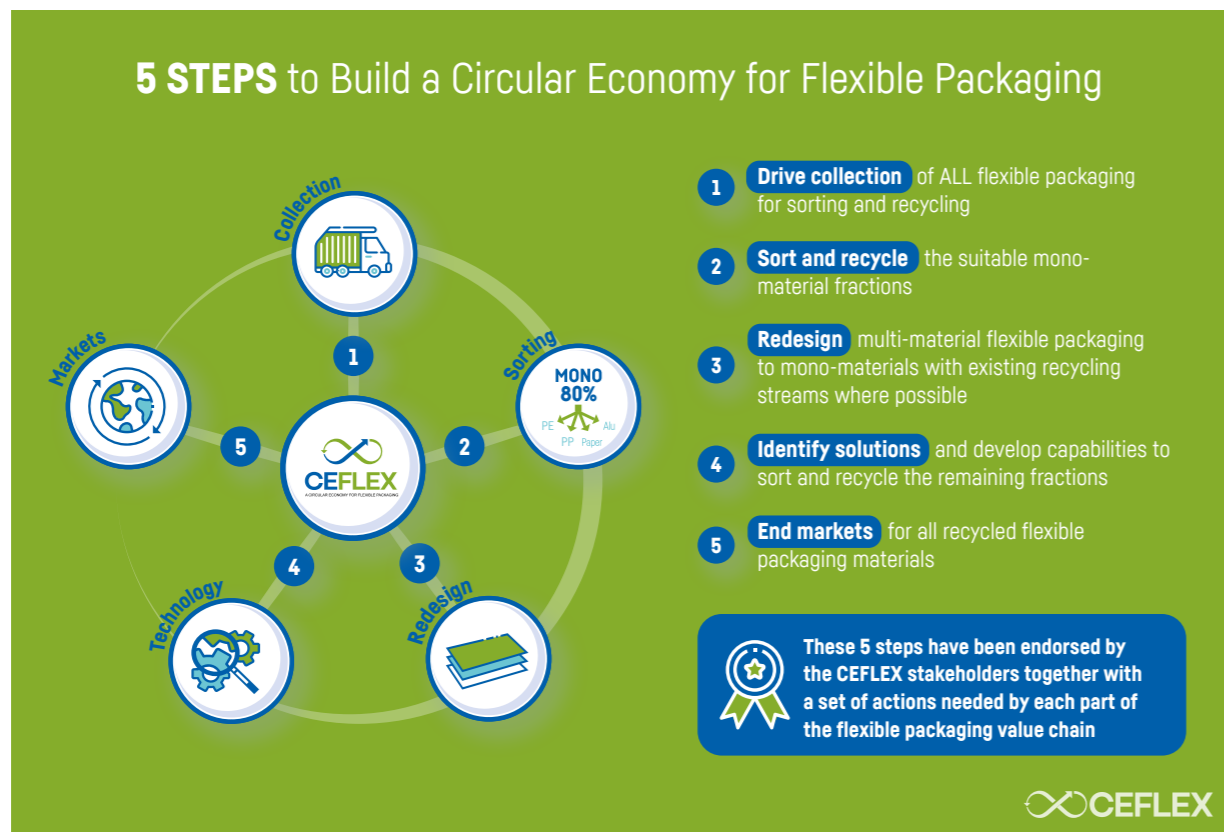


A common vision: 5-steps to building a circular economy for flexible packaging

CEFLEX stakeholders collaborate across the entire value chain to accelerate solutions in collection, sorting, packaging design, facilitating technologies and sustainable end markets – all underpinned and incited by an environmental and economic business case.

A 5-step roadmap to build a circular economy for flexible packaging has been endorsed by CEFLEX stakeholders, together with a set of actions needed by each part of the value chain to make it happen.

By 2025, we target an established collection, sorting and reprocessing infrastructure and economy for post-consumer flexible packaging across Europe. It will be based on end-of-life technologies and processes which deliver the best economic, technical and environmental outcome for a circular economy.



BY 2025, WE TARGET AN ESTABLISHED COLLECTION, SORTING AND REPROCESSING INFRASTRUCTURE AND ECONOMY FOR POST-CONSUMER FLEXIBLE PACKAGING ACROSS EUROPE

Key Questions Answered

To realise CEFLEX's ambitious vision, the initiative's Sustainable End Markets workstream trials are working to demonstrate a Quality Recycling Process – able to deliver polymers for non-food applications like collation shrink, pouches, bags or labels.

The name of the game, is performance infrastructure and processes are able to boost recycling rates, create value and keep resources in the economy.

A number of key questions need to be addressed. Discover these highlight issues from a CEFLEX stakeholder perspective:

Sorting out recycled polypropylene from flexible plastic waste



Berry Bellert, Sales Engineer and Development, Plastics Recycling at Dutch environmental company, Atterro.

“It is not a matter if we can, it is a matter of justifying the investment to do it. We have to realise that sorting flexibles is much more complex than sorting rigid packaging. At the moment, there is very few infrastructure in place throughout Europe to sort out PP film. Right now, there is no business case for sorters to do so. PP film is currently recycled in PO agglomerates for injection molding or extrusion of thicker wall products. But it is recycled. Means for recycling rates there is nothing to gain, there is no extra EPR money to claim. The real question is how to stimulate improved sorting?”

CEFLEX's workstream Sustainable End Markets already proved that technically you can recycle PP film into non-food film applications which is a good start to build the business case for investment.”

Increasing the amount of polyethylene (PE) and polypropylene (PP) put on the market as flexible packaging



Dr Michael Langen, Managing Director of HTP Engineers

“A viable strategy to make flexible packaging easier to recycle is to internalise operational costs along the recycling value chain and to reflect these costs to the consumer. Basically, this is one of the key founding principles of EPR schemes. Any measure to get easier to recycle material structures like mono-PE and mono-PP is to:

- Modulate EPR fees according to a scaled recyclability; and
- Assess the recyclability by standardised procedures.

Modulating fees according to the recyclability of packaging is both ecologically and economically beneficial. Ecological indicators are, for example, the use of primary resources like energy and raw materials. Economic indicators include the minimisation of residues, improved product qualities and sales prices for recyclates.

However, there is a major obstacle in getting more mono-PE and mono-PP recycled: the lack of recycling capacities in Europe, in particular with respect to flexible mono-PE and mono-PP.

While the past years have seen major investments in sorting capacities, investments in recycling capacities are still well behind market demands. Germany alone needs an additional capacity of min. 350.000 tonnes/year which cannot be compensated by exports sustainably... The risk profile of an investment in recycling technologies is fundamentally different from one in sorting technologies. The risk profile of recycling technologies is well suited for a consortium of material or packaging producers and brand owners. A traditional waste management company has less strategic interest and market knowledge in the flexible packaging market and is more often than not reluctant to invest beyond sorting technologies.”

The role of existing technologies in value creation



*Clemens Kitzberger, Business
Development Manager Application
Post Consumer at EREMA Group*

“Existing technologies are able to do a lot more than we use at the moment. But to really make a sizable shift into the circular economy, we need packaging designed for the circular economy and investment in the latest technologies to produce high quality recyclates.

As with any major investment, a secure business case and model is needed. To make this a reality, investors need a clear business case and security of that investment in time. Achieving this has to include political discussions; what would help is an European harmonization of collection schemes supported by the whole value chain. Additionally a minimum stability in the price of virgin polymers is of critical importance.”

Ensuring the maximum amount of recycled polymers fit for packaging applications



*Valentina Betto, R&D and Sustainability
Manager, Plastotecnica S.p.A.*

“Everyone has to make as many efforts as possible in order to achieve this goal. The very first step is related to packaging design: we should push for mono PE and mono PP films where possible and sustainable.

Moreover, we should minimize printing, different material labels, dark colors in order to get better quality recycled materials. More effort should be made to find and develop efficient technologies to delaminate different materials, sort them and clean them. The most difficult challenge we have to face right now is delivering the desired quality of rPE by removing inks, contaminants, dirt or different polymers.

The second step is to educate as many as possible people in doing an always better separate collation at home. We have to inform consumers on what is sustainable and what is not, because they can push brand-owners in the right direction.

Then every single actor in the value chain can give an effective support to reach the goal. Everybody should improve their technology in order to get the desired quality of the rPE.

As a converter, Plastotecnica can use additives to improve the process behaviour of rPE and to develop new boosting structure in order to support possible poor mechanical properties. Furthermore, our plant needs to be adapted to work with recycled material better. It is a difficult path which can be covered only thanks to the collaboration of all the value chain like we are doing in the CEFLEX initiative.”

End markets for recycled polyethylene and polypropylene from flexible packaging waste



Dr. Gottfried Weyhe, Senior Research & Development Manager at POLIFILM EXTRUSION

“With current mechanical recycling technologies there are limits regarding recycled material content, properties and quality of polyolefin films for flexible packaging. The main limitation is that it is not applicable to food packaging applications with direct food contact yet. But as far as I know, some stakeholders already work on addressing this issue which requires bold solutions.

If the quality of the recycled polyolefins will be improved, which we with fellow CEFLEX stakeholders are working on, I see some end markets to use these materials. Depending on the film properties needed for each market I can imagine a PCR- content- range between 10%, all the way up to 99%. Such end markets could be industrial packaging like shrink films, stretch films, packaging films for industrial goods and non-food goods, mailing bags for online retail etc. But I also see possibilities for higher value applications like labels and laminating films for flexible packaging for non-food packaging. There are other packaging markets where it would be possible to use more PCR recyclates like films for agriculture, building industry and other industrial films, e.g. for surface protection. At POLIFILM, we are working on all these applications in close collaboration with different suppliers and partners.”



Florian Egner, R&D Manager Multipack at RKW Group

“The main markets, in which RKW sees a potential for the usage of recycled polyethylene retrieved from flexible packaging waste are high quality film applications for which the usage of recycled materials out of the household collected waste is not possible so far.

Talking about applications in the field of secondary packaging without direct food contact the most promising products, which would certainly appeal to end-consumers, are collation shrink films for the beverage industry or form-fill-seal films, used to produce bags for non-food applications, like for example potting soil, peat or fertilizers.

In these applications RKW sees a great potential using certain contents of recycled polyethylene to come to more sustainable products and re-use packaging waste in the meaning of a circular economy.”



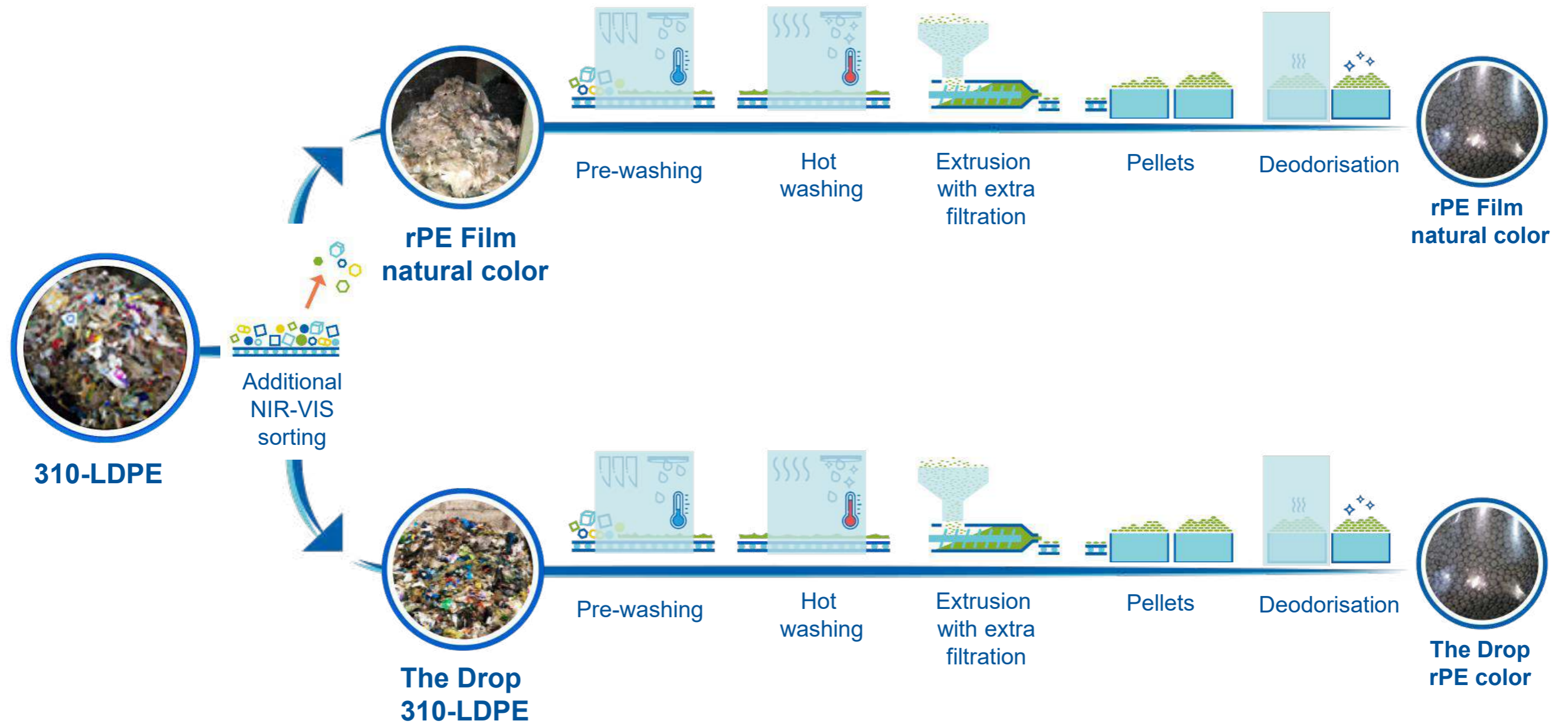
Monica Battistella, Product Manager and Sustainability Advisor at Taghleef Industries

“Recycled polyethylene and polypropylene have been used for many applications but very seldom back into flexibles for household applications.

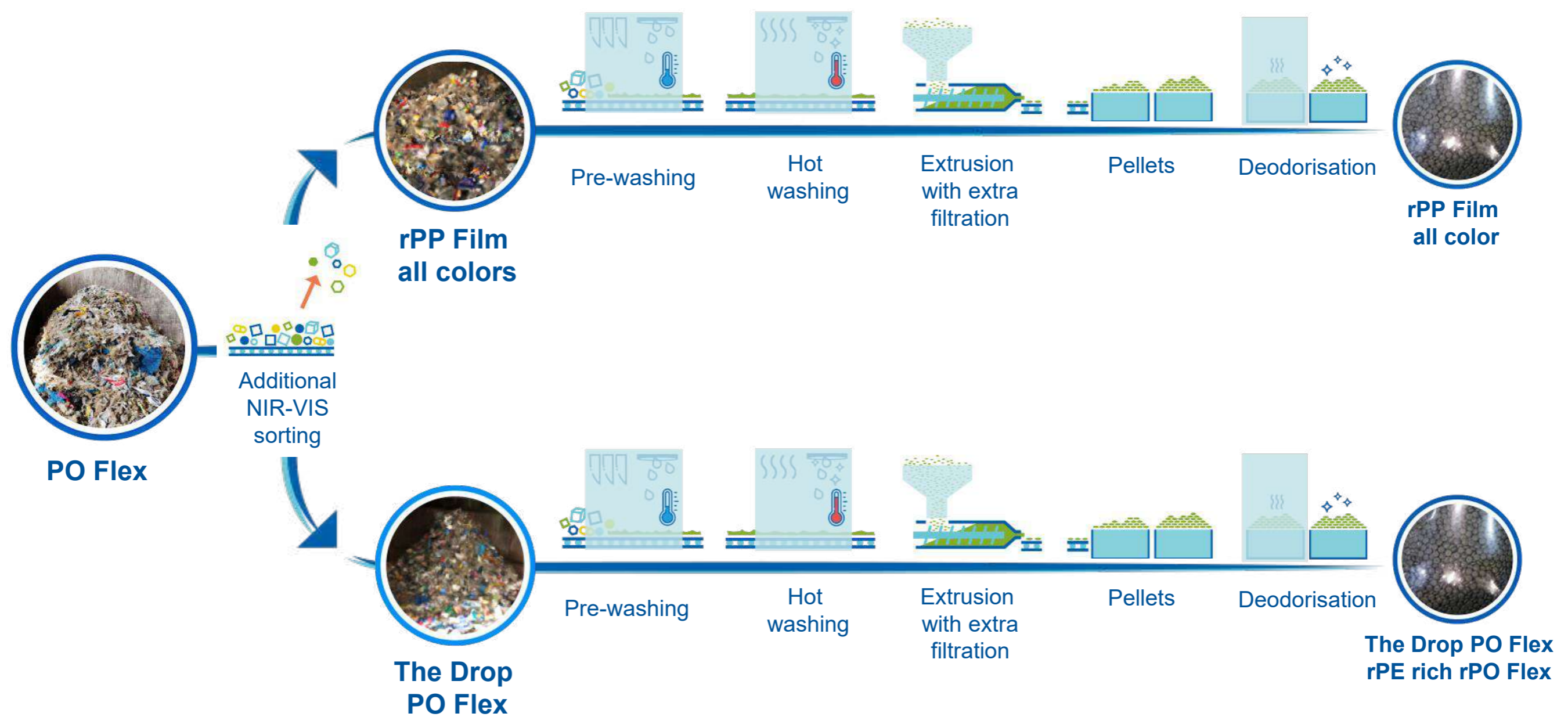
However, the need to better close the loop in a circular economy has triggered new ideas so that we have now some examples in flexibles packaging as well. We could think of many applications If we could just understand that recycled plastic does not need to look perfect, just like recycled paper and cardboard are not - and then we would see the higher value that it has in simply being good for the planet. Consumers have already understood this. The only limit we have in applications is the compliance to food contact legislation.”

The Process

Quality Recycling Process PE Stream

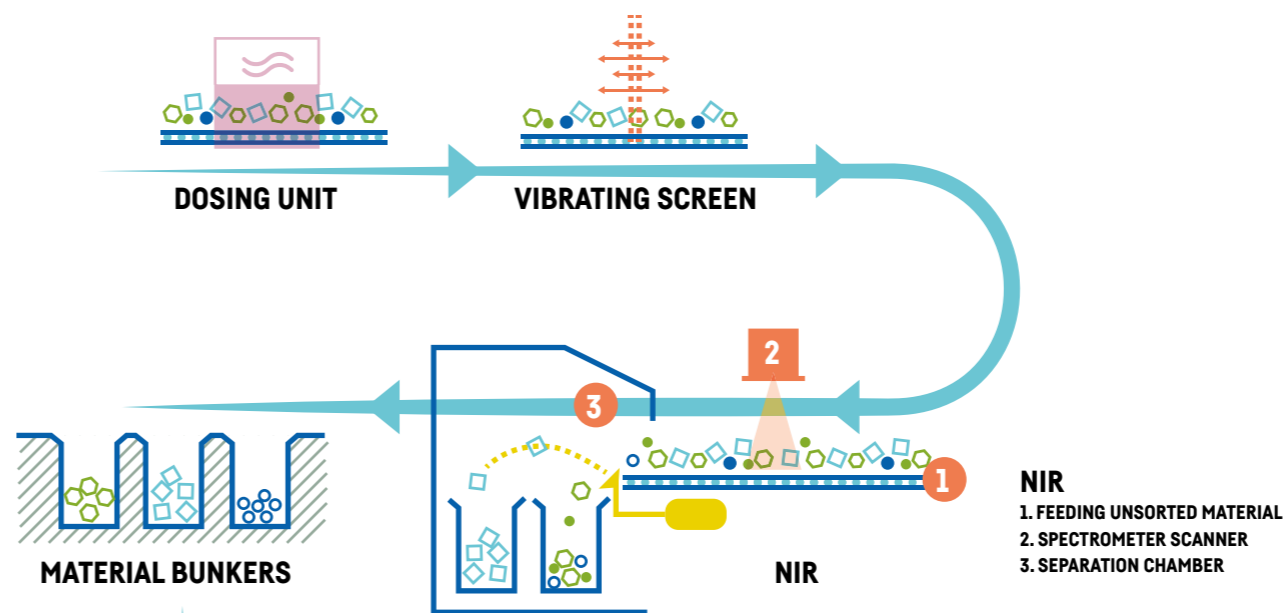


Quality Recycling Process **PP Stream**



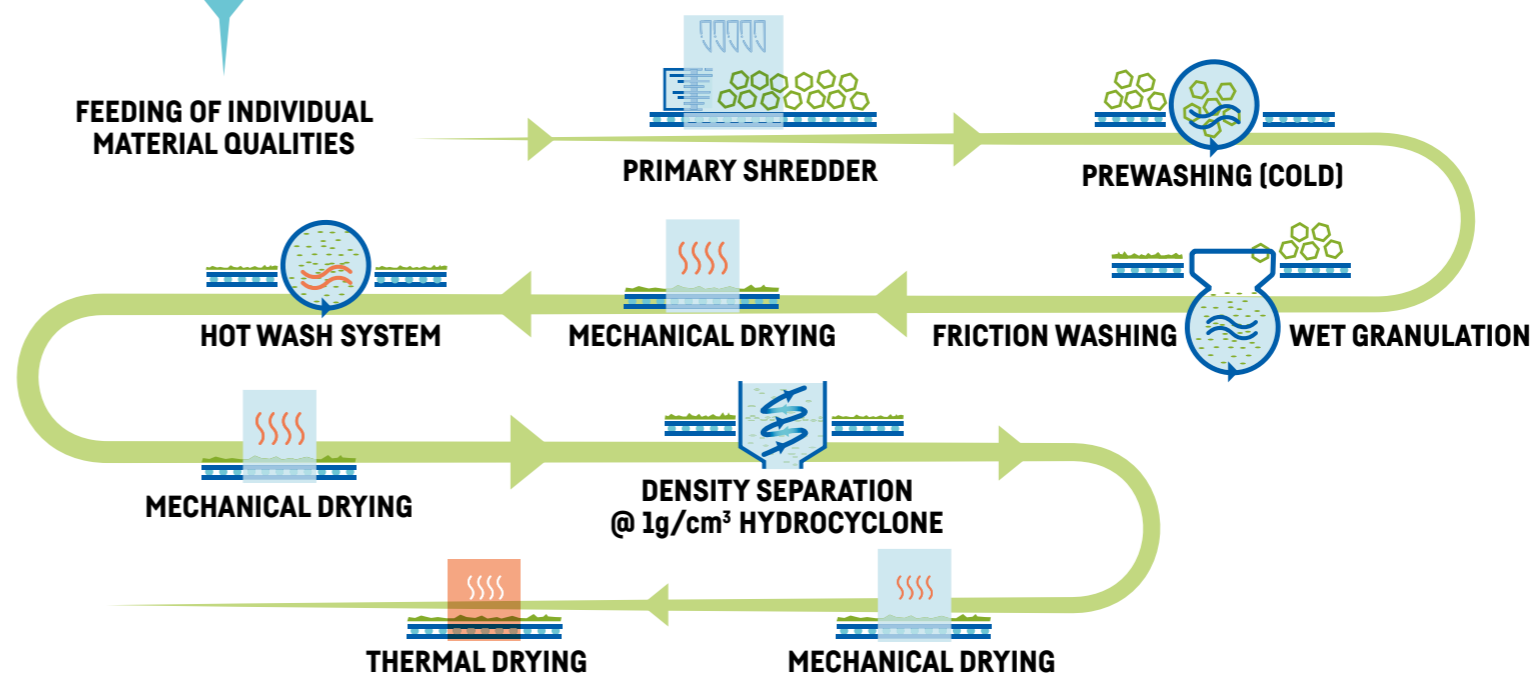
Sorting

To elevate the quality of the recycled materials, CEFLEX envisions a Quality Recycling Process which can start from the sorted bales commercially available today and increase the value of the material by additional sorting by polymer and by color



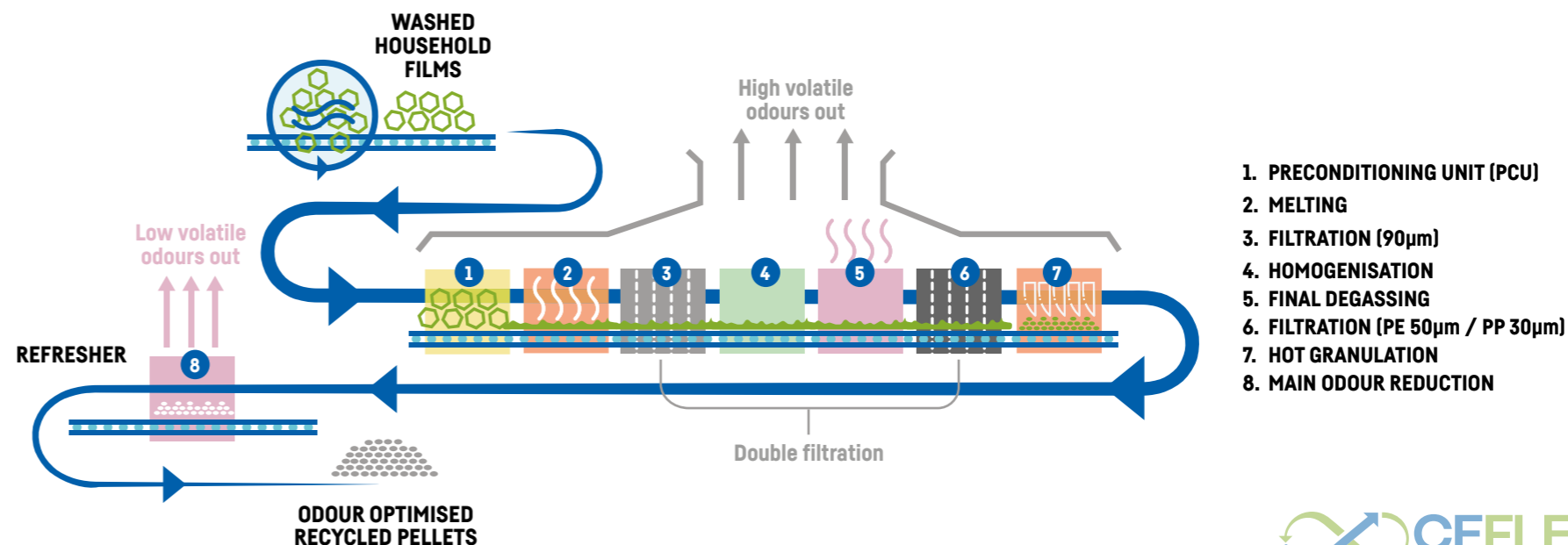
Washing

and advanced decontamination through hot washing to remove most of the organic contaminants, some of the inks and other additives



Extrusion

and extrusion with double filtration which will remove most of the remaining unwanted polymers and other contaminants followed by deodorization





When the recycled polyethylene film bales (for instance the new DSD 310-LDPE) are fed to such quality recycling process the resulting materials will be:



- a recycled polyethylene film grade of natural color (unprinted and not colored) which has been proven of quality appropriate for use in making collation shrink or non-food packaging like pouches or small to medium size bags;



- a so-called Drop grade recycled polymer which can be used in some applications like DSD 310-LDPE today or in injection molding applications, being currently under development.



In Germany today a new commercial specification is available, as a result of the increased focus in making possible to recycle all flexivle packaging: The Polyolefins Flexible Packaging (PO Flex). When this new specification is fed to such Quality Recycling Process, the resulting materials will be:



- a recycled polypropylene film grade of all colors (printed or not, colored or not, metallized or not) which has been proven of quality appropriate for BOPP film for pouches, bags or labels for non-food packaging applications.* Trials for cast film applications are ongoing.



- a so-called Drop grade recycled material for which applications in injection molding technology are currently under development.

*Hot washing trials for this fraction have been performed by SOREMA Plastics Recycling Systems (not a CEFLEX stakeholder) in the test center in Previero, Italy.

Boosting value and keeping materials in the loop



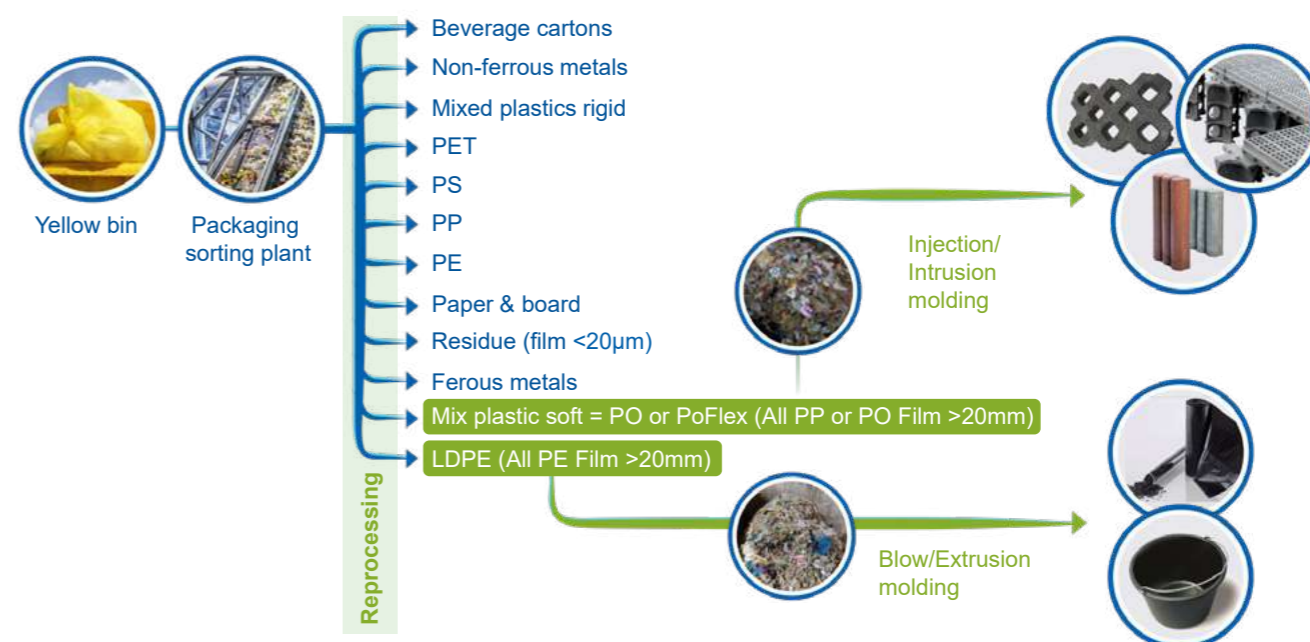
Interview with Dana Mosora, CEFLEX workstream manager, on the significant industrial and technical collaboration looking to 'tune the quality' and provide sustainable end markets...

What are the end market applications for the recycled materials coming from flexible packaging today... and how do you see them changing in the future?

First, let's clarify the scope and status quo. We are talking about flexible packaging collected as post-consumer waste from household after the disposal in a collection bin or bag. This waste is either sorted into a polyethylene (PE) film fraction, which can be recycled into garbage bags or other non-demanding film applications like construction sheets. Alternatively, mixed plastics are further recycled into various injection moulding or more often compression moulding applications while the rejects go into either refuse derived fuel (RDF) or solid refuse fuel (SRF) for Energy from Waste industrial processes.

It is clear that this scenario is not enough from many perspectives – which is why we are pushing so hard to support a circular economy for flexible packaging. In Germany, for instance, 63% of plastic packaging must be recycled by 2022, up from 40% in 2018 and we know that 55% of all plastic packaging has to be recycled by 2030 Europe-wide. This represents a significant increase of recycling rates for flexible packaging.

To realise an ambitious vision in which these targets are met, CEFLEX Sustainable End Markets workstream trials are working to demonstrate a Quality Recycling Process – able to deliver polymers for non-food applications like collation shrink, pouches, bags or labels. This is the name of the game, where performance infrastructure and processes are able to boost recycling rates, create value and keep resources in the economy.



New sorting specifications have been already created in Germany, which extract the maximum possible polyethylene (PE), polypropylene (PP) or a combination of these two polyolefins in either LDPE film (310-LDPE) or Polyolefin Flexibles (PO Flex) recycling specifications. CEFLEX brings them into a new higher value mechanical recycling by post-sorting of mono polymers from these new sorting fractions to create recycled PE or PP film grades. These can be further recycled into non-food flexible packaging.

Unlocking these possibilities requires further decontamination by effective removal of organic contaminants with hot washing and maximum removal of remaining contaminants via extrusion with double filtration and further deodorisation.

TO REALISE AN AMBITIOUS VISION IN WHICH THESE TARGETS ARE MET, CEFLEX SUSTAINABLE END MARKETS WORKSTREAM TRIALS ARE WORKING TO DEMONSTRATE A QUALITY RECYCLING PROCESS

The Roadmap

2018-19

Trial potential

Experimental scale trials: test the limits of existing technology

2020-21

Prove the concept

Industrial scale trials: mass balance and OPEX/CAPEX
Application development for resulting fractions

From 3Q2021

Go circular

Business case for investment
Drive implementation of recycled content in various applications
Drive investment in new infrastructure

Where can we make the biggest changes and create the most value?

The circular economy is all about keeping resources and value in play at the highest quality possible. Well, we have been working to identify pockets of high material and resource efficiency potential, able to create revenue for recycling plants.

The Quality Recycling Process uses post-sorting and advanced decontamination to produce higher value recycled fractions of polymers for higher value end markets. Key to this is extracting valuable film grades of recycled PE or PP, in which we target preserving the value of the rest of the respective flexible packaging waste specifications. The PE film and polyolefins flexible rests which we call “the drops”, are pockets of end markets potential and quality, able to generate revenue for recycling plants and the circular economy. Without this improved approach, the originating specifications would go entirely to a recycler to produce pellets for garbage bags for instance and a residue which could only be sent to energy from waste.

Only by exploiting the intrinsic value in these drops’ fractions, will recyclers close the mass balance in their plants and profit from emerging end markets in extrusion and injection moulding. If we can put all the pieces together, it provides a compelling business case as well as environmental benefits of a circular economy.

In 2020 we are working to identify, assess and develop valuable end applications for these drops, which will bring flexible packaging materials back to the economy in a resource efficient manner.

These valuable new recycled polymers will eventually replace a large part of the growing PE film and mixed plastics specifications of recycled polymers from post-consumer flexible packaging waste - helping Europe reach higher recycling rates and prove the circularity of flexible packaging.

How is CEFLEX and its stakeholders working to achieve this?

This is the most valuable part of the story, because these efforts and rewards are only made possible by CEFLEX’s “entire value chain DNA”. Quality recycling is not trivial. It calls for expertise, action and collaboration - to the power of three I would say - a forward-looking approach and a “we can do it” mind set.

Sorters, recyclers, technology providers, raw material producers, converters and brand owners have embraced the challenge in this and connecting workstreams. Together we can challenge the recycling status quo and develop new end markets for recycled materials coming from flexible plastic packaging.

We are looking at several aspects in parallel. The design of a new quality recycling process; characterisation of recycled materials produced; and development briefs for the various end applications targeted. This year will be a critical phase, validating the potential of the recycling technologies. Once this is done, we can take major strides towards a circular economy and development of new end market applications.

Right now, we are validating recycling technologies we tested at experimental scale last year and moving to industrial scale trials. These will enable production of enough large volumes of the new quality of recycled PE and PP of film grade to explore new end market applications. We are also collaborating with promising start-ups proving themselves in the lab and facilitating trials to really accelerate opportunities to recycle more flexible packaging and at better quality.

Based on the results from all this work we will then start to build the business case for investment into the Quality Recycling Process at sorters and recyclers – moving full speed into the various new end markets.

This work embodies our Mission Circular – designing, specifying and delivering value creation for flexible packaging, armed with detailed technical applications and solutions to achieve a circular economy.

Interviews with CEFLEX stakeholders in the action team

In this series of interviews, CEFLEX stakeholders leading the Quality Recycling Process and circular economy transformation explore what this means in practice and prospects for the future.

Michael Langen, HTP Engineers

Managing Director of HTP Engineers, and a publicly appointed expert in plants and machinery for waste recycling and waste disposal by the German Chamber of Engineers.

What should be done to increase the amount of polyethylene (PE) and polypropylene (PP) put on the market as flexible packaging?

A viable strategy to make flexible packaging easier to recycle is to internalise operational costs along the recycling value chain and to reflect these costs to the consumer. Basically, this is one of the key founding principles of EPR schemes. Any measure to get easier to recycle material structures like mono-PE and mono-PP is to:

- **Modulate EPR fees according to a scaled recyclability and**
- **Assess the recyclability by standardised procedures.**

As a founding partner of the CHI cyclos-HTP institute, we have been one of the first expert organisations to elaborate and implement a fully transparent assessment procedure for post-consumer packaging - based on scientific principles as well as hands-on experiences in recycling operations. That was back in 2011-2012 and, since then, the CHI standard has become widely accepted in the industry,

particularly with CEFLEX stakeholders in the flexible packaging market.

Modulating fees according to the recyclability of packaging is both ecologically and economically beneficial. Ecological indicators are, for example, the use of primary resources like energy and raw materials. Economic indicators include the minimisation of residues, improved product qualities and sales prices for recyclates.

However, there is a major obstacle in getting more mono-PE and mono-PP recycled: the lack of recycling capacities in Europe, in particular with respect to flexible mono-PE and mono-PP. While the past years have seen major investments in sorting capacities, investments in recycling capacities are still well behind market demands. Germany alone needs an additional capacity of min. 350.000 tonnes/year which cannot be compensated by exports sustainably.

HTP Engineers has designed and developed numerous projects in sorting and recycling technologies and is well familiar with procedures and risks. The risk profile of an investment in recycling technologies is fundamentally different from one in sorting technologies. The risk profile of recycling technologies is well suited for a consortium of material or packaging producers and brand owners. A traditional waste management company has less strategic interest and market knowledge in the flexible packaging market and is more often than not reluctant to invest beyond sorting technologies.

How do you see existing technologies play a role in making the shift from today's volume-based recycling into tomorrow's value creating via quality recycling?

Technologies play a key role in the implementation of a sustainable recycling strategy. HTP strongly emphasize the need for a dual strategy, volume-based plus quality-based recycling. Whereas volume-based strategies are indispensable to meet ambitious volume related targets, quality-based strategies are key to drive circularity to a level where closed loops get feasible.

Technologies play a role as enabler of both volume- and quality-based recycling. Presently, it is more often than not a question of economic viability whether a technology is implemented or not. Sophisticated recycling technologies are well developed technically and ready to be implemented on industrial scale. There are several examples, such as hot-washing, color/polymer-flake sorting, solvent-based processes or de-odorisation processes.

Now, the implementation of existing technologies rises operational cost and the rise needs to be covered by a premium on sales prices. Production cost of recycled polymers are intrinsically higher than production cost of virgin polymers. Recycled polymers carry the cost of collection, sorting and washing whereas virgin polymers are to some extent a by-product of Petro-chemical processes. As

a consequence, recycled polymers will not be able to compete with virgin polymers on a level playing field unless the end-of-life cost are internalized and considered appropriately.

HTP Engineers develops investment projects in recycling technology with a design flexibility that enables to go for both routes, volume-based and quality-based recycling. Characteristically, a recycling project reflects on a certain range of input and output qualities. Thus, adaptations to market fluctuations are possible. Further options are technological expansions and retrofits of existing recycling lines.

Can we sort out recycled polypropylene from flexible plastic waste?

Yes, fully automatic sorting of polypropylene can be done by optical, near-infrared-based sorting machines. These types of machines are well established in sorting facilities to separate rigid polymers like bottles, canisters, pots, tubs and trays. Since about three years, the feeding and separation units of these machines can process flexible plastic packaging. First applications were done in PE-film sorting, particularly larger sizes like > 240 mm. Nowadays, even smaller sizes down to 50mm can be sorted efficiently and beside PE-film sorting even PP-film can be identified and separated efficiently.

The design of sorting facilities needs to consider the total range of polymers in the input and the aspiration to maximise the yield

of recyclable bales in the output. The answer to whether or not PP-film is separated into a mono-stream in a given sorting facility, regardless of a new investment or a retrofitted facility is a very specific one. Aspects to be considered include the national EPR-framework, input composition, local trade routes and the technical base of a given sorting facility.

HTP engineers develop investment projects in sorting technology with a design flexibility that enables to adapt to a change in the EPR- and market framework, like with the design principle in recycling projects.

Berry Bellert, Atterro

*Sales Engineer and Development
Plastics Recycling*

What should be done to increase the amount of polyethylene and polypropylene that are put on the market as recycled flexible packaging?

To make more recycled flexible PE and PP packaging possible, we have to focus on collecting, sorting and recycling of film and striving to make all recycled materials as high quality as possible. This means using top quality where top quality is needed; but also accepting that for some applications (cover hoods, shrink wrap, film wrap) impeccable optics is not a necessity but more of a “habit”.

Adopting a mindset of “Design for recycled content” or “design follows function” can mean tuning the quality of materials to the purpose of the application. We have to educate every citizen or business partner that imperfections in film packaging, like dots, spots, color differences is not a matter of failure but a sign of “optimal use of resources”.

How do you see existing technologies play a role in making the shift from today’s volume-based recycling into tomorrow’s value creating via quality recycling?

There are many techniques in use, but not a lot of them reaching their potential. For example, if a sorter focuses on throughput instead on quality the cost will be lower.. . but so will the quality. As long as recycled polymer has to be cheaper than virgin – and why is that by the way? - the whole chain will focus on cost.

If producers, brand owners, retailers and more would be willing to pay at least the price of virgin, a much better quality is possible, like for rPET. But we also have to accept that “recycling rates”, now more seen as collection rates, might drop when we change our focus from quantity to quality.

**PERFORMANCE
INFRASTRUCTURE AND
PROCESSES ABLE TO BOOST
RECYCLING RATES**

Can we sort out recycled polypropylene from flexible plastic waste?

It is not a matter if we can, it is a matter of justifying the investment to do it. We have to realise that sorting flexibles is much more complex than sorting rigid packaging. At the moment, there is very few infrastructure in place throughout Europe to sort out PP film. Right now, there is no business case for sorters to do so. PP film is currently recycled in PO agglomerates for injection molding or extrusion of thicker wall products. But it is recycled. Means for recycling rates there is nothing to gain, there is no extra EPR money to claim. The real question is how to stimulate improved sorting?

CEFLEX's workstream Sustainable End Markets already proved that technically you can recycle PP film into non-food film applications which is a good start to build the business case for investment.

What end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

Many brand owners and policy makers want to reach a plastic packaging recycling target of 55% and reuse recycled content in packaging applications at the same time. The new measurement point for recycling will already make it very challenging to collect and sort enough packaging waste to even get close to

these targets. One way to reach the targets in some urban areas is to also sort packaging waste from residual waste in post-separation plants. Existing technology today can sort and recycle flexible packaging from such co-mingled waste delivering comparable quality with the one from separately collected waste, as also proven by trials done in CEFLEX.

How can recycled polyethylene and recycled polypropylene from household collected waste be used in packaging applications?

Use rPE or rPP when possible, or better, when virgin is not particularly needed! Every application has to justify the use of virgin or if not justifiable in a circular economy, use as much recycled polymer as possible. It is currently too easy to use virgin and the spread in EPR fees is not big enough by far.

Who has to implement the changes in the collection, sorting and recycling of household collected flexible packaging so you can use the maximum amount of recycled polymers fit for packaging applications?

The producers, (EPR schemes) are in the lead. In the end they have to pay the cost for collection, sorting and recycling. So, better than complain about rising EPR fees, take the lead, because their members produce all the packaging.

Clemens Kitzberger, EREMA Group

*Business Development Manager
Application Post Consumer*

What should be done to increase the amount of polyethylene and polypropylene that are put on the market as flexible packaging?

Improved design is a key element for achieving a circular economy in plastic packaging. Monomaterial polyethylene (PE) especially, but also mono polypropylene (PP) can get high quality recycled with existing mechanical technology. To make that work, the surface size and thickness of the packaging have to be big enough. So, reducing plastics by not producing very small flexible's like single pack for small portions of confectionary. Industry also like recycled polymers in natural colors, so careful consideration of inks and coloring on packaging is important.

To avoid multimaterial packaging, brands and retailers can also check which performance requirements, such as shelf life are really necessary for their products. I am confident many multimaterials can get over to monomaterial packs, enabling the return of those resources back into the economy and benefiting the environment.

How do you see existing technologies play a role in making the shift from today's volume-based recycling into tomorrow's value creating via quality recycling?

Existing technologies are able to do a lot more than we use at the moment. But to really make a sizable shift into the circular economy, we need packaging designed for the circular economy and investment in the latest technologies to produce high quality recyclates.

As with any major investment, a secure business case and model is needed. To make this a reality, investors need a clear business case and security of that investment in time. Achieving this has to include political discussions; what would help is an European harmonization of collection schemes supported by the whole value chain. Additionally a minimum stability in the price of virgin polymers is of critical importance.

Can we sort out recycled polypropylene from flexible plastic waste?

Of course we can! This is not an issue at all with latest NIR technologies. This needs to be tackled and done as PP is the second largest polymer amount in packaging. Important considerations to keep in mind for PP based packaging is to avoid thin wall packaging, too small packaging size (below A5) and heavy ink coverage which are reducing its sortability and value in recycling.

What end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

At the moment in PE, I would say non-food transport packaging (stretch, shrink, bags, etc.) and non-food packaging bags for PP.

To make food grade recycling possible – as they have done for years in HDPE milk bottle recycling – EFSA requirements call for dedicated collection schemes for food packaging which is not feasible in flexible packaging. More work is required to understand and demonstrate how food grade material quality can be delivered for flexible packaging recycling with the existing or emerging mechanical recycling technologies.

Furthermore, risk assessment studies demonstrating that plastic packaging made with recycled polymers brings no contamination risk nor harmful substance for humans could provide a huge advantage to recycling flex packs. All in all, the consumer is key to making economically viable recycling possible, by keeping packs as clean as possible.

How can recycled polyethylene and recycled polypropylene from household collected waste be used in packaging applications?

The whole value chain can look to how they operate in the PET bottle industry. Here, the requirements are clear:

- 100% food grade virgin use
- Design for recycling: monolayer with no color, ink, > 30µm thickness, > A5 size
- An adequate collection scheme with consumers keeping packaging as clean as possible

A Quality Recycling Process incorporating all the elements we are working to achieve in CEFLEX workstream 3, that is to say: post NIR sorting, hot wash with decontamination agents, flakes sorting, double filtration extrusion at max 50µm, necessary homogenization and deodorization; for the last one EREMA has developed a performant technology called ReFresher which stands for odor reduction equipment and online quality measurement systems for quality control.

If we can manage to put this in place, then we would have recyclates with properties comparable with the virgin polymers' properties and which can be used as fit for the purpose for any targeted end application.

Who has to implement the changes in the collection, sorting and recycling of household collected flexible packaging in order to use the maximum amount of recycled polymers fit for packaging applications for your brands?

I think it is a combined effort throughout the value chain and this is why CEFLEX is such an important initiative which can facilitate this.

Brands and retailers need to cooperate with converters and petrochemical companies to embrace Designing for a Circular Economy Guidelines and a rational assessment of packaging properties. We need political engagement and action on strict, harmonized rules for whole EU to achieve quality collection, sorting and recycling and to also tackle CO2 emissions.

I would also add to this engagement, waste managers and license holders which “own or contracted the waste”.

And finally, technology providers have to support the whole value chain with new technical possibilities and equipment that help accelerate delivery to the significant potential of a circular economy.

Valentina Betto,
Plastotecnica, S.p.A.

R&D and Sustainability Manager

What end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

For the first time we are experiencing a real step forward about the possible applications of recycled PE coming from household waste. Until now, it was only possible to use it in less technological applications such as garbage bags and injection moulding.

What we are doing now with fellow stakeholders in the CEFLEX Sustainable End Markets team will bring to a significantly better quality of rPE, with less contaminants and higher performance. Therefore, we will be able to use it also in more demanding applications such as collation shrink packaging film and heavy-duty bags, which require high mechanical resistance (like impact resistance) or a proper thermal shrink behaviour which has to guarantee a high stability of the load.

Moreover, for many other industrial products Plastotecnica will be able to consider rPE: small bags for plastic components, spare parts, electronic devices; shrink tube for heavy pallets for example in glass or brick industries; shrink film for furniture, mattresses, insulation panels, building materials; bags for sand, chemicals, powder, concrete, wood pellets.

Another application field is the food industry, where recycled PE can be introduced in the secondary packaging, so not in direct contact with food. This sector will be more challenging because we need to consider the risk of migration and food contamination. However, we believe that it could be a very good chance to use amounts of rPE, since food packaging represents a very large part of the flexible packaging market. If we think of the amount of shrink film for beverages (bottles and cans) and for food containers in general (pots, cans, boxes, etc.), it is clear how many products rPE could be applied to.

In this sector, the very first step is to assess the risk of contamination, especially in the case of plastic bottles; on metallic cans or glass pots there is no risk.

How can recycled polyethylene and recycled polypropylene from household collected waste be used in packaging applications?

First, recycled material's quality should be controlled according to precise specifications. The elaboration of the relevant criteria to be included in the specifications is one of the purposes of our CEFLEX workstream group.

According to our experience as a PE converter, the percentage of recycled content for every application should be carefully evaluated, in order to achieve both technical and economic results, from the point of view of every stakeholder involved. For example, if we produce a 30 µm film for little bags, the maximum percent-

age of rPE should be assessed taking in account several requirements: not only mechanical resistance, but eventually slippery features that allow the film to be used properly during the filling process, and, last but not least, economical sustainability during every production step.

To obtain genuinely sustainable products, from every point of view, we must take into consideration parameters such as the quantity of scraps and constancy of process. Indeed, if manufacturing the same product, I duplicate the quantity of waste of raw materials, I will affect the environment and lose the sustainability benefits targeted.

Finally, everybody should find a compromise on the product requirements: optical properties will never be the same as for virgin products, but as we started years ago to appreciate yellowish paper because it was recycled, we should in the same way accept film opacity, presence of little dark spots and less glossy effect. Moreover, also the plant output of converters and brand-owners could be affected by the presence of recycled material, and we should accept this partial efficiency loss.



**HIGHER VALUE
APPLICATIONS AND
END MARKETS**

Who has to implement the changes in the collection, sorting and recycling of household collected flexible packaging so you can use the maximum amount of recycled polymers fit for packaging applications?

Everyone has to make as many efforts as possible in order to achieve this goal. The very first step is related to packaging design: we should push for mono PE and mono PP films where possible and sustainable.

We should minimize printing, different material labels, dark colors in order to get better quality recycled materials. More effort should be made to find and develop efficient technologies to delaminate different materials, sort them and clean them. The most difficult challenge we have to face right now is delivering the desired quality of rPE by removing inks, contaminants, dirt or different polymers.

The second step is to educate as many as possible people in doing an always better separate collation at home. We have to inform consumers on what is sustainable and what is not, because they can push brand-owners in the right direction.

Then every single actor in the value chain can give an effective support to reach the goal. Everybody should improve their technology in order to get the desired quality of the rPE.

As a converter, Plastotecnica can use additives to improve the process behaviour of rPE and to develop new boosting structure in order to support possible poor mechanical properties.

Furthermore, our plant needs to be adapted to work with recycled material better. It is a difficult path which can be covered only thanks to the collaboration of all the value chain like we are doing in the CEFLEX initiative.

Florian Egner, RKW Group

R&D Manager Multipack

How can recycled polyethylene and recycled polypropylene from household collected waste be used in packaging applications?

Today, recycled polyethylene retrieved from household collected waste is not known as a material of sufficient quality to fulfill the requirements of high-quality packaging films, as produced by RKW.

With the CEFLEX initiative to improve the quality of recycled polyethylene from household collected waste, this has significantly improved and new opportunities for the usage of such materials are made up.

To enable a usage of recycled polyethylene in high-quality packaging applications, the requirements of all parties, involved in the processing of the material, have to be satisfied.

First of all, for RKW the recycled polyethylene needs to be processable on conventional film production equipment, without negative influence on the line efficiency. Therefore, a constantly uniform quality of the recycled material is required. In addition, the final film needs to meet all technical requirements for a processing on the respective packaging lines. For this, it needs sufficient mechanical properties that allow that even thin films can be manufactured and used for a wide variety of products.

The final film has to have a good appearance, without any strong coloration or high amount of impurities, which could negatively influence the printing quality or lead to an unpleasant look at the final packaging. Supporting the brand image and transfer marketing messages to the end-consumer is an important task of the packaging film.

From an end-consumer perspective, RKW sees it as necessary as well, that the final packaging offers a nice appearance without any strong coloration or noticeable odor, which could leave a negative mark and cause a lack of acceptance in the market, or raise the impression of a low-quality product.

For what end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

The main markets, in which RKW sees a potential for the usage of recycled polyethylene retrieved from flexible packaging waste are high quality film applications for which the usage of recycled materials out of the household collected waste is not possible so far.

Talking about applications in the field of secondary packaging without direct food contact the most promising products, which would certainly appeal to end-consumers, are collation shrink films for the beverage industry or form-fill-seal films, used to produce bags for non-food applications, like for example potting soil, peat or fertilizers.

In these applications RKW sees a great potential using certain contents of recycled polyethylene to come to more sustainable products and re-use packaging waste in the meaning of a circular economy.

Dr. Gottfried Weyhe, POLIFILM Extrusion

Senior Research & Development Manager

How do you see existing technologies play a role in making the shift from today's volume-based recycling into tomorrow's value creating via quality recycling?

Existing technologies play a big role in the transformation process and value creation potential of a quality recycling process. But as not all existing technologies are really used widely yet, a big investment would be necessary for sorting and recycling companies. Furthermore, some interesting developments of new recycling technologies, like chemical recycling or solvent based separation for recycling are on the way as well.

For what end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

With current mechanical recycling technologies there are limits regarding recycled material content, properties and quality of polyolefin films for flexible packaging. The main limitation is that it is not applicable to food packaging applications with direct food contact yet. But as far as I know, some stakeholders already work on

addressing this issue which requires bold solutions.

If the quality of the recycled polyolefins will be improved, which we with fellow CEFLEX stakeholders are working on, I see some end markets to use these materials. Depending on the film properties needed for each market I can imagine a PCR- content- range between 10%, all the way up to 99%. Such end markets could be industrial packaging like shrink films, stretch films, packaging films for industrial goods and non-food goods, mailing bags for online retail etc. But I also see possibilities for higher value applications like labels and laminating films for flexible packaging for non-food packaging. There are other packaging markets where it would be possible to use more PCR recyclates like films for agriculture, building industry and other industrial films, e.g. for surface protection. At POLIFILM, we are working on all these applications in close collaboration with different suppliers and partners.

Who has to implement the changes in the collection, sorting and recycling of household collected flexible packaging such as you can use the maximum amount of recycled polymers fit for packaging applications for your brands?

There must be an improvement and differentiation of the sorting and recycling quality. In my opinion, it is also necessary that legislation must honour the use of post-industrial recyclates (PIR) as well. PIR

is easier to use in high end applications even with direct food contact. However, it is often used for downcycling in low end applications. So, it would make sense to use more PIR in high end application to have more space in low end applications for near household PCR.

Monica Battistella, Taghleef Industries

Product Manager and Sustainability Advisor

What should be done to increase the amount of polyethylene and polypropylene that are put on the market as flexible packaging?

It is not always easy to drive a change in favour of polyethylene and polypropylene structures. The main reason is that stakeholders in this industry feel unsure due to a lack of consistency in EU regulations on topics such as recyclability or due to unclear guidelines on better packaging design.

Not to mention that there are still cases when the value chain is putting all efforts to redesign the packaging so that it can fit in the polyethylene and polypropylene recycling schemes; but collection schemes, sorting and recycling infrastructures are missing, so efforts are made in vain.

How do you see existing technologies play a role in making the shift from today's volume-based recycling into tomorrow's value creating via quality recycling?

Flexible packaging has a tremendous value when it comes to marketing the product it contains. Bright colors, metallic inks, bright lacquers, full prints are undoubtedly very appealing and attractive for consumers. However, the reverse side is that all this wonderful embellishment decreases the quality of recycled resin we can get from these packages. Technologies which can help "cleaning" and get back or closer to original quality, would make a lot of difference.

Another aspect, not to underestimate, is consumer education, so that they can dispose correctly of the package once empty. Having a simple label or instruction on the package, would help the consumers to dispose of it correctly either into plastics or to waste for energy recovery. Consumers would then act as "pre-sorting" of what is ending up into plastics streams.

Can we sort out recycled polypropylene from flexible plastic waste?

Our experiences in the CEFLEX Sustainable End Markets workstream have helped prove that it is possible to sort polypropylene out. Provided that a value and larger end market can be created, then polypropylene fraction is surely expected to grow along with its quality.

What end markets do you see fit for the recycled polyethylene and recycled polypropylene from flexible packaging waste?

Recycled polyethylene and polypropylene have been used for many applications but very seldom back into flexibles for household applications.

However, the need to better close the loop in a circular economy has triggered new ideas so that we have now some examples in flexibles packaging as well. We could think of many applications if we could just understand that recycled plastic does not need to look perfect, just like recycled paper and cardboard are not - and then we would see the higher value that it has in simply being good for the planet. Consumers have already understood this. The only limit we have in applications is the compliance to food contact legislation.

Who has to implement the changes in the collection, sorting and recycling of household collected flexible packaging in order to use the maximum amount of recycled polymers fit for packaging applications for your brands?

On one side we need investment to guarantee that all flexible packaging is collected. This is essential to the next steps of sorting and recycling. Clear guidelines will make sure that we can get higher and consistent quality already at sorting gate. Better quality will most certainly bring along higher value end applications because of the better properties of the recycled resin. The industry and the entire value chain can do their own part by investing money, time and knowhow. Yet, it is essential that governments and public authority recognize these efforts and support them through proper legislation and benefits.



**RECYCLING FLEXIBLE
PACKAGING THROUGH
MECHANICAL RECYCLING**

Reactions from CEFLEX stakeholders in the value chain

Gareth Callen



*PepsiCo Sustainability
Packaging Manager, R&D*

Your company is at the forefront of the circular economy for plastic packaging. How do you see your engagement with CEFLEX contributing to enabling breakthrough solutions to increase recyclability of flexible packaging?

PepsiCo's sustainable packaging vision is to build a world where plastic never becomes waste. While we're working on our efforts to reduce the amount of plastic packaging we use, increase the amount of plastic that gets recycled and use more recycled content and finally reinvent our packaging through looking at new materials and models; we recognise that no one company can build a circular economy on its own. Being an active member of industry bodies like the Circular Economy for Flexible Packaging (CEFLEX) helps us to drive the system wide changes that are needed to advance the collection, sorting and recycling of our packaging. Through CEFLEX we're able to share our expertise, participate in trials around new solutions and also engage in discussions with relevant authorities and others in the value chain to develop a circular approach that works for all.

Today the name of the game in recycling seems to become quality. CEFLEX is developing and starts to promote the Quality Recycling Process which will come at a cost. Do you see the value created with this new process help your flexible packaging goals?

We aim to make 100% of our packaging recyclable, compostable or biodegradable by 2025 and so we're committed to driving change across the system around the recycling of flexible packaging. Many believe flexible packaging to be a more complex recycling approach than for rigid with challenges presented around the perceived quality of the material for future recycling. However flexible packaging is currently collected, sorted and recycled into other products in the Netherlands and Germany and we need to learn from this approach for other European markets. We're working to make sure that the EPR systems that we pay into across Europe are 'fit for purpose' to ensure waste is collected and effectively managed.

What is the Quality Recycling Process being developed by CEFLEX opening as solution to your packaging challenges today?

The Quality Recycling Process is enabling us to engage with multiple organisations to achieve the common goal of a circular future for flexible packaging. Through the process we hope to see scale sorting and re-process-

ing of packaging materials which will help make recycling more economically feasible. In addition we are hoping to see advancement in the sorting process to ensure more packaging materials can be identified and redirected to a second use.

Jesús Maza Lisa



*Packaging Materials
Development Manager
– Flexibles, Danone*

Your company is at the forefront of the circular economy for plastic packaging. How do you see your engagement with CEFLEX contributing to enabling breakthrough solutions to increase recyclability of flexible packaging?

All plastic packaging has an impact on resources, climate change, waste, biodiversity or water use but we also need it to deliver Danone's mission: Bring Health Through Food To As Many People As Possible.

Nevertheless, Danone is working to support a systemic shift from a linear to a circular economy for packaging. Our objective is to eliminate the concept of waste by keeping materials within the economy and out of nature. One of our commitments is that all our packaging must

be designed for circularity by 2025. This means that all our packaging will be 100% reusable, recyclable or compostable. Alternatives will be found to plastic or single-use in all major markets. Problematic and unnecessary plastic packaging will be eliminated.

Supporting initiatives like CEFLEX help us to make it happen, helping us put in place an effective waste management system and ensuring our packaging is recycled and never becomes a waste. We believe that this needs to be a collaborative mission joining forces and expertise. CEFLEX is a good example of such a cross value chain collaboration. Indeed, Danone is already actively working to make all flexibles recyclable following CEFLEX guidelines.

Today the name of the game in recycling seems to become quality. CEFLEX is developing and starts to promote the Quality Recycling Process which will come at a cost. Do you see the value created with this new process help your flexible packaging goals?

High quality of recyclate is key to stimulating demand - a key success factor of boosting and creating a recycling system around flexible packaging. Nevertheless, quality and cost shouldn't be decoupled from each other, especially in the new post-COVID situation we face today. That's why all the actors from the whole value chain have a word to say to focus

on quality. If, all together, we manage to have a quality recycling process, new markets will be developed, more and more brand owners will be interested in using quality recycled polymers and more recyclers will be interested in recycling flexibles. Quality brings value, as we can see in the rPET market, for instance.

Again, as a brand owner, Danone believe this is a collaborative mission and the circularity of our packaging is key. And of course, we do see the value created with this new process.

What is the Quality Recycling Process being developed by CEFLEX opening as solution to your packaging challenges today?

Transitioning to a circular economy means seeking to no longer use packaging from finite resources. This helps preserve natural resources and keep existing materials in use and out of nature. To reduce the need for newly created material, we are working to increase recycled content. We are also developing renewable materials that further decouple packaging from natural resource use.

We intend to drastically expand the amount of recycled and bio-plastic used in our packaging. We have already launched 100% recycled PET bottles in all our major water markets. By 2025, we will reach 50% of recycled material on average in our plastic packaging.

A Quality Recycling Process by CEFLEX opens a solution to our flexibles packaging challenges bringing back to the market high quality recycled polyolefins which will for sure help us to reach our commitments.



**ENSURING PACKAGING
IS RECYCLED AND NEVER
BECOMES A WASTE**

Conclusion

Through the power of their value chain collaboration and expertise in the waste management of flexible packaging, many stakeholders of CEFLEX actively engaged in the New Sustainable End Markets workstream have proven so far that ‘recycling of household collected post-consumer flexible packaging back to non-food flexible packaging through mechanical recycling via the Quality Recycling Process’.

In this booklet we detailed the Quality Recycling Process from several perspectives and give insights from those who have participated to its development. We run the technical ‘proof of concept’ for household collected post-consumer flexible packaging Post-Consumer Waste (PCR) which demonstrates:

- ▶ **Recycling back to a wider range of non-food flexible packaging is possible - including more demanding applications through mechanical recycling via the Quality Recycling Process.**
- ▶ **The Quality Recycling Process produces film grade quality rPE and rPP polymers appropriate for non-food flexible packaging by applying near infrared (NIR) sorting by polymer and color, followed by hot washing and extrusion with extra filtration and deodorization.**
- ▶ **As a real breakthrough, film grade recyclates for natural rPE and all color rPP can be obtained at good product yield and quality and with mechanical and processing properties (i.e. film extrusion process) which make these materials suitable for replacement of virgin polymer grades.**

Data from industrial trials running in 2020-21 will assess the economic viability of the process and a business case for investment in necessary infrastructure.

As the workstream moves to confirm the process with industrial trials, it will also further the work on development of new applications, with the resulting recycled polymers from household collected post-consumer waste, like the ones bellow:

- Pouches and bags for non-food packaging
- Labels
- Collation shrink
- and other injection molding and extrusion applications appropriate for the materials resulting from the Quality Recycling Process.

Industrial trials are currently planned for 4Q2020 and 1Q2021 and application development is expected to last throughout 2Q-4Q2021.

Stay tuned to our updates in the following quarters and, do not hesitate to join our efforts and our project if you also wish to broaden the opportunities for a circular economy of flexible packaging.

For further information and questions contact us at: dana@ceflex.eu

Annex: further resources ▾

[Delivering a Quality Recycling Process - a Packaging Europe & CEFLEX Webinar](#)