Feedstock Recycling
Opportunities to recycle all plastic

It is the ambition of PlasticsEurope and The British Plastics Federation to prevent high calorific waste going to landfill and to promote the recovery of all plastics for recycling. For those plastics that cannot be economically and environmentally recycled today, it is preferable to recover the embedded energy.

We agree with other leaders in the field of waste management – that long term energy recovery, as we know it today, is a transient technology. In the future, those plastics that cannot currently be recycled will increasingly be recycled either through improvements in collection, sorting and processing in mechanical recycling. However, there are technological and ecological limits to what can be achieved by mechanical recycling and there will always be materials for which mechanical recycling is not appropriate.

For such materials, a number of exciting feedstock technologies are being developed. With continued support for their innovation, we foresee that these will pave the way for the recovery of non-mechanically recyclable plastics to be recycled into feedstock for the production of new plastics or other chemistries.

Plastics: the resource efficiency champions

1. Resource savings

Plastics are widely utilised as they meet the demands of today’s lifestyles while contributing to resource savings in diverse applications. For instance, plastics enable the manufacturing of products that:

- Use less energy and emit less CO2 over their life cycle due to their low weight and/or insulating properties, such as in the packaging, building and construction, and automotive and aircraft sectors
- Help goods last longer, allowing consumer goods and industrial packaging to have an increased lifespan
- Contribute to reducing food waste, as packaging
  - significantly protects and increases the shelf life of fresh food
  - reduces in store and logistics chain food waste
  - ensures the highest food safety standards are maintained
  - and in some applications, ensures the preservation and integrity of the cool chain
- Increase the safety of electrical appliances and electronic devices, providing high strength and excellent electrical insulation
- Provide insulation in buildings
- Are used in applications that help enable the supply of renewable energy, thanks to their mechanical strength and lightweight properties necessary for wind turbines and solar panels
- Save and improve the quality of people’s lives thanks to highly technical medical applications

2. Reduction of CO2 emissions

Plastics contribute greatly in facilitating reductions in CO2 emissions in transporting goods due to their light weight. Over the years, thanks to just the continued light weighting of plastics packaging this has saved millions of tonnes of plastic packaging alone with many applications showing a 28% reduction in the weight of plastic in just the last decade.

3. Environmental benefits

A recent study done by Trucost\(^1\) confirms the findings of previous studies such as Denkstatt,\(^2\) and concluded that the environmental costs of using plastics in consumer goods and packaging are nearly four times lower than if plastics were replaced by alternative materials. The authors highlight the importance of choosing the materials that create the materials that create the least impact of the final goods over the full life cycle.
Recovering the embedded resources from end of life articles manufactured with plastics

1. Energy should not be wasted in landfill

While the landfilling of plastics-rich waste is decreasing in European member states, in many countries this remains a significant option for its disposal, with only 9 member states today effectively banning the landfilling of such materials. In 2014, 25.8 million tonnes of post-consumer plastics ended up in the officially reported waste streams, 69.2% was recovered through recycling (29.7%) and energy recovery processes (39.5%), while 30.8% still went to landfill.³

This represents a great waste of resource as the majority of these materials can be recovered for recycling and for those materials not currently mechanically recyclable – their embedded thermal energy can be recovered for heating, cooling or electricity production thereby displacing virgin fossil fuels and contributing to a member states energy mix to reduce the reliance on imported energy.

Feedstock Recycling

1. Landfill wastes resources

Sending plastics to landfill is a waste of resources. It makes no sense to bury valuable recoverable resources, particularly after you have already invested energy in extracting them out of the ground. We should therefore prevent the burying of plastics in landfill and promote the recycling of all plastics when it makes sense to do so. Where it is not possible to economically and environmentally recycle plastics today, we promote the recovery of their embedded energy using combined heat and power. However, this material stream needs to be increasingly recycled if the ambitious targets for recycling are to be met.

2. Challenges for mechanical recycling

There are limits to what can be mechanically recycled even with new innovations in collection, sorting and processing technologies. There are potential economic and environmental challenges to the recycling of some plastics due to the limitations of mechanical recycling in the recovery of certain waste streams, such as:

- Complex multi-laminated and multi-material containing plastics – these provide benefits in terms of being hugely resource efficient and/or offering functional barriers that minimise food waste and extend food life
- Plastics containing legacy additives
- Composite plastics
- Thermoset plastics
- Highly contaminated plastics

3. Opportunities for feedstock recycling

This is where feedstock recycling has the potential to play a future key role by diverting these materials away from landfill or energy recovery. In addition, those plastics that are challenging to recycle at present would then be able to be looped back into the circular economy.

Such technologies break down the longer molecular polymeric carbon chains in plastics into medium length carbon chains producing waxes (for which potential markets exist) and into a synthetic crude oil that can be used to make new plastics. Technologies, such as pyrolysis, are also available that may be used to break plastics down into even smaller simple molecules like CO, CH₄ and H₂ that have the potential to be used for chemical synthesis. Such technologies as described, in combination with mechanical recycling, potentially will pave the way for the recovery of value from virtually all waste plastics.

Whilst this technology is in its early stages of development, the progress is encouraging and there are signs that we will see this technology commercialised. For example, please see the information provided by UK Company Recycling Technologies (see Attachment 1) who have benefited from support by UK Government and public bodies in the development of their technology, which originally started out as a spin-out from Warwick University. Today they have
developed a demonstrator unit that is creating a lot of interest among investors and industry players and will feature in one of the Ellen MacArthur Foundations Pioneer projects (Project Lodesta).

Other companies are also active in this space as well and there is a considerable amount of accompanying activity in the UK’s research sector and other centres around the world. However, to bring this technology to market will require continued support for innovation by both the private and the public sector.

How policymakers can contribute to retaining plastics in the Circular Economy

1. Supporting innovation & investment

Policy makers have a critical role in helping to accelerate the rate of innovation for the increased recycling of plastics by creating advantageous fiscal instruments to promote investment in newly developed innovative technologies and to increase research funding within the UKs centres of technical and academic excellence to fill the innovation pipeline with the technologies that are required for tomorrows Circular Economy.

We can immediately identify the areas below where such efforts should be directed to encourage and stimulate innovation in plastics:

- feedstock recycling (plastic waste and CO2)
- re-use models
- lower carbon feedstocks
- innovation in traceability of materials, collection schemes, sorting and treatment of secondary raw materials
- fiscal/legislative incentives for demonstrator units to prove new technologies and enhance their investment potential

To that end, we remain at your service and willing to explore this subject further and in particular, how the public sector and policy makers could ensure that the UK economy makes the most of this opportunity. If you wish to pursue this offer, please contact us to set up a more detailed and exploratory meeting.

References

1. Trucost – Plastics and Sustainability, 2016
2. Denkstatt – How packaging contributes to food waste prevention, 2014

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Chemical Recycling of Plastic

Summary
Recycling Technologies [RT] has developed a process that recycles residual plastic waste into Plaxx®. This is a naphtha rich material suitable for use as the chemical feedstock for producing polymers.

Plastic is a fantastic material with a strong environmental narrative however, the total levels of plastic being recycled are undeniably too low. Mechanical Recycling of plastic continues to improve and has a much greater role to play globally in the future. However, this approach has inherent limitations especially when considering contaminated, laminated and engineered plastics. RT’s process has been built into a modular, transportable machine, the RT7000. This modular approach allows the solution to be mass produced and located at Material Recovery Facilities [MRFs] around the globe, quickly scaling the recycling capacity for plastic.

The commercial and environmental credentials of RT’s Chemical Recycling technique make it a very attractive alternative to energy from waste and landfilling for residual plastic waste.

Background
Plastic has a significant role to play in developing a sustainable future and so it is unsurprising that global production has topped 320Mtpa and that this is expected to double again in the next 20 years. However, there can be no doubt that waste plastic is presenting a global challenge. In January 2016, the World Economic Forum and the Ellen MacArthur Foundation, with analytical support from McKinsey & Company, launched the report The New Plastics Economy – Rethinking the future of plastics. This reported that on a global level only 14% of plastic packaging is collected for recycling with just 10% actually recycled and then only 2% recycled back into the original product [closed loop or “bottle to bottle” recycling].

Current mechanical recycling techniques, which account for the vast majority of today’s plastic recycling, will continue to improve but few believe they will ever provide a solution for more than 50 – 60% of all plastic since laminates, food contamination, additives, etc. present significant challenges for these techniques. Chemical recycling offers to provide the solution to the plastic that cannot be mechanically recycled. In turning it back into the feedstock for polymer production, virgin quality polymers can be produced containing recycled material.

The Process
Housed in five 20ft shipping frames the RT7000 thermally cracks residual plastic waste into a broad range of hydrocarbons. From the resulting hot gas, heavy metals, fillers and halides (such as chlorine) are removed in a series of product refining steps before it is cooled to form Plaxx®. This is readily transported for use as the feedstock for a steam cracker.

The capital cost of the RT7000 is relatively low when compared to alternative facilities as it is produced on a modular basis. By locating units at Mechanical Recycling Facilities [MRFs] the expensive and environmentally polluting transportation of waste plastic is avoided. Low capital cost and low operational costs combine to provide a solution for residual plastic that is lower cost than EFW gate fees, produces a feedstock that is lower priced than Naphtha and provides a payback on the machine of less than 3 years.