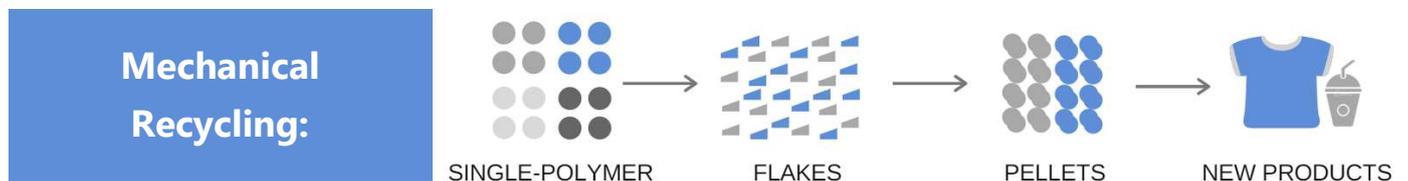


# QUESTIONS AND ANSWERS: CHEMICAL RECYCLING

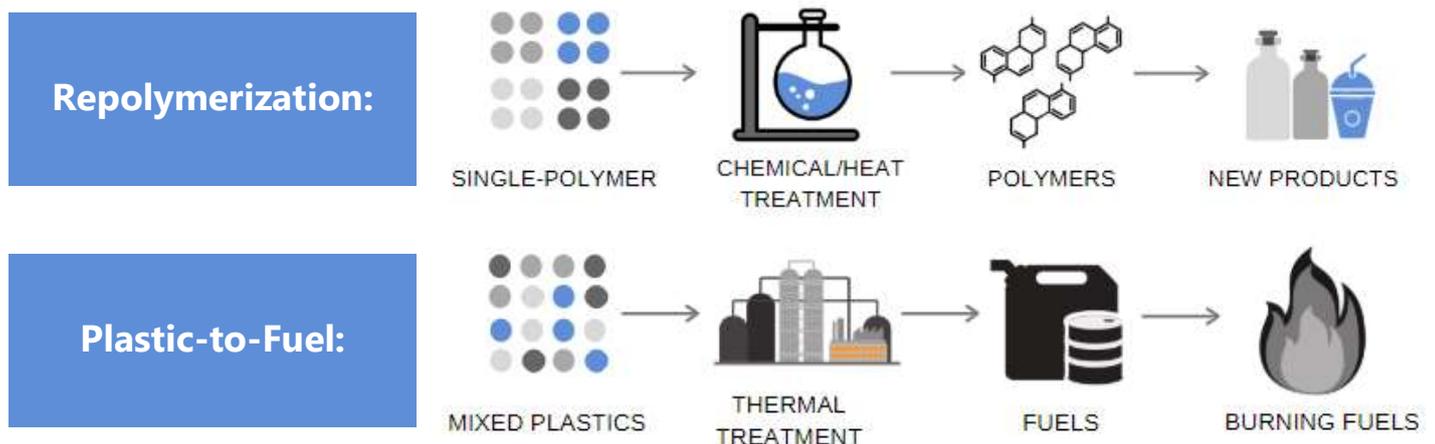
## Q. How is plastic recycled?

**A.** Plastic is collected, sorted, washed, ground into flakes, sorted again, and then melted into pellets, which are used to make new products. This process is called "mechanical recycling." Recently, the plastics industry has been proposing the use of new technologies that they call "chemical recycling."



## Q. What is chemical recycling?

**A.** "Chemical recycling" is an industry greenwash term used to lump together various plastic-to-fuel and plastic-to-plastic technologies. These processes turn plastic into liquids or gases which could be used to make new plastic but in practice are usually burned. The terms "pyrolysis", "solvolyis", and "depolymerization" are also used to refer to different technological variants of this process. **Whatever the process is called, if the end-products are burned, it's plastic-to-fuel.**



## Q. Why is it called recycling?

**A.** In principle, the liquids and gases can be turned back into plastic, a process which is better called "repolymerization." However, this is at present technically challenging and uneconomical. Industry uses the term "chemical recycling" to deliberately blur the distinction between recycling (plastic to plastic repolymerization) and incineration (plastic-to-fuel).

## Q. Why is it important to distinguish plastic-to-plastic from plastic-to-fuel?

**A.** Repolymerization produces new plastic, which reduces the demand for fossil fuels, lessening the environmental impact of producing plastic. Turning plastic into fuel to be burned does nothing to address the many forms of pollution created by producing ever-increasing quantities of plastic. The European Union's Waste Framework Directive is crystal clear that producing fuels from waste cannot be labeled or counted as "recycling."

## Q. Is plastic-to-fuel climate-friendly?

**A.** No, almost all plastic is made from oil and natural gas, so **it is still a fossil fuel**. Greenhouse gases are released in the production of plastic, in transforming it into fuel, and in burning the fuel.

## Q. Are there other problems with plastic-to-fuel?

**A.** Plastic-to-fuel facilities are both waste and petrochemical factories, with the ensuing toxic emissions, liquid effluent, and solid waste. In addition, the plastic-derived fuel releases toxic substances when burned. Plastic-to-fuel technology is energy inefficient and costly, and has had several high-profile failures, including facility fires and explosions.

### The problems of plastic-to-fuel



PTF PRODUCES  
DIRTY FOSSIL  
FUEL



TOXIC EMISSIONS,  
ASH, CHAR, SLAG  
AND WASTE WATER



ENERGY-  
INTENSIVE TO  
OPERATE AND  
MAINTAIN



COST-  
PROHIBITIVE,  
HIGH-PROFILE  
FAILURES



PTF JUSTIFIES  
OVERPRODUCTION  
OF PLASTIC

## Q. Is repolymerization economical?

**A.** Repolymerization requires collecting post-consumer plastic, cleaning it, and sorting it according to polymer type and additives. This is highly expensive. Meanwhile, new polymer made from fracked natural gas is very cheap, so plastic manufacturers use new polymer rather than recycled polymer, further adding to the plastics and climate crises. Repolymerization is even more expensive than mechanical recycling, which is struggling to find markets.

## Q. How does repolymerization compare with traditional (mechanical) recycling?

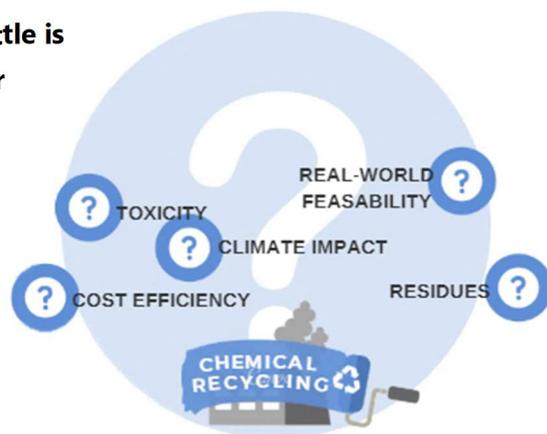
**A.** Both usually require input streams that consist of a single type of plastic (polymer). Mechanical recycling generally downgrades plastic by shortening the polymer length. It also has trouble with additives and contaminants in the plastic. Repolymerization can produce plastic that is similar in quality to new plastic. It is also more tolerant of some additives and contaminants. However, repolymerization is much more energy-intensive than mechanical recycling, resulting in greater greenhouse gas emissions.

## Q. What is the operational history of “chemical recycling”?

**A. Most plants that claim to do chemical recycling are turning plastic into fuel.** A few pilot-scale projects do produce plastic, but they handle relatively limited inputs, not the full range of plastic waste. Many such plants use pyrolysis, which is not a new technology; it has been around for decades, but has never been technically or commercially successful. Despite the industry hype, the European Union Commission has said that repolymerization technology is at least ten years away from commercial application -- far too long to tackle the climate and pollution issues posed by plastics.

## Q. What is the environmental track record for repolymerization?

**A.** Because the operators are not forthcoming with their emissions data, **little is known about these technologies’ toxic air emissions, liquid effluent, or solid waste streams**, but they are probably comparable to other petrochemical facilities. A particular concern is the fate of contaminants and additives, including toxic metals, in the plastic, and their post-processing management. These questions will need to be impartially studied under real-world operating conditions to understand the full environmental impact of repolymerization.



## Q. If “chemical recycling” is an immature technology, why are we hearing so much about it?

**A.** The oil, gas, and petrochemical industries are rapidly expanding plastic production; they aim to increase 40% in the next decade. To quell growing concern, they are trying to convince the public that they can clean up the plastic pollution problem with technology. This is a distraction tactic to avoid talking about the real solution, which is to stop fracking and produce less plastic, especially single-use plastic products.

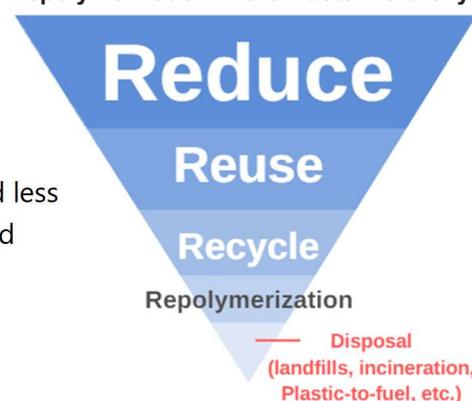
## Q. Who is promoting these technologies?

**A.** The chemical recycling companies are pretty small, but they are financially backed by the oil and gas majors, incineration giants, and large petrochemical firms. For example, a major promoter is the Alliance to End Plastic Waste, which includes BASF, ExxonMobil, Occidental Petroleum, PepsiCo, Reliance Industries, SABIC, Shell Oil, Suez, and Veolia among others.

## Q. How should “chemical recycling” be regulated?

**A. Regulations should clearly distinguish between repolymerization and plastic-to-fuel.** Plastic-to-fuel should be phased out, along with other fossil fuels. Repolymerization should not benefit from subsidies, regulatory incentives, or environmental deregulation. These could help it compete against preferable activities including mechanical recycling, which has a smaller carbon footprint and less toxic byproducts. Such facilities must be carefully monitored for toxic and greenhouse gas emissions, waste and effluent handling.

Repolymerization in the waste hierarchy



## Q. What should we do with plastics that cannot be safely recycled?

**A.** Landfilling plastic is the “least bad” option; plastics in landfills are relatively inert, as long as the landfills do not burn. Incineration and plastic-to-fuel are worse; they release large quantities of greenhouse gases and toxic air emissions. Open dumping of plastic is problematic for other reasons: it creates microplastics, threats to wildlife, water pollution, and more. The real solution is to stop making so much plastic, beginning with hard-to-recycle, disposable, and single-use plastics.

## So what is the real solution to the plastic problem?

**Make LESS Plastic. It's that simple.**

## Glossary

- **Depolymerization:** One of several technologies that breaks plastic down into its constituent building blocks.
- **Effluent:** Liquid waste, generally requiring wastewater treatment.
- **Plastic-to-fuel:** A process for turning plastic into a liquid or gas that is then burned for energy.
- **Polymer:** One of several distinct types of plastic, each with its own chemical structure. Different polymers generally cannot be recycled together.
- **Pyrolysis:** The process of heating waste in the absence of oxygen to produce a liquid or gas fuel.
- **Gasification:** Similar to pyrolysis, heating waste in a low-oxygen environment.
- **Repolymerization:** The process of turning plastic waste back into plastic by breaking it down into its constituents and reconstructing the plastic polymers.
- **Solvolysis:** Technologies that use solvents to depolymerize plastic.

## Resources

- **[Report]** Zero Waste Europe. (2019). [El Dorado of Chemical Recycling, State of play and policy challenges](#).
- **[Report]** GAIA. (2017). [Waste Gasification & Pyrolysis: High Risk, Low Yield Processes for Waste Management](#)
- **[Journal article]** Rollinson, A. (2018). [Fire, explosion and chemical toxicity hazards of gasification energy from waste](#). Journal of Loss Prevention in the Process Industries, 54, pp.273-280.
- **[Journal article]** Rollinson, A. and Oladejo, J. (2019). [‘Patented blunderings’, efficiency awareness, and self-sustainability claims in the pyrolysis energy from waste sector](#). Resources, Conservation and Recycling, 141, pp.233-242.
- **[Briefing]** GAIA. (2018). [False solutions to the plastic pollution crisis](#)
- **[Campaign]** GAIA. (2018). [Say NO to Dow’s Dirty Energy Bag!](#)

This publication was made possible in part through funding support from the Plastic Solutions Fund.