The Fraud of "Advanced Recycling"

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Positioned as the plastics industry's latest "solution" to the plastic waste crisis, so-called "advanced recycling" (or chemical recycling) is an industry catch-all term for a variety of processes—most commonly, pyrolysis and gasification—that are intended to break a polymer down into its basic chemical elements. Contrary to industry representations, advanced recycling is not "advanced"—it relies on decades-old technology that has never proven viable at scale. Further, it is not "recycling"—it does not meaningfully keep plastic in the production cycle and does not satisfy the definition of recycling as established by the U.S. Environmental Protection Agency (EPA) and others.

"Advanced recycling" is not a solution to the plastic waste crisis.

Despite nearly 50 years of failure, and citing no meaningful breakthroughs, the plastics industry wants us to believe that chemical recycling technologies will suddenly develop into a silver-bullet solution to the plastic waste crisis. In reality, "advanced recycling" is nothing more than the plastics industry's most recent boondoggle—an effort to deceive the public and preserve its social license to continue producing plastic.

Advanced recycling is not "advanced."

The plastics industry knows that chemical recycling is not "new."

Despite the plastics industry's efforts to present "advanced recycling" as a recent breakthrough—ExxonMobil CEO Darren Woods, for example, called it a "brand new technology" in a 2022 interview[1]—these technologies have been around for decades. As early as 1977, a brochure from the Society of the Plastics Industry (SPI) claimed that pyrolysis would allow plastic waste to be "recycled into feedstocks that can be used again to make new plastics."[2] Yet, this has never been realized at scale, and the industry has cited no breakthroughs that would allow it to scale now.

The plastics industry knows that chemical recycling is not economically viable at scale.

Over the decades, chemical recycling has run up against many of the "same constraints that bedevil all plastics recycling processes,"[3] in particular, the overall economics of the process. A 1973 report on pyrolysis produced by industry consultants found that, as with mechanical recycling, the level of collection and sorting needed to produce a usable oil product through chemical recycling was "neither technically nor economically feasible at the present time, and probably will not be in the future."[4] Due to the economics, in 1981, experts concluded that it was "difficult at this time to foresee the building of plants to pyrolyse municipal refuse."[5] As an Exxon Chemical employee explained to American Plastics Council (APC) staffers in a 1994 meeting, pyrolysis is a **"fundamentally uneconomical process."**[6]

The plastics industry knows that chemical recycling is energy inefficient.

The scientific community has long understood that chemical recycling is inherently inefficient. The "loss of efficiency and emission potential" of pyrolysis and gasification presents "an obvious limitation," according to a 1986 research paper.[7] And in 2003, a long-time industry consultant criticized the industry for entertaining the idea of chemical recycling on this basis, writing: "It's disgraceful either way—either people knew it was an energy-loser and didn't want to let it be known, or else they didn't bother to figure it out at all."[8]

In 50 years, industry efforts to develop and scale up chemical recycling have repeatedly failed.

The plastics industry has first-hand knowledge of the limitations of chemical recycling due its repeated failures across Europe and North America between the 1970s and 2010s.[9] In the 1990s, petrochemical companies like DuPont and Eastman established chemical recycling programs to much fanfare before shutting down their facilities by the end of the decade.[10] In recent years, numerous investigations have revealed that of the dozens of facilities announced since the 2000s, few are in operation, and none are successfully recycling plastic waste at scale.[11]

Advanced recycling is not "recycling."

The plastics industry knows that plastic-to-fuel conversion is not "recycling."

For all the plastics industry's promotion of "advanced recycling" as the key to achieving closed-loop recycling, plastic-to-plastic chemical recycling has never proven viable at scale. Rather than being made into new plastic products, the majority of pyrolysis oil generated by advanced recycling technologies is converted into fuel that is later combusted.[12] This is not "recycling," nor is it recognized as such by the U.S. EPA,[13] various states,[14] and international standards.[15]

The plastics industry knows that chemical recycling results in low yields and low recycled content.

The majority of plastic fed into an advanced recycling system is consumed through the process of depolymerization. Even in a lab setting, only 1-14% of plastic waste processed via chemical recycling could become new plastic feedstocks.[16] In addition, this pyrolysis oil is contaminated and must be heavily diluted with virgin fossil fuels to be used in the production of new plastics.[17] Thus, even if plastic-to-plastic chemical recycling were economically viable at scale, it is not "circular" and would not meaningfully offset the need for new plastic production.

The plastics industry is recycling its deception.

The plastics industry is using the same deceptive tactics it employed in the 1980s and 1990s to sell the public on mechanical recycling. The plastics industry has long promoted recycling, not because it is a true solution for plastic waste, but because it relieves public and regulatory pressure on plastic producers. Just as the plastics industry promoted mechanical recycling in the 1980s and 1990s, the plastics industry is today employing the same playbook with respect to "advanced recycling" by: running deceptive advertising campaigns overstating its viability, announcing unrealistic recycling targets, and publicizing performative investments in recycling technology with no likelihood of success.

Deceptive Advertising

The American Chemistry Council has ramped up its advertising campaigns promoting "advanced recycling" in recent years. The trade organization spent $265,000 advertising on Meta digital platforms in 2022,[18] and significantly expanded its budget the following year, spending more than half a million dollars in just the first three months of 2023.[19] These ads make deceptive claims about chemical recycling, for example, that it "essentially makes things as good as new"[20] and "takes hard-to-recycle plastics and turns them into new plastics that can be renewed again and again."[21]

Unrealistic Targets

The American Chemistry Council has announced a target to make 100% of plastic packaging re-used, recycled, or "recovered" (which is the plastics industry code word for incinerating plastic or turning it into fuel) by 2040.[22] Yet, even at full capacity, current advanced recycling facilities could process only 1.3% of U.S. plastic waste.[23] Even adding this to the 5-6% of plastics that are processed via mechanical recycling,[24] it would be impossible for the industry to meet the 100% recycled or recovered goal without extraordinary growth in capacity.

Performative Investments

Companies such as ExxonMobil,[25] Chevron Phillips,[26] Dow,[27] and Shell[28] have publicized investments in facilities with the capacity to chemically recycle upwards of a billion pounds of plastic. Yet, Exxon recently announced the closure[29] of one of the two facilities that it said in 2021[30] would support this goal, citing poor economics and over 500 million Euros in losses since 2018.

Just as mechanical recycling has failed to live up to the plastics industry's decades of promises, advanced recycling, too, is not a viable solution. Rather, it is the plastics industry's most recent false solution intended to prevent action that could affect plastic production.

For questions or more information, reach out to plastics@climateintegrity.org.

[1] CNBC, *How ExxonMobil Will Survive in The New Climate Reality*, YouTube (43:34) (June 24, 2022), https://www.youtube.com/watch?v=gTZK94-5yjU&t=2614s.

[2] Joel Frados, Society of the Plastics Industry, *The Story of the Plastics Industry* (1977) (on file with CCI #5149.15).

[3] K.F. Drain et al., *Polymer Waste–Resource Recovery*, CONSERVATION & RECYCLING 216 (1981) (on file with CCI #724.16).

[4] Arthur D. Little, Inc., *A State-of-the-Art Study of the Pyrolysis of Solid Wastes* 49-50 (1973) (on file with CCI #782.49-50).

[5] K.F. Drain et al., *supra* note 3, at 216.

[6] Bailey Condrey, *ART Meeting—Houston*, NOTES 1, 27 (Jan. 26, 1994) (on file with CCI #79.27).

[7] A.G. Buekens, et al., *Status of RDF-Production and Utilization in Europe*, 9 CONSERVATION & RECYCLING 233, 249 (1986) (on file with CCI #672.17).

[8] Allan L. Griff, Consulting Engineer, IS RECYCLING GOOD FOR THE ENVIRONMENT? 4 (2003), https://griffex.com/wp-content/uploads/2020/09/Griff-gpec-and-tables.pdf?c772ab&c772ab.

[9] *See* Zero Waste Europe, LEAKY LOOP "RECYCLING" 15-17 (Oct. 26, 2023), https://zerowasteeurope.eu/wp-content/uploads/2023/10/Leaky-Loop-Recycling_-A-Technical-Correction-on-the-Quality-of-Pyrolysis-Oil-made-from-Plastic-Waste-.docx.pdf.

[10] *Dupont Films Spending $16 Million On DMT*, PLASTICS NEWS (Aug. 28, 1995), https://www.plasticsnews.com/article/19950828/NEWS/308289951/dupont-films-spending-16-million-on-dmt; Tom Ford, *Recycled Nylon Resin Output Up*, PLASTICS NEWS (Sept. 11, 1995), https://www.plasticsnews.com/article/19950911/NEWS/309119956/recycled-nylon-resin-output-up; *Dupont Ends Recycling Experiment*, PLASTICS NEWS (Nov. 2, 1998), https://www.plasticsnews.com/article/19981102/NEWS/311029985/dupont-ends-recycling-experiment; Partnership for Plastics Progress, *What Industry is Doing*, P3 10 (Aug. 1992) (on file with CCI #244.220); Development of Recycling Markets: Hearing Before the Subcomm. on Transportation & Hazardous Materials of the H. Comm. on Energy & Commerce, 102nd Cong. 526 (1991) (statement of Bruce Perlson, Ph.D., Manager, Plastics Environmental Affairs, Quantum Chemical Corp. on behalf of the Council for Solid Waste Solutions), *available at* https://books.google.com/books/about/Development_of_Recycling_Markets.html?id=BKwr6JCPCYsC; Associated Press, Kodak Closing Rochester Unit; 80 Jobs Impacted, Manufacturing.net (May 15, 2012), https://www.manufacturing.net/home/news/13209289/kodak-closing-rochester-unit-80-jobs-impacted.

[11] *See, e.g.*, Denise Patel et al., Global Alliance for Incinerator Alternatives, ALL TALK AND NO RECYCLING: AN INVESTIGATION OF THE U.S. "CHEMICAL RECYCLING" INDUSTRY (2020), https://www.no-burn.org/all-talk-and-no-recycling-an-investigation-of-the-u-s-chemical-recycling-industry/ (finding that, of the 37 chemical recycling facilities proposed since 2000, only three were currently operational and none were successfully recycling plastics into new plastics at scale).

[12] *See, e.g.*, Ivy Schlegel, Greenpeace, Deception by the Numbers: American Chemistry Council Claims About Chemical Recycling Investments Fail to Hold Up to Scrutiny 8 (Sept. 9, 2020), https://www.greenpeace.org/usa/wp-content/uploads/2020/09/GP_Deception-by-the-Numbers-3.pdf (finding that of 51 "recycling" facilities, only four were plastic-to-plastic facilities, while 12 were waste-to-fuel facilities, and another seven lacked sufficient data to be classified); Lee Bell, Beyond Plastics & IPEN, Chemical Recycling: A Dangerous Deception 40 (Oct. 2023), https://www.beyondplastics.org/publications/chemical-recycling (finding that of the 11 chemical recycling facilities that have been constructed in the U.S. to date, at least eight of them produce fuel rather than plastic resins).

[13] U.S. Envtl. Prot. Agency, DRAFT NATIONAL STRATEGY TO PREVENT PLASTIC POLLUTION 15 (Apr. 2023) https://www.epa.gov/circulareconomy/draft-national-strategy-prevent-plastic-pollution.

[14] *See, e.g.*, Me. P.L. 2024, ch. 517, §§ 1, 3 https://legislature.maine.gov/legis/bills/getPDF.asp?paper=SP0665&item=3&snum=131 (excluding chemical plastic processing, which includes turning plastic waste into fuel for combustion and other materials other than resins, from the definition of plastic-to-plastic recycling and vice versa); Cal. Pub. Res. Code, §§ 40180, 40201 (2023) https://law.justia.com/codes/california/code-prc/division-30/part-1/chapter-2/ (stating that recycling does not include 'transformation,' including pyrolysis).

[15] *See, e.g.*, Directive 2008/98/EC, of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives, art. 3, 2008 O.J. (L 312) 5, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20240218 (excluding from the definition of recycling "energy recovery and reprocessing into materials that are to be used as fuels" and treating "re-use and material recycling" as distinct and preferred over "energy recovery from waste").

[16] Taylor Uekert et al., *Technical, Economic, and Environmental Comparison of Closed-Loop Recycling Technologies for Common Plastics*, 11 ACS SUSTAINABLE CHEM. ENG. 965, 969 (2023), https://pubs.acs.org/doi/pdf/10.1021/acssuschemeng.2c05497.

[17] See generally Marvin Kusenberg et al., Opportunities and Challenges for the Application of Post-Consumer Plastic Waste Pyrolysis Oils as Steam Cracker Feedstocks: To Decontaminate or Not to Decontaminate, 138 WASTE MANAGEMENT 83 (2022), https://www.sciencedirect.com/science/article/pii/S0956053X21005894 (describing dilution ratios required for various contaminants).

[18] Jordan Wolman, *Advanced Recycling Mines the Meta-verse*, POLITICO (Jan. 5, 2023), https://www.politico.com/newsletters/the-long-game/2023/01/05/advanced-recycling-goes-digital-00076537.

[19] Emily Sanders, *Why Big Oil and the Chemical Lobby are Blasting us with "Advanced" Recycling Ads*, EXXONKNEWS (Mar. 28, 2023), https://www.exxonknews.org/p/why-big-oil-and-the-chemical-lobby.

[20] America's Plastics Makers, *Meet Natalie: The Finder*, YouTube (June 23, 2022), https://youtu.be/6aUZirQvlcw.

[21] America's Plastics Makers, *Meet Jeremy: The Disrupter*, YouTube (Feb. 10, 2023), https://youtu.be/oupNXQpTSag.

[22] Press Release, American Chemistry Council, U.S. Plastics Resin Producers Set Circular Economy Goals to Recycle or Recover 100% of Plastic Packaging by 2040 (May 9, 2018), https://www.americanchemistry.com/chemistry-in-america/news-trends/press-release/2018/us-plastics-resin-producers-set-circular-economy-goals-to-recycle-or-recover-100-of-plastic-packaging-by-2040.

[23] Lee Bell, *supra* note 12, at 39.

[24] Beyond Plastics & The Last Beach Cleanup, THE REAL TRUTH ABOUT THE U.S. PLASTICS RECYCLING RATE 3 (2022), https://static1.squarespace.com/static/5eda91260bbb7e7a4bf528d8/t/62b2238152acae761414d698/1655841666913/The-Real-Truth-about-the-US-Plastic-Recycling-Rate-2021-Facts-and-Figures-_5-4-22.pdf.

[25] ExxonMobil, ANNUAL REPORT 2022 iv (2023), https://d1io3yog0oux5.cloudfront.net/_0525f46847911a3ef8ef04b23fb23196/exxonmobil/db/2301/22049/annual_report/2022-Annual-Report.pdf.

[26] Press Release, Chevron Phillips Chemical, Chevron Phillips Chemical Deepens Collaboration with Nexus Circular, Securing Contracted Long-Term Supply of Advanced Recycled Plastic Feedstocks from New Facility (Feb. 7, 2023) https://www.cpchem.com/media-events/news/news-release/chevron-phillips-chemical-deepens-collaboration-with-nexus-circular.

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[28] Shell, 2022 ANNUAL REPORT 70 (2023), https://reports.shell.com/annual-report/2022/.

[29] Nel Weddle, *ExxonMobil to Close Gravenchon, France Cracker and Related Derivative Units in 2024*, INDEPENDENT COMMODITY INTELLIGENCE SERVICES (Apr. 11, 2024), https://www.icis.com/explore/resources/news/2024/04/11/10989084/exxonmobil-to-close-gravenchon-france-cracker-and-related-derivative-units-in-2024/.

[30] ExxonMobil, Form 8-K 3 (Oct. 29, 2021), https://ir.exxonmobil.com/node/33506/html.