

GREENPEACE

THE CLIMATE EMERGENCY UNPACKED

**HOW CONSUMER GOODS COMPANIES
ARE FUELING BIG OIL'S PLASTIC EXPANSION**

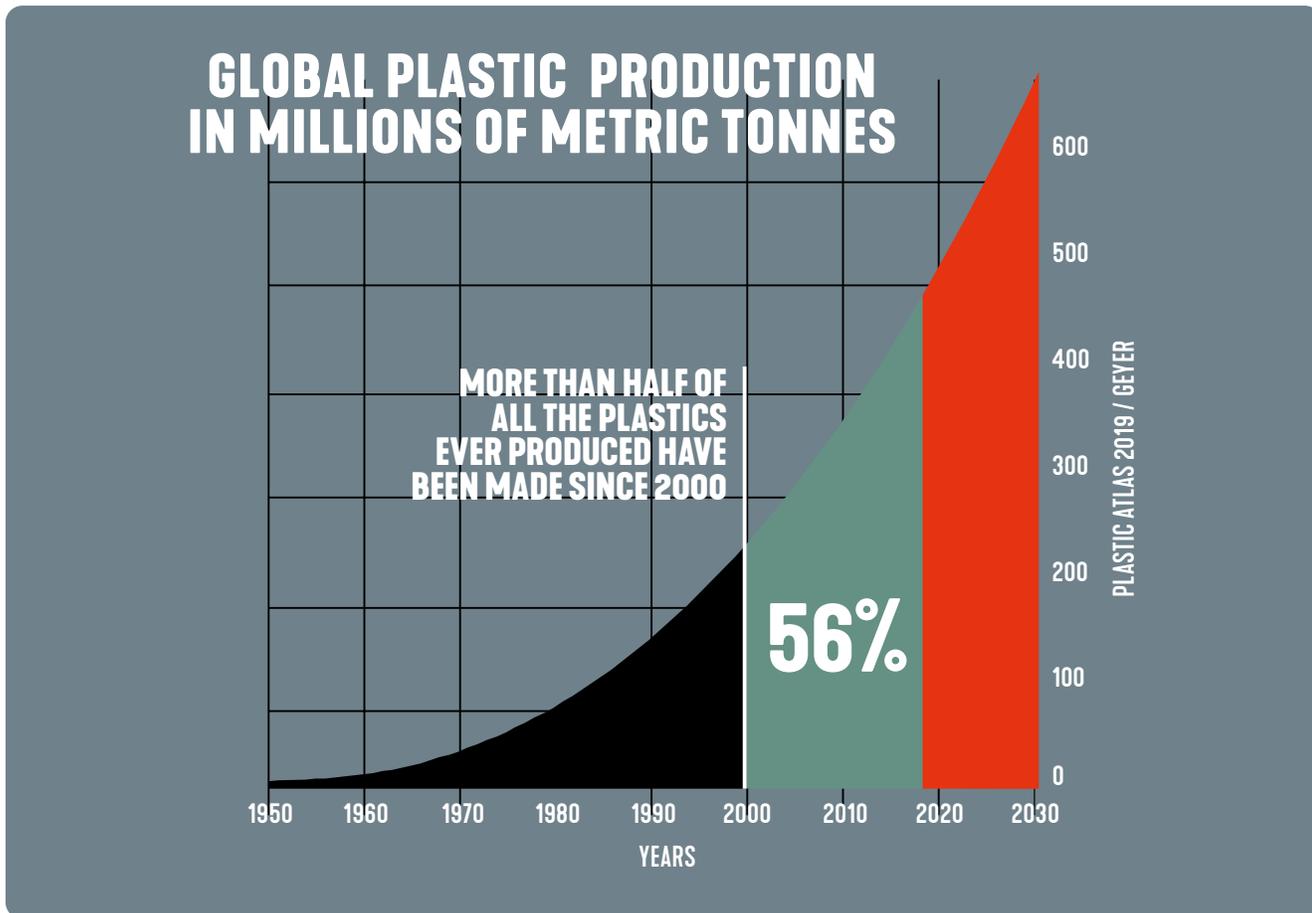




- A** A tar sands 'upgrader' plant.
© Ian Willms / Greenpeace
- B** Shopping for single-use water bottles.
© 2017 Tony Thiethoaly/Shutterstock
- C** Waste incinerator plant with smoking
smokestack. © 2017 Roneyda/
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INTRODUCTION



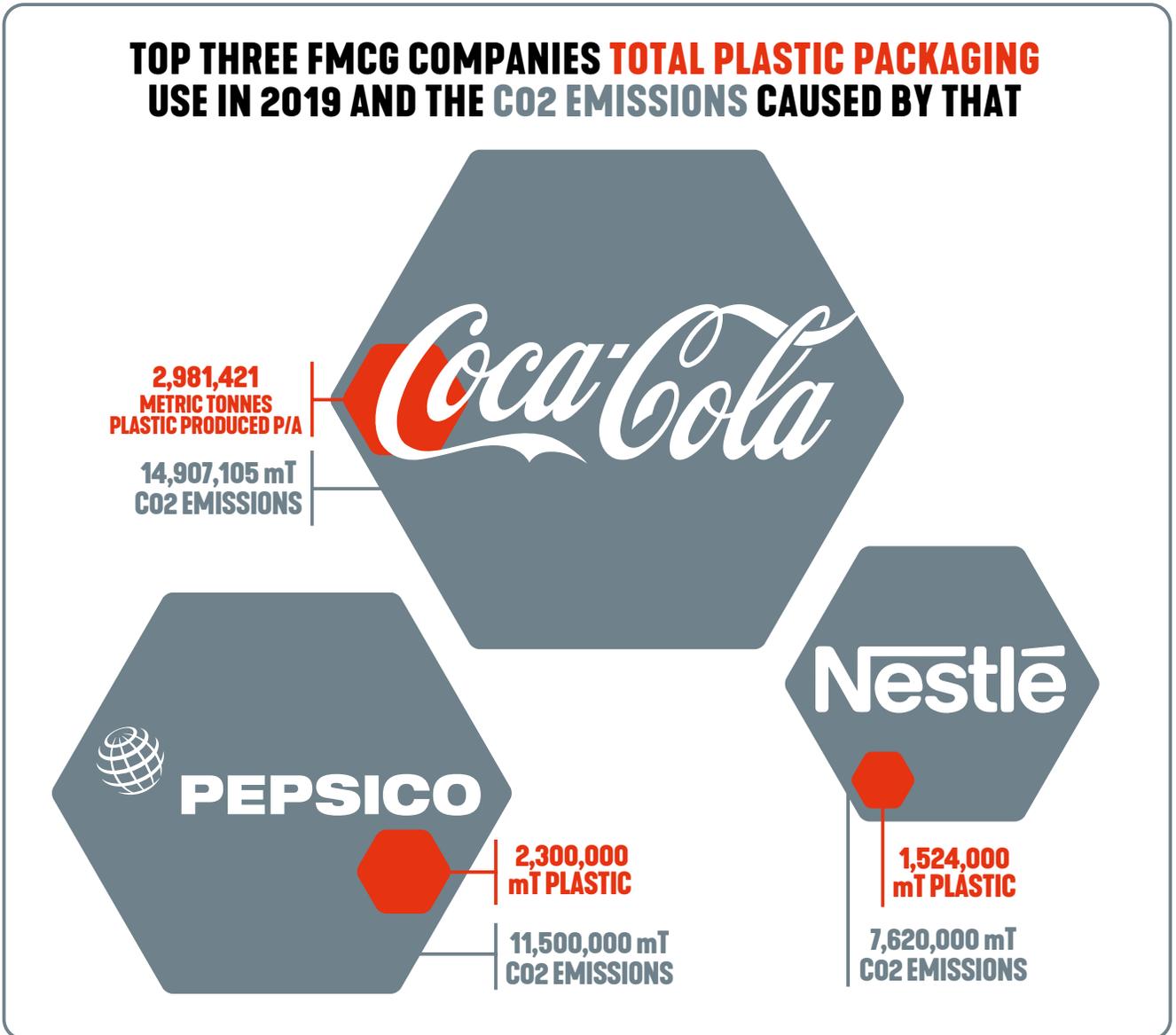
As the climate crisis intensifies, there is growing worldwide acceptance of the need to slash greenhouse gas (GHG) emissions from the burning of fossil fuels to limit global heating to 1.5 °C above pre-industrial levels.¹ As this need for drastic cuts in fossil fuel emissions begins to assume concrete form - as car companies invest heavily in electric technology, and local and national governments start to timetable bans on gasoline and diesel vehicles² and domestic gas boilers³ - the fossil fuel industry's future is necessarily coming into question. Institutional and equity investors, banks and insurers have been progressively withdrawing from the sector because of its doubtful future in a world increasingly alert to the urgent need to halt global heating.⁴ Companies that have invested and continue to invest huge sums of money in finding and developing new oil and gas fields and building refineries (even though the oil and gas in already operational fields would by itself be enough to take the world past the 1.5 °C carbon budget⁵)

risk being left with stranded assets⁶ and plunged into financial jeopardy.

In response to this existential uncertainty, vertically integrated fossil fuel majors such as Aramco,⁷ Total,⁸ Exxon⁹ and Shell¹⁰ have reportedly been making massive investments in petrochemical and plastic production. They are well placed to do so, as more than 99% of plastic is produced from fossil fuels,¹¹ with an estimated 6% of global oil production either used as feedstock for plastics or burned to provide energy for the production processes.¹² Significant amounts of ethane and propane separated from natural gas are also used. Coal is also used as a plastic feedstock, particularly in China.¹³

Global production and consumption of plastics have increased dramatically since the 1950s.¹⁴ According to trade body PlasticsEurope, in 2020 global plastic production reached 367 million metric tons, up from 359 million metric tons in 2018.¹⁵ If business as usual continues,

TOP THREE FMCG COMPANIES TOTAL PLASTIC PACKAGING USE IN 2019 AND THE CO₂ EMISSIONS CAUSED BY THAT



industry estimates predict that plastic production could double by 2030-2035 and triple by 2050, in comparison to 2015.¹⁶ Indeed, according to a recent report by the Minderoo Foundation, producers of the five primary single-use plastic polymers plan to increase capacity by 30% - an additional 70 million metric tons - in the five years between 2020 and 2025 alone.¹⁷

As well as driving an increase in plastic pollution, such expansion would bring a huge increase in GHG emissions, threatening humanity's ability to keep global heating below 1.5 °C. In the U.S., a recent study found that new and proposed oil, gas and petrochemical infrastructure in the industry's Texas and Louisiana heartland alone will potentially emit an extra 541 million metric tons of carbon dioxide equivalent (CO₂e) annually by 2030, equal to the emissions of 131 coal-fired power plants - with 38% of this attributable directly to petrochemical facilities.¹⁸ A report from the Center for International Environmental Law (CIEL)

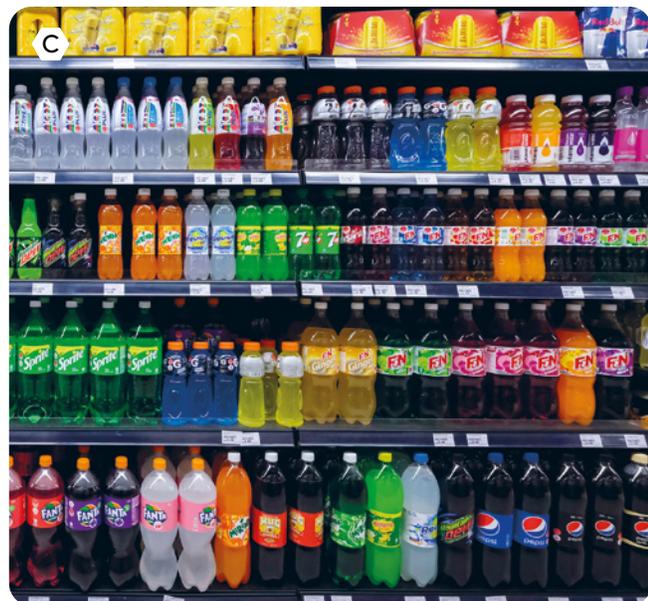
estimates that projected growth in plastic production would see global emissions from the plastic life cycle increase by more than 50% of 2019 levels to 1.34 billion metric tons CO₂e a year by 2030 - equivalent to nearly 300 coal-fired power plants - and more than double again by 2050. The report adds that the sector's total emissions by 2050 could use between 10% and 13% of the entire 1.5 °C carbon budget, rising to a quarter or more by 2100.¹⁹

Plastic industry expansion seems to be grounded in sectoral assumptions not only that fossil feedstocks will go on being cheap and abundant,²⁰ but also that demand for plastic will keep growing (both in the global North and in the global South).²¹ And as some of the world's most iconic users of single-use plastic packaging, fast-moving consumer goods (FMCG) companies like Coca-Cola, Nestlé and PepsiCo are playing a key role in creating that demand.

Plastic packaging has been estimated as the single largest use of virgin plastic annually - packaging accounts



- Ⓐ La Porte, Texas. Ineos and Braskem oil facilities. © Aaron Sprecher / Greenpeace
- Ⓑ Plastic nurdles are plastic in its raw state, before being manufactured into plastic objects. © Shutterstock
- Ⓒ Kuala Lumpur, Malaysia. Energy drinks, soda and soft drinks in single-use plastic bottles. © Abdul Razak Latif/Shutterstock
- Ⓓ Malaysia. Packaging from everyday British products - exported as recycling - is discarded at multiple illegal dump sites. © Greenpeace
- Ⓔ Waste incinerator. © hassan/Shutterstock
- Ⓕ Indonesia. People collect plastic and paper to take to a local factory, where it is burned as fuel. © Ecaton/Fully Handoko
- Ⓖ Wiang Thoeng subdistrict, Thoeng District, Chiang Rai Province, Thailand. Waste disposal by burning. © NikonStocker/Shutterstock
- Ⓗ Dumaguete City, Philippines. Discarded Coca-Cola label is seen on a pile of plastic bottles at a dumpsite. © Greenpeace



for around 40% of total non-fiber plastic demand and contributes over half of plastic waste worldwide.²² And bullish industry projections talk up the scope for sector growth, driven by sharp increases in plastic consumption in developing economies.²³ Despite intensifying public and regulatory pressure on consumer brands to address their plastic pollution, most FMCG companies have failed to meaningfully reduce single-use plastic packaging and adopt reuse-based alternatives.²⁴ In this context, **the FMCG sector's continued dependence on single-use plastic packaging is helping enable the fossil fuel industry's move to expand plastic production.**

In this report, we examine how **consumer brands' failure to significantly reduce their reliance on single-use plastic, combined with ongoing fossil fuel industry investments of billions of dollars in expanding plastic production capacity, risk creating a plastic boom that could triple production capacity by 2050.** In addition to accelerating

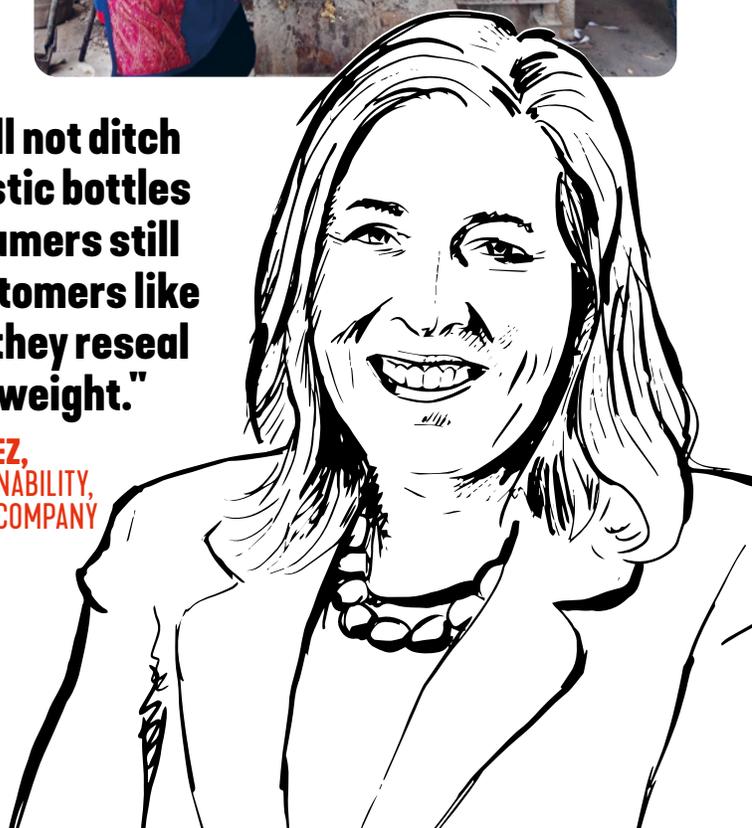
the plastic pollution crisis, this expansion poses a serious threat to our ability to stay within the 1.5 °C carbon budget. Specifically, we examine:

- **How FMCG companies are failing to transparently report the full climate impacts of their plastic packaging;**
- **Supply chain connections between nine major FMCG companies and the fossil fuel industry;**
- **The decades-long focus on recycling as a smokescreen to enable increased plastic production;**
- **Climate impacts and issues with "chemical recycling";**
- **Human health and environmental justice impacts of the petrochemical expansion;**
- **Key geographies where the expansion is happening; and**
- **The need for FMCGs to shift to package-free or reusable systems of delivery to stop enabling the fossil fuel industry expansion and to help meet climate goals.**



"Coca-Cola will not ditch single-use plastic bottles because consumers still want them. Customers like them because they reseal and are lightweight."

**BEA PEREZ,
HEAD OF SUSTAINABILITY,
THE COCA-COLA COMPANY**



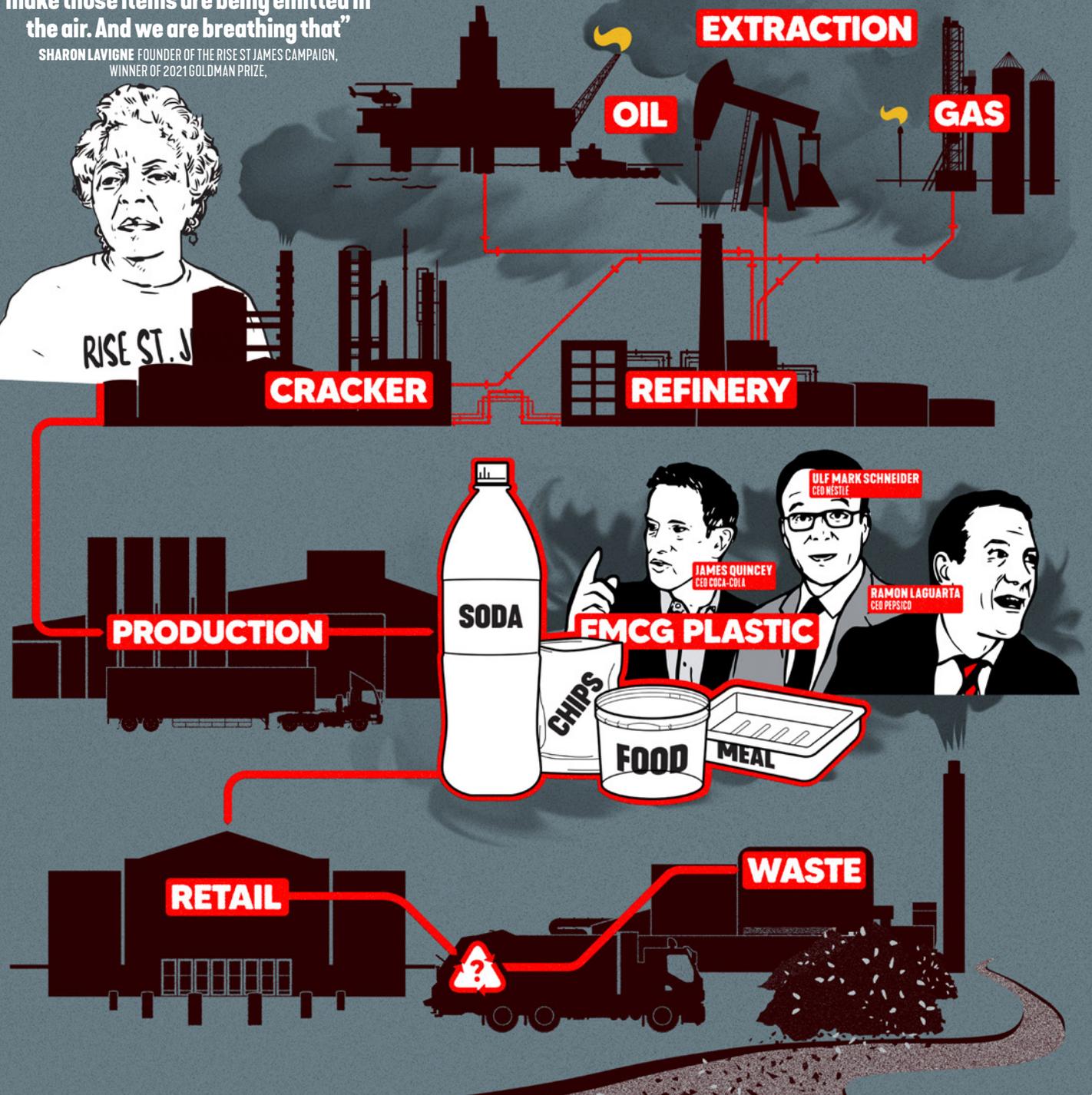
THE EMISSION INTENSIVE PLASTIC PRODUCTION SYSTEM

HOW OIL AND GAS ARE TURNED INTO PLASTIC PACKAGING – AND WHAT BECOMES OF THAT PACKAGING AFTER IT HAS BEEN USED

FROM BREATHE THIS AIR, PEAK PLASTIC FOUNDATION.

“The plastics we use in our everyday life, the chemicals that are used to make those items are being emitted in the air. And we are breathing that”

SHARON LAVIGNE FOUNDER OF THE RISE ST JAMES CAMPAIGN, WINNER OF 2021 GOLDMAN PRIZE.



PLASTICS ARE CONTRIBUTING TO CLIMATE CHANGE

GHGs are emitted at every stage of the plastic life cycle. During oil and gas extraction, gas consisting mainly of methane – a GHG tens of times as powerful as carbon dioxide – leaks into the atmosphere. In oil fields that lack gas processing infrastructure, gas from wells may be intentionally vented or flared (burned off): the latter consumes the methane but releases large amounts of carbon dioxide and other harmful air pollutants. Emissions also result from the fossil fuel-derived energy consumed by the drilling process and the piping of oil and gas to processing facilities, as well as from leaking pipelines and tanks.

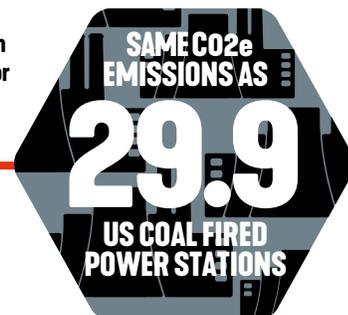
Energy is used by each stage in the production of plastic packaging from raw natural gas or crude oil. These include refining out the feedstock, such as ethane (one of several gaseous so-called “natural gas liquids” processed out from the methane that is the main constituent of natural gas) or naphtha (a liquid fraction refined from crude oil), “cracking” this feedstock into substances called olefin monomers,²⁵ polymerizing these monomers and processing them further into plastic resins with the desired qualities, and then manufacturing packaging items from these resins. These processes all involve GHG emissions, with cracking being especially energy-intensive. Between some of these stages there are transport-related emissions too.

Once plastic packaging is discarded, it may end up being burned in an incinerator/waste-to-energy plant or (especially in developing countries) in the open air. Both scenarios release large amounts of GHGs and other harmful air pollutants. Alternatively, the packaging may be recycled. Mechanical recycling is said to produce around half the emissions that would result from production of an equivalent amount of virgin plastic.²⁶ So-called “chemical recycling” processes may be even more energy-intensive; companies have been reluctant to disclose their emissions, but the available data indicate very large carbon footprints.

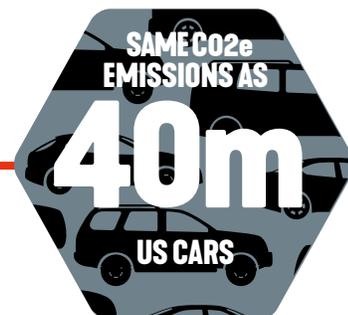
If plastic packaging is sent to a landfill, emissions are largely confined to those from its collection and transportation. However, plastic at the surface of landfills, as well as plastic that ends up in the environment, degrades on exposure to sunlight, emitting methane and other gases.²⁷ Plastic in the oceans may also interfere with plankton’s ability to absorb carbon dioxide from the atmosphere,²⁸ which serves as a vital brake on global heating. In 2019, the estimated global emissions of the entire plastic life cycle (including incineration) for that year were calculated to be equivalent to those of nearly 200 coal-fired power stations.²⁹

Many analyses of plastics’ climate impact have focused on the emissions from resin production and manufacturing of plastic products,³⁰ overlooking the large upstream contribution of fossil feedstocks and the impact of disposal. CIEL has estimated that oil extraction, transportation and refining for plastic production are responsible for emissions of 108 million metric tons CO₂e worldwide, with natural gas extraction and transportation for plastic production in the

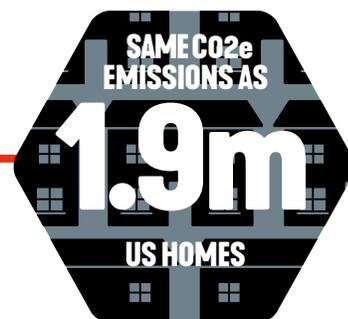
Worldwide emissions from extraction and refining of fossil hydrocarbons for use in plastic production up to 118.5 million metric tons CO₂e;



Worldwide emissions from steam cracking of ethane, naphtha and other primary feedstocks to produce ethylene and other petrochemical feedstocks between 184 and 213 million metric tons of carbon dioxide;



Worldwide emissions from incineration of plastic packaging 16 million metric tons CO₂e.



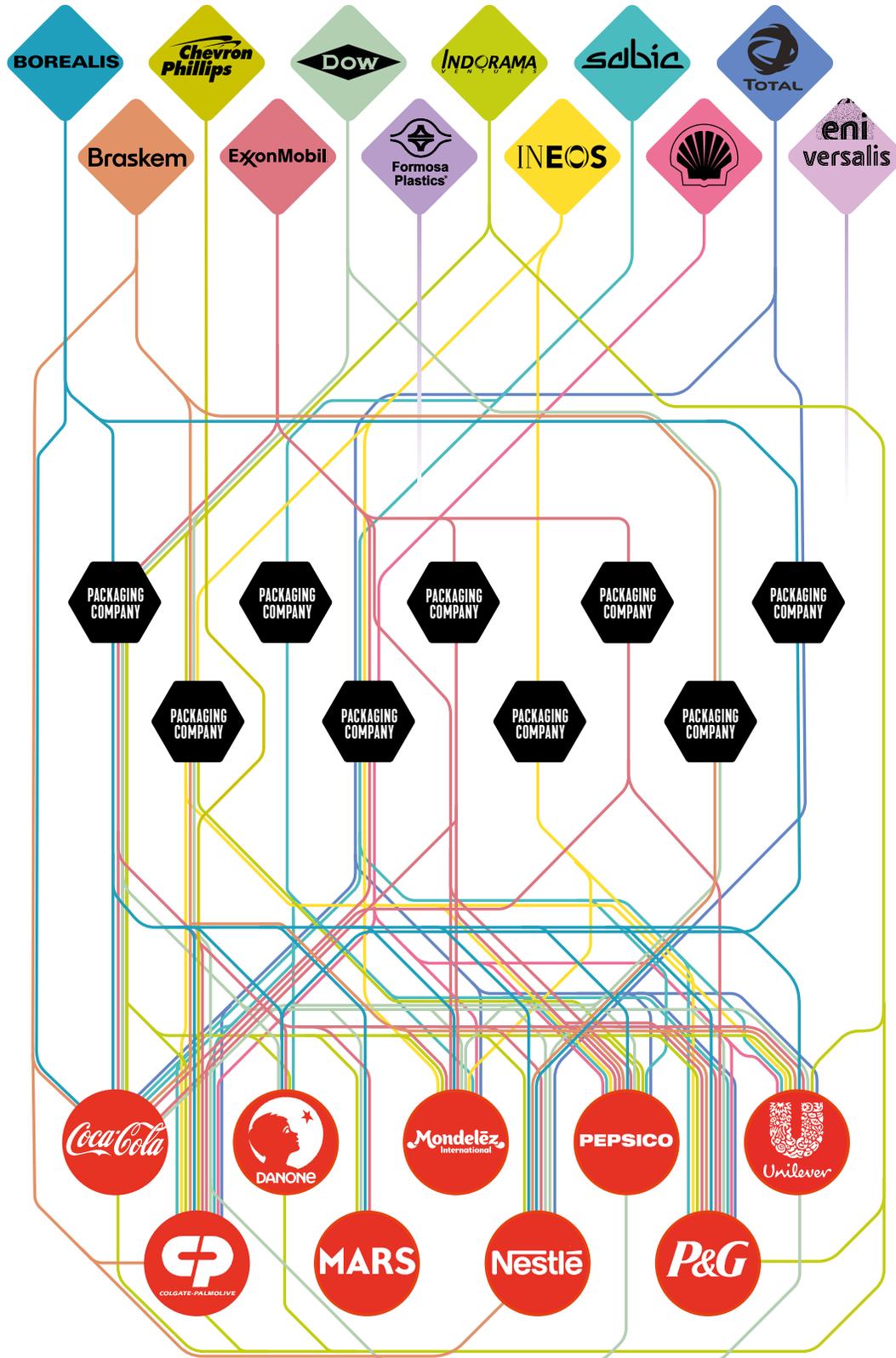
U.S. alone contributing an additional 9.5 to 10.5 million metric tons a year.³¹ The boom in gas and oil fracking is of particular concern, owing to large-scale leakage and venting of methane.³²

Analyses that include these embedded upstream emissions have estimated the average emissions of plastic production at around 5 metric tons CO₂e per metric ton of plastic if end-of-life emissions (associated with landfill, incineration or recycling) are also included.³³

While many FMCG companies disclose the GHG emissions attributed to their overall supply chain, and in some cases the total emissions that they attribute to plastic packaging, none of the nine major companies on which we have focused in this report (Coca-Cola, PepsiCo, Nestlé, Mondelēz, Danone, Unilever, Colgate-Palmolive, Procter & Gamble and Mars) publicly discloses how it calculates the emissions produced by each metric ton of plastic that it uses – making independent verification of their claims impossible. **Given that historically some life-cycle analyses of plastic performed by or relied on by FMCG companies do not fully include the impacts attributable to oil and gas exploration, extraction and processing, the GHG emissions of these companies’ plastic packaging could be much higher than they realize or are willing to disclose.** This could also be the case if the companies are failing to take proper account of the risk of their packaging being incinerated, for example, by mapping their local sales data onto publicly available information about municipal waste disposal methods.

PLASTIC PACKAGING

THE KEY PLAYERS



Known and suspected supply chain connections between fossil fuel companies and consumer brands shown here.

BIG BRANDS PARTNER WITH BIG OIL TO PROFIT FROM PLASTICS



The plastic supply chain is largely opaque, making it hard to trace an individual single-use plastic package sold by an FMCG company back through the processes of packaging manufacturing, plastic resin production, petrochemical production, and oil and gas extraction, refining and processing. However, establishing supply chain links is made somewhat easier by the fact that many of the world's largest fossil fuel companies are vertically integrated businesses with significant downstream operations, supplying and processing oil and gas, producing petrochemicals and manufacturing plastic resin - in fact, some of them are among the world's largest plastic resin producers.

This report looks at the supply chain relationships between nine major FMCG companies responsible for significant amounts of plastic pollution globally, and 12 key resin producers providing the world with plastic resin and packaging. Ten of the resin suppliers are large fossil fuel companies, and only two exclusively make plastic and plastic packaging. At least one analysis suggests that nearly all of the plastic producers profiled here have at least half of their capacity tied directly to plastic packaging.³⁴ To determine which companies to include for this analysis, we reviewed worldwide 2019 plastic resin production capacity, prioritizing polyethylene and polypropylene for their relevance to the plastic packaging market. Of the top 25 plastic resin producers, we examined ExxonMobil (#1 in worldwide capacity), Dow (#2), SABIC (#3, a subsidiary

of Saudi Aramco), Ineos (#5), Braskem (#6), Formosa (#8), Total (#12), Indorama (#13), Chevron Phillips Chemical (#15) and Borealis (#22, a subsidiary of OMV).³⁵ Shell³⁶ and Eni³⁷ (through its subsidiary Versalis³⁸) are also key players in the production of single-use plastic packaging.

Despite the FMCG sector's lack of transparency concerning its plastic supply chains, our investigation revealed plastic supply chain connections between every single FMCG company we researched and at least one major fossil fuel and/or petrochemical company. **Coca-Cola, PepsiCo, Nestlé, Mondeléz, Danone, Unilever, Colgate-Palmolive, Procter & Gamble and Mars all buy packaging from manufacturers supplied with plastic resin or petrochemicals by well-known companies like ExxonMobil, Shell, Chevron Phillips, Ineos and Dow.** All the connections our research identified are shown in the supply chain graphic and in the Appendix.³⁹

To establish these supply chain connections, we consulted detailed import/export records⁴⁰ and analyzed customer-supplier relationships via the Bloomberg data service.⁴¹ We also reviewed publicly available sources, including company annual reports, press releases and websites, and identified plastic manufacturers co-located at FMCG manufacturing facilities.

To understand the nature of the relationships we found and that are presented in this chart, it is helpful to consider the example of PET bottles.

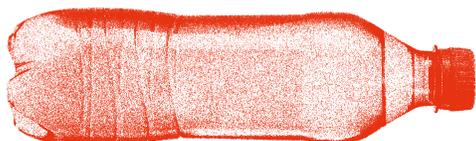


17 December, 2020, Baytown, Texas.
Oil storage facilities at ExxonMobil Baytown refinery and petrochemical complex.
© Aaron Sprecher / Greenpeace

THE PET BOTTLE

One of the most iconic and familiar plastic packaging materials is polyethylene terephthalate (PET), used for water and soda bottles as well as bottles for shampoo, liquid soap and body wash. For the majority of the nine FMCG companies highlighted in this report, PET represents a large share of their packaging portfolios by weight.⁴² For example, in 2020, PET made approximately 45% of the total packaging mix used by Coca-Cola⁴³ 49% and 27% respectively of the plastic packaging used by Danone,⁴⁴ and Colgate-Palmolive.⁴⁵

The use of PET bottles has long been justified by the beverage industry on the grounds that they are more environmentally friendly than other packaging types because of their lower weight, and thus lower transport-related emissions.⁴⁶ Indeed in the late 1960s, Coca-Cola sponsored the first life-cycle analysis to justify the use of plastic for its soda bottles in light of rising environmental concerns around disposable plastic bottles.⁴⁷ However, recent analyses suggest that PET is one of the more emissions-intense plastics, second only to polystyrene, when total life-cycle emissions are considered.⁴⁸



HOW A PET BOTTLE IS MADE

PET is a type of polyester. The two primary raw materials for PET are the petrochemicals monoethylene glycol (MEG), also known as ethylene glycol, and terephthalic acid (TPA) or purified terephthalic acid (PTA).⁴⁹ TPA/PTA itself is produced from paraxylene (PX), which is produced at oil refineries, generally from naphtha,⁵⁰ while MEG is produced from ethylene, via the intermediate ethylene oxide.⁵¹ PET specifically and polyester more broadly represent a key end use of both TPA/PTA⁵² and MEG.⁵³ TPA/PTA is reacted with MEG to produce PET resin.⁵⁴ The resin is heated until molten, then injection-molded into what are known as PET preforms, which can later be blown into plastic bottles. PET resin can also be extruded into sheets that can then be formed into packaging such as cupcake trays and fruit and vegetable containers.

KEY MANUFACTURERS

Key manufacturers of both PET and TPA/PTA include **Alpek** (notably U.S. subsidiary DAK Americas), **Indorama Ventures (IVL)** and **Nan Ya Plastics** (a subsidiary of **Formosa**). Growth projections indicate that Indorama's PET capacity could reach 6 million metric tons per year by 2024, nearly double that of its closest competitor Alpek/DAK Americas.⁵⁵ **Ineos Oxide** is the largest producer of ethylene oxide and MEG in western Europe.⁵⁶



PET plastic bottle production conveyor belt. ©Shutterstock

DIFFERENT WAYS OF OPERATING

Some PET producers are integrated, meaning that they produce and market petrochemicals and resin (in the form of chips or pellets), as well as PET preforms, bottles and sometimes finished bottles (with caps and closures). PET producers also sell their PET resin to packaging manufacturers, such as **Amcor** or **Berry Global**,⁵⁷ that use it to make preforms, bottles, sheets, and rigid PET packaging, which are then sold to FMCG companies. Some beverage companies, however, make their own PET bottles from purchased resin, or blow-mold bottles from purchased preforms. Some large beverage companies even engage a packaging company to set up a bottle manufacturing plant within their production facility (co-location).

Thai-based Indorama is an example of an integrated petrochemical and resin manufacturer; it claims that one in five PET bottles in the world is manufactured from its resins.⁵⁸ In recent years Indorama has purchased key petrochemical inputs from fossil fuel companies **Chevron Phillips** (ethylene), **ExxonMobil** (PX, ethylene), **Ineos** (ethylene), **SABIC** (MEG) and **Shell** (MEG).⁵⁹ Indorama reportedly secured a long-term contract to purchase ethane and propane feedstock from Targa Resources in 2016, for its hydrocarbon cracking facility (“cracker”) in Louisiana.⁶⁰ Targa has natural gas fractionation facilities at Mont Belvieu, Texas,⁶¹ and owns gas gathering and

processing infrastructure across the U.S., including in the Permian Basin, at the heart of the U.S. fracking boom.⁶² Indorama stated as recently as 2019 that **Coca-Cola**, **PepsiCo** and **Procter & Gamble** were three of its four main customers.⁶³ As of 2018, **Nestlé** had also been a major customer.⁶⁴ Indorama’s supplier relationships with Coca-Cola,⁶⁵ PepsiCo⁶⁶ and Nestlé⁶⁷ have been corroborated in the press and through research by Greenpeace USA.

OTHER PLASTIC PACKAGING

Just as with the PET bottle, almost every type of plastic packaging is the end product of its own multi-stage production process that begins with a fossil fuel – oil, gas or coal. While these processes differ in their details, the overall business relationships are similar. Some of the world’s largest resin producers, such as **ExxonMobil**, **Shell** and **Chevron Phillips**, are vertically integrated fossil fuel/petrochemical companies that make their own petrochemicals from their oil and gas operations – sometimes purchasing additional key inputs from other companies – and then produce and market plastic resin. Some of these companies, including ExxonMobil, produce and market resins specifically designed for particular packaging applications, such as films, wraps and pouches.⁶⁸ These resins are purchased by packaging manufacturers such as **Amcor** and **Berry Global Group Inc.**; such companies are known as “converters,” as they convert the resin into products.

As demonstrated through the public LinkedIn accounts of self-identified current and former ExxonMobil Chemical employees, the company (like some other fossil fuel and petrochemical companies with significant plastic interests) likely has connections with large FMCG companies, including Mars, PepsiCo, and Unilever.⁶⁹

In our investigation, we also found evidence that some of the FMCG companies on which we focused have received shipments of plastic resin produced by large integrated resin manufacturers. For example, **Colgate-Palmolive** has received shipments of **Chevron**-branded high-density polyethylene (HDPE) resin from a Chevron distribution division.⁷⁰

Frequently, however, FMCG companies are supplied by specialist packaging manufacturers without significant upstream interests, among the most notable of which is **Amcor**. Amcor is a global business manufacturing flexible and rigid packaging, specialty cartons and closures, polyethylene film and bags; the vast majority of its sales are of flexible packaging (accounting for 78% of its revenue in 2020).⁷¹ Amcor designs and manufactures flexible packaging for many large FMCG companies, including all nine highlighted in this report: **Coca-Cola**, **Colgate-Palmolive**, **Danone**, **Mars**, **Mondelēz**, **Nestlé**, **PepsiCo**, **Procter & Gamble** and **Unilever**.⁷² **PepsiCo** is one of Amcor's largest customers: 8% of Amcor's revenue was attributable to PepsiCo as of July 2021.⁷³ Amcor has a plant co-located with a PepsiCo Gatorade factory in Mountaintop, Pennsylvania,⁷⁴ and also manufactures PET containers for PepsiCo's Lipton tea in Central America.⁷⁵ Amcor and **Nestlé** have partnered to create recyclable pet food pouches and candy packaging,⁷⁶ about 5% of Amcor's revenue is attributable to Nestlé.⁷⁷ Approximately 1.8% of Amcor's revenue is attributable to **Unilever**,⁷⁸ with Amcor supplying products such as home laundry packaging to Unilever in India.⁷⁹ **Danone** provides about 1.5% of Amcor's revenue,⁸⁰ with products including PET yogurt jars for Danone's La Serenisima brand in Argentina.⁸¹ **Mondelēz** and Amcor have partnered to produce chocolate tray packaging for Mondelēz's Cadbury brand.⁸² Amcor's resin suppliers include **ExxonMobil Chemical**, **Borealis**, **Alpek/DAK Americas**, **Indorama** and **Dow**.⁸³ Thus, all nine of the consumer goods companies featured in this report have indirect supply chain connections through Amcor to **Alpek/DAK Americas**, **Borealis**, **Dow**, **ExxonMobil** and **Indorama**. Many global shipments of polyethylene and polypropylene films originate at Amcor's Italy plant, which is adjacent to a large Eni facility.

Berry Global is another major global manufacturer and marketer of plastic packaging products. Berry has claimed to be the largest resin buyer among plastic packaging manufacturers, procuring approximately 3.2 million metric tons of resin annually (mostly polyethylene and polypropylene).⁸⁴ The company's suppliers of resin include **Total** and **SABIC**,⁸⁵ and it has received plastic closures from **Shell**.⁸⁶ Berry also recently entered into a supply agreement with **Borealis**.⁸⁷ Berry's known customers include **Coca-Cola**, **Colgate-Palmolive**, **Mondelēz**, **Nestlé**, **PepsiCo**, **Procter & Gamble** and **Unilever**.⁸⁸

Alpla is a privately owned company headquartered in Austria, and one of the largest packaging producers in Europe. It specializes in blow-molded bottles and caps, injection-molded parts, preforms and tubes. Alpla has received HDPE resin from **Braskem** and **Ineos**, and both HDPE and polypropylene from **SABIC**.⁸⁹ Alpla has also received PET from **Indorama**.⁹⁰ **Alpla's** known customers include **Coca-Cola**,⁹¹ **Colgate-Palmolive**,⁹² **Procter & Gamble**, for which it produces bottles for Head & Shoulders shampoo with up to 25% "beach plastic";⁹³ **PepsiCo**, for which it produces 50% recycled PET bottles;⁹⁴ and **Unilever**, for which it makes bottles for Dove bodywash.⁹⁵ Thus, **Coca-Cola**, **Colgate-Palmolive**, **PepsiCo**, **Procter & Gamble** and **Unilever** have indirect supply chain connections via Alpla to Braskem, Indorama, Ineos and SABIC. Similar indirect connections between FMCG and fossil fuel/petrochemical companies were identified via a number of other packaging manufacturers.

The only petrochemical companies included in the graphic for which we found no links with the nine FMCG companies we focused on were Formosa and Eni/Versalis. Given Formosa's ranking as the sixth-largest chemical company⁹⁶ and tenth-largest producer of propylene⁹⁷ in the world, and in view of its operations' reported health impacts on communities, the lack of supply chain information about the company is particularly concerning.

Unsurprisingly, **FMCG companies tend not to advertise their reliance on the industry that poses the number one threat to the global climate**. This lack of transparency allows FMCG companies to evade accountability for any environmental and human rights violations committed by the companies that supply the plastic or fossil feedstocks for their plastic packaging, and to trumpet climate commitments that ignore their role in enabling the fossil fuel industry's pivot to expand production of petrochemicals that are used to make plastic.

ONLY

9%

OF ALL PLASTIC
WASTE EVER CREATED
HAS BEEN RECYCLED

WHAT SOME OF THOSE SYMBOLS REALLY MEAN



The **Der Grune Punkt** symbol does not mean a pack is recyclable. It does mean the brand has paid a fee towards unrelated costs of recycling



Typically downcycled into carpet or synthetic clothing



Versions of throwaway plastic that are difficult to recycle; usually sent to an incinerator or landfill

BIG BRANDS AND THE FOSSIL FUEL INDUSTRY

USE RECYCLING AS A SMOKE SCREEN

It is clear that plastics recycling cannot resolve the plastic pollution problem and is being used as a smokescreen by industry to divert attention away from the systemic changes that are needed. Globally, as of 2015, only 9% of all plastic waste ever created had been recycled.⁹⁸

One study estimated that less than 1% of plastic has been recycled more than once.⁹⁹ The vast majority of plastic packaging ends up either “downcycled” into lower-grade products or in a landfill, in the environment or incinerated.¹⁰⁰ One analysis reported the 2018 U.S. domestic plastic recycling rate at just 2.2%,¹⁰¹ and similarly abysmal rates can be found around the world. Recent Greenpeace USA research shows that much of the plastic packaging used by food and beverage companies in the U.S. has so little chance of being recycled by municipal systems that the “recyclable” labels on the products in question appear not to meet the legal requirements for such claims, putting the companies at risk of legal challenge for deceptive marketing.¹⁰²

To take one company-specific example, in 2020 Mondelēz reported to the Ellen MacArthur Foundation that 93% of its total packaging, including a significant proportion of its plastic packaging, was “designed for the future of recycling,” but conceded that most of its plastic packaging “is not currently recycled ‘in practice and at scale’ as is required to be considered recyclable under the [Foundation’s own] Global Commitment¹⁰³ definition” – in fact, the proportion that actually met that definition was a mere 2%.¹⁰⁴ Mondelēz also makes the 93% recyclability claim on its website but without clarifying that in reality just 2% of its plastic packaging is actually recyclable.¹⁰⁵

Some types of packaging are effectively unrecyclable because of their design – for example, sachets and pouches that typically consist of layers of different materials (also known as “flexibles”).¹⁰⁶ These are widely used in the global North for products from snacks to pet food, and are ubiquitous in India and parts of Southeast Asia as a means of marketing personal care and other products, especially to low-income households.¹⁰⁷ Though Unilever claims to have developed a process to recover the polyethylene (the main constituent) from such sachets, this has not been proved commercially viable.¹⁰⁸ Another flexible waste recycling project (Materials Recovery

for the Future) has found collected material to be of insufficient quality for like-to-like recycling.¹⁰⁹ Regardless of the technological shortcomings, the logistics and economics of collecting flexible plastic waste make its recycling unviable at scale.

“CHEMICAL RECYCLING”

“Chemical recycling” is the next act of a decades-long effort by the fossil fuel and consumer goods industries to convince the public that recycling can mitigate the massive environmental costs of single-use plastic despite overwhelming evidence to the contrary.

Currently, commercial-scale technologies promoted by industry as “chemical recycling” or “advanced recycling” involve one of two related “plastic-to-fuel” processes: gasification and pyrolysis. Both use heat to break down the polymer, not into its constituent monomers, but respectively into either a hydrogen-rich gaseous mixture called “syngas” or a cocktail of various gaseous and liquid hydrocarbons. While either of these outputs can then in theory be further processed to create olefin monomers from which new plastic can be produced, in practice they tend not to be of sufficient quality.¹¹⁰ They can more readily be refined into fuel¹¹¹ – which is then burned with the emission of just as much GHG as the equivalent conventional fossil fuel,¹¹² making nonsense of the “recycling” claim. The fact that the U.S. petrochemical sector’s front organization, the American Chemistry Council (ACC), in arguing for light-touch regulation of chemical recycling, states that “Advanced recycling facilities... receive plastic feedstock that is converted to valuable fuels and petroleum products” and that “regulations should identify companies that manufacture fuels and petroleum products from post-use plastics feedstock as producers of alternative energy”¹¹³ shows clearly where the industry’s priorities lie. One major pyrolysis proponent, Dow Chemical, has even admitted to the National Recycling Coalition that its program “is not recycling.”¹¹⁴

Moreover, **even when the output of plastic-to-fuel plants is further processed into new plastic, the energy-intensive multi-stage process entails high GHG emissions.** Studies have exaggerated plastic-to-fuel’s



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Between January and July 2018, Malaysia imported 754,000 metric tons of plastic from countries including the United States, Japan, UK, Australia, New Zealand, Finland, France, Belgium, Germany, Spain, Sweden and Switzerland. © Nandakumar S. Haridas / Greenpeace

emissions performance by assuming that the plastic processed would otherwise have been incinerated and subtracting the corresponding emissions,¹¹⁵ and by arguing that the pyrolysis process can generate most of its own energy, though this is only made possible by burning some of the hydrocarbons produced in the process - effectively incinerating a percentage (often a considerable one) of the waste plastic feedstock. Thus the less external energy input the plant uses, the greater the GHG emissions from the plant itself and the lower its output of olefins.¹¹⁶

When gasification uses municipal solid waste as a feedstock, its global heating potential is up to seven times that of virgin plastic production if “avoided emissions” from waste incineration are ignored.¹¹⁷ The oil produced by pyrolysis is so impure that it can only be cracked to make olefins if it is first subjected to energy- and carbon-intensive purification, or mixed with a much larger quantity of virgin feedstock, further undermining the technology’s low-carbon pretensions. Moreover, pyrolysis and gasification emit carcinogens and other toxins.¹¹⁸

Finally, the economics of “chemical recycling” appear not to be viable without heavy government subsidies due to the low value of the recovered feedstock.¹¹⁹ It is therefore unsurprising that, according to the ACC’s own figures, shale gas-driven investment in U.S. petrochemical facilities is currently outpacing investment in “chemical recycling” by over 12 to 1.¹²⁰ **Rather than limiting plastic production, “chemical recycling” appears if anything to be providing an excuse to increase it.**¹²¹ In any case, as with mechanical recycling, it would not be in the fossil fuel industry’s interest for “chemical recycling” to be so successful that it began to threaten virgin plastic production.¹²² Furthermore, the need to earn a return on the capital investments in facilities using such technologies will necessitate a steady plastic waste stream, and so could be used to justify a ramping up of virgin plastic output.

BIG BRANDS’ COLLABORATION WITH THE FOSSIL FUEL INDUSTRY

Despite the failures of plastic recycling, FMCG companies have been working in partnership with the fossil fuel, petrochemical and packaging sectors to promote recycling, oppose legislation that would restrict single-use packaging and/or adopt so-called “chemical recycling” as part of their “circular economy” commitments.

The petrochemical industry has been aware of doubts about the economic viability and technical limitations of recycled plastic for decades.¹²³ Initially oil companies set up their own recycling projects, but more recently the industry has relied on targeted investment in existing local infrastructure and research and development,¹²⁴ along with lobbying for public-sector investment.¹²⁵ At the end of the 1980s industry players also began a successful lobbying campaign to persuade state legislatures that the

international recycling symbol should be made mandatory on all plastic packaging. By this means, **industry largely succeeded in convincing the public that all plastic is recyclable and thus environmentally acceptable**, protecting its highly profitable core business of selling virgin, non-recycled plastic.¹²⁶ Though there is growing public skepticism as to whether material of all kinds sent for recycling is actually recycled, and confusion around plastic recyclability, recycling participation rates remain high.¹²⁷

Despite knowing the economic and technical shortcomings of plastic recycling, the fossil fuel/petrochemical sector and FMCG companies frequently collaborate to promote recycling as the primary solution to the plastic crisis and lobby against restrictions on single-use plastic. Such alliances can trace their inspiration back to Keep America Beautiful, an organization set up in the 1950s to promote the idea that litter was consumers’, not companies’, responsibility - and still going strong today with board membership including BlueTriton Brands (formerly Nestlé Waters North America¹²⁸), Mars, PepsiCo and Dow Chemical.¹²⁹ In the late 1980s, faced with the threat of anti-plastic legislation at the state and even federal level, the U.S. plastic industry reportedly embarked on a multimillion-dollar PR campaign.¹³⁰ The industry front group Society of the Plastics Industry (later to become the Plastics Industry Association, or PLASTICS¹³¹) set up the Council for Solid Waste Solutions,¹³² which reportedly involved fossil fuel and plastic companies, including Amoco, Chevron, Dow, DuPont, Exxon and Mobil, as well as FMCG major Procter & Gamble.¹³³ Even though many in the industry had long been aware that the economic and technical viability of plastic recycling was doubtful,¹³⁴ the Council, the Society and the wider industry proceeded to campaign successfully across the U.S. to avert the threat of restrictions on plastic packaging by promoting recycling.¹³⁵ Companies including Amoco and Mobil even set up short-lived recycling projects themselves,¹³⁶ although the public sector soon began to shoulder most of the cost of plastic recycling.¹³⁷

In a 2020 investigative report by the National Public Radio, Larry Thomas, former president of PLASTICS, underscored the apparent intent behind the industry’s recycling playbook, saying “If the public thinks that recycling is working, then they are not going to be as concerned about the environment.” Thomas continued, “You know, they were not interested in putting any real money or effort into recycling because they wanted to sell virgin material. Nobody that is producing a virgin product wants something to come along that is going to replace it. Produce more virgin material - that’s their business.”¹³⁸

A newer front group pushing a similarly disingenuous message is the Alliance to End Plastic Waste, formed in 2019 - this time with the involvement of two FMCG majors, PepsiCo and Procter & Gamble, alongside dozens of fossil fuel and plastic companies.¹³⁹ The Alliance sponsors projects aiming to improve recycling infrastructure and develop “chemical recycling” technologies,¹⁴⁰ but has yet to announce any significant achievements. Its highly publicized project with Renew Oceans



ALLIANCE TO END PLASTIC WASTE



The Alliance to end Plastic Waste's apparent enthusiasm for recycling is matched only by their member's commitment to fossil fuel extraction and single use plastic production.

The Alliance sponsors projects aiming to improve recycling infrastructure and develop technologies, but has yet to announce any significant achievements. Instead, its highly publicised project with Renew Oceans to recycle plastic waste from India's River Ganges recently closed after allegedly collecting just one ton of waste

Industry-Led Program to Solve Plastic Waste Problem Falls by Wayside



Funded by some of the world's biggest oil and chemicals companies, Renew Oceans has failed to meet its goal of keeping plastic waste in the Ganges River from entering the ocean surrounding India.

Clare Goldsberry | Jan 19, 2021

The plastics industry has devoted tremendous resources to trying to solve the plastic waste challenge, even if anti-plastic activists are loath to recognize the efforts. Sometimes, though, the industry gives *itself* a black eye, as is seemingly the case with Renew Oceans. Funded by some of the world's biggest oil and chemicals companies, Renew Oceans has failed to meet its intended goal of keeping plastic waste in the Ganges River from entering the ocean surrounding India.

According to a Reuters report, the "closure of Renew Oceans... is a sign that an industry whose

to recycle plastic waste from India's River Ganges recently closed after allegedly collecting just one metric ton of waste.¹⁴¹ The Alliance's status as a charity obscures the fact that it was set up as a project of the ACC,¹⁴² which represents nearly 150 chemicals, plastic and packaging companies.¹⁴³ The ACC itself was an early opponent of anti-plastic bag laws,¹⁴⁴ spending more than \$9m between 2007 and 2010 on obstructing bans in California and Seattle alone.¹⁴⁵

Other ACC front groups include the misleading Wrap Recycling Action Program, which encourages U.S. consumers to drop off wrappers, bags and flexible packaging at stores, even though they will mostly end up being downcycled - if they are recycled at all;¹⁴⁶ and Materials Recovery for the Future (MRFF), a research initiative whose FMCG members and supporters include Johnson & Johnson, KraftHeinz, Mars, Mondeléz, Nestlé, PepsiCo, Procter & Gamble, SC Johnson, Unilever and Walmart.¹⁴⁷ MRFF is supposedly aiming to pioneer recycling of post-consumer flexible packaging, but in practice appears focused mainly on downcycling opportunities.¹⁴⁸

Most recently the ACC has lobbied the U.S. government to oppose anti-plastic legislation in Kenya in order to expand U.S. export markets,¹⁴⁹ was an early opponent of domestic plastic bag laws (through its front organization the Progressive Bag Alliance)¹⁵⁰ and has promoted so-called "advanced recycling."¹⁵¹ At the same time it has pledged to ensure that all plastic packaging is "re-used, recycled or recovered" - but not until 2040,¹⁵² a date hardly consistent with the 45% global emissions cut needed by 2030 to keep within the 1.5 °C barrier.¹⁵³

The Society of the Plastics Industry's successor, PLASTICS, has continued to lobby across the U.S., along with the ACC, successfully pressuring state legislators to introduce preemptive laws against plastic bans.¹⁵⁴ PLASTICS does not disclose its membership, although Coca-Cola, PepsiCo and SC Johnson are known to have been members until they left in 2019 following public pressure.¹⁵⁵ FMCG companies, including PepsiCo and Unilever, have joined with the ACC, PLASTICS and others in supporting the US RECOVERY Bill, which proposes a \$500m boost for recycling while restricting funds for incineration - but does not address the need to reduce single-use plastic production.¹⁵⁶ The Recycling Partnership, with members including PepsiCo, Colgate-Palmolive, Nestlé and Procter & Gamble, as well as the ACC,¹⁵⁷ is reportedly pursuing a similar agenda, calling for investment in recycling while failing to support the introduction of state-level legislation requiring refundable deposits on plastic bottles (even though such legislation and the resultant collection infrastructure have been shown to increase collection rates massively).¹⁵⁸ Such lobbying activity is not confined to the U.S.: Coca-Cola, Danone, L'Oréal and Nestlé, along with a number of plastic and packaging companies including Alpla and Greiner, are members of an Austrian group called Packaging With a Future¹⁵⁹ which encourages reliance on plastic packaging¹⁶⁰

and has opposed the introduction of minimum quotas for the proportion of reusable packaging sold by retailers.¹⁶¹

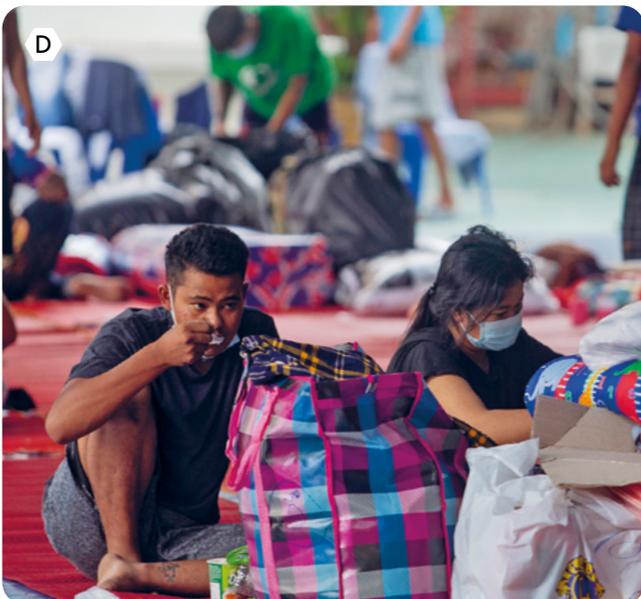
In addition to joint lobbying, FMCGs have been partnering with fossil fuel companies to push "chemical" or "advanced recycling" to justify their continued reliance on single-use plastic. One FMCG major, Procter & Gamble, has even developed its own process to purify and recycle contaminated polypropylene using a gas solvent.¹⁶² It has licensed this to a company called PureCycle,¹⁶³ which has in turn partnered with Nestlé to develop new packaging¹⁶⁴ and signed a supply agreement with L'Oréal.¹⁶⁵ It has also partnered with two FMCG packaging suppliers: petrochemical giant Total, with which it has a strategic partnership encompassing a U.S. supply agreement and a commitment to explore the feasibility of a plant in Europe;¹⁶⁶ and packaging company Aptar, with which it has formed a product development partnership.¹⁶⁷ In May 2021, a class action lawsuit was filed alleging PureCycle executives made false and misleading statements, including overstating the effectiveness of the company's technology.¹⁶⁸

Coca-Cola,¹⁶⁹ Danone,¹⁷⁰ L'Oréal¹⁷¹ and PepsiCo¹⁷² all signed supply agreements for recycled bottles with Loop Industries, a Canadian startup developing a new low-heat, pressureless depolymerization project in partnership with plastics giant Indorama.¹⁷³ The company claimed the process could produce virgin-quality, food-grade PET resin from inputs "of any color, transparency or condition," including ocean-degraded plastic.¹⁷⁴ As of 2020, PepsiCo and L'Oréal were still citing their involvement with Loop (described in PepsiCo's case as a "partnership") as evidence of their environmental commitments.¹⁷⁵ However in late 2020 Loop faced accusations from investment research firm Hindenburg that it had grossly exaggerated the efficacy and financial viability of its technology.¹⁷⁶ Two weeks later, Coca-Cola canceled its agreement with Loop after the company failed to deliver by the agreed date.¹⁷⁷ Soon afterward an "independent review" commissioned by Loop apparently confirmed the technical viability of its process,¹⁷⁸ but Hindenburg responded by pinpointing numerous flaws in the review's scientific methodology and noted that in any case its failure to address questions concerning the process's yield and economic viability made it "largely meaningless."¹⁷⁹ Loop is now facing a class-action lawsuit alleging securities fraud.¹⁸⁰

While Loop was at least purporting to offer a plastic-to-plastic technology, FMCG companies have also partnered with fossil fuel and technology companies to develop pyrolysis ("plastic-to-fuel") plants - for example, Mars and Nestlé with Total and Recycling Technologies.¹⁸¹ Buyers of pyrolysis-derived plastic from Saudi Aramco subsidiary SABIC's TruCircle range¹⁸² include Unilever, which has used it for its Knorr¹⁸³ and Magnum¹⁸⁴ brands, and Mars, which has begun to use it in pet food packaging.¹⁸⁵ Procter & Gamble has announced it will use chemically recycled resin from Indorama.¹⁸⁶



- A** 2 June 2018. Youngsville, Louisiana, USA. Melinda Tillies watching the installation of the Bayou Bridge Gas Pipeline next to her home. © Julie Dermansky / Greenpeace
- B** 19 March 2015. Karnes County, Texas, USA. Lynn Buehring lives near three different hydrofracking wells, flaring since 2011. She suffers from severe reactions to the chemicals and hydrogen sulfide (H₂S) gas released from the wells. © Les Stone / Greenpeace
- C** 15 January 2001 Cemetery next to the Taft Carbide Plant in Louisiana. © Les Stone / Greenpeace
- D** 10 July 2021 © Thailand. Explosion at expanded polystyrene (EPS) factory Ming Dih Chemical on 5 July affecting residents in Samut Prakan area. The Factory has since been told by the Thai Industry Ministry to relocate to a less populated location
- E** 10 July 2021. Thailand. Explosion at expanded polystyrene factory Ming Dih Chemical on 5 July severely damaged the facility.
- D** and **E** © Greenpeace / Chanklang Kanthong



THE FOSSIL FUEL INDUSTRY IS EXPANDING PLASTIC PRODUCTION

THREATENING CLIMATE AND HUMAN HEALTH

The cross-sector promotion of recycling (and “advanced recycling”) is enabling fossil fuel and petrochemical companies to appear committed to addressing the plastic pollution crisis while continuing to invest massively in new infrastructure to extract oil and gas to make virgin plastic.¹⁸⁷ The fact that fossil fuel companies are investing hugely both in new fossil exploration and production¹⁸⁸ and in new ethane crackers¹⁸⁹ and associated virgin plastic production strongly suggests that they do not envisage a wholesale shift to recycled plastic. Indeed, a study from the Mindereroo Foundation found that none of the world’s largest 100 polymer producers procures more than 2% of its feedstock from recycled or bio-based materials.¹⁹⁰

If business as usual continues, industry estimates predict that plastic production could double by 2030–2035 and triple by 2050, in comparison to 2015.¹⁹¹ One conservative estimate predicts that by 2050 the sector will have used up between 10% and 13% of the world’s 1.5 °C carbon budget (the remaining allowance of carbon emissions that must not be exceeded if we are to stay within the 1.5°C carbon budget).¹⁹²

ENVIRONMENTAL JUSTICE IMPACTS

The expansion of plastic production, if allowed to continue, won’t only impact our climate and environment. The toxic and carcinogenic pollutants that fossil fuel extraction and plastic production emit¹⁹³ alongside GHGs will continue to threaten the health of more communities close to the new facilities (in the U.S. a burden disproportionately borne by low-income communities and communities of color).¹⁹⁴

Fossil fuel extraction sites,¹⁹⁵ refineries¹⁹⁶ and petrochemical plants¹⁹⁷ all emit a range of toxic and carcinogenic chemicals into the air, putting nearby communities as well as local ecosystems at risk. In the case of fracking, surface and groundwater pollution can also be significant.¹⁹⁸ A recent compendium of scientific studies “uncovered no evidence that fracking can be practiced in a manner that does not threaten human health.”¹⁹⁹

As of 2010 in the U.S., 17.6 million people (6% of the population) lived within a mile of an active oil or gas extraction site.²⁰⁰ According to the recent report **Fossil Fuel Racism** by Greenpeace USA, the Gulf Coast Center for Law & Policy and the Movement for Black Lives,²⁰¹ 56% of the “toxic burden” of U.S. refineries is borne by people of color (who make up 39% of the country’s population) and 19% by low-income people (who make up 14% of the

population). The petrochemical sector’s impact on people of color is even worse: they bear 66% of the toxic burden, while 18% falls on low-income people. For both refineries and petrochemical facilities, a majority of toxic burden falls in areas that have both above-average populations of color and below-average income.²⁰²

Turning to end-of-life impacts, toxic emissions from incineration of plastic and other waste materials (including so-called “waste-to-energy”) also threaten the health of nearby residents.²⁰³ **In the U.S., approximately 80% of waste incinerators are located in low-income communities, communities of color, or both.**²⁰⁴ Incinerators being built in the UK are following the same pattern: they are three times more likely to be built in the poorest communities than in the wealthiest ones. Moreover, existing UK incinerators tend to be located in areas with above-average populations of people of color.²⁰⁵ **Landfills often present similar environmental injustices.**²⁰⁶

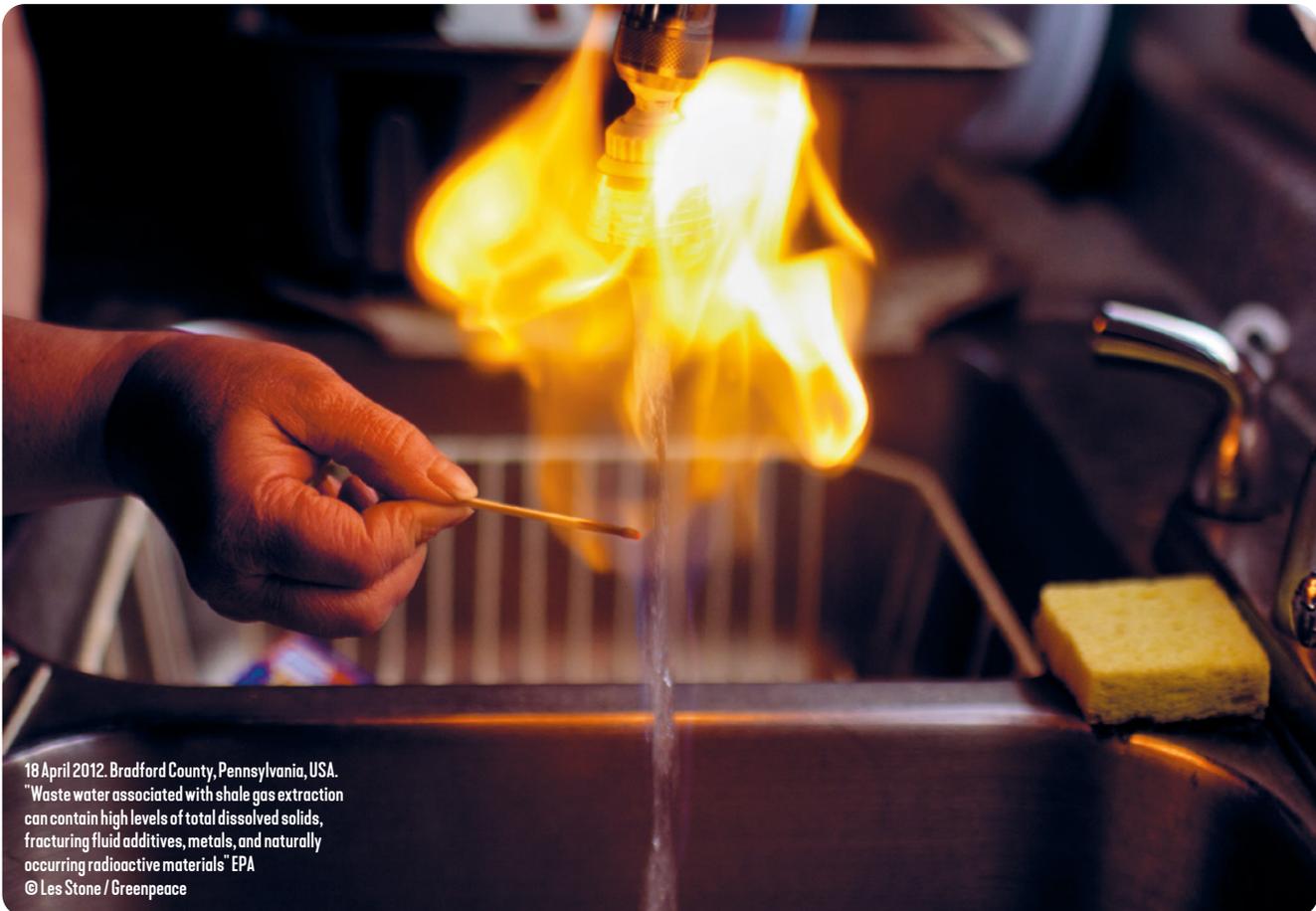
The plastic waste trade also particularly impacts communities in the Global South – where historically much of Europe and North America’s plastic waste has been exported, supposedly for recycling. China used to take the bulk of this waste, but since it banned plastic imports in 2018, plastic waste streams have been redirected, first toward Southeast Asian and African countries²⁰⁷ and more recently to Turkey as well.²⁰⁸

A series of investigations has revealed exported waste from countries in the Global North being illegally dumped and polluting local environments. For instance, Greenpeace investigators from Italy, UK, and Malaysia found household plastic from countries including the UK,²⁰⁹ Italy²¹⁰ and Germany²¹¹ at multiple illegal dump sites in Malaysia, while a BBC investigation found British plastic waste being burned near communities in Turkey.²¹² A 2019 Frontline/NPR investigation found plastic waste exported from the U.S., supposedly for recycling, being dumped in Indonesian communities.²¹³ Greek and Liberian authorities remain at loggerheads about an illicit shipment of plastic waste from Greece to the West African nation in late 2019.²¹⁴

Such disputes can drag on for years. Between 2013 and 2014, 103 shipping containers of mixed municipal waste from Canada, including unrecyclable plastics, were illegally dumped²¹⁵ in the Philippines. Although 69 containers were eventually repatriated in 2019 after numerous campaigns for their return, the contents of 26 containers were dumped in open landfills and eight remain unaccounted for to this day.²¹⁶



29 March 2021, Balongan Oil Refinery,
West Java, Indonesia. The fire broke out at
the Balongan refinery, run by state oil firm
Pertamina in Indramayu. Five people were
seriously injured and 1,000 were evacuated.
© Panji Purnomo / Greenpeace



18 April 2012, Bradford County, Pennsylvania, USA.
"Waste water associated with shale gas extraction
can contain high levels of total dissolved solids,
fracturing fluid additives, metals, and naturally
occurring radioactive materials" EPA
© Les Stone / Greenpeace

WHERE THE EXPANSION IS HAPPENING AND WHO IS RESPONSIBLE



There is limited publicly available data regarding which companies are expanding and where plastic production is set to increase. However, recent analysis from the Minderero Foundation shows that of the companies we examined for this report, Exxon, Shell, Saudi Aramco, Formosa and Borealis are among the top producers planning to add virgin polymer capacity between 2020 and 2025.²¹⁷ According to the analysis, Exxon is one of three producers adding the most capacity, and Shell is notably expanding capacity at a rate of 145% over the same five-year period.

In terms of where in the world new plastic production facilities are likely to be built, we know that currently Asia, North America and Europe are the biggest producers; within Asia, China is the major player, producing an estimated 31% of the world's plastics, according to PlasticsEurope.²¹⁸

Data on future expansion is difficult to find, however projected ethylene production offers a reasonable proxy for future plastic expansion, and here data are available. Industry analysts identify India,²¹⁹ North America, the Middle East, China and Southeast Asia²²⁰ as key regions looking to expand ethylene production capacity. Factors expected to drive expansion in these regions include cheap ethane (North America²²¹ and the Middle East), low capital costs (China) and unmet demand for ethylene derivatives along with the desire to balance trade and generate employment (China, India and Southeast Asia). However, China and North America are expected to continue to be the largest drivers of global ethylene demand growth as they add production capacity for ethylene and derivatives.²²²

PLASTIC INDUSTRY EXPANSION PROJECTS AND THE PIPELINE INFRASTRUCTURE CONNECTING THEM TO GLOBAL OIL AND GAS FIELDS

This expansion has serious implications both for the communities near the facilities and for the climate. Following are three snapshots from around the world, showing how the fossil fuel/petrochemical sector is ignoring both the climate imperative and public health in pursuit of increased plastic profits.

INEOS

'PROJECT ONE', ANTWERP, BELGIUM
Capacity 1.25 ethylene, 0.725 propylene
APPROVED SITES



Imagery ©2021 Aerodata International Surveys, CNES / Airbus, Landsat / Copernicus, Maxar Technologies, Map data ©2021



BAYPORT POLYMERS (BAYSTAR), PORT ARTHUR, TEXAS. Capacity - 1.0 total, Downstream 0.625 PE.



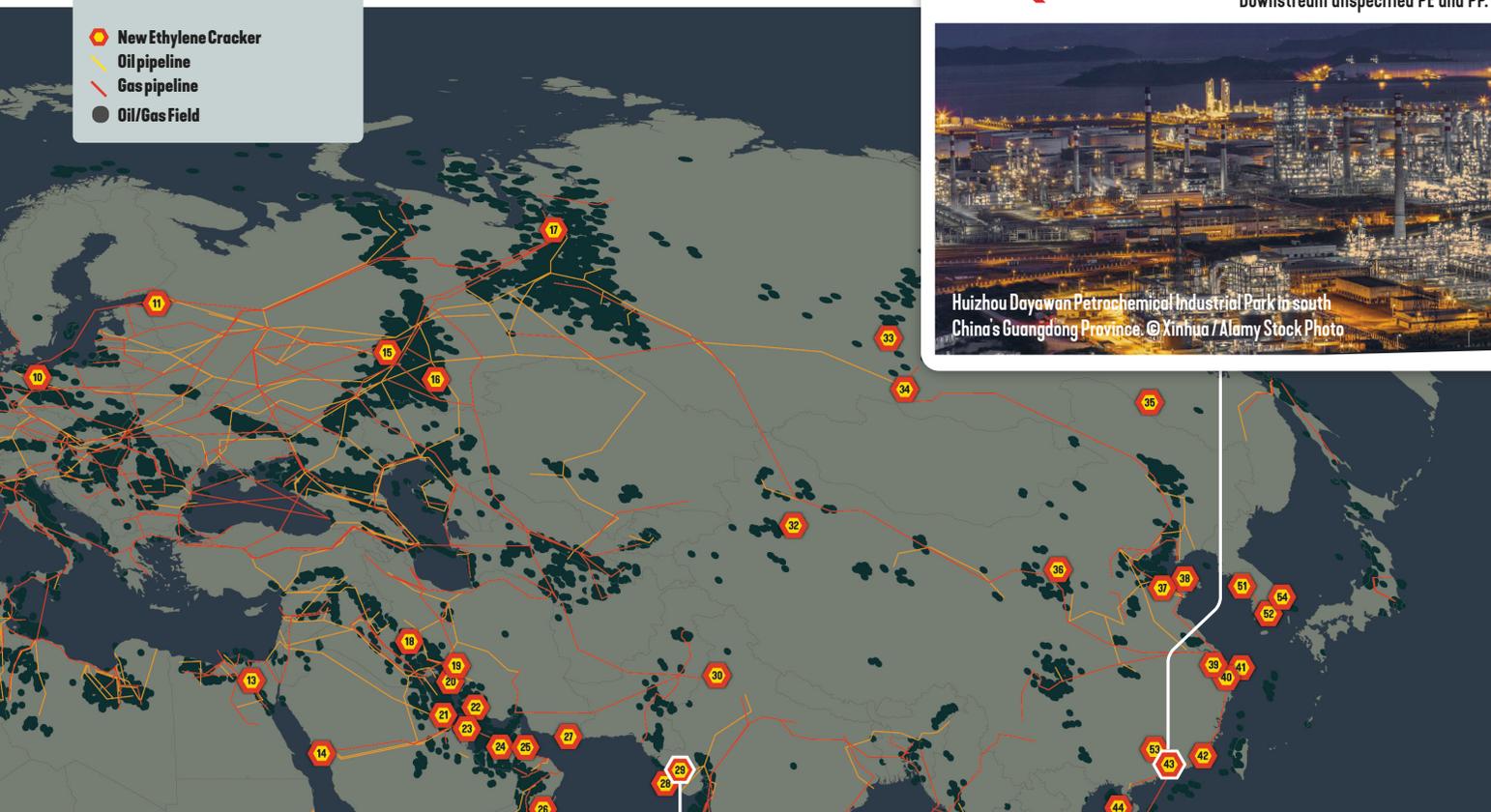
9 December 2019

- | | | | |
|--|--|--|--|
| <p>1 OWNER West Coast Olefins
FACILITY Prince George, BC, Canada
CRACKER 1.0 ethylene
DOWNSTREAM Unspecified capacity PE.
DATES Start-up due 2024</p> <p>2 OWNER ExxonMobil / SABIC - Gulf Coast Growth Ventures
FACILITY San Antonio County, Corpus Christi, Texas, USA
CRACKER 1.8 total
DOWNSTREAM 1.3 PE, 1.1 monoethylene glycol (MEG).
DATES Due to open in Q4 2021</p> <p>3 OWNER Total / Borealis
FACILITY Bayport Polymers (Baystar) and Port Arthur, Texas
CRACKER 1.0 total
DOWNSTREAM 0.625 PE.
DATES Cracker due to open 2021, downstream 2022</p> <p>4 OWNER Chevron Phillips Chemical / Qatar Petroleum
FACILITY Gulf Coast / Orange, Texas
CRACKER 2.0 total
DOWNSTREAM 2.0 PE.
DATES Start-up projected for 2024, on hold - COVID</p> <p>5 OWNER Formosa Plastics
FACILITY Sunshine Project, St James Parish, Louisiana
CRACKER Phase 1, 1.2 total, Phase 2, 1.2 total
DOWNSTREAM Phase 1, 0.8 PE, 0.6 PP, Phase 2, 0.8 PE.
DATES Phase 1, 2025 and Phase 2, 2028, on hold - COVID</p> <p>6 OWNER Nova Chemicals
FACILITY Sarnia, Ontario, Canada
CRACKER Existing cracker capacity to increase by over 0.4 ethylene, plus new 0.45 PE unit.
DATES Start-up due late 2022</p> <p>7 OWNER Shell
FACILITY Monaca, Pennsylvania
CRACKER 1.6 total
DOWNSTREAM 1.6 PE.
DATES Due for completion early 2020s</p> | <p>8 OWNER Ineos
FACILITY Antwerp, Belgium
CRACKER 1.25 ethylene
DOWNSTREAM 0.725 propylene
PP UNIT
DATES Cracker start-up due 2025. PP unit start-up originally due 2023, but postponed in Jan 2021</p> <p>9 OWNER Borealis
FACILITY Kalle, near Antwerp, Belgium
CRACKER 0.74 propylene
PP UNIT
DATES Start-up end 2022, but likely to slip due to Covid</p> <p>10 OWNER Grupa Azoty Polyliefins
FACILITY Police, West Pomerania Province, Poland
CRACKER 0.428 propylene
PP UNIT 0.437 PP.
DATES Start-up originally scheduled for Q4 2022 but postponed until Q1 2023 due to Covid</p> <p>11 OWNER RusGazDobrycho
FACILITY Baltic Chemical Complex, Ust-Luga, Leningrad Oblast, Russia
CRACKER 2.8 ethylene
DOWNSTREAM 2.88 PE.
DATES Start-up due 2023 and 2024</p> <p>12 OWNER BUA Group
FACILITY Akwa Ibom State, Nigeria
CRACKER unspecified propylene
DOWNSTREAM 0.265 PP.
DATES Completion due 2024</p> <p>13 OWNER Carbon Holdings
FACILITY Ichin Petrochemical Complex, Ain Sokhna, Suez Governorate, Egypt
CRACKER 1.35 PE, 1.0 propylene
DOWNSTREAM 1.35 PE, 0.7 PP, etc.
DATES Start-up projected for 2023, may have slipped.</p> | <p>14 OWNER Saudi Aramco / Sabic
FACILITY Yanbu, Al Madinah Province, Saudi Arabia
CRACKER unconfirmed - "world-scale unconfirmed" (b)
DOWNSTREAM
DATES</p> <p>15 OWNER Waf - volkamselmafshchim (NKNK)
FACILITY Ethylene-800, Nizhnekamsk, Tatarstan, Russia
CRACKER 0.6 ethylene, 0.27 propylene.
DOWNSTREAM Start-up due second half of 2023</p> <p>16 OWNER Gazprom
FACILITY Gazprom Neftekhim Salavat, Salavat, Republic of Bashkortostan, Russia
CRACKER 1.8 ethylene
DOWNSTREAM 0.416 PE, 0.617 PP.
DATES Completion due between 2023 and 2026.</p> <p>17 OWNER PJSC Sibur / Gazprom
FACILITY Mary Brangay Gas Chemical Complex, Yamalo-Nenets Autonomous Area, Siberia, Russia
CRACKER 0.42 ethylene
DOWNSTREAM 0.4 PE.
DATES Start-up due mid-2020s</p> <p>18 OWNER Dehloran Sepah PC
FACILITY Dehloran, Ilam Province, Iran
CRACKER 0.6 ethylene
DOWNSTREAM
DATES Completion due 2024</p> <p>19 OWNER Gachsaran Petrochemical Company (PC)
FACILITY Gachsaran Ethylene Plant, Kohgiluyeh and Boyer-Ahmad Province, Iran
CRACKER 1.0 ethylene
DOWNSTREAM Completion due by 2022 or 2023</p> <p>20 OWNER Ganaveh-Dashtestan PC
FACILITY Ganaveh, Bushehr Province, Iran
CRACKER 0.5 ethylene
DOWNSTREAM
DATES opens latest 2025</p> | <p>21 OWNER Saudi Aramco / Total
FACILITY Jubail, Eastern Province, Saudi Arabia
CRACKER 1.0 ethylene
DOWNSTREAM
DATES Completion due 2024</p> <p>22 OWNER Bushehr PC
FACILITY Asaluyeh Ethylene Plant, Asaluyeh (also Asaluyeh/Asabuyeh), Bushehr Province, Iran
CRACKER 1.0 ethylene
DOWNSTREAM
DATES Completion due by 2022</p> <p>23 OWNER Qatar Petroleum / Chevron Phillips Chemical
FACILITY Ras Laffan, Qatar
CRACKER 1.8 ethylene
DOWNSTREAM 1.68 PE.
DATES Start-up due late 2025</p> <p>24 OWNER Abu Dhabi National Oil Co / Borealis
FACILITY Boraqas, Ras Al Khaima, United Arab Emirates
CRACKER 1.8 ethylene, unspecified propylene
DOWNSTREAM unspecified PE and PP.
DATES Start-up due 2023</p> <p>25 OWNER OQ
FACILITY Liwa Plastics Industries Complex, Sohar, Oman
CRACKER 0.88 total or more
DOWNSTREAM 0.88 PE, 0.215 PP.
DATES Cracker start-up due by 2026; downstream units possibly already operational</p> <p>26 OWNER OQ / Kuwait Petroleum International
FACILITY Duqm Refinery and Petrochemicals Company, Duqm, Oman
CRACKER 1.8 ethylene
DOWNSTREAM unspecified PE and PP.
DATES Not yet announced</p> <p>27 FACILITY Sepah Mahran Chahubar Ethylene Plant, Chahubar, Sistan and Baluchistan Province, Iran
CRACKER 1.35 ethylene
DOWNSTREAM 1.2 PE, unspecified PP.
DATES Completion due by 2030</p> |
|--|--|--|--|



Huizhou Dayawan Petrochemical Industrial Park in south China's Guangdong Province. © Xinhua / Alamy Stock Photo

- New Ethylene Cracker
- Oil pipeline
- Gas pipeline
- Oil/Gas Field



JAMNAGAR REFINERY, GUJARAT, INDIA. CAPACITY - New steam cracker: 4.1 ethylene and propylene combined. New multi-zone catalytic cracker and converted fluid catalytic cracker: 8.5 ethylene and propylene combined. Downstream: 3.0 PE, 5.2 PP



23 December 2016. Reliance Refinery, Jamnagar, India. From https://youtu.be/h1uFDVdR_uj

The world's largest oil refinery as of 2013 Jamnagar's owner Reliance Industries Ltd plans to convert it from fuel production to petrochemicals and jet fuel.

- 21** OWNER: Nayara Energy
FACILITY: Vadinar, Gujarat, India
CRACKER: 1.8 ethylene
DOWNSTREAM: unspecified PE, PP etc.
DATES: Completion of entire project due 2025
- 22** OWNER: Reliance Industries
FACILITY: Jamnagar, Gujarat, India
CRACKER: 4.1 ethylene and propylene combined. New multi-zone catalytic cracker: 8.5 ethylene and propylene combined.
DOWNSTREAM: 3.0 PE, 5.2 PP ETC
- 23** OWNER: HPCL Mittal Energy Ltd
FACILITY: Bathinda, Punjab, India
CRACKER: 1.2 ethylene
DATES: Complete. Start-up due September or October 2021
- 24** OWNER: GAIL/HPCL
FACILITY: Kakinada, Andhra Pradesh, India
CRACKER: unknown input capacity 1.2 ethane
DATES: Start-up originally scheduled for 2022
- 25** OWNER: PetroChina
FACILITY: Keila, Xinjiang Uygur Autonomous Region, China
CRACKER: 0.6 ethylene
DATES: Commercial start-up due around Q3 2021
- 26** OWNER: Irkutsk Oil
FACILITY: Irkutsk Polymer Plant, Ust-Aur, Irkutsk Oblast, Russia
CRACKER: 0.65 ethylene
DOWNSTREAM: 0.65 PE
DATES: Start-up due 2022
- 27** OWNER: Rosneft
FACILITY: Angren, Irkutsk Oblast, Russia
CRACKER: expansion to 0.39 ethylene and 0.21 propylene
DATES: Completion due 2023 or later.

- 28** OWNER: Sibur
FACILITY: Amur Gas Chemical Complex, Svobodny, Amur Oblast, Siberia, Russia
CRACKER: >1.5 ethylene
DOWNSTREAM: 2.2 PE, 0.4 PP
DATES: Start-up due 2024 or 2025.
- 29** OWNER: PetroChina
FACILITY: Yulin, Shaanxi Province, China
CRACKER: 0.8 ethylene
DOWNSTREAM: 0.8 PE
DATES: Commercial start-up due Q3 2021
- 30** OWNER: Luqing Petrochemical
FACILITY: Shouguang, Shandong Province, China
CRACKER: 0.76 total
DOWNSTREAM: unspecified PE
DATES: Commercial start-up due around Q3 2021
- 31** OWNER: Wanhua Chemical Group
FACILITY: Yantai, Shandong Province, China
CRACKER: 1.2 ethylene
DOWNSTREAM: unspecified PE and PP
DATES: Not yet announced.
- 32** OWNER: Zhejiang Petrochemical Co. Ltd.
FACILITY: Zhoushan, Zhejiang Province, China
CRACKERS 12: 1.4 total each
DATES: Start-ups due Q2 and Q4 2021 respectively
- 33** OWNER: Huatui Shengfu
FACILITY: Ningbo, Zhejiang Province, China
CRACKER: 0.6 total
DATES: Start-up due May 2021
- 34** OWNER: Zhejiang Satellite Petrochemical Co.
FACILITY: Lianyungang, Jiangsu Province, China
CRACKERS 12: 1.25 total each
DOWNSTREAM: 0.4-0.65 PE
DATES: First cracker and PE plant on-stream March 2021. 2nd cracker and PE plant start-up due 2022

- 35** OWNER: Gulei Refinery
FACILITY: Zhangzhou, Fujian Province, China
CRACKER: 1.0 total
DOWNSTREAM: 0.8 styrene
DATES: Start-up due Q3 2021
- 36** OWNER: ExxonMobil
FACILITY: Huizhou Petrochemical Complex, Huizhou, Guangdong Province, China
CRACKER: 1.6 total
DOWNSTREAM: unspecified PE and PP
DATES: Start-up due 2023
- 37** OWNER: Sinopec
FACILITY: Yangpu Economic Development Zone, Hainan Province, China
CRACKER: 1.0 ethylene (?)
DOWNSTREAM: 1.0 total
DATES: Start-up due by October 2022
- 38** OWNER: Long Son Petrochemicals
FACILITY: Long Son Petrochemicals Complex, Long Son Island, Ba Ria-Vung Tau Province
CRACKER: 1.0 ethylene, 1.65 total
DOWNSTREAM: 0.45 HDPE (- unspecified LDPE), 0.4 PP
DATES: Start-up due 2023
- 39** OWNER: Hengyi Petrochemical / State of Brunei
FACILITY: Pulau Muara Besar, Brunei
CRACKER: 1.65 ethylene
DOWNSTREAM: 1.05 PE, 1.0 PP
DATES: Completion due 2023
- 40** OWNER: Lotte Chemical Titan
FACILITY: Lotte Chemical Indonesia New Ethylene (Line), Merak, Banten Province, Java, Indonesia
CRACKER: 1.0 ethylene, 0.6 propylene
DOWNSTREAM: 0.5 PE
DATES: Originally due 2023, but review instigated 2020 due to Covid, with no new date yet announced.

- 41** OWNER: Chandra Asri
FACILITY: Ciliga, Banten Province, Java, Indonesia
CRACKER: 1.1 ethylene
DOWNSTREAM: 0.75 PE, 0.45 PP
DATES: Start-up due 2024 onwards
- 42** OWNER: Pertamina / CPC
FACILITY: Belong, West Java Province, Indonesia
CRACKER: 1.0 ethylene
DATES: Start-up due 2026
- 43** OWNER: Pertamina / Rosneft
FACILITY: PT Pertamina Rosneft Pengolahan dan Petrokimia, Tuban, East Java Province, Indonesia
CRACKER: 1.0 ethylene
DOWNSTREAM: 1.2 PP etc.
DATES: Completion due before 2025
- 44** OWNER: Hyundai Bilbank / Lotte Chemical
FACILITY: Daejeon, South Chungcheong Province, South Korea
CRACKER: 0.85 ethylene
DOWNSTREAM: 0.85 PE, 0.5 PP
DATES: Commercial start-up due before end of 2021
- 45** OWNER: GS Caltex
FACILITY: Yeosu, South Jeolla Province, South Korea
CRACKER: 0.7 ethylene, 0.35 propylene
DOWNSTREAM: 0.5 PE
DATES: Start-up due June 2021
- 46** OWNER: Shell / China National Offshore Oil Corp.
FACILITY: Huizhou, Guangdong Province, China
CRACKER: 1.5 ethylene
DATES: Not announced
- 47** OWNER: LG Chem
FACILITY: Yeosu, South Jeolla Province, South Korea
CRACKER: 0.8 ethylene
DOWNSTREAM: 0.8 PE
DATES: Start-up due July or August 2021

THE U.S.

TOXIC EXPANSION

CANCER ALLEY

LOUISIANA

ExxonMobil

BATON ROUGE, BATON ROUGE COUNTY



Imagery ©2021 Landsat / Copernicus, Maxar Technologies, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2021

Williams

GEISMAR, ASCENSION COUNTY



Imagery ©2021 Landsat / Copernicus, Maxar Technologies, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2021

Dow

PLAQUEMINE, IBERVILLE COUNTY



Imagery ©2021 Landsat / Copernicus, Maxar Technologies, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2021

BATON ROUGE

GONZALES

WELCOME

ST JAMES PARISH



Formosa Plastics

SUNRISE PROJECT, PROPOSED CRACKER SITE



Imagery ©2021 Landsat / Copernicus, Maxar Technologies, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2021

“We stood up for our health because it is more important than wealth.”

SHARON LAVIGNE, RISE ST JAMES

- Oil Refinery
- Gas Processing Plant
- Ethylene Cracker
- Oil pipeline
- Gas pipeline
- Highway
- County Boundaries
- Urban area

RISE ST. JAMES



TAFT,
ST CHARLES PARISH

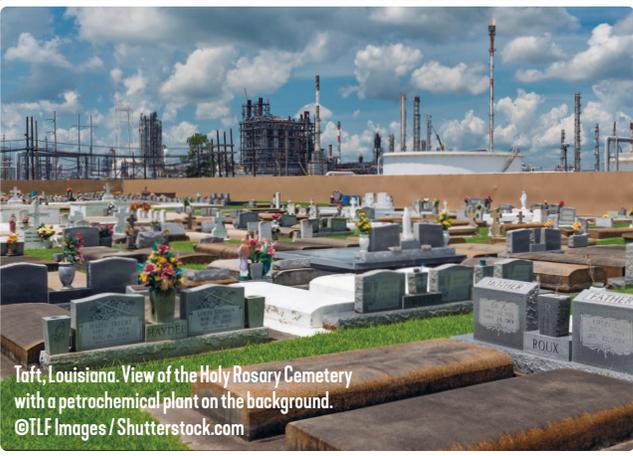


"...many of our products are already helping reduce our customer's carbon emissions"

JIM FITTERLING, CEO DOW CHEMICALS



Imagery ©2021 Landsat / Copernicus, Maxar Technologies, NOAA, U.S. Geological Survey, USDA Farm Service Agency, Mapdata ©2021



Taft, Louisiana. View of the Holy Rosary Cemetery with a petrochemical plant on the background. ©TILF Images / Shutterstock.com

Louisiana's "Cancer Alley" is a region along the lower Mississippi River that acquired its nickname in the 1980s as a result of suspected cancer clusters that locals believed stemmed from toxic pollution from nearby chemical plants.²²³ The region currently has nearly 150 oil refineries and plastics and chemicals facilities.²²⁴ It is also home to an above-average Black/African American population²²⁵ whose human rights are severely threatened by the concentration of polluting industries, according to the UN.²²⁶ One study found that census tracts with the highest risk of toxic air pollution exposure were predominantly located in two parishes, East Baton Rouge Parish and Orleans Parish, which had Black/African American populations of 84% and 60% respectively.²²⁷ According to the EPA's 2015 National Air Toxics Assessment map, seven out of the 10 census tracts with the highest levels of air pollution-related cancer risk in the U.S. are located in St. John the Baptist Parish,²²⁸ another of the 11 parishes that make up Cancer Alley.²²⁹ As the founder of environmental justice group RISE St. James puts it, polluting industries "come to Black communities because they think no one's going to say anything."²³⁰

RISE St. James is based in another Cancer Alley parish, St. James. Taiwanese company Formosa Plastics aims to build an enormous plastic production complex in St. James Parish - a project driven, as the firm acknowledges, by growing plastic demand and the falling cost of gas,²³¹ but also consistent with the company's reported desire to develop production overseas due to opposition to air and water pollution in Taiwan.²³² According to opponents, among other things the complex will produce resins and petrochemicals to be used for single-use plastic packaging.²³³ The complex is to be located next to a predominantly Black/African American community and just a mile from an elementary school,²³⁴ yet the Louisiana Department of Environmental Quality (LDEQ) gave it approval to emit high levels of multiple carcinogens and other harmful pollutants,²³⁵ on the basis of state-level standards that campaigners say ignore current science from the U.S. EPA.²³⁶ EPA data show that **another Formosa plant, in Baton Rouge, breached the Clean Air Act every quarter between 2009 and 2018.**²³⁷ Toxic pollution aside, the new complex, due to be fully operational by 2029 (but with its first



NEW ORLEANS



TAFT, ST CHARLES PARISH



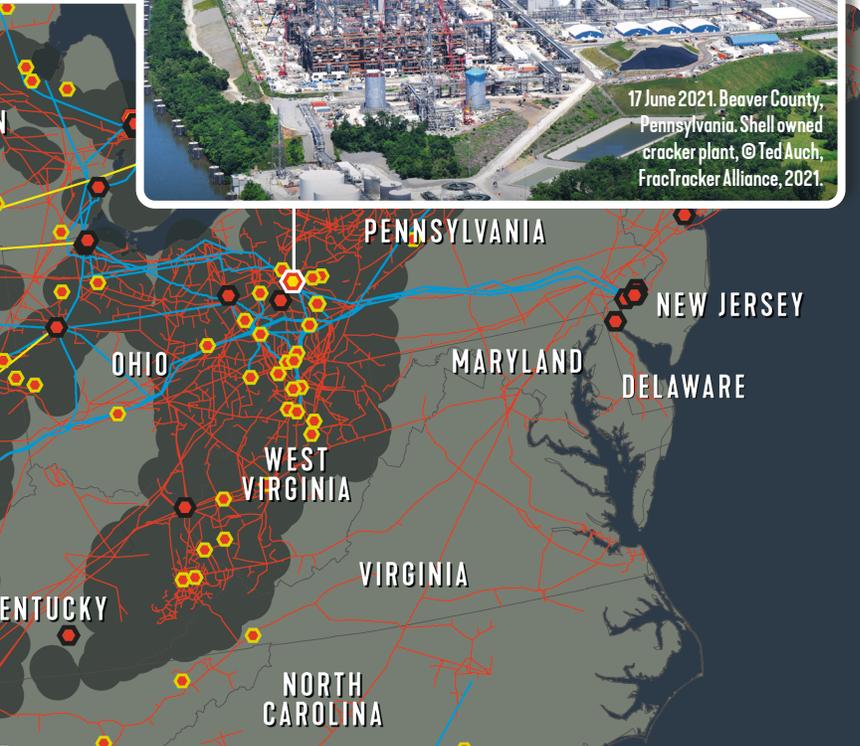
Imagery ©2021 Landsat / Copernicus, Maxar Technologies, NOAA, U.S. Geological Survey, USDA Farm Service Agency, Mapdata ©2021



SHELL PENNSYLVANIA PETROCHEMICALS COMPLEX,
POTTER TOWNSHIP, BEAVER COUNTY, PENNSYLVANIA



17 June 2021, Beaver County, Pennsylvania. Shell owned cracker plant. © Ted Auch, FracTracker Alliance, 2021.



stage to be completed by 2024), has been approved to emit 13.6 million metric tons of carbon dioxide a year – equivalent to the emissions of 2.6 million cars.²³⁸ Lawyers representing a Formosa subsidiary reportedly downplayed the plant’s climate impact with the bizarre argument that because its emissions would be “miniscule” in national and global terms, its potential contribution to climate change should be regarded as “also miniscule, assuming there are any effects at all”; meanwhile, the LDEQ explained its air quality permit approval on the grounds that because “GHGs emitted anywhere in the world affect climate everywhere in the world,” the project will “have no more impact on Louisiana (relative to GHGs) than if the facility was constructed elsewhere, but will provide the social and economic benefits.”²³⁹ Though it has no jurisdiction over the plans, in April 2021 the New Orleans City Council expressed unanimous opposition to the plant, citing fears over potential environmental and public health impacts on the city, even though New Orleans is 65 miles downriver from the site.²⁴⁰ Formosa’s plant is just one of 88 new petrochemical facilities under construction or planned in the Gulf region.²⁴¹



Oil refining facility,
LA PORTE, TEXAS



La Porte Texas. Ineos oil facilities. © Aaron Sprecher / Greenpeace

Farther down the Gulf coast, ExxonMobil’s Baytown complex near Houston, Texas, includes an olefins facility, one of the largest ethylene plants in the world. The facility’s history of air quality violations goes back at least to the 1990s, and in the decade 2010 to 2019 the Texas Commission on Environmental Quality fined it 22 times, with the EPA imposing additional penalties for Clean Air Act breaches.²⁴² Negative impacts from the Baytown facility have been shown to disproportionately affect both people of color and low-income populations.²⁴³ Yet despite this history and a Sierra Club lawsuit aimed at preventing the facility’s expansion,²⁴⁴ in 2019 it saw completion of a multi-billion-dollar ethane cracker to feed two polyethylene lines that started up in 2017 – all part of ExxonMobil’s 10-year, \$20 billion “Growing the Gulf” expansion program.²⁴⁵ Within months of the new cracker’s completion, an explosion and fire at the olefins plant had injured 37 and necessitated a shelter-in-place order to local residents.²⁴⁶ Unfortunately, safety incidents are a relatively common occurrence for chemical facilities. As of 2015, a major chemical incident occurred every six weeks, on average, in the greater Houston area.²⁴⁷

Bayou Bridge gas pipeline, LOUISIANA



31 March 2018, Acadia Parish, Louisiana. Construction on the Bayou Bridge Pipeline. © Julie Dermansky / Greenpeace



Melinda Tilles by Atchafalaya Basin Pipeline Construction. © Julie Dermansky / Greenpeace

ExxonMobil is currently engaged in a joint venture with SABIC (a subsidiary of the Saudi state petroleum and gas company Saudi Aramco) to build an ethylene and polyethylene complex (including what is claimed to be the world’s largest steam cracker²⁴⁸) near Corpus Christi, Texas, due to open in Q4 2021.²⁴⁹ ExxonMobil has confirmed that the plant’s location is intended to take advantage of growing output from the nearby Permian Basin,²⁵⁰ a center of the U.S. fracking boom.²⁵¹ Its output will reportedly include packaging materials.²⁵² The facility’s expected high water consumption is increasing pressure for construction of a desalination plant that opponents say may impact marine life and add further climate concerns.²⁵³

EUROPE

SWITCHING TO U.S. SHALE GAS

Braskem + INEOS
LA PORTE, TEXAS

La Porte, Texas. Ineos and Braskem oil facilities. © Aaron Sprecher / Greenpeace



AN INEOS 'DRAGON' SHALE GAS SHIP



IS Ineos Insight shale gas ship carrying ethane gas to Grangemouth. © Michael McCurk / Alamy Stock Photo

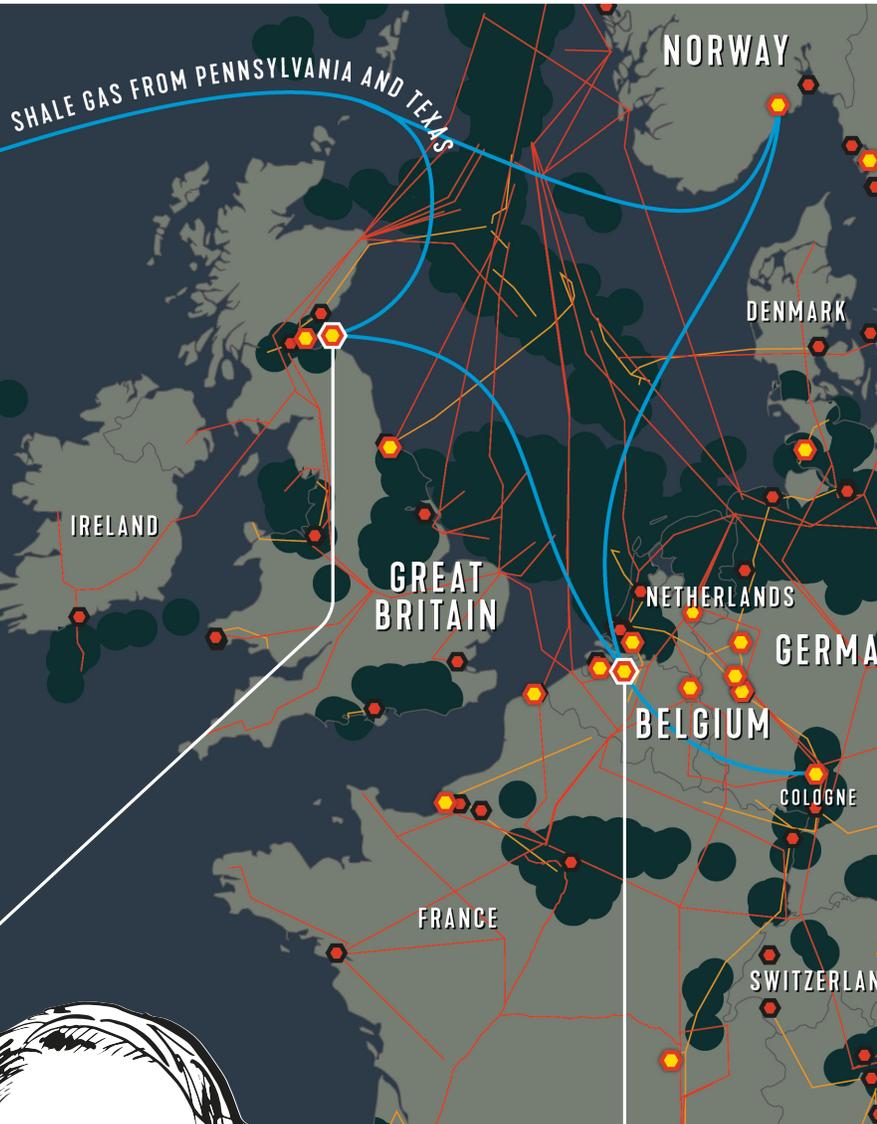
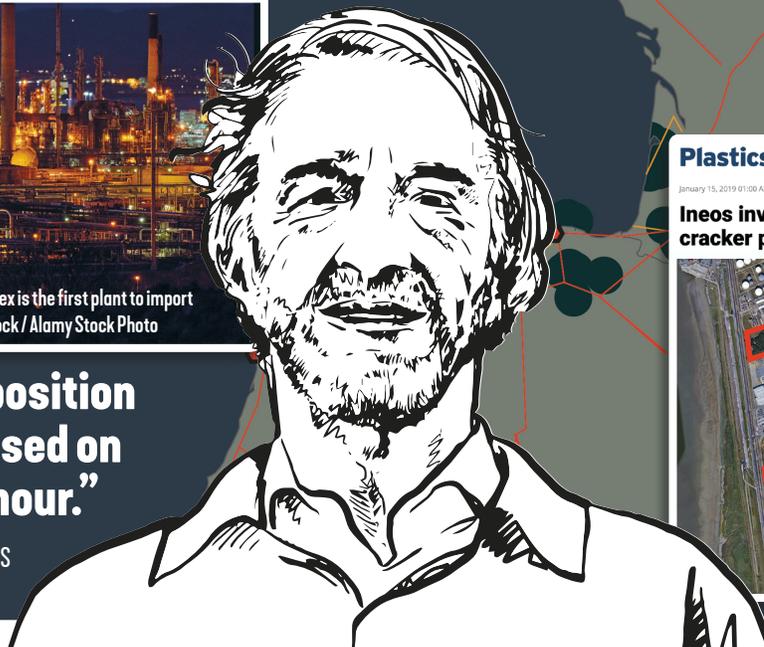
INEOS
GRANGEMOUTH, UNITED KINGDOM



Grangemouth oil refinery and petrochemical complex is the first plant to import ethane from US shale oil. © Quillpen royalty free stock / Alamy Stock Photo

"I think a lot of opposition (to fracking) is based on hearsay and rumour."

JIM RATCLIFFE, CEO INEOS



Plastics News

January 15, 2019 01:00 AM

Ineos investing \$3.4B in major European cracker project in Belgium



Project one, INEOS, Antwerp, Belgium. Image: @2021 Aerdata/Airgrid/Mapbox/Spreys, INEOS / Airbus, London / Copernicus, Maxar Technologies, Map data @2021

Although Europe favors naphtha as a petrochemical feedstock (as was the case in the U.S. until the fracking boom), significant amounts of natural gas liquids (ethane, propane and butane) are also used, and naphtha's importance as a feedstock in Western Europe was projected to fall by more than 25% between 2010 and 2020.²⁵⁴ The EU is keen to diversify its energy supplies, and

in 2018 European Commission President Jean-Claude Juncker pledged to support infrastructure investment to facilitate liquefied natural gas imports from the U.S., which was eager to boost gas exports.²⁵⁵ This trend, along with the low price of U.S. shale gas, is likely to help drive a switch to ethane as a petrochemical feedstock in Europe, along with the associated development of facilities.

The Port of Antwerp in Belgium is the world's second-largest petrochemical cluster after Houston and sits at the heart of the Western European pipeline network, with dedicated pipeline systems for naphtha, ethylene and propylene, among others, serving a multitude of sites.²⁵⁶ A number of firms are expanding or upgrading their cracking capacity in the region to take advantage of cheap gas feedstocks – including Total, which has upgraded its Antwerp plant in part to enable one cracker to use ethane imported from Norway,²⁵⁷ and Borealis, which has been sourcing U.S. ethane for its cracker in Sweden since 2016²⁵⁸ and is building what will be one of the world's largest propylene plants at Antwerp.²⁵⁹

However, Anglo-Swiss chemical giant Ineos is the European company that is likely investing most heavily in plans reliant on U.S. fracking. Ineos, which claims to be Europe's largest ethylene producer,²⁶⁰ has its own fleet of tankers (the so-called Dragon ships) that began importing U.S. shale gas-derived ethane to Europe in 2016. Ineos states that it has invested \$2 billion in its U.S. ethane supply chain, including the ships and infrastructure in the U.S. and Scotland, and it has signed 15-year contracts for U.S. ethane.²⁶¹ In October 2020, Ineos announced that it will also import U.S. butane to Antwerp.²⁶² In 2020, the company itself obtained its first permits to drill in the Texas shales.²⁶³ Ineos's founder has predicted a "shale gas revolution" in the UK²⁶⁴ and has said "Shale gas economics has revitalized U.S. manufacturing. When U.S. shale gas arrives in Europe, it has the potential to do the same for European manufacturing."²⁶⁵ The company attributes its switch to U.S. shale gas to historic high feedstock prices and poor availability in Europe.²⁶⁶

In 2019, Ineos announced a £3 billion (\$4.1 billion) investment in a new ethane cracker – supposedly the first in Europe for 20 years – and a propylene plant at Antwerp, specifically citing the need to compete with the fracking-driven U.S. petrochemical expansion. Both plants are intended to process U.S. shale gas shipped by Ineos.²⁶⁷ Ineos presents the cracker as a low-carbon alternative to crackers that use naphtha, and claims that the two plants' huge processing capacity will not equate to new plastics production capacity but will simply enable the firm to replace more carbon-intensive feedstock – while also justifying virgin plastic production as necessary to boost the performance of recycled plastic.²⁶⁸ However, in the wake of a delay caused by legal action,²⁶⁹ and facing a poor economic outlook along with the wider petrochemical sector, Ineos suspended construction of the propylene plant in January 2021.²⁷⁰





Imagery ©2021 Maxar Technologies, TerraMetrics
Map data ©2021 SIO, NOAA, U.S. Navy, NGA and GEBCO

- Oil Refinery
- Ethylene Cracker
- Oil pipeline
- Gas pipeline
- National Borders
- Oil/Gas Field
- Water



JAMNAGAR, INDIA. facility expanded to become the largest cracker in the world

ASIA

FROM BIG TO BIGGER

Northeast Asia has been the largest producer and consumer of ethylene in recent years – accounting for 27% of global capacity and around 29% of global demand in 2020. Industry experts predict that the region’s ethylene output will continue to increase rapidly and that capacity additions in the region will total around 28 million metric tons in the period from 2020 to 2025.²⁷¹

This growth is predicted to be led by mainland China, which is expected to have eight ethylene crackers become operational in 2021. This expansion will raise China’s effective ethylene capacity to 39.8 million metric tons per year by the end of the year – a 23% increase from 2020.²⁷² It follows the startup of six new ethylene crackers in 2020, which is calculated to have taken effective ethylene capacity to 32.2 million metric tons per year by the end of that year, up by 21% from 2019.²⁷³

This Chinese capacity growth has been partly driven by several joint ventures (JVs) and collaborations with global fossil fuel and petrochemical majors. For instance, China’s state-controlled Sinopec Engineering has reportedly

signed an engineering and construction contract with ExxonMobil for the latter’s planned Huizhou petrochemical complex in Guangdong Province. Early construction work for the complex, which will include a 1.6 million metric tons per year flexible-feed steam cracker and downstream polyethylene and polypropylene plants, began in April 2020, with startup planned for 2023. In what is unusual for a non-Chinese company, ExxonMobil will own 100% of the project.²⁷⁴ International companies involved in JVs in China include ExxonMobil itself (also with Sinopec),²⁷⁵ BASF,²⁷⁶ Shell²⁷⁷ and SABIC.²⁷⁸

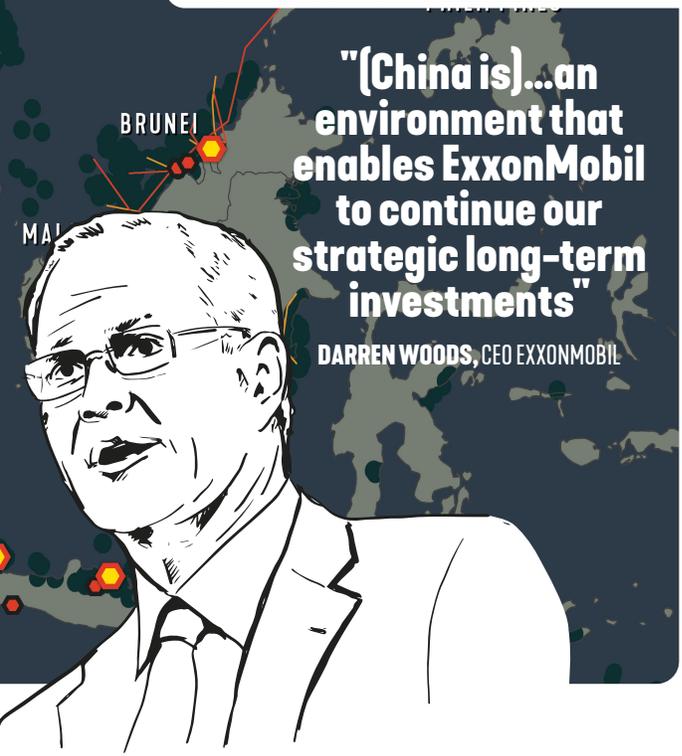
While naphtha remains by far the most widely used feedstock in Northeast Asia, much of China’s ethylene capacity growth in the years since 2012 has been based on coal-to-olefin and methanol-to-olefin plants because of the cost advantages that they offered at a time of high oil prices.²⁷⁹ However, with pressure on new coal-to-olefin projects due to climate and other environmental impacts, recent years have seen growing interest in importing U.S. ethane as a feedstock, with several new ethane crackers.



Huizhou Petrochemical Complex, Huizhou, Guangdong Province, China. From http://www.xinhuanet.com/english/2020-04/22/c_138999462.htm

ExxonMobil  **SINOPEC**

Huizhou Petrochemical Complex, HUIZHOU, GUANGDONG PROVINCE, CHINA



"(China is)...an environment that enables ExxonMobil to continue our strategic long-term investments"

DARREN WOODS, CEO EXXONMOBIL

South Korea is also predicted to be a leader in the construction of new crackers,²⁸⁰ with three such facilities expected to be completed in 2021. GS Caltex is building a mixed-feed cracker with capacity to produce 700,000 metric tons per year of ethylene and 350,000 metric tons per year of propylene. It is expected to be fully operational sometime in 2021 and will have an integrated 500,000 metric tons per year of polyethylene capacity.²⁸¹ Korean petrochemical firm LG Chem's second cracker at Yeosu began operating in June 2021 after a technical issue forced the new plant to shut down for several days. The cracker is intended to have 800,000 metric tons per year of ethylene capacity and 800,000 metric tons per year of fully integrated polyethylene capacity.²⁸² Hyundai Oilbank and Lotte Chemical are involved in a joint venture in Daesan which includes building a steam cracker and downstream units capable of producing 850,000 metric tons per year of polyethylene and 500,000 metric tons per year of polypropylene. It is expected to be operational by the end of 2021.²⁸³

India is also a potential focus for expansion, with the government having recently announced a raft of new petrochemical projects. Around 11 projects worth about \$17 billion are scheduled to be completed by 2024, and new projects under consideration are worth a potential total of \$87 billion. These include Nayara Energy's proposed \$20 billion complex at Vadinar in Gujarat, which as reported may include a cracker and downstream units for polypropylene and polyethylene. There are also proposals to invest an additional \$10 billion in expanding production of polypropylene, polyethylene and PVC at the already vast Reliance Industries-owned Jamnagar site in Gujarat.²⁸⁴ These proposals are

part of plans to more than double the megacomplex's conversion of crude to chemicals to 35%, at the expense of fuel production.²⁸⁵

Ethylene production capacity in **Southeast Asia** has increased by 43% in the last 10 years, with growth driven both by increasing regional demand for ethylene and derivatives and by the region's proximity to the Chinese market.²⁸⁶ Large olefins and derivatives complexes have been constructed in Singapore, Thailand and Malaysia in the last decade,²⁸⁷ and new capacity is planned for the coming years in Indonesia,²⁸⁸ Vietnam²⁸⁹ and Brunei.²⁹⁰

In **Thailand**, after many delays petrochemical producer PTT Global Chemical (PTTGC) is reported to have started commercial operation of its fifth cracker at Map Ta Phut - a naphtha cracker with the capacity to produce 500,000 metric tons per year of ethylene and 260,000 metric tons per year of propylene - in March 2021.²⁹¹

In 2019 **Malaysia's** state-owned Petronas started up a 1.29 million metric tons per year cracker complex at Pengerang in a JV with Saudi Aramco. However, production has twice been halted by explosions and is not set to resume until the fourth quarter of 2021.²⁹²

In **Indonesia**, a JV between Russia's Rosneft and state-owned PT Pertamina (known as PT Pertamina Rosneft Pengolahan dan Petrokimia or PRPP) is developing an integrated refinery and petrochemical complex at Tuban, one of several new facilities planned for the island of Java. Scheduled to be completed by 2025, it reportedly aims to produce 1.2 million metric tons per year of polypropylene products, 1.3 million metric tons per year of paraxylene and 650 metric tons per year of polyethylene.²⁹³

These are just a few examples of the many expansion projects currently under way or planned around the world - more of which are detailed on the global map.

HIDDEN EMISSIONS, OBVIOUS IMPACTS



Whether new 'virgin' plastic or part-recycled, plastic production causes huge emissions of CO₂e, invisible to consumers. However, the impacts on the climate become more obvious daily.

- A** 22 April 2020, Biebrza National Park, Poland, firecrews fight its largest fire in the history of the park, caused by drought. © Rafal Wojczal / Greenpeace
- B** 17 July 2021, Nordrhein-Westfalen, Germany. Extremely heavy rain causing widespread damage. © Bernd Lauter / Greenpeace
- C** 15 July 2021, Bad Neuenahr, Germany. Flooding streets, destroyed houses and infrastructure. © Dominik Ketz / Greenpeace
- D** 15 Nov, 2020, Rodriguez, Philippines. Aftermath of Typhoon Vamco residents queue to receive relief materials. © Basilio H. Sepe / Greenpeace
- E** 24 October 2019, California USA, a house burns during the Tick Fire. © David McNew / Greenpeace
- F** 17 July 2020, Siberia, Russia. Forest fires in the Tiaga. © Julia Petrenko / Greenpeace
- G** 4 September 2017, Port Arthur, Texas, Homes next to flooded oil storage tanks. © Aaron Sprecher / Greenpeace
- H** 5 November 2011, Bangkok, Thailand. People sleeping at the evacuation center after the worst flooding in 50 years. © Athit Perawongmetha / Greenpeace
- I** 7 February 2020, Mwingi, Kitui County, Kenya. The largest locust invasion in 70 years caused by severe droughts and floods creating favourable breeding conditions. © Greenpeace / Paul Basweti
- J** 20 September 2020, California. Firefighters at the Bobcat Fire in Southern California, a wildfire which burned over 100,000 acres of forest. © David McNew / Greenpeace
- K** 17 August 2020, Lábrea, Amazonas state, Brazil. Deforestation and forest fires. © Christian Braga / Greenpeace
- L** 21 May 2020, Migori and Homa Bay Counties in Kenya. These floods left hundreds dead, thousands displaced, crops destroyed and livestock killed. © Bernard Djwang / Greenpeace
- M** Doritos plastic chip bags - Doritos is owned by PepsiCo. © Tonelson Productions / Shutterstock.com
- N** Take away food delivered in plastic packaging. © Shutterstock.com
- O** UK. Tesco own-brand plastic food packaging. © Hamilton / Greenpeace
- P** MaPET single-use Coca Cola bottles. © Bramanyuro / Shutterstock.com
- Q** PET bottles of energy drinks, soda, soft drinks. © Abdul Razak Latif / Shutterstock.com
- R** Indonesia. Plastic food sauce sachets. © Sukarman S.T / Shutterstock.com

BIG BRANDS MUST SHIFT TO REUSE TO STOP THE PETROCHEMICAL EXPANSION AND MEET CLIMATE GOALS



Clearly, given the detrimental impacts to communities and the need to keep climate change below 1.5 °C, the fossil fuel industry cannot be allowed to continue expanding petrochemical production to make plastic.

The consumer goods sector has a clear choice to make: Companies can rapidly move away from single-use plastic and seriously invest in reuse and packaging-free based delivery systems, or they can continue to enable the fossil fuel industry's attempts to ramp up plastic production behind the smokescreen of recycling.

Among progressive businesses, governments and nongovernmental organizations, there is already a consensus that our current linear economic model with its "take, make, dispose" philosophy must be abandoned in favor of a circular model that decouples economic activity from the consumption of finite resources and designs waste out of the system. Reuse will be central to such a slow circular economy, with recycling confined mainly to dealing with reusable packaging that has reached the end of its life.

However, while some major FMCG companies have acknowledged the need to either avoid packaging altogether or replace single-use packaging with containers that can be reused a large number of times,²⁹⁴ to date not one has committed to targets for large-scale reuse or significant reduction of single-use plastic packaging. For instance, **big brands like Coca-Cola, Nestlé and PepsiCo**

have all made high-level pledges to tackle plastic pollution that focus on recycling, while in reality these companies and others in the sector have made very little progress on reducing throwaway plastic. In fact, a 2020 review of action by companies signed up to the Ellen McArthur Foundation Global Plastics Commitment found that plastic packaging use by signatories actually grew by 0.6% in 2019 and that reusables accounted for just 1.9% of their packaging, up just 0.1% from the previous year.²⁹⁵

Instead, most brands continue to propose plastic recycling as the central solution to the plastic pollution crisis, even though there is abundant evidence of its failure. This is despite the fact that **multiple studies have shown that reusing packaging is far less carbon-intensive than relying on single-use packaging.** For instance, one life-cycle assessment study estimated that if the glass bottles used in the food and drinks packaging sector were reused by up to three times, it would save approximately 50,000 metric tons of CO₂e per year.²⁹⁶

It's time for these big brands to shift direction - to reduce both their dependence on oil and gas and their plastic footprints and move beyond the throwaway culture that single-use plastic exemplifies - by investing in reuse- and packaging-free-based delivery systems and other innovations. Governments must encourage, assist and, where necessary, compel them to act.

GREENPEACE IS CALLING ON FMCG COMPANIES TO TAKE THE FOLLOWING STEPS:

MOVE QUICKLY TO ALTERNATIVE DELIVERY SYSTEMS BASED ON REUSE

- Set reuse targets of at least 25% reusable packaging by 2025 and 50% by 2030.²⁹⁷ Sectors for which a switch to reuse is comparatively easy – such as soft drinks, mineral water, alcoholic beverages and coffee chains – should set more ambitious targets than this.

PHASE OUT ALL SINGLE-USE PLASTIC

- Phase out all single-use plastic (packaging²⁹⁸ and products²⁹⁹), not just “virgin” or “new” plastic.
- Prioritize elimination of unrecyclable/hard-to-recycle plastics³⁰⁰ and produce a roadmap for phasing them out by the end of 2022.

WORK TOGETHER

- Collaborate with packaging manufacturers and retailers (and, pre-competitively, with other FMCG companies) to standardize reusable packaging and build shared reuse systems and infrastructure (e.g. return logistics, washing facilities, tracking technology).
- Publicly share learnings on reuse for the benefit of other companies in the sector and other stakeholders (e.g. packaging manufacturers, retailers, legislators).
- Collaborate to address the drivers of single-use packaging. Promote shorter supply chains and seasonal produce, and challenge use of excessive packaging for

marketing purposes, along with the wasteful “convenience” culture exemplified by the “on-the-go” market.

BE TRANSPARENT AND CONSISTENT

- Implement annual public reporting of independently verified and comprehensive data about the company’s packaging, including its single-use packaging climate footprint (taking account of the entire life cycle of the plastic used), reduction of packaging and uptake of reusable packaging.
- Ensure that packaging reduction and reuse commitments are enacted consistently across all markets in which the company (and its subsidiaries) operates.

ADVOCATE FOR POLITICAL ACTION

- Advocate for an ambitious Global Plastics Treaty that will address the entire plastics life cycle and emphasize the need to reduce plastic production and eliminate single-use plastic.
- Advocate for ambitious regional and national legislation to promote the slow circular economy and extended producer responsibility, ban single-use plastic and fast-track reuse and packaging-free systems.
- Avoid and/or terminate alliances with companies or organizations that lobby against action to eliminate single-use plastic.



3 March 2021, Washington DC. A supermarket with bulk items, an effort to reduce single use plastics. © Tim Aubry / Greenpeace



20 December, 2020 Lenasia, South Africa. Reusable glass and plastic Coca-Cola bottles. © Dillion Jacobs / Greenpeace



16 April 2019, Italy, Stop plastic action at San Pellegrino Nestlé Plant.
© Francesco Alesi / Greenpeace



22 May 2021, Washington DC. A Break Free From Plastic message lights up the night near the U.S. Capitol Building.
© Tim Aubry / Greenpeace

GREENPEACE IS CALLING ON LOCAL AND NATIONAL GOVERNMENTS TO TAKE THE FOLLOWING STEPS:

ADVOCATE FOR INTERNATIONAL ACTION

- Support development of an ambitious Global Plastics Treaty that will address the entire plastics life cycle and emphasize the need to reduce plastic production and eliminate single-use plastic.
- Support bans on the plastics waste trade.

MOVE TOWARD A ZERO-WASTE ECONOMY

- Adopt a zero-waste approach that progressively reduces waste generation. Act to reduce landfilling of waste and eliminate its incineration and export altogether.
- Make building a zero-waste, reuse-centered economy a central part of plans for a green recovery from the coronavirus pandemic, starting with investments enabling the creation of stable, high-quality employment and ensuring a just transition for workers in the fossil fuel, petrochemical/plastic and waste sectors (including waste-picker communities where present).

ENCOURAGE A PHASE-OUT OF SINGLE-USE PLASTIC VIA LEGISLATION AND POLICY MEASURES

- Set legally binding, time-bound national/local targets to phase out all single-use plastic, with the exception of essential single-use medical supplies.
- Design and implement extended producer responsibility legislation that prioritizes packaging reduction and uptake of reusables by financially penalizing companies that continue to sell single-use products and incentivizing the transition to reuse and packaging-free models.

- End all fossil fuel subsidies and immediately suspend permitting of both petrochemical expansion intended to supply the plastic industry, as well as waste-to-fuel and waste-to-energy plants.

ENCOURAGE ADOPTION OF REUSE AND PACKAGING-FREE SYSTEMS VIA LEGISLATION, INVESTMENT AND POLICY MEASURES

- Set legally binding, time-bound targets for specific sectors (e.g. beverages, food, e-commerce) to adopt reuse or packaging-free systems.
- Invest in systems that incentivize reuse, such as deposit-return schemes.
- Incentivize and support standardization of reusable packaging and provide financial incentives to help businesses shift to reuse and packaging-free approaches.
- Adopt public procurement policies that prioritize reuse-based or packaging-free services and products.

ENSURE INVOLVEMENT OF AFFECTED COMMUNITIES

- Ensure Black, Brown, Indigenous, low-income and other frontline communities impacted by any stage in the plastic production process (including fossil fuel extraction and refining), or by plastic recycling, incineration and disposal, have opportunities to contribute to the design of a slow circular economy and to benefit from that economy. When anti-plastic and pro-reuse legislation is developed in countries with informal waste-collection sectors, it is important that it be context-specific and actively include waste-picker communities in its development.

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ENDNOTES

- 1 Article 2, paragraph 1 of the Paris Agreement states: "This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change." See United Nations Framework Convention on Climate Change (2015) p.3.
- 2 See e.g. CIEL (2018) p.10.
- 3 See e.g. Mufson (2021) and Department for Business, Energy & Industrial Strategy (2020) Chapter 4.
- 4 CIEL (2020) pp.9-10
- 5 Oil Change International (2020) p.6
- 6 See e.g. Carbon Tracker (2020).
- 7 Raval & Ward (2017)
- 8 Baystar, Who we are (Online), Melinek & Hays (2020), Reuters (2020) and Total, Antwerp: Total's largest integrated complex in Europe (Online)
- 9 Global Energy Infrastructure (2021), Loh (2020) and Taylor (2017)
- 10 Brelsford (2021), Chang (2020) and Taylor (2017)
- 11 CIEL (2019a) p.8
- 12 World Economic Forum (2016) p.13
- 13 Xu et al. (2019)
- 14 Renewable Carbon Publications (2019). This graphic is based on data from PlasticsEurope, which also features in annual reports; see PlasticsEurope (2013) p.10 and PlasticsEurope (2020) p.16.
- 15 PlasticsEurope (2021) p.16
- 16 World Economic Forum (2016) pp.13-14, drawing on data from the ICIS Supply & Demand database and IEA (2015), suggests a projected growth rate of 3.8% per year from 2015 to 2030 and 3.5% from 2030 to 2050. These figures are endorsed by CIEL (CIEL (2019a) pp.17-18).
- 17 Charles et al. (2021) p.40
- 18 Waxman et al. (2020) pp.1, 8, 10
- 19 CIEL (2019a) pp.2, 4-5, 80-81
- 20 See e.g. CIEL (2017a) pp.1-4 and CIEL (2018) pp.1-2, 4-5.
- 21 See e.g. Charles et al. (2021) p.40 and CIEL (2018) p.2.
- 22 Researchers estimate that as of 2015, 42% of primary non-fiber plastic produced worldwide was for packaging. See Geyer et al. (2017) p.2.
- 23 IEA (2018) pp.1, 3
- 24 For example, as of 2019 just 1.9% by weight of the plastic packaging used for goods sold by the retail signatories of the Ellen MacArthur Foundation's New Plastics Economy Global Commitment was reusable, an increase of just a tenth of a percentage point on the previous year. Source: Ellen MacArthur Foundation (2020b) pp.10, 29.
- 25 In the case of the most common plastics, polyethylene and polypropylene. Production of some other plastics (such as polystyrene) involves more complicated but broadly similar processes.
- 26 Pew Charitable Trusts & SYSTEMIQ (2020) p.23
- 27 Royer et al. (2018)
- 28 Shen et al. (2020)
- 29 CIEL (2019a) p.2
- 30 Levi & Cullen (2018), Zheng & Suh (2019)
- 31 CIEL (2019a) p.26. Owing to a lack of data, this estimate excludes the significant contribution of natural gas to plastic production elsewhere in the world, notably in the Middle East.
- 32 Howarth (2019)
- 33 Material Economics (2019) pp.104, 106-107, drawing on data from PlasticsEurope and the IPCC, estimates average life cycle emissions of 5 metric tons of carbon dioxide (not CO₂e) per metric ton of plastic, comprising 2.3 metric tons from production (including oil/gas production and refining) and 2.7 metric tons from disposal (assumed to be by incineration). The presentation of carbon dioxide rather than CO₂e figures may indicate an underestimate of total global heating potential (if methane emissions have been omitted) or may simply be an error. The latter seems possible, given the very similar estimate arrived at by ODI (2020) p.27, which, drawing on a number of earlier studies including the above, estimates an average 4.9 metric tons CO₂e per metric ton of plastic as of 2015 (again including oil/gas production and end-of-life emissions from incineration, landfill or recycling).
- 34 Powell et al. (2020)
- 35 Ranking from Powell et al. (2020) p.14, based on resin production capacity.
- 36 Charles et al. (2021) p.50
- 37 Charles et al. (2021) p.50, Closed Loop Partners (2019) p.43
- 38 Eni, Versalis (Online)
- 39 Appendix, <https://www.greenpeace.org/usa/reports/the-climate-emergency-unpacked/>
- 40 Panjiva database, <https://www.panjiva.org>
- 41 Bloomberg Terminal. Search performed using "Supply Chain Analysis" (SPLC function).
- 42 Analysis based on reporting in Ellen MacArthur Foundation (2020b).
- 43 Coca-Cola (2021) p.70
- 44 See Ellen MacArthur Foundation, Organisation report for 2020 reporting cycle: Danone S.A. (Online).
- 45 See Ellen MacArthur Foundation, Organisation report for 2020 reporting cycle: Colgate-Palmolive Company (Online).
- 46 Quinault (2019)
- 47 Elmore (2015) pp.248-249, Hunt & Franklin (1996)
- 48 Scott et al. (2020) p.27
- 49 IHS Markit (2019)
- 50 Gentry (2015)
- 51 Chemical Engineering (2015)
- 52 Plastics Insight, Purified terephthalic acid (PTA) production and market (Online)
- 53 Plastics Insight, Mono-ethylene glycol (MEG): Production, market, price and its properties (Online). About half of global demand for MEG is for the manufacture of polyester fibers, and a quarter for PET. The remainder is for antifreeze and other industrial uses.
- 54 O.Berk (2018)
- 55 Polyglobe (2019)
- 56 Cook & Romm watt (2020) p.23, Ineos, Ethylene oxide and EO glycols (Online)
- 57 Bloomberg Terminal analysis by Greenpeace USA, June 2021
- 58 Indorama Ventures, PET (Online)
- 59 Indorama described its purchasing from these key suppliers through both short- and long-term contracts – see Indorama Ventures (2017a) p.94 and Indorama Ventures (2018) p.95. Indorama has not disclosed its key suppliers in subsequent annual reports.
- 60 Brelsford (2016)
- 61 Targa Resources, About us (Online)
- 62 Targa Resources, About us (Online)
- 63 Indorama Ventures (2020) p.111
- 64 Indorama Ventures (2019) p.94
- 65 Coca-Cola Europe (2019), Reynolds (2018)
- 66 Indorama Ventures (2013), Indorama Ventures (2015)
- 67 Miller (2019), Setboonsarng (2019)
- 68 ExxonMobil, Packaging (Online)
- 69 See appendix.
- 70 Panjiva analysis by Greenpeace USA. See appendix for more information.
- 71 Amcor (2021b) pp.6-7
- 72 Bloomberg analysis by Greenpeace USA, June 2021. See also Powell et al. (2020) p.40.
- 73 Bloomberg analysis by Greenpeace USA, July 2021
- 74 Edelbrock (2012)
- 75 Packaging Strategies (2015)
- 76 Amcor (2020), Amcor (2021a)
- 77 Bloomberg analysis by Greenpeace USA, July 2021
- 78 Bloomberg analysis by Greenpeace USA, July 2021
- 79 Amcor (2018)
- 80 Bloomberg analysis by Greenpeace USA, July 2021
- 81 Amcor (2019)
- 82 Kezzler, Brand engagement: Make it personal in a crowded market (Online)
- 83 See appendix.
- 84 Berry Global (2019) pp.7, 11
- 85 See appendix.
- 86 See appendix.
- 87 Goldsberry (2021)
- 88 Berry Global (2019) p.4, Berry Global (2021) p.19
- 89 See appendix.
- 90 See appendix.
- 91 Bloomberg analysis by Greenpeace USA, February 2021. See also Alpla, Beverages (Online) and Alpla Sustainability Report 2018, Many opportunities and challenges (Online).
- 92 Panjiva analysis by Greenpeace USA, February 2021. See also Alpla, Beauty care (Online).
- 93 Alpla (2020) p.15
- 94 Alpla (2020) p.15
- 95 Alpla (2020) p.15, Unilever (2014)
- 96 Tullu (2020)
- 97 Polyglobe (2019)
- 98 Geyer et al. (2017) pp.2-3
- 99 Geyer et al. (2017) p.3
- 100 The Ellen MacArthur Foundation has estimated that in 2013, of an estimated 14% of plastic packaging collected for recycling globally, only 2% was recycled back into similar-quality applica-

- tions. See Ellen MacArthur Foundation et al. (2016) pp.26-27.
- 101 In 2018 2.2% of U.S. post-consumer plastic waste was recycled domestically, with a further 3% being exported purportedly for recycling. Source: Dell (2019).
- 102 Greenpeace USA (2020)
- 103 Ellen MacArthur Foundation (2020a)
- 104 Ellen MacArthur Foundation, Organisation report for 2020 reporting cycle: Mondelēz International (Online), endnotes
- 105 The company claims on its website that 93% of its packaging is “designed to be recyclable or recycle-ready.” See Mondelēz International, Packaging innovation (Online).
- 106 Friends of the Earth Europe (2018) pp.9-10
- 107 See e.g. Singh & Sy-Changco (2009).
- 108 Unilever (2018)
- 109 Materials Recovery for the Future (2020) pp.24-26
- 110 “The main challenge of waste plastics gasification is the high tar content in the gas product ... a very efficient gas cleaning system is needed to meet the requirements for applying the syngas to chemical production.” Lopez et al. (2018) p.577.
- 111 Rollinson & Oladejo (2020) p.11
- 112 Rollinson & Oladejo (2020) p.29
- 113 American Chemistry Council (2020)
- 114 Tullo (2018)
- 115 Zero Waste Europe (2020) pp.4-5; see e.g. BASF (2020b) p.82.
- 116 Rollinson & Oladejo (2020) p.29, Zero Waste Europe (2020) pp.5-6
- 117 Approximately 12.5 kg CO₂e per kg of olefin produced, compared with 1.56 kg CO₂e per kg of olefin produced using crude oil as a primary feedstock. Source: Keller et al. (2020).
- 118 Zero Waste Europe (2020) p.8
- 119 CIEL (2019a) p.84
- 120 The ACC reports investments of \$5.5bn in advanced recycling between July 2017 and February 2021 (American Chemistry Council (2021a)), compared with investments in completed or under-construction chemical facilities as a whole of \$128bn since 2010, with projects worth a further \$81bn at the planning stage – the scale of these investments being attributed to the shale gas boom (American Chemistry Council (2021b)).
- 121 GAIA (2020) p.5
- 122 Sullivan (2020)
- 123 Sullivan (2020)
- 124 For example, through the Recycling Partnership, of which a large number of fossil fuel, petrochemical, plastic and FMCG companies are funding partners (Recycling Partnership, Funders (Online)). See Recycling Partnership (2019) pp.12, 52.
- 125 Changing Markets Foundation (2020) p.90, Crunden (2019)
- 126 Sullivan (2020)
- 127 For example, a 2016 U.S. national survey for Keep America Beautiful found that 33% of all respondents were skeptical that their curbside recycling (not specifically plastic) was actually recycled, with millennials being the most skeptical age group at 43% (Keep America Beautiful (2016)). A similar 2019 survey for the Carton Council is reported to have found a 44% overall level of skepticism, though 85% of its respondents reported that they did recycle (Mohan (2019)). A 2019 survey by YouGov for packaging company Hi-Cone found that 31% of respondents in the four survey countries (the US, the UK, Spain and Mexico) believed that only a quarter of what they put in recycling bins was recycled, while a further 34% believed that only half was recycled, and 56% of respondents (48% in the U.S.) “found recycling different plastics difficult to understand”; nevertheless 75% of adults (60% in the U.S.) engaged in some recycling at home (Hi-Cone (2020) pp.5, 11, 18). Another survey conducted by YouGov for Hi-Cone in 2020 (with different questions) found that 61% of respondents across the four countries claim to recycle at least 75% of their plastic waste (Hi-Cone (2021) p.12).
- 128 Nestlé Waters US, Home (Online)
- 129 Keep America Beautiful, Board of Directors (Online).
- 130 Sullivan (2020)
- 131 PLASTICS, Our rebrand (Online)
- 132 Buranyi (2018)
- 133 Frontline/NPR (2020), Meadows (1992)
- 134 Sullivan (2020)
- 135 See Buranyi (2018), Lodge & Rayport (1991), Root (2019) and Sullivan (2020).
- 136 Sullivan (2020)
- 137 Buranyi (2018)
- 138 Sullivan (2020)
- 139 Of the fossil fuel and petrochemical companies featured in the supply chain graphic of this report, Braskem, Chevron Phillips, Dow, Eni/Versalis, ExxonMobil, Formosa, SABIC, Shell and Total are members of the Alliance. See Alliance to End Plastic Waste, About (Online).
- 140 Alliance to End Plastic Waste (2021), Alliance to End Plastic Waste, Our work (Online)
- 141 Brock & Geddie (2021), Chevron Phillips Chemical (2019) p.54
- 142 The ACC has acknowledged its role in helping to establish the Alliance (see American Chemistry Council (2019) part III, line 4a), while the Alliance’s address on its IRS forms is given as “c/o American Chemistry Council” (U.S. Internal Revenue Service (2020)).
- 143 American Chemistry Council, Member companies (Online)
- 144 Romer (2019) p.20
- 145 CIEL (2017b) p.5, citing Freinkel (2011) pp.163-165
- 146 Changing Markets Foundation (2020) p.94
- 147 American Chemistry Council (2018a), Materials Recovery for the Future (2020) p.4
- 148 Materials Recovery for the Future (2020) pp.25-26
- 149 See Howard (2020) and Tabuchi et al. (2020).
- 150 The Society of the Plastics Industry has since taken over from the ACC as the parent organization of the Progressive Bag Alliance, which under the new name American Progressive Bag Alliance continues to oppose plastic bag laws. See Romer (2019) p.20.
- 151 American Chemistry Council (2020)
- 152 American Chemistry Council (2018b)
- 153 IPCC (2018) p.12
- 154 See Lerner (2019), Wheeler (2019b) and Wheeler (2019c).
- 155 Wheeler (2019b,c)
- 156 Changing Markets Foundation (2020) p.90, Crunden (2019)
- 157 Recycling Partnership, Funders (Online)
- 158 See Bottle Bill Resource Guide, What is a bottle bill? (Online), Changing Markets Foundation (2020) p.93, Container Recycling Institute (2009) slides 2, 9, 19, Corkery (2019) and Recycling Partnership (2019) pp.10-14, 46.
- 159 In German, Verpackung mit Zukunft (<https://www.verpackung-mitzukunft.at/>).
- 160 PETplanet (2020)
- 161 APA-OTS (2020)
- 162 Paben (2018d), Peters (2019)
- 163 Paben (2018d)
- 164 PureCycle Technologies (2019b)
- 165 PureCycle Technologies (2019b)
- 166 Total (2020)
- 167 PureCycle Technologies (2019a)
- 168 Robbins Geller Rudman & Dowd LLP (2021)
- 169 Paben (2018a)
- 170 Loop Industries (2019)
- 171 Paben (2018c)
- 172 Paben (2018b)
- 173 Paben (2020)
- 174 Loop Industries (2019)
- 175 Ellen MacArthur Foundation, Organisation report for 2020 reporting cycle: L’Oréal (Online), Staub (2020)
- 176 Hindenburg disclosed that it had taken a short position in shares of Loop as a result of its findings; see Hindenburg Research (2020a). See also Fox (2020).
- 177 Paben (2020)
- 178 Loop Industries (2020)
- 179 Hindenburg Research (2020b), Nagarajan (2020)
- 180 Business Wire (2020)
- 181 Total (2019)
- 182 ECSP (2020). While the TruCircle range also includes bioplastics and mechanically recycled plastics, the customers mentioned are purchasing chemically recycled plastic from the range, as the sources cited for them make clear.
- 183 PackagingInsights (2020b)
- 184 SABIC (2020)
- 185 PackagingInsights (2020a)
- 186 Tudball (2020)
- 187 Despite the impact of the Covid pandemic, which saw upstream oil and gas investment fall by nearly a third in 2020, global investment still totaled \$328bn (IEA (2020)). See also Carbon Tracker (2020), Charles et al. (2021) and Rainforest Action Network (2021).
- Between 2010 and 2017 in the U.S., fossil fuel and petrochemical companies reportedly invested \$186bn in new cracking facilities that will produce the raw materials for plastics (see Taylor (2017)). ExxonMobil alone has an ongoing \$20bn-plus program of petrochemical expansion just in the U.S. Gulf Coast region (see ExxonMobil, Growing the Gulf (Online)).
- 188 See e.g. Carbon Tracker (2020) and Rainforest Action Network (2021) pp.37, 126-127, 130-137.
- 189 CIEL (2018) p.9
- 190 Charles et al. (2021) p.36
- 191 World Economic Forum (2016) pp.13-14, drawing on data from the ICIS Supply & Demand database and IEA (2015), suggests a projected growth rate of 3.8% per year from 2015 to 2030 and 3.5% from 2030 to 2050. These figures are endorsed by CIEL

- (CIEL (2019a) pp.17-18).
- 192 CIEL (2019a) pp.2, 4-5, 80-81
- 193 See e.g. CIEL (2019b) pp.17-20, Garcia-Gonzales et al. (2019) and Ragothaman & Anderson (2017).
- 194 See Donaghy & Jiang (2021) (analysis based on 2018 data from the Political Economy Research Institute).
- 195 Garcia-Gonzales et al. (2019)
- 196 Ragothaman & Anderson (2017)
- 197 CIEL (2019b) pp.17-20 and Ragothaman & Anderson (2017)
- 198 See Concerned Health Professionals of NY & Physicians for Social Responsibility (2019), Hill (2018) and U.S. Environmental Protection Agency (2016).
- 199 Concerned Health Professionals of NY & Physicians for Social Responsibility (2019) p.19
- 200 Czalowski et al. (2017) p.4
- 201 Donaghy & Jiang (2021). The analysis was based on 2018 data from the Political Economy Research Institute, in turn using the Risk-Screening Environmental Indicators methodology developed by the U.S. Environmental Protection Agency to synthesize Toxic Release Inventory data into simpler indicators of the overall "toxic burden" of a facility, combining overall emissions with the toxicity of each pollutant and the size of the exposed population [see U.S. Environmental Protection Agency, EasyRSEI dashboard version 2.3.9 (Online)].
- 202 Donaghy & Jiang (2021). See also Donaghy (2021).
- 203 GAIA (2018)
- 204 Baptista & Perovich (2019)
- 205 Roy (2020)
- 206 Martuzzi et al. (2010) pp.22-23
- 207 McCormick et al. (2019)
- 208 Clarke (2020), Greenpeace East Asia (2019), McCormick et al. (2019)
- 209 Ross (2018)
- 210 Guiffrida (2020)
- 211 Greenpeace Malaysia (2018), Greenpeace Malaysia (2020)
- 212 Crawford (2020)
- 213 Frontline/NPR (2020)
- 214 InforMEA (2020)
- 215 Rabson (2019)
- 216 Aglibot (2019)
- 217 Charles et al. (2021) p.40
- 218 PlasticsEurope (2020) p.17
- 219 Suratman (2021)
- 220 IHS Markit (2020a)
- 221 Boswell (2019)
- 222 GlobalData (2020)
- 223 Campisano (2021), Lartey & Laughland (2019)
- 224 UN News (2021)
- 225 The US Census 2000 gives a figure of 40% compared with a state average of 32% and a national average of 12%, according to James et al. (2012) p.4366.
- 226 UN News (2021)
- 227 James et al. (2012) pp.4372-4374
- 228 Hammer (2018)
- 229 James et al. (2012) p.4384
- 230 Ramirez (2021)
- 231 Storrow (2020)
- 232 Einhorn & Carroll (2019)
- 233 StopFormosaPlastics.org (nd-a) p.1
- 234 Storrow (2020)
- 235 See StopFormosaPlastics.org (nd-a) p.2, StopFormosaPlastics.org (nd-b), Sanzillo & Mattei (2021) p.28 and 19th Judicial District Court, Parish of East Baton Rouge, State of Louisiana (2020) p.36.
- 236 19th Judicial District Court, Parish of East Baton Rouge, State of Louisiana (2020) p.16
- 237 StopFormosaPlastics.org (nd-a) p.2, citing EPA, Enforcement & Compliance History Online, Detailed Facility Report (accessed September 17, 2018)
- 238 Storrow (2020)
- 239 Storrow (2020)
- 240 Adelson (2021)
- 241 Waxman et al. (2020) p.6
- 242 Alexander (2019), OGG Links (2019)
- 243 Donaghy (2021)
- 244 AP (2021)
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- 294 Greenpeace does not in general consider the replacement of single-use plastic packaging with single-use packaging made of other materials such as paper, card, glass or metal – even when recyclable – to be a satisfactory solution to the problems created by plastic, as this has the potential in its own right to exacerbate climate change and other environmental crises. See e.g. Greenpeace USA (2019) pp.7-8.
- 295 Ellen MacArthur Foundation (2020b) pp.10, 29
- 296 Amienyo et al. (2013)
- 297 Greenpeace defines reusable packaging as an item of packaging designed for significant reuse within a system of reuse.
- 298 Excluding essential single-use plastic medical supplies such as plastic syringes and tubing.
- 299 Excludes essential single-use plastic medical equipment such as plastic syringes and tubing.
- 300 Non-recyclable/hard-to-recycle plastics include (but are not limited to) multi-layer laminates, film, black plastic, EPS and PVC. Regional differences also exist in what polymers can be recycled at scale.

2 March 2019, Dumaguete, Philippines.
Plastic waste dump.
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Greenpeace is a network of global, independent campaigning organizations that use peaceful protest and creative communication to expose global environmental problems and promote solutions that are essential to a green and peaceful future.

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EDITORS

Joan O'Callaghan and Rachel Head

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Front: The sun sets behind Total's Culzean Platforms located in the Culzean Field. Culzean is a gas condensate field located in the British North Sea, 230 kilometres off the coast of Aberdeen.
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This page: 22 April 2020, Poland. The largest fire in the history of the Biebrza National Park is a result of drought, one of the most severe effects of the climate crisis in Poland.
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