

GREENHOUSE GAS EMISSIONS & PLASTICS:

Presentation to

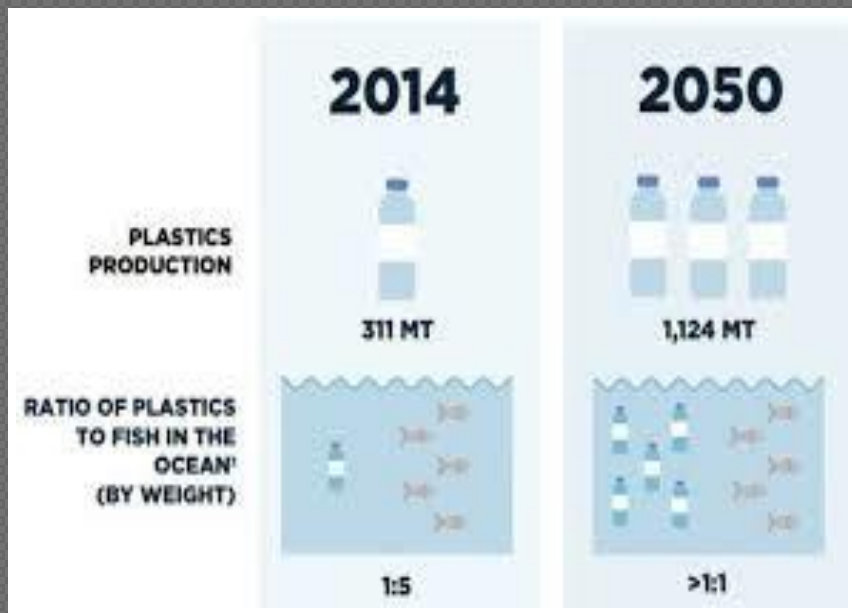
Minnesota House of Representatives
Environment & Natural Resources
Finance Division

MARCH 7, 2019



Lisa Anne Hamilton, Director
Climate & Energy Program





Today, more than 8 million metric tons of plastic goes into the ocean every year.



PLASTIC OCEAN

192 COUNTRIES BORDERING THE ATLANTIC, PACIFIC, INDIAN OCEANS AND MEDITERRANEAN AND BLACK SEAS PRODUCED **2.5 BILLION METRIC TONS OF SOLID WASTE IN 2010**.
AN ESTIMATED **8 MILLION METRIC TONS** OF PLASTIC ENTERED THE OCEAN THAT SAME YEAR.



Ocean Conservancy

**2.5
BILLION**

METRIC TONS OF SOLID
WASTE IS PRODUCED
ALL AROUND THE WORLD

2 BILLION PEOPLE WITHIN
30 MILES OF THE COAST CREATE

100M

METRIC TONS
OF COASTAL
PLASTIC WASTE

AND WITHIN THAT

275M

METRIC TONS IS
PLASTIC WASTE

AND EVERY YEAR,

8 MILLION
METRIC TONS
OF PLASTIC GOES
INTO THE OCEAN

WHAT WE
CAN DO

REDUCE
PLASTIC IN
WASTE STREAM

IMPROVE
SOLID WASTE
MANAGEMENT

INCREASE
CAPTURE &
REUSE

HEALTHY
OCEANS

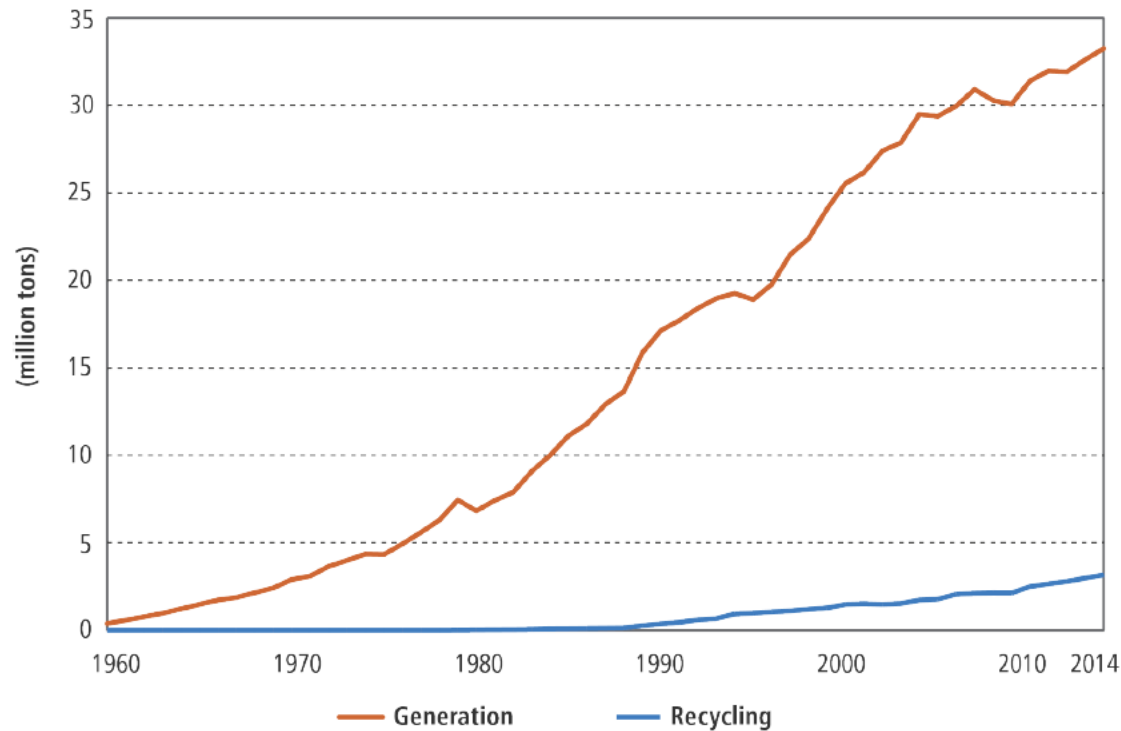


JAMBECK ET AL., SCIENCE 2015
*PLASTICS EUROPE, "PLASTICS—THE FACTS 2013" (2010 DATA)
**COZAR ET AL., 2014; ERIKSEN ET AL., 2014

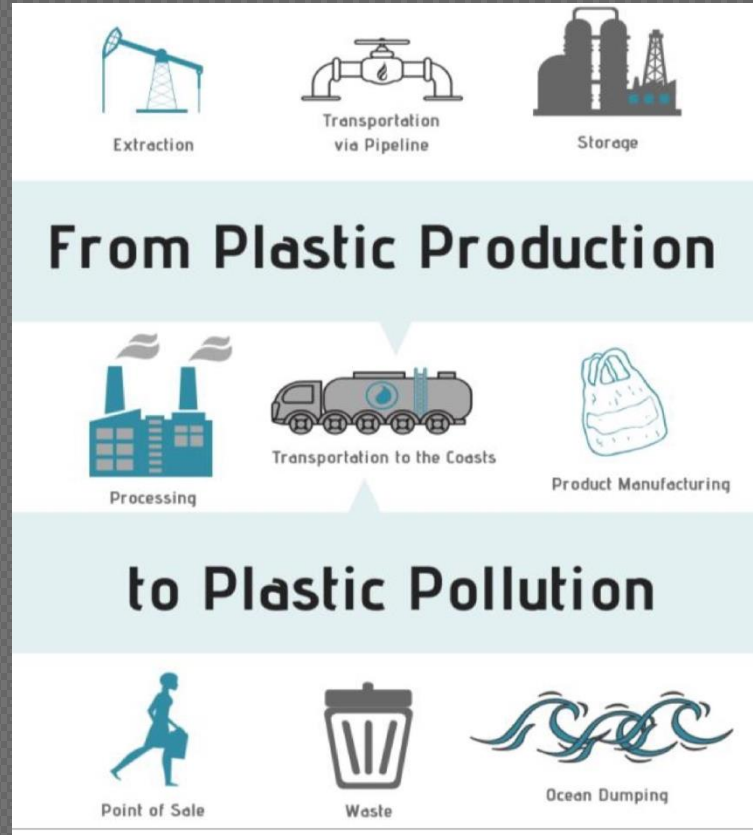
Anticipated Rate and Volume of Pollution is Staggering

Enough is Not Enough: Recycling Efforts

Figure 10. Plastics Generation and Recycling, 1960 to 2014



LIFECYCLE IMPACTS OF PLASTICS



UNITED STATES



Plentiful and affordable natural gas supplies have transformed America's chemical industry from the world's high-cost producer five years ago to among the lowest-cost producers today. The United States now enjoys a decisive competitive advantage in the making of basic petrochemicals. Companies from around the world are investing in new U.S. production capacity, leading to industry revival and new jobs. ACC analyzed the economic benefits of these investments.

American manufacturers use natural gas to fuel and power a wide variety of processes. Chemical companies use ethane, a natural gas liquid derived from shale gas, as a feedstock. Competitively-priced natural gas and ethane are enabling chemical companies to build new plants, expand, or improve their facilities in the United States. Other industries stand to benefit as the downstream effects of shale gas are felt.

NEW MANUFACTURING PROJECTS ARE GROWING OUR ECONOMY & CREATING JOBS


333
new
chemical
industry
projects due
to shale gas*

\$202 billion
in new capital investment



431 thousand
direct & indirect jobs by 2025
355K add'l jobs generated by household spending



\$292 billion
in new economic output



THE CHEMICAL INDUSTRY IS LEADING EXPANSION IN U.S. MANUFACTURING

*Completed, started and potential chemical industry projects announced as of September 2018

americanchemistry.com/Policy/Energy/Shale-Gas

POLICY PRIORITIES

Government policies will influence whether the U.S. fully realizes the shale gas opportunity.

Access - Allow access to natural gas reserves on government and private lands.

State Regulations - Continue responsible state-based regulations that avoid undue restrictions on production.

Infrastructure - Expedite the building of reliable infrastructure to transport supplies.

Permitting - Ensure a timely, transparent, and efficient regulatory permitting process for manufacturing projects and investments.

Trade - Expand access to foreign markets for U.S. goods.

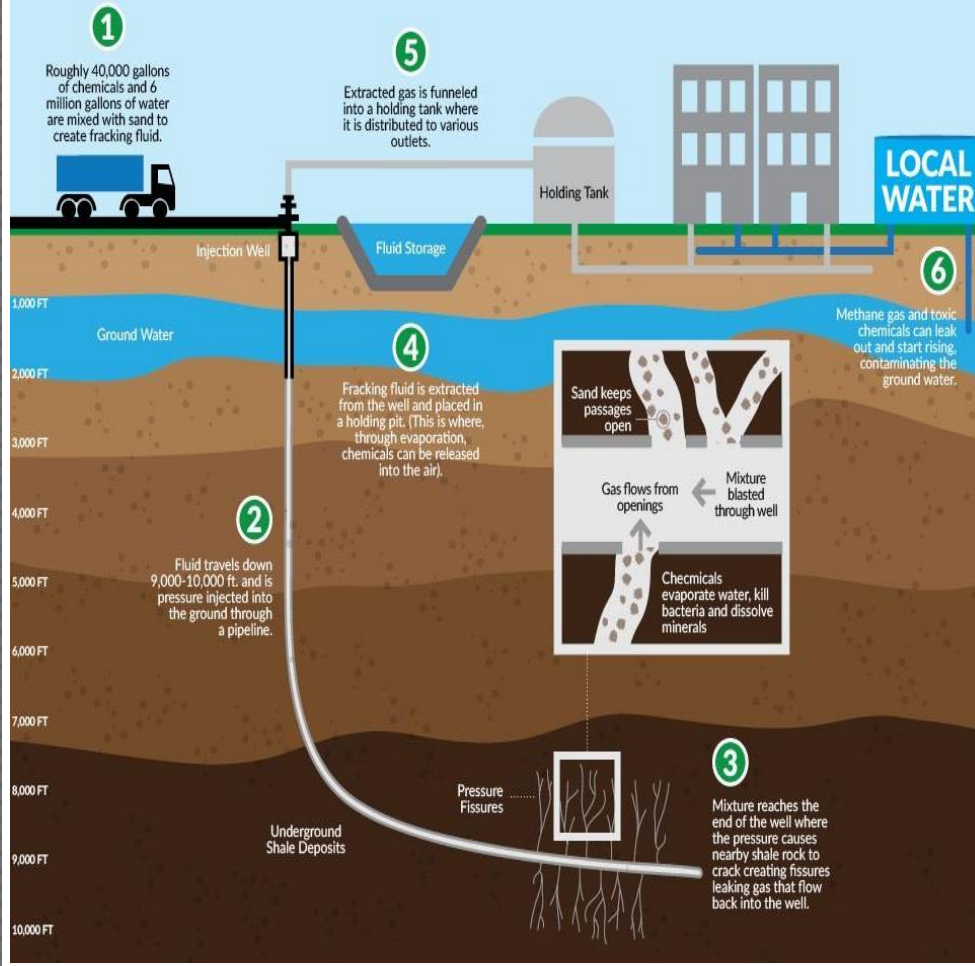
As of
September
2018, the
American
Chemistry
Council
Projects 333
Projects and
\$202 Billion in
investment.

TWO NEW REPORTS HIGHLIGHT LIFECYCLE IMPACTS



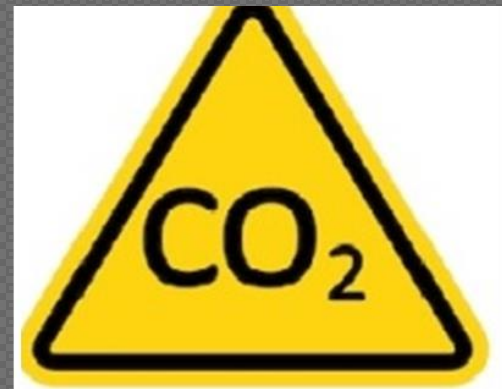
HYDRAULIC FRACTURING

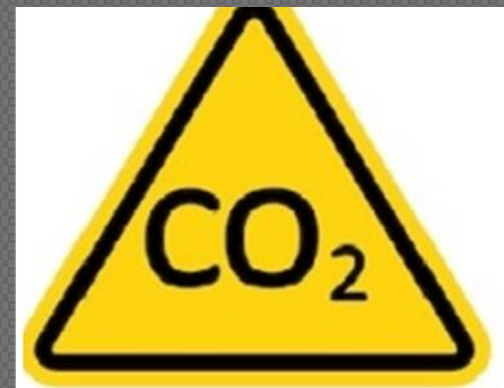
Hydraulic Fracturing, often referred to as simply “fracking,” is a process where thousands of gallons of water, sand and a mixture of chemicals are injected at extremely high pressures underground. This mixture is used to extract and harvest the natural gas from shale rock formations deep in the ground. This process has become controversial in the news today. While it has many positive benefits, such as a quick solution for increasing the supply, it also may pose risks to the environment and communities.



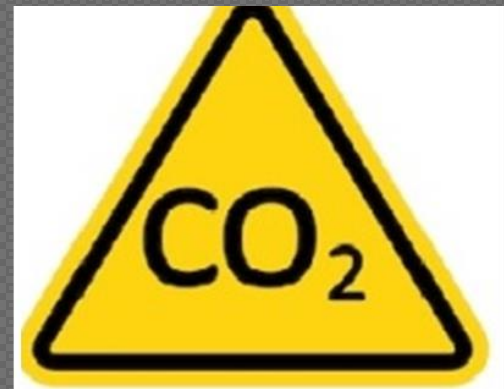


ETHANE CRACKERS FOR PLASTICS





Open Burning & Incineration of Waste



Plastics in Oceans & Waterways

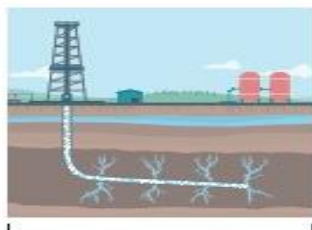
FIGURE 2

Plastic & Health: The Hidden Costs of a Plastic Planet

Humans are exposed to a large variety of toxic chemicals and microplastics through inhalation, ingestion, and direct skin contact, all along the plastic lifecycle.

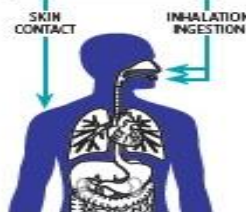
DIRECT EXPOSURE

Extraction & Transport



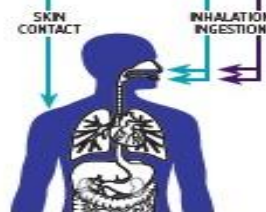
- **Emissions:** Include Benzene, VOCs, and 170+ toxic chemicals in fracking fluid
- **Exposure:** Inhalation and Ingestion (air and water)
- **Health:** affects the immune system, sensory organs, liver, and kidney; impacts include cancers, neuro-, reproductive, and developmental toxicity

Refining & Manufacture



- **Emissions:** Include Benzene, PAHs, and Styrene
- **Exposure:** Inhalation, Ingestion, skin contact (air, water, and soils)
- **Health:** impacts can include cancers, neuro-toxicity, reproductive toxicity, low birth weight, and eye and skin irritation

Consumer Use



- **Emissions:** Include heavy metals, POPs, carcinogens, EDCs, and microplastics
- **Exposure:** Inhalation, Ingestion, and skin contact
- **Health:** affects renal, cardiovascular, gastro-intestinal, neurological, reproductive, and respiratory systems; impacts include cancers, diabetes, and developmental toxicity

Waste Management



- **Emissions:** Include heavy metals, dioxins and furans, PAHs, toxic recycling
- **Exposure:** Ingestion and Inhalation (air, ash, slag)
- **Health:** impacts include cancers, neurological damages, and damages to immune, reproductive, nervous, and endocrine system

ENVIRONMENTAL EXPOSURE

- **Microplastics** (e.g. tire dust and textile fibers) and **toxic additives:** including POPs, EDCs, carcinogens, and heavy metals
- **Exposure:** Inhalation and Ingestion (air, water, and food chain)
- **Health:** affects cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems; impacts include cancers, diabetes, neuro-, reproductive, and developmental toxicity

KEY: ———> Microplastics ———> Chemicals

Source: © CIEL/NonprofitDesign.com

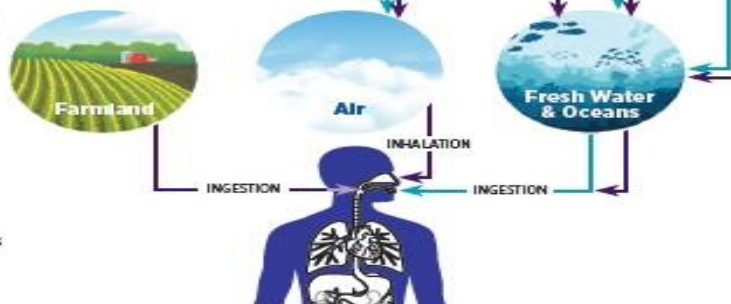
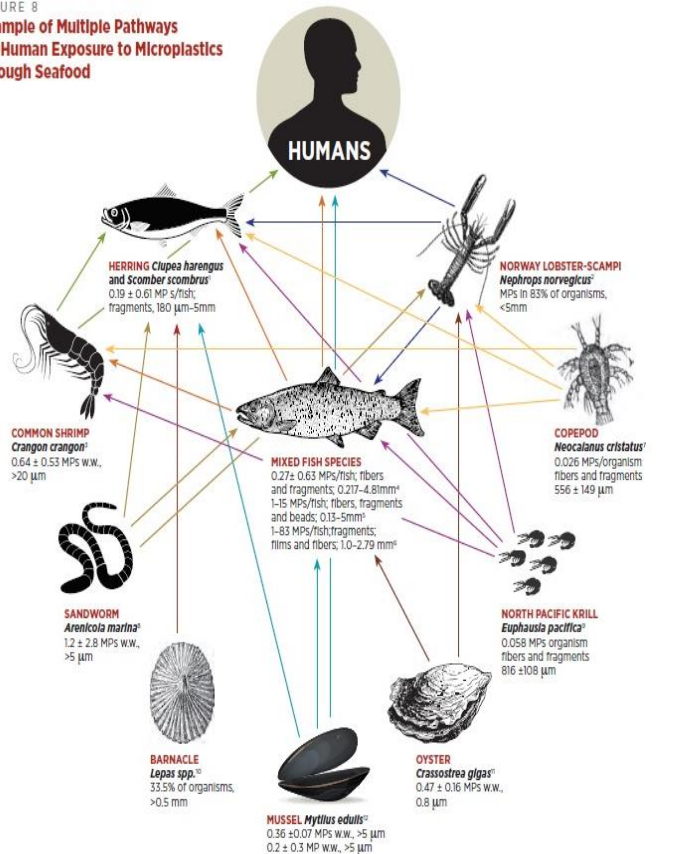


FIGURE 8
Example of Multiple Pathways
for Human Exposure to Microplastics
through Seafood



REFERENCES

- 102(1) Rummel, C.D. et al., Plastic ingestion by pelagic and demersal fish from the North Sea and Baltic Sea 134–141 (Marine Pollution Bulletin 2016).
- 62(6) Murray, F. & Cowie, P., Plastic contamination in the decapod crustacean *Nephrops norvegicus* (Linnaeus, 1758) 1207–1217 (Marine Pollution Bulletin 2011).
- 98(1–2) Devriese, L. et al., Microplastic contamination in brown shrimp (*Crangon crangon*, Linnaeus 1758) from coastal waters of the Southern North Sea and Channel area 179–187 (Marine Pollution Bulletin 2015).
- 101 (1) Neves, D. et al., Ingestion of microplastics by commercial fish off the Portuguese coast 119–126 (Marine Pollution Bulletin 2015).
- Lusher, A.L. et al., Microplastic and macroplastic ingestion by a deep diving, oceanic cetacean: the True's beaked whale *Mesoplodon mirus* 199 (Environmental Pollution 2015).
- 60 (12) Boerger, C.M. et al., Plastic ingestion by planktivorous fishes in the North Pacific Central Gyre 2275–2278 (Marine Pollution Bulletin 2010).
- Desforges, J.P., Galbraith, M., & Ross, P.S., Ingestion of microplastics by zooplankton in the Northeast Pacific Ocean 69 (Arch. Environ. Contam. Toxicol 2015).
- Van Cauwenbergh, L. et al., Microplastics are taken up by mussels (*Mytilus edulis*) and lugworms (*Arenicola marina*) living in natural habitats 199 (Environmental Pollution 2015).
- Desforges, J.P., Galbraith, M., & Ross, P.S., Ingestion of microplastics by zooplankton in the Northeast Pacific Ocean 69 (Arch. Environ. Contam. Toxicol 2015).
- Goldstein, M.C., Goodwin, D.S., Gooseneck barnacles (*Lepas spp.*) ingest microplastic debris in the North Pacific Subtropical Gyre 1(PeerJ, 2013).
- 193 Van Cauwenbergh, L., Janssen, C., Microplastics in bivalves cultured for human consumption 65–70 (Environmental Pollution 2014).
- 193 Van Cauwenbergh, L., Janssen, C., Microplastics in bivalves cultured for human consumption 65–70 (Environmental Pollution 2014).

SOURCE: Re-created based on Carbery, M., O'Connor, W., & Thavamani, P., Trophic transfer of microplastics and mixed contaminants in the marine food web a implications for human health (Environment International 2018).

MULTIPLE PATHWAYS FOR HUMAN EXPOSURE TO MICROPLASTICS THROUGH SEAFOOD

Source: CIEL, Plastics & Health, The Hidden Costs of a Plastic Planet, February 2019.

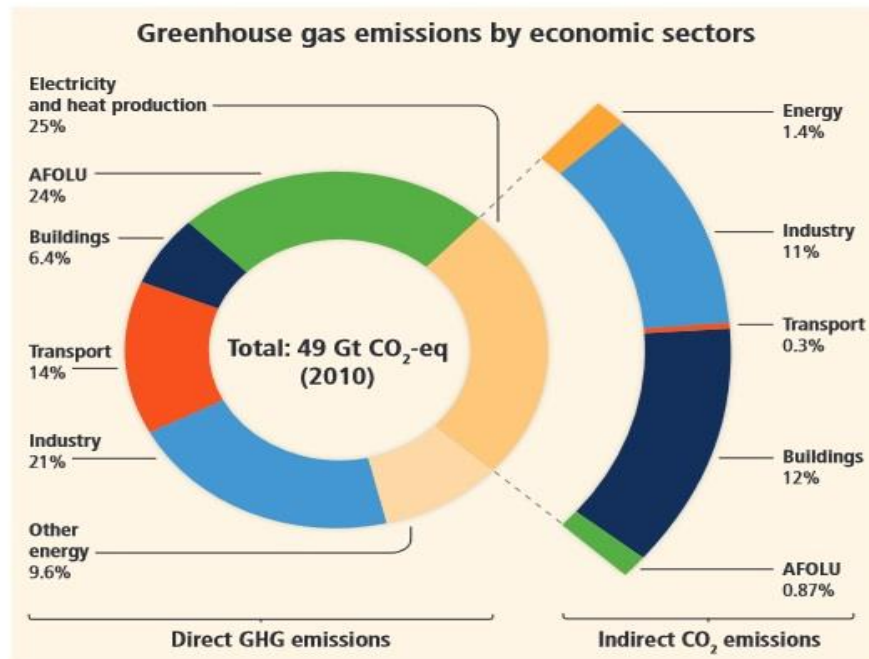
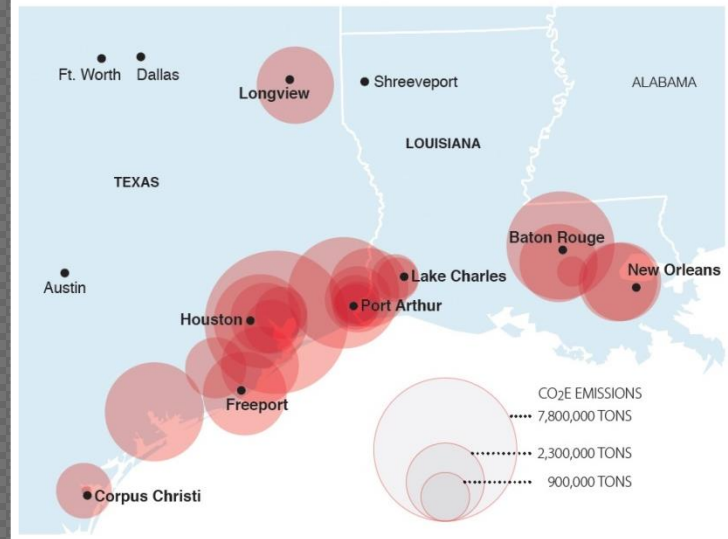


Figure 1.7 | Total anthropogenic greenhouse gas (GHG) emissions (gigatonne of CO₂-equivalent per year, GtCO₂-eq/yr) from economic sectors in 2010. The circle shows the shares of direct GHG emissions (in % of total anthropogenic GHG emissions) from five economic sectors in 2010. The pull-out shows how shares of indirect CO₂ emissions (in % of total anthropogenic GHG emissions) from electricity and heat production are attributed to sectors of final energy use. 'Other energy' refers to all GHG emission sources in the energy sector as defined in WGIII Annex II, other than electricity and heat production [WGIII Annex II.9.1]. The emission data on agriculture, forestry and other land use (AFOLU) includes land-based CO₂ emissions from forest fires, peat fires and peat decay that approximate to net CO₂ flux from the sub-sectors of forestry and other land use (FOLU) as described in Chapter 11 of the WGIII report. Emissions are converted into CO₂-equivalents based on 100-year Global Warming Potential (GWP₁₀₀), taken from the IPCC Second Assessment Report (SAR). Sector definitions are provided in WGIII Annex II.9. [WGIII Figure SPM.2]

metric tons of ethylene a year. These sites reported total emissions of 53 million metric tons of CO₂e in 2015, though many make a range of products, so not all of those emissions can be attributed to steam cracking. All but three of these sites were near the Gulf coast in Texas and Louisiana.



PLASTICS, GREENHOUSE GAS EMISSIONS & MEETING THE PARIS TARGETS

IPCC Special Report 1.5

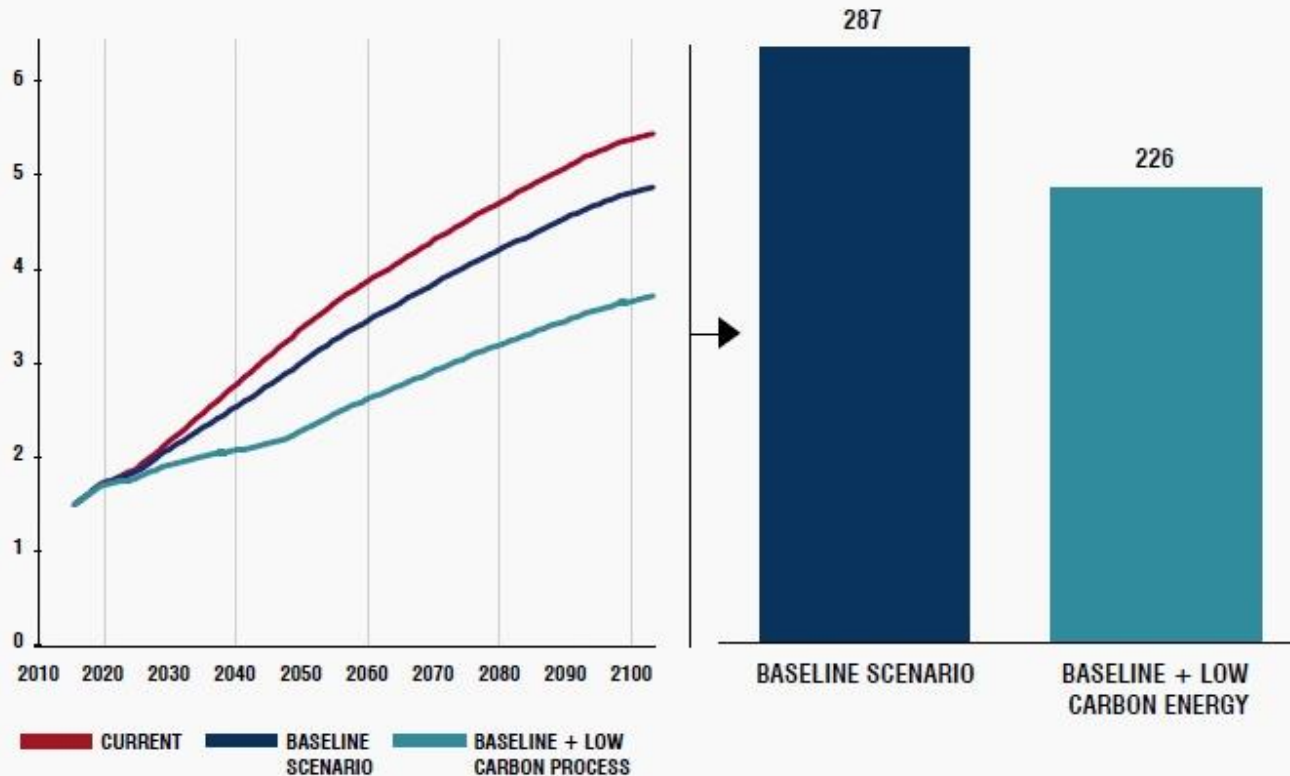
UN EMISSIONS GAP REPORT
2018

Exhibit 3.2

PLASTICS ALONE RISK EXCEEDING THE CARBON BUDGET QUOTA AVAILABLE FOR INDUSTRIAL EMISSIONS

CO₂ EMISSIONS, PLASTICS PRODUCTION
Gt CO₂ PER YEAR, 2015-2100, GLOBAL

CUMULATIVE CO₂ EMISSIONS, PLASTICS PRODUCTION
Gt CO₂, 2015-2100, GLOBAL

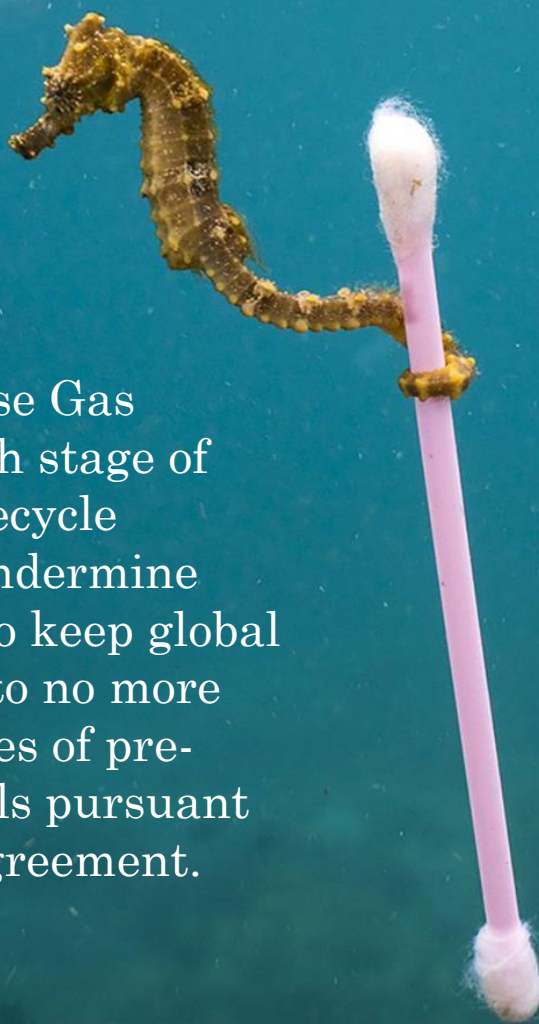


SOURCE: MATERIAL ECONOMICS MODELLING.



Plastics Ban at County Level

Plastic Ban At the State Level

A photograph of a small, brown, textured seahorse-like creature wrapped around a pink cotton swab. The background is a solid blue color. The seahorse is positioned in the upper left, and the swab extends vertically from the center towards the bottom right.

The Greenhouse Gas
Impacts at each stage of
the plastics lifecycle
threatens to undermine
global efforts to keep global
temperatures to no more
than 1.5 degrees of pre-
industrial levels pursuant
to the Paris Agreement.

Plastics and Petrochemicals are a Blindspot to Emissions Reduction Initiatives.



#breakfreefromplastic

The Global Movement to Stop Plastic Pollution for Good

OVER 800 GLOBAL NGO'S HAVE JOINED FORCES
TO STOP PLASTICS AT THE SOURCE


With support from the Plastics Solutions Fund

Break Free From Plastics (A Global Movement)










<https://www.breakfreefromplastic.org/>

Learn more by reading CIEL's ongoing series on the linkages between the fossil fuels and plastics industries.

Fueling Plastics
<https://www.ciel.org/fuelingplastics/>



Fueling Plastics



- Plastic
- Because specific Coast
- Natural
- Chemical
- Graph
- Expansion
- Naph
- Ductio
- Five co
- Ration
- Because
- Vertical
- Panies
- Bil, SL


Origins

Although plastic is everywhere, not many people know where it comes from or even how "plastic" is. Broadly speaking, plastic is a material that can be molded into various shapes. The production of plastic is a complex process involving the extraction of raw materials, refining, and polymerization.


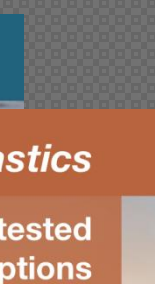
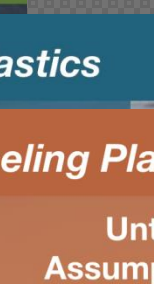
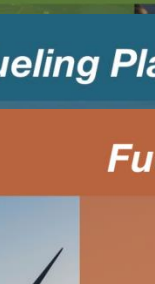




Excess production of plastic, especially in the form of single-use plastics, is causing widespread environmental damage. The increasing volume of plastic waste is a major concern because it takes hundreds of years to decompose and can pollute the world's oceans.

How Fracked Gas, Coal, and Oil Fuel the Plastics Industry

Plastic Industry Association



Fueling Plastics




- Fossil fuels are made
- Cheap shale infrastructure expansion
- China is expensive
- The fracturing in American
- A recent energy security
- By 2025, propylene production for


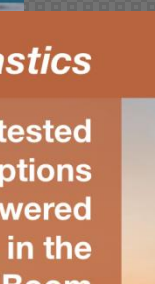
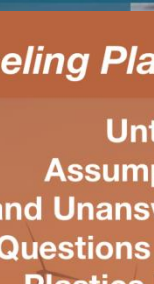
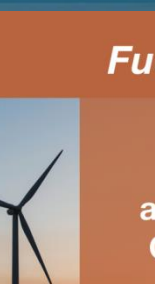



The use of plastic goods has been increasing since the 1950s. In the years of that expansion, observers began to notice plastic pollution in the environment. Plastic is a pollutant because it takes hundreds of years to decompose and can pollute the world's oceans.

As the problem of plastic pollution gains attention, it is crucial to investigate what is causing the problem and how to solve it. This includes understanding the production and use of plastic and the impact of plastic waste on the environment.

Plastic Industry Association



Fueling Plastics



SOURCES & DATA

For more information :

- CIEL, Plastics & Health, Hidden Costs of a Plastic Planet available at <https://www.ciel.org/wp-content/uploads/2019/02/Plastic-and-Health-The-Hidden-Costs-of-a-Plastic-Planet-February-2019.pdf>
- • American Chemistry Council (ACC) re: U.S. Petrochemical Buildout available at : <https://www.americanchemistry.com/Media/PressReleasesTranscripts/ACC-news-releases/US-Chemical-Industry-Investment-Linked-to-Shale-Gas-Reaches-200-Billion.html>
- Compendium of Health & Toxic Impacts of Hydraulic Fracturing : https://www.psr.org/wp-content/uploads/2018/04/Fracking_Science_Compendium_5.pdf
- IEA The Future of Petrochemicals
- <https://webstore.iea.org/the-future-of-petrochemicals>
- • IPEN Ocean Pollutants Guide
- <https://ipen.org/news/new-release-ipen-ocean-pollutants-guide-now-available>