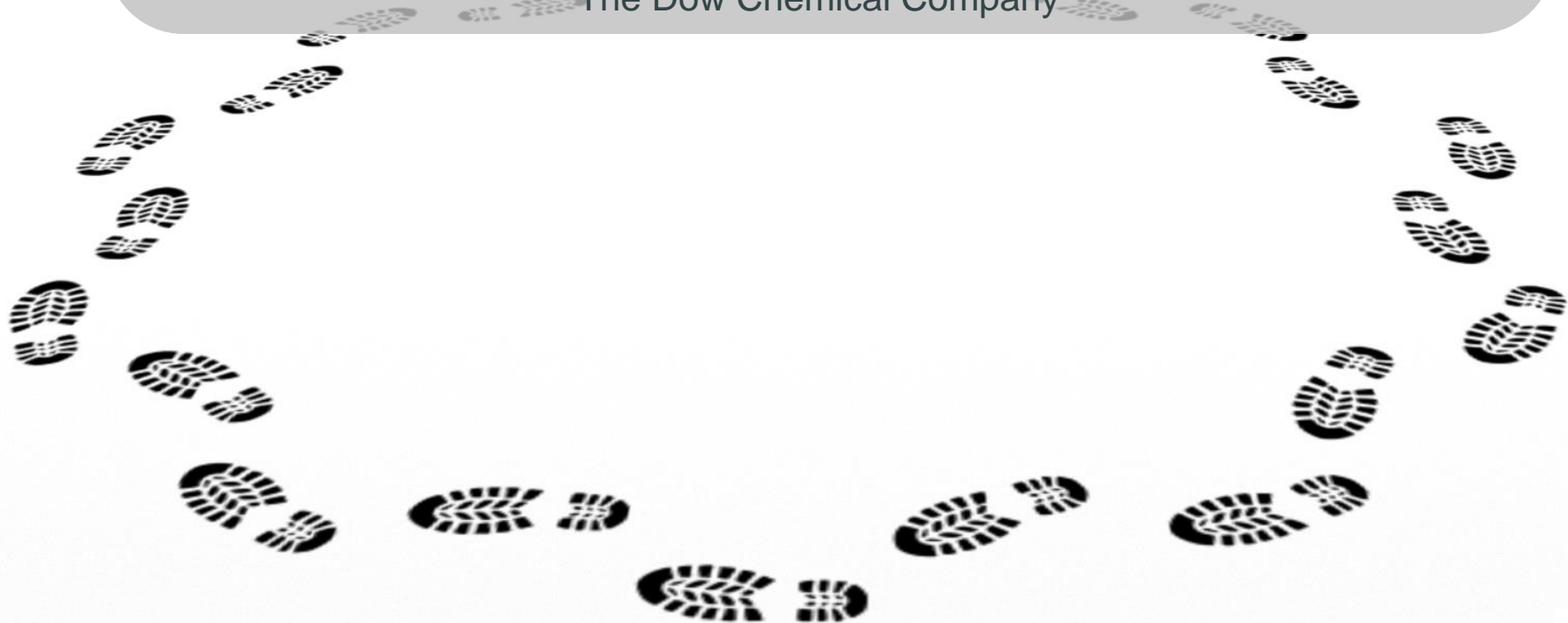


# Sustainability Initiatives:

*How Expectations of a Circular Economy Strain the Chemical Industry*

Mark Jones

*Executive External Strategy and Communications Fellow*  
The Dow Chemical Company



**13 February 2019**



## THE COLLINS WORD OF THE YEAR 2018 IS...

# SINGLE-USE

'**Single-use**', a term that describes items whose unchecked proliferation are blamed for damaging the environment and affecting the food chain, has been named Collins' Word of the Year 2018.

**Single-use** refers to products – often plastic – that are 'made to be used once only' before disposal. Images of plastic adrift in the most distant oceans, such as straws, bottles, and bags have led to a global campaign to reduce their use.

The word has seen a four-fold increase since 2013, with news stories and images such as those seen in the BBC's Blue Planet II steeply raising public awareness of the issue.

## SINGLE-USE

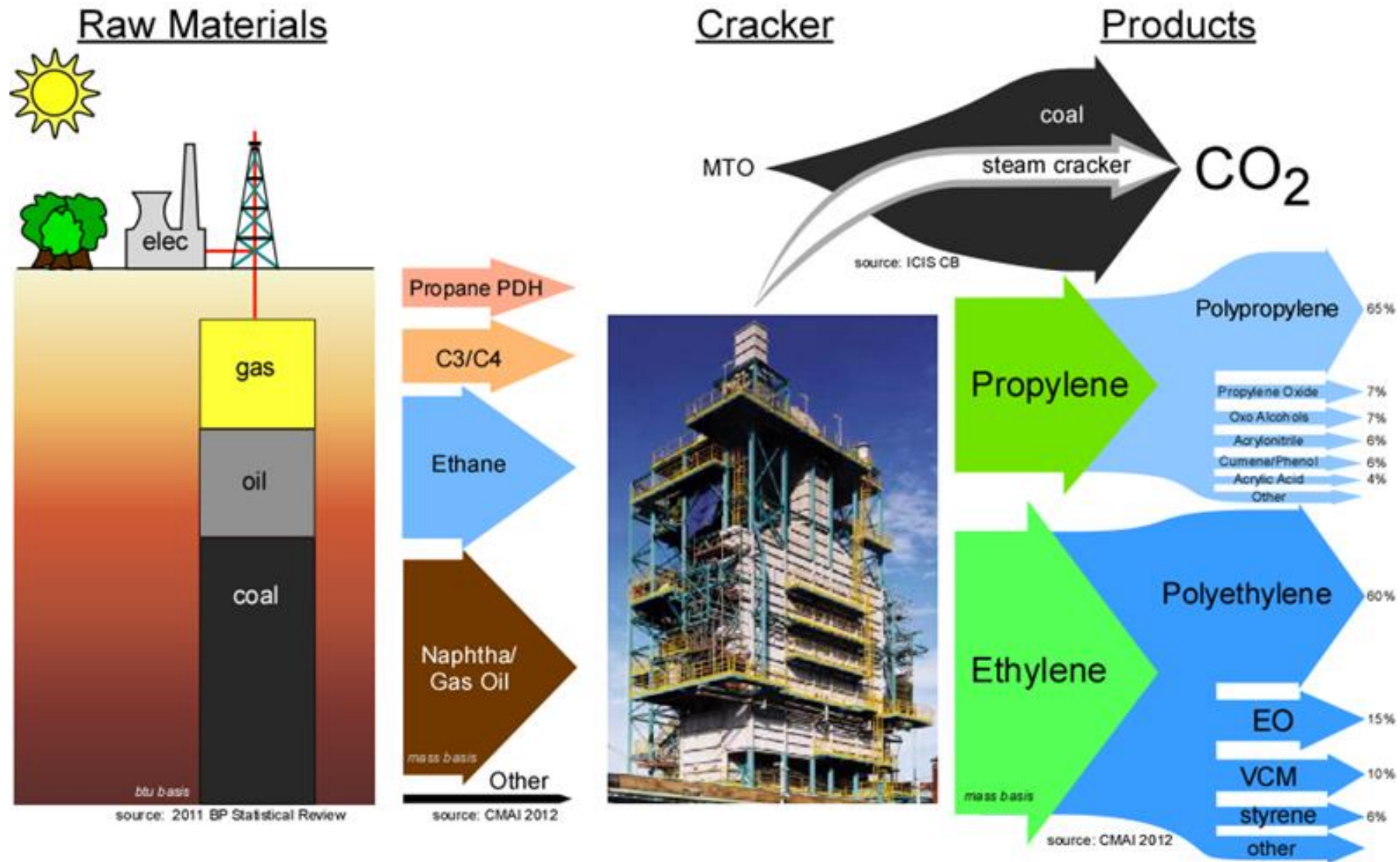


adj (sɪŋgəlˈjuːs)  
made to be used  
once only

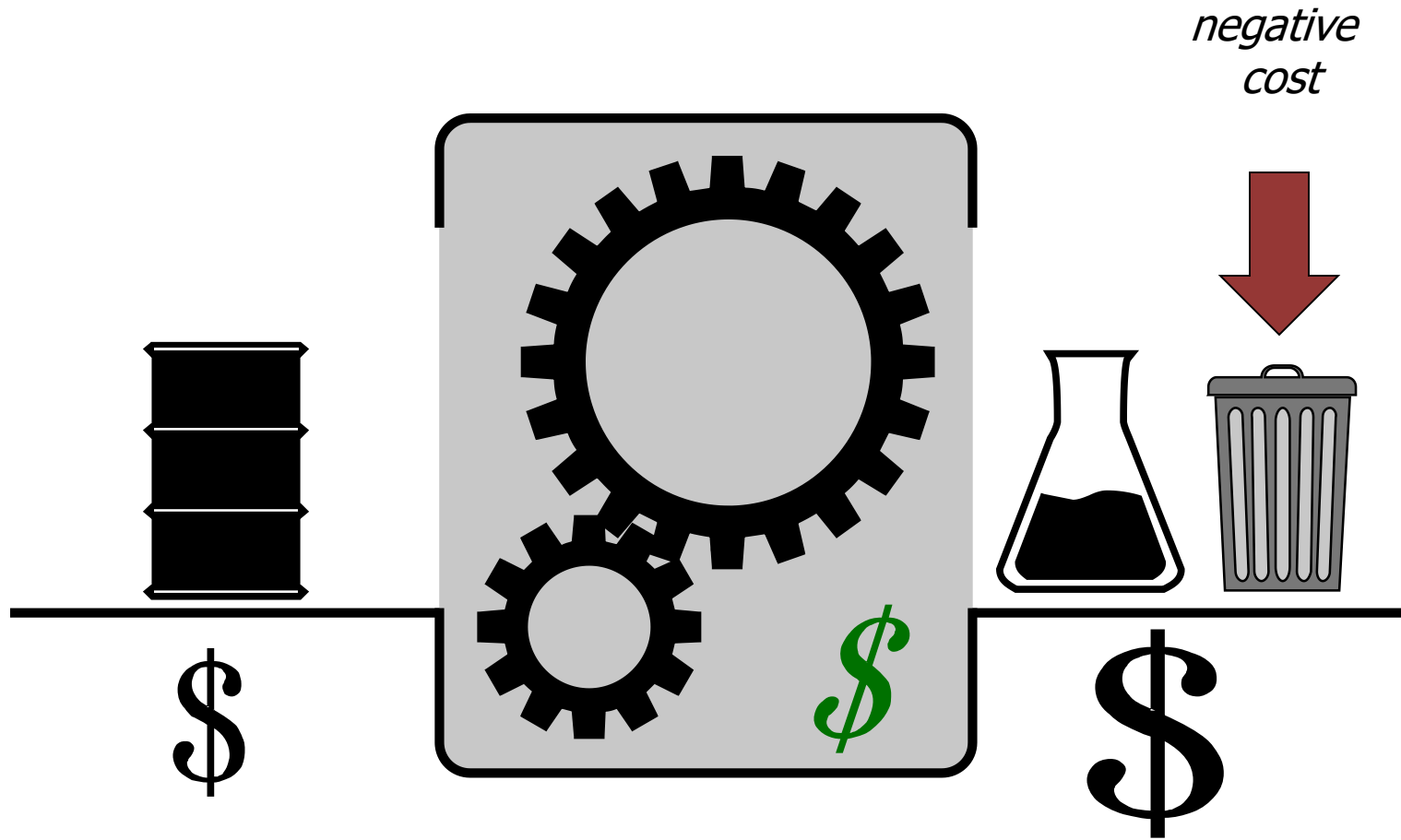
#CollinsWOTY



# Global Chemical Industry

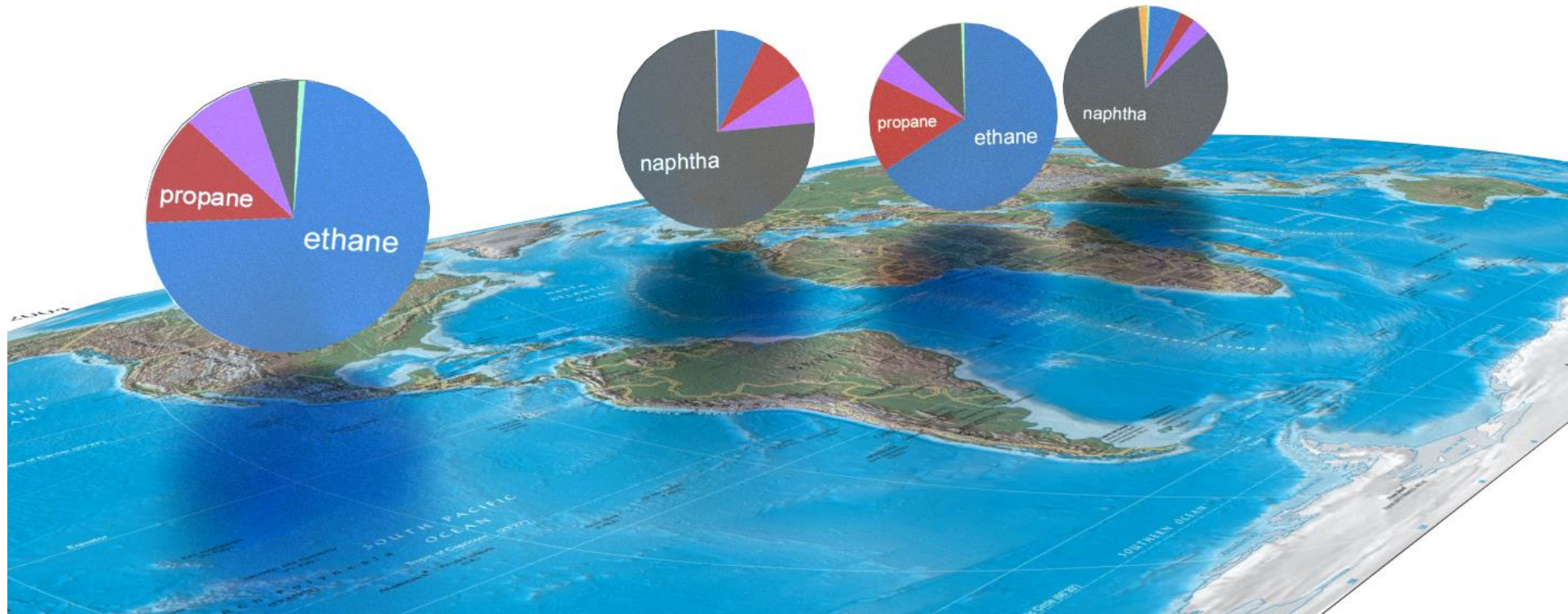


# Simplified Chemical Industry

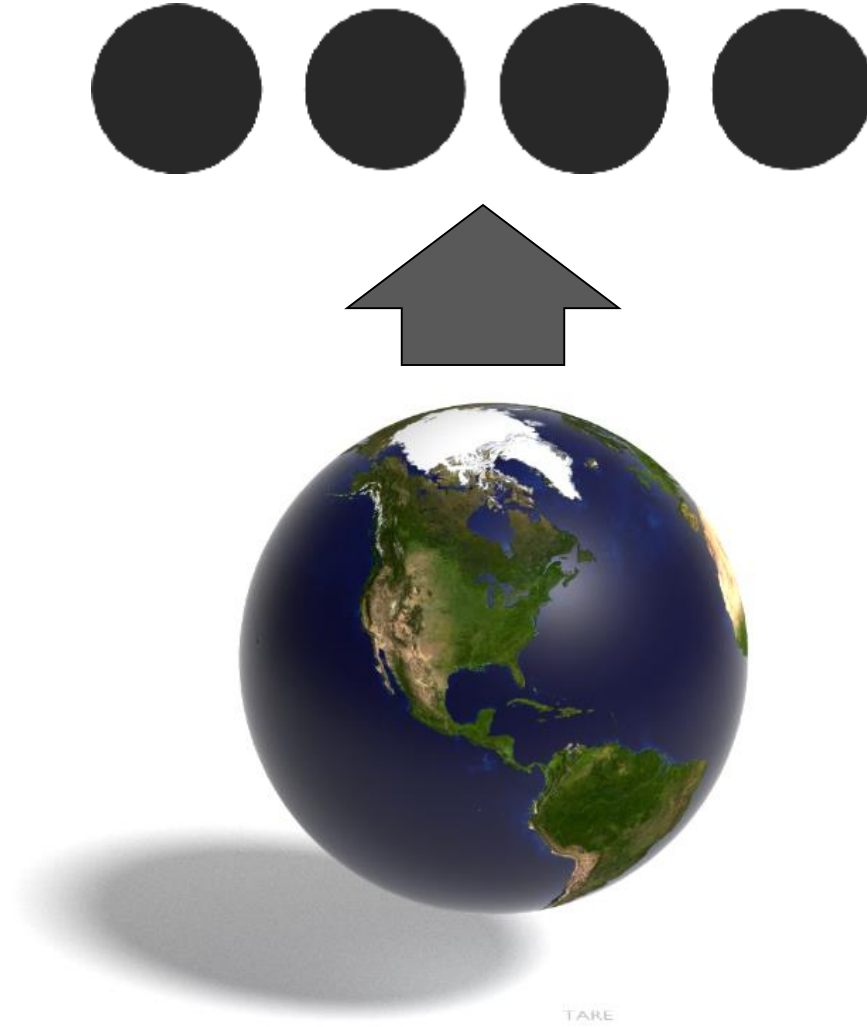


# Global Feedstock Slates Differ

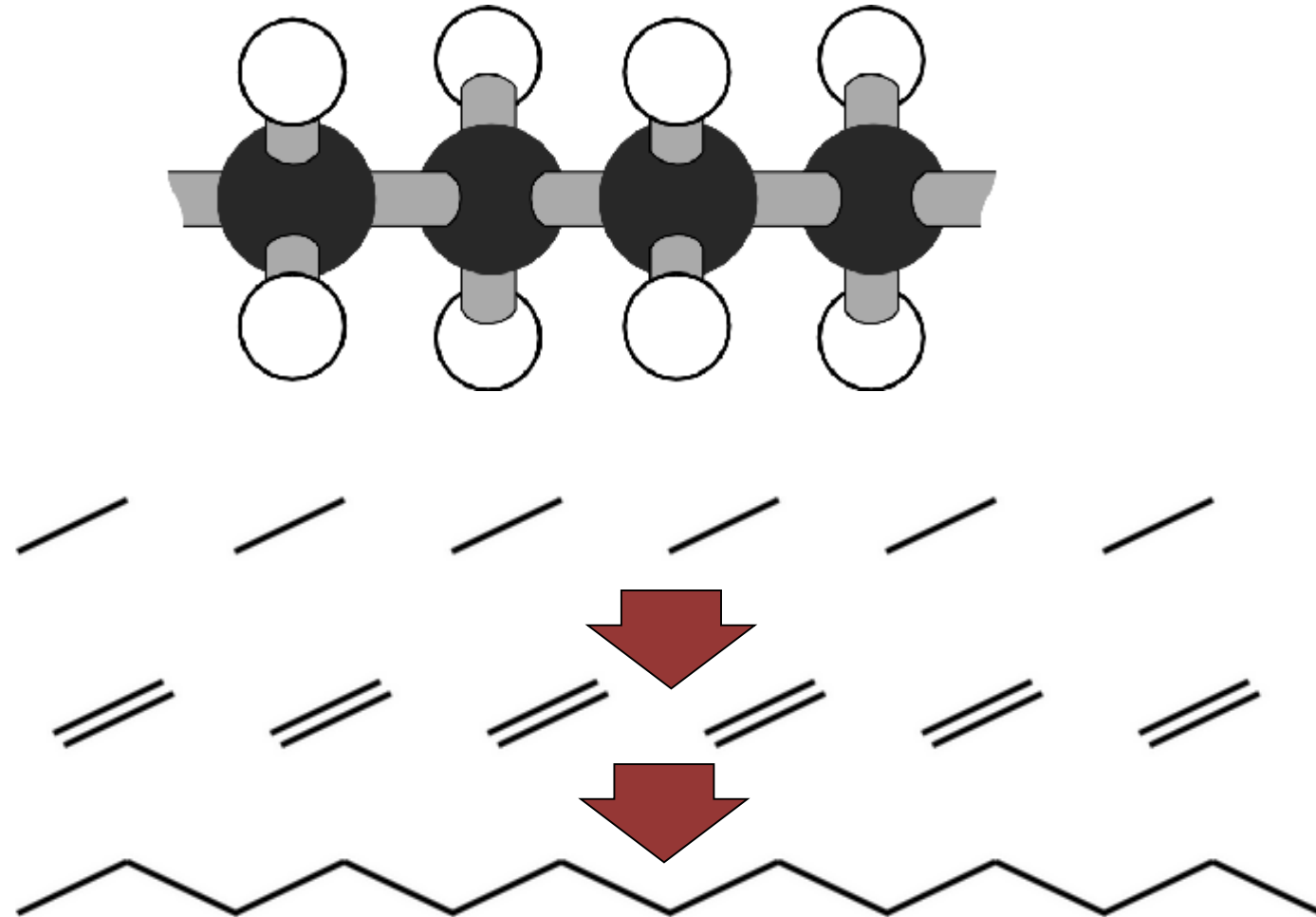
ethane propane butane naphtha MTO/CTO other



# Rough Mass Balance for Chemical Industry

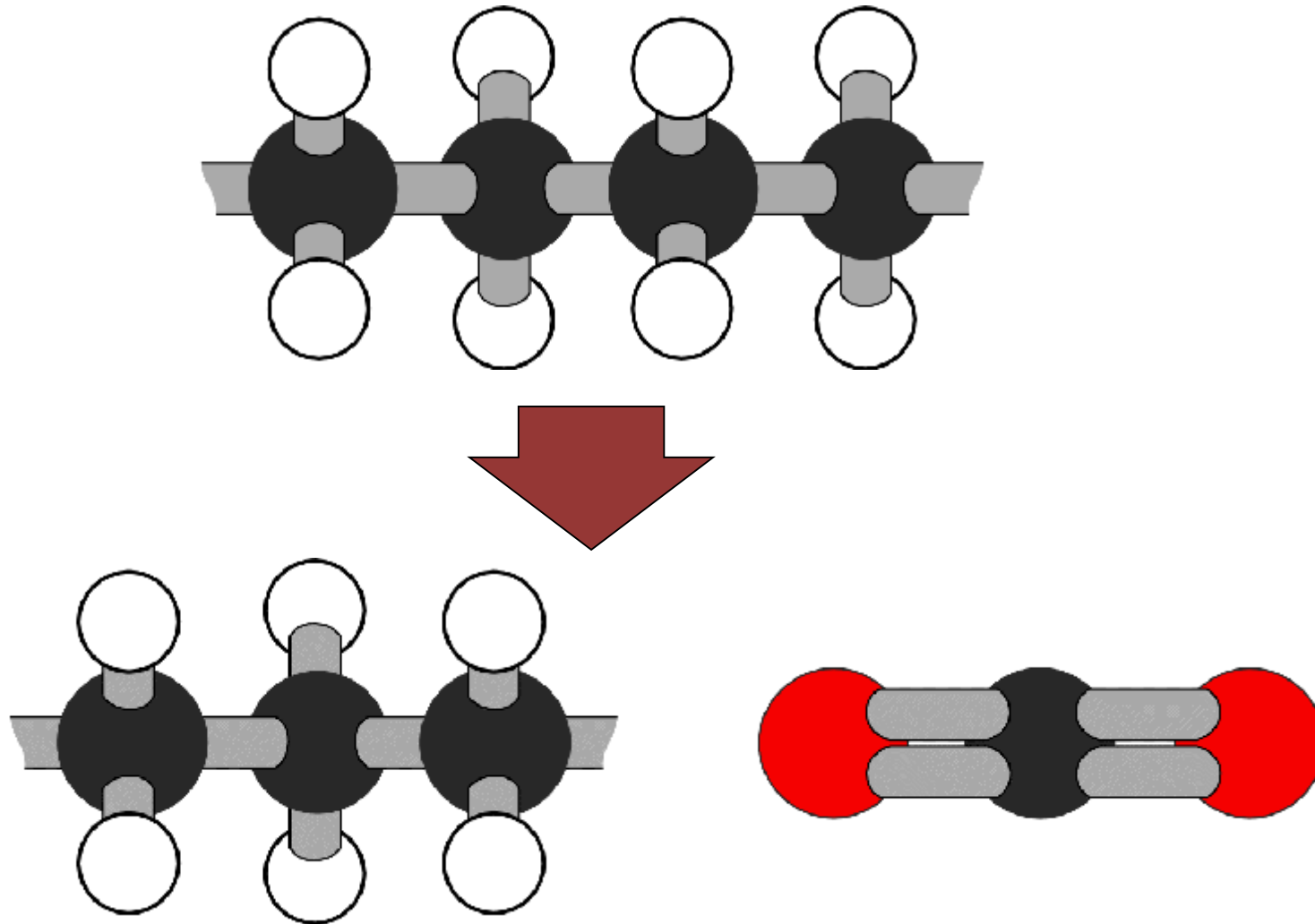


## Rough Mass Balance for Chemical Industry

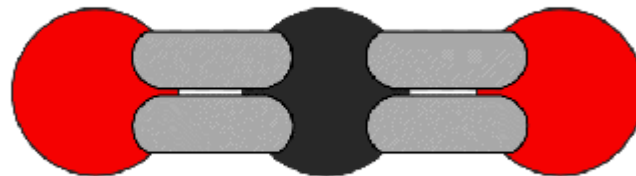
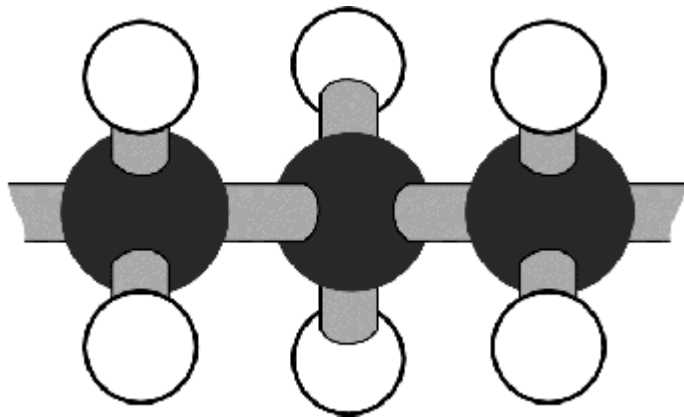




## Rough Mass Balance for Chemical Industry

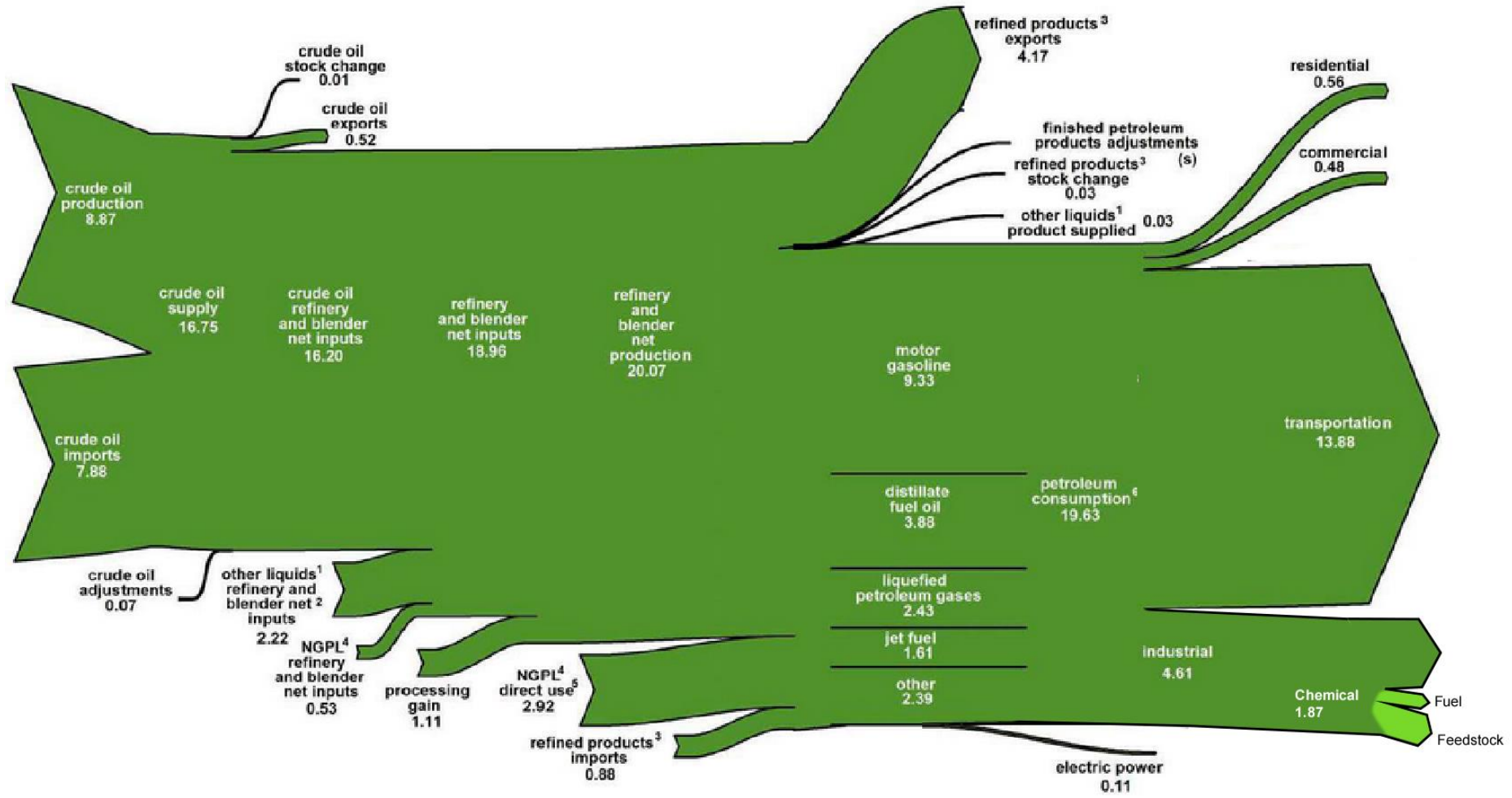


# Rough Mass Balance for Chemical Industry



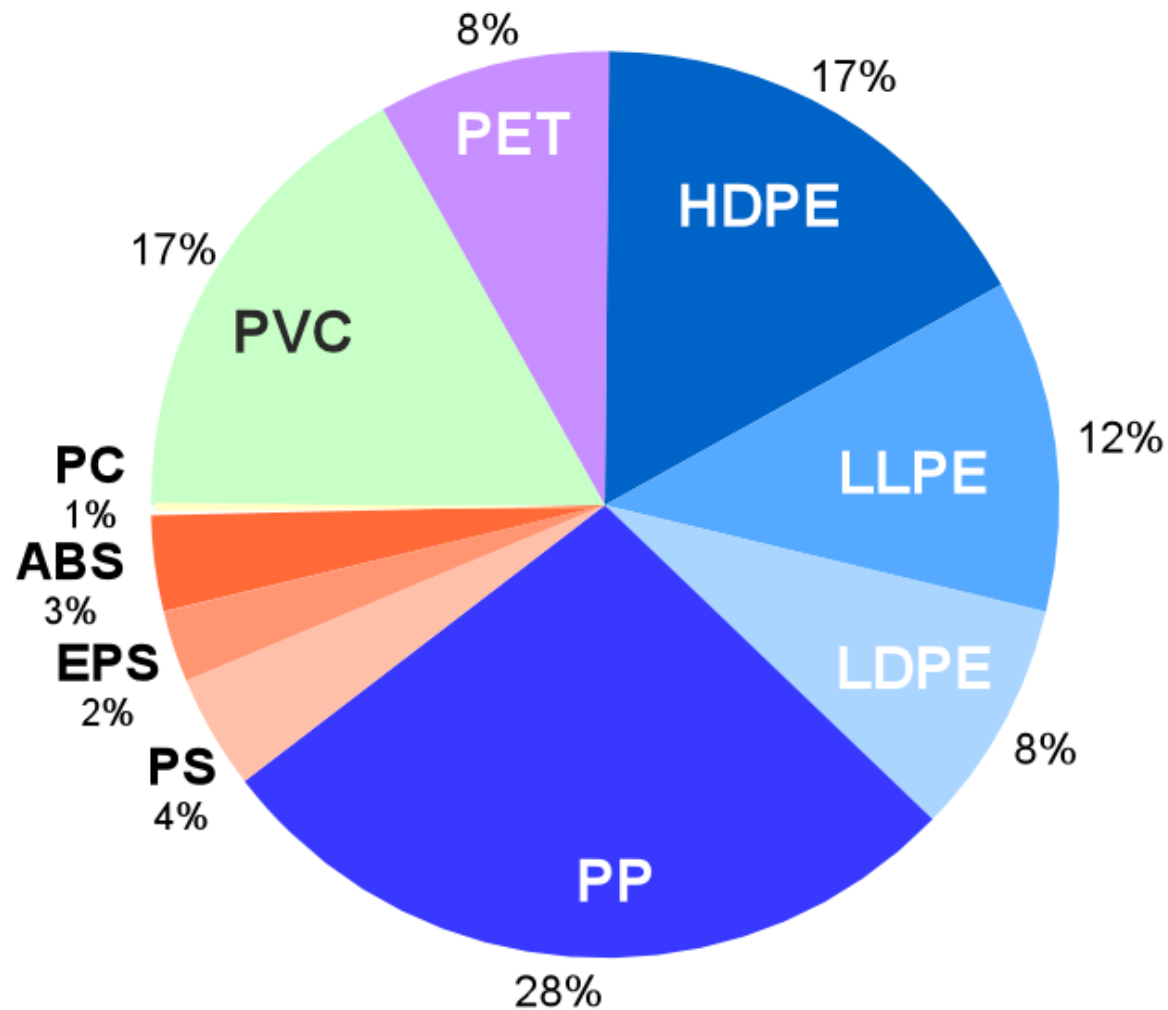
# US Petroleum Flow, 2016

in million barrels per day



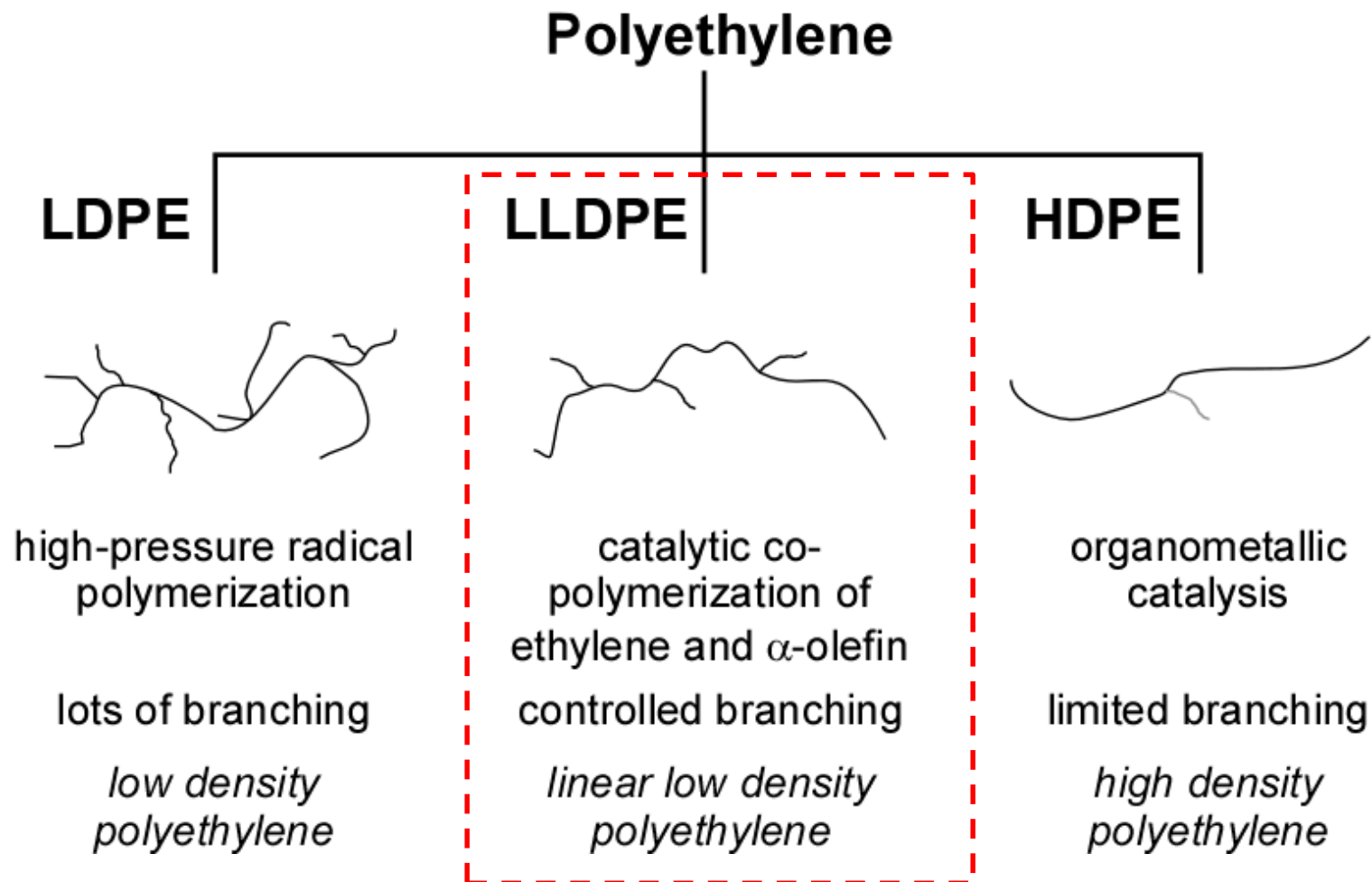
# 257 Million Tonnes

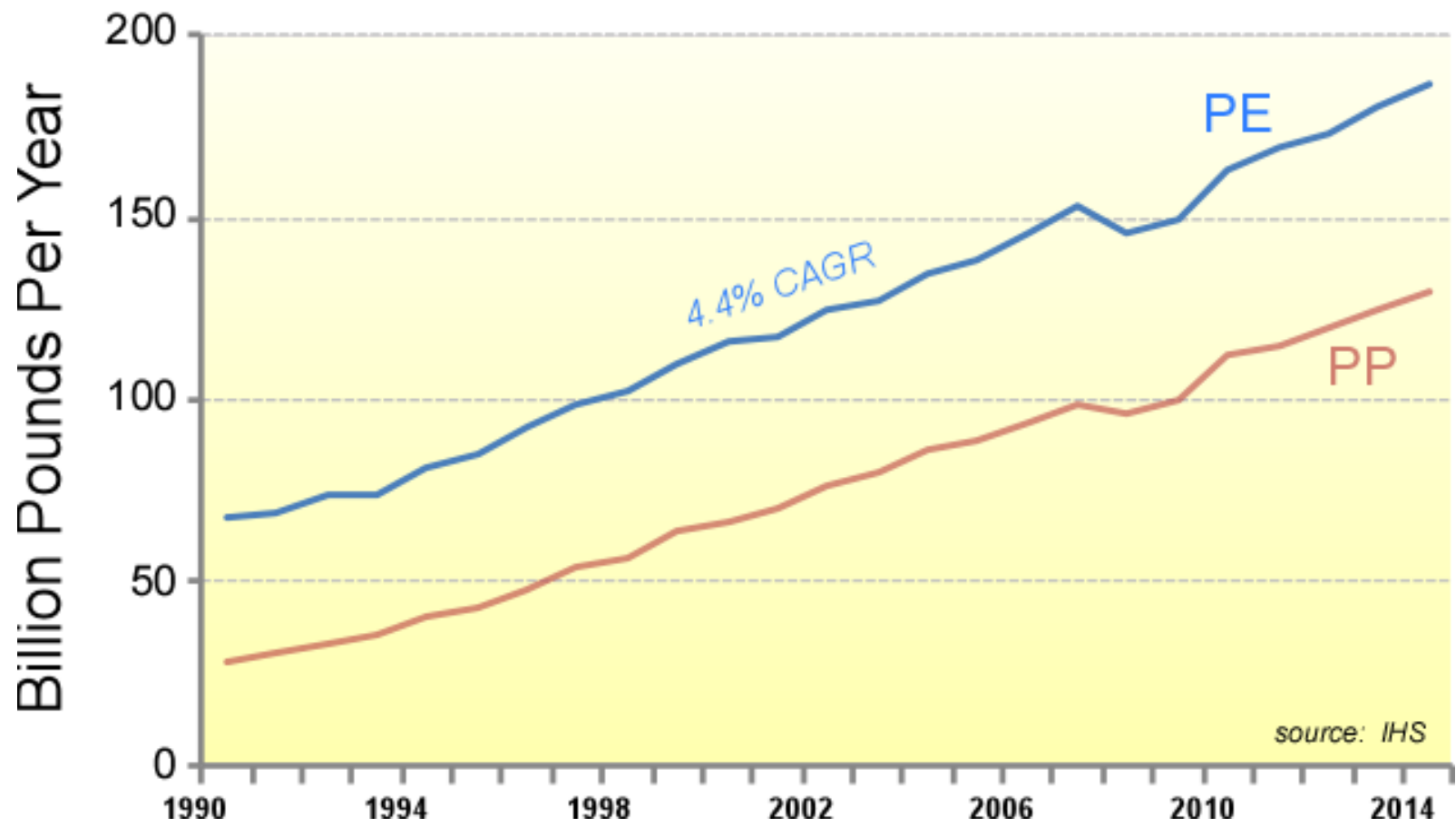
2017 world demand



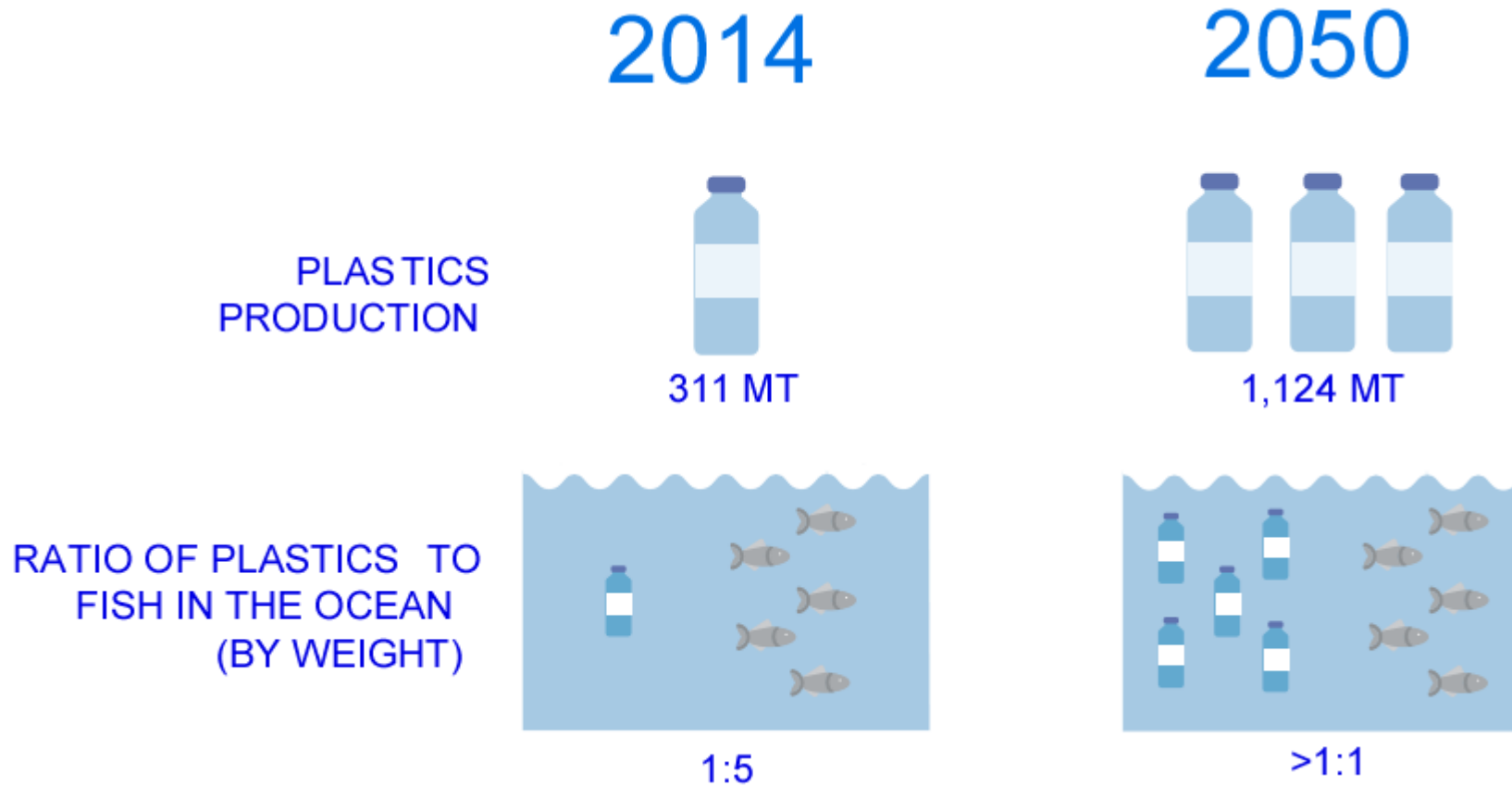
Source: IHS Markit

# Polyethylene





## Production and Impact



Source: World Economic Forum



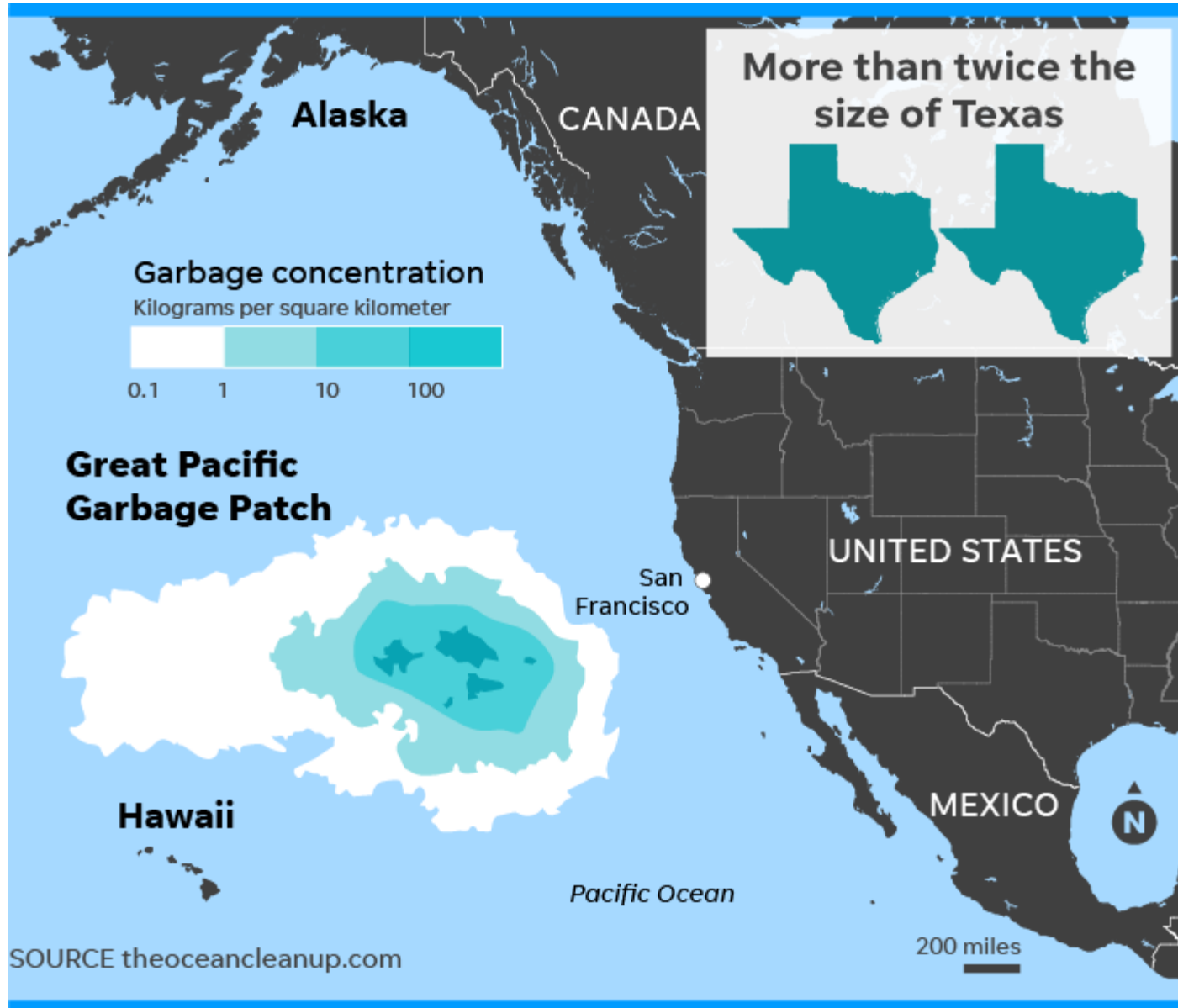
# WHAT GOES IN THE OCEAN GOES IN YOU.

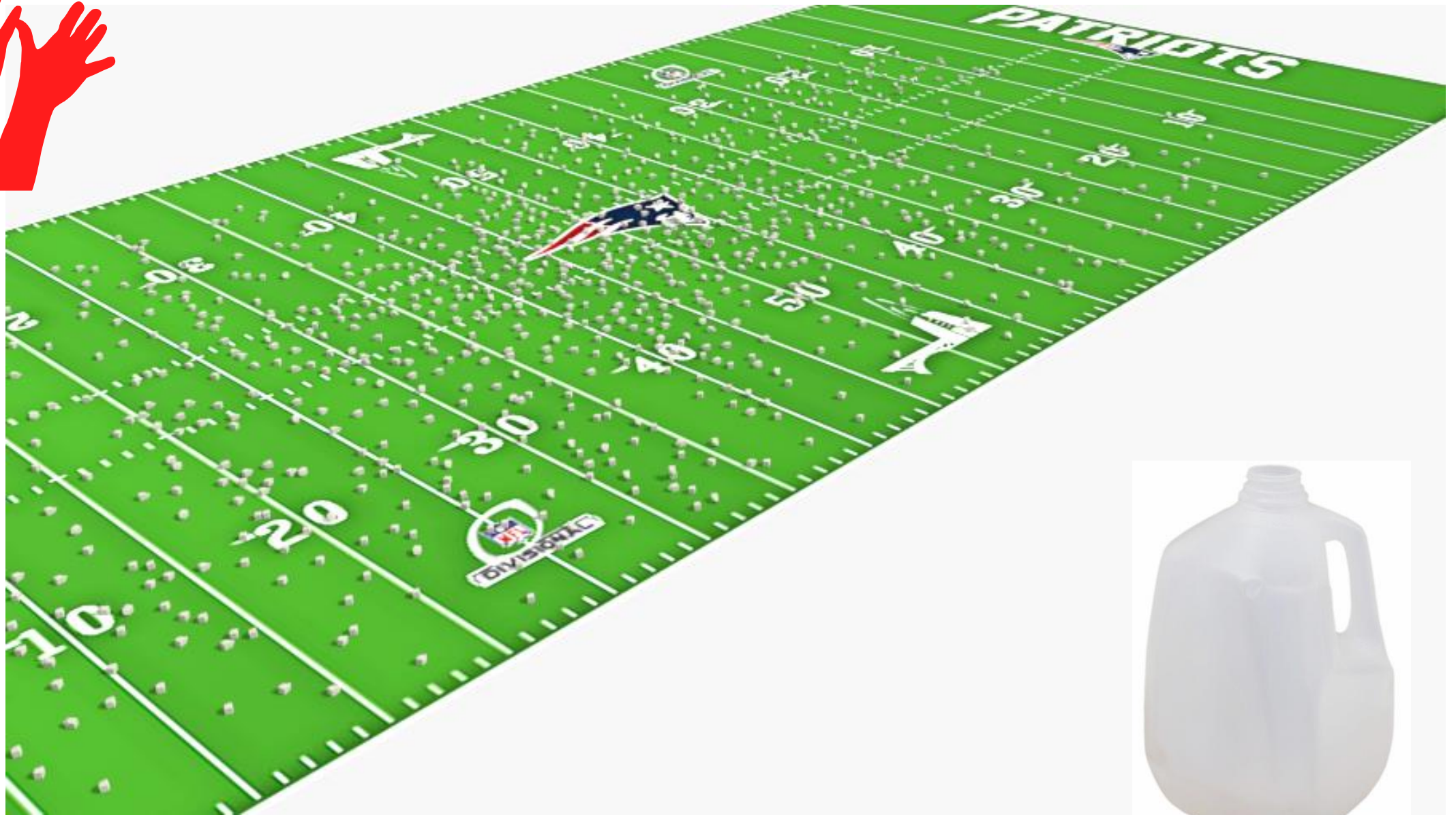


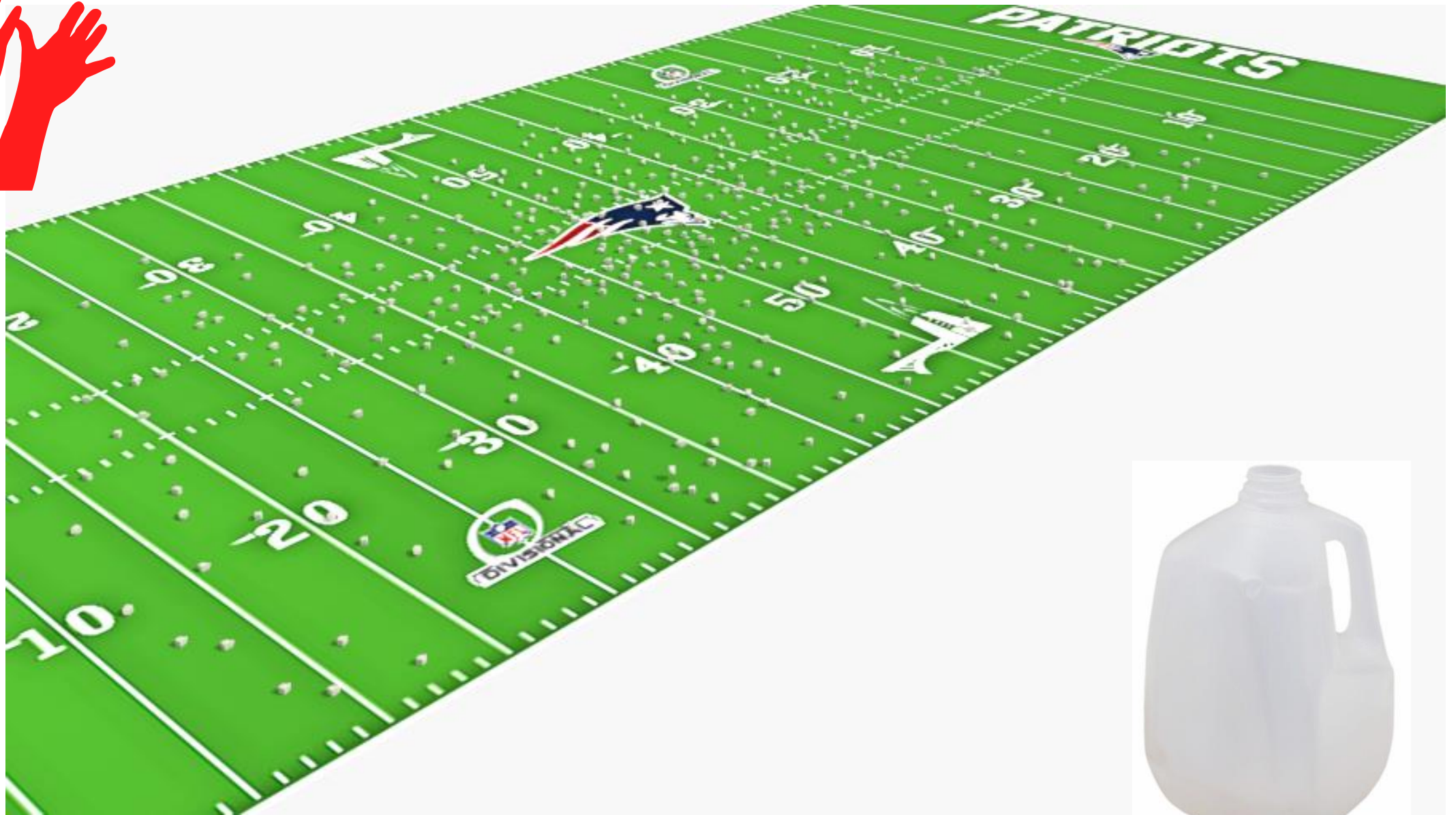
RECENT STUDIES ESTIMATE THAT FISH OFF THE WEST COAST INGEST OVER 12,000 TONS OF PLASTIC A YEAR. FIND OUT HOW YOU CAN HELP TURN THE TIDE ON PLASTIC POLLUTION AT [WWW.SURFRIDER.ORG/RAP](http://WWW.SURFRIDER.ORG/RAP)



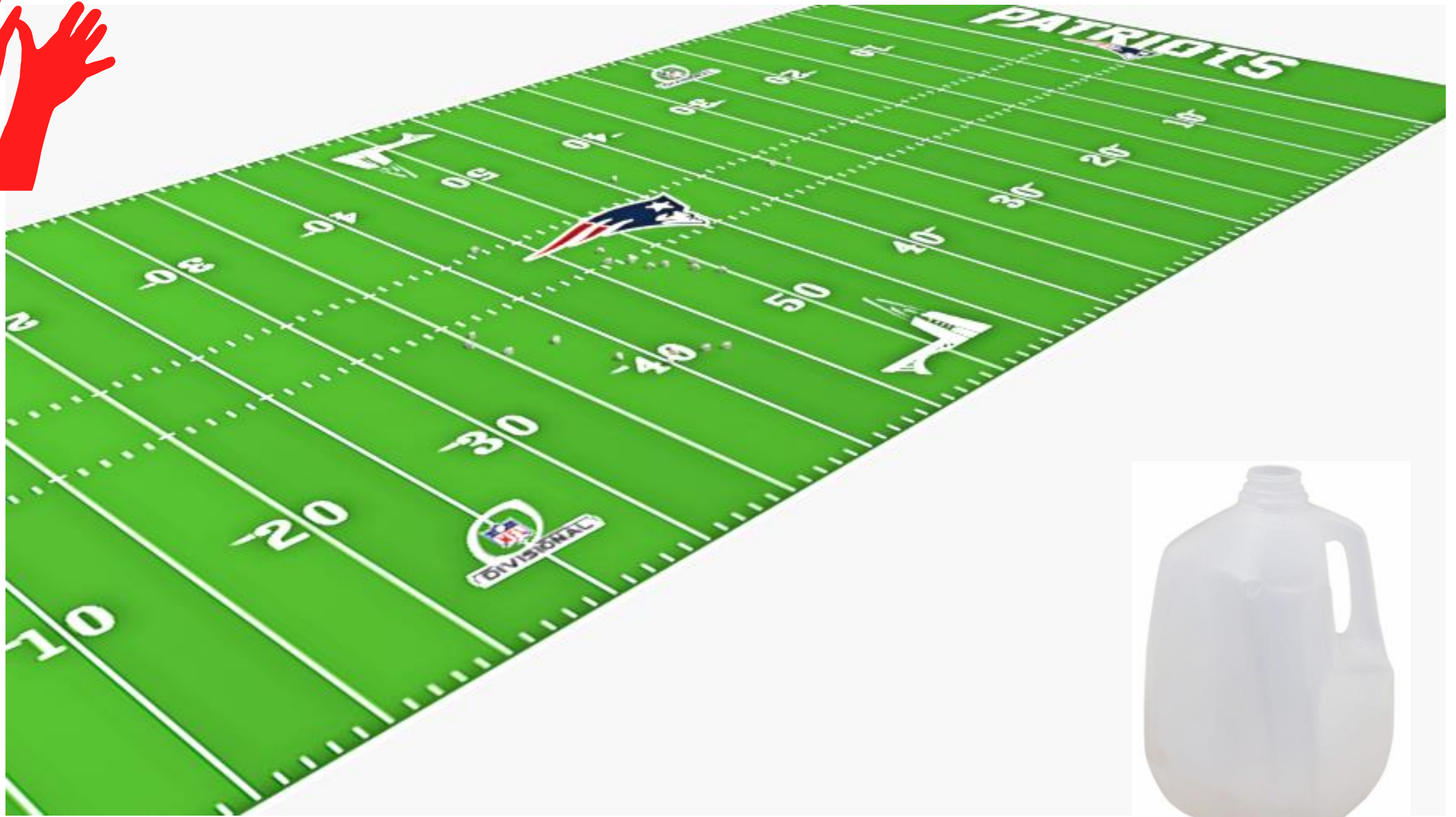


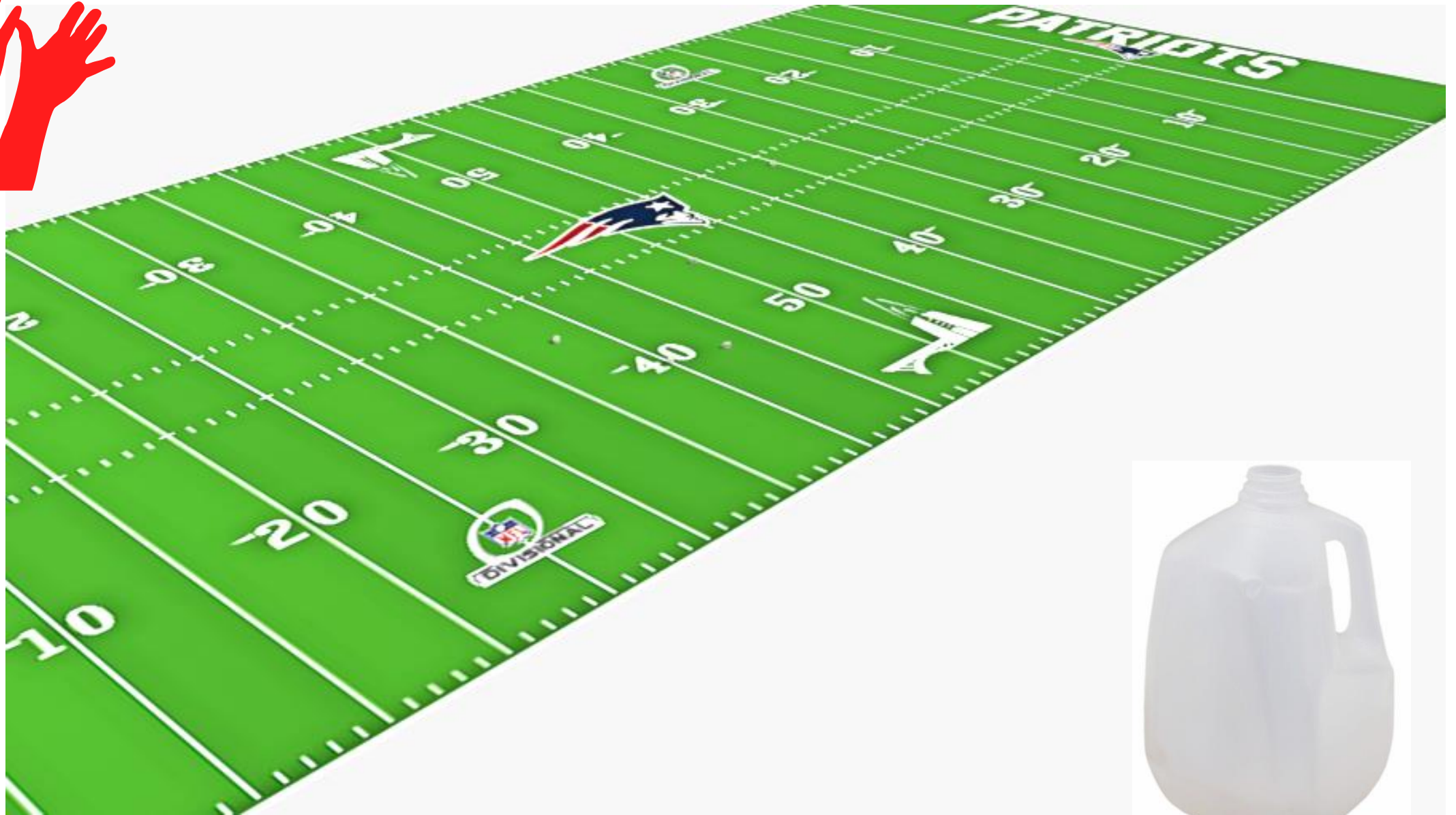










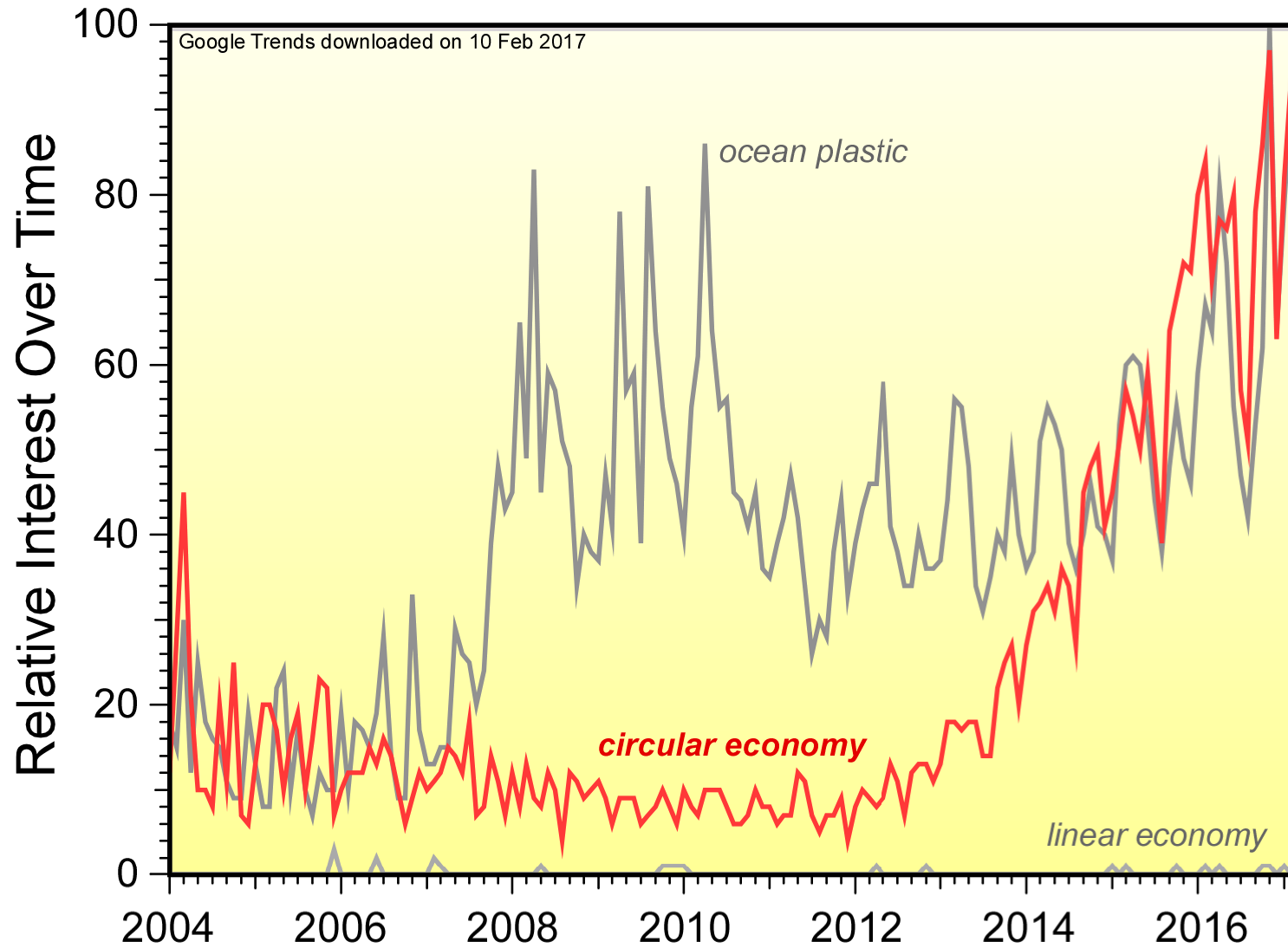






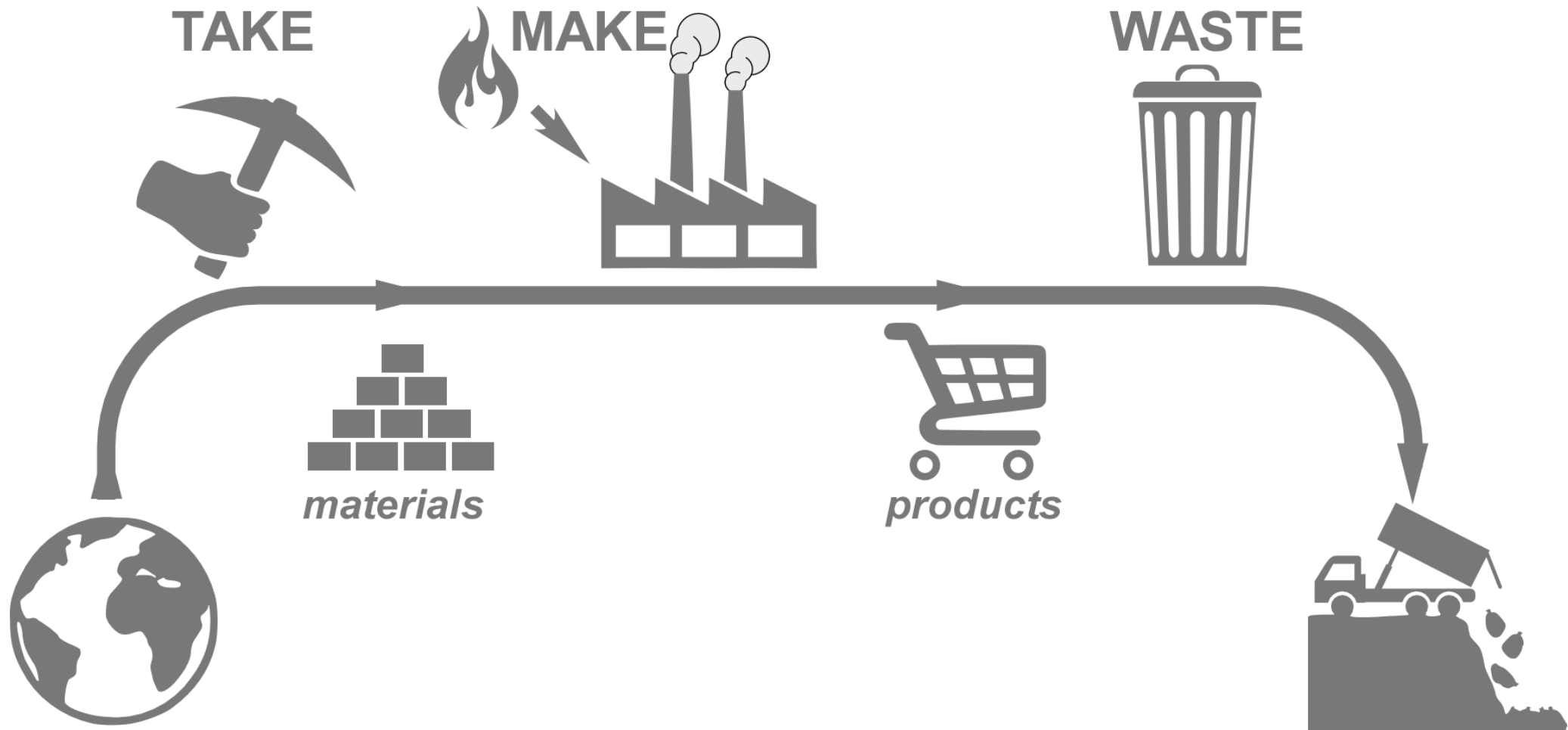


# Use of Circular and Linear Economy



What is the circular economy?  
**NOT**

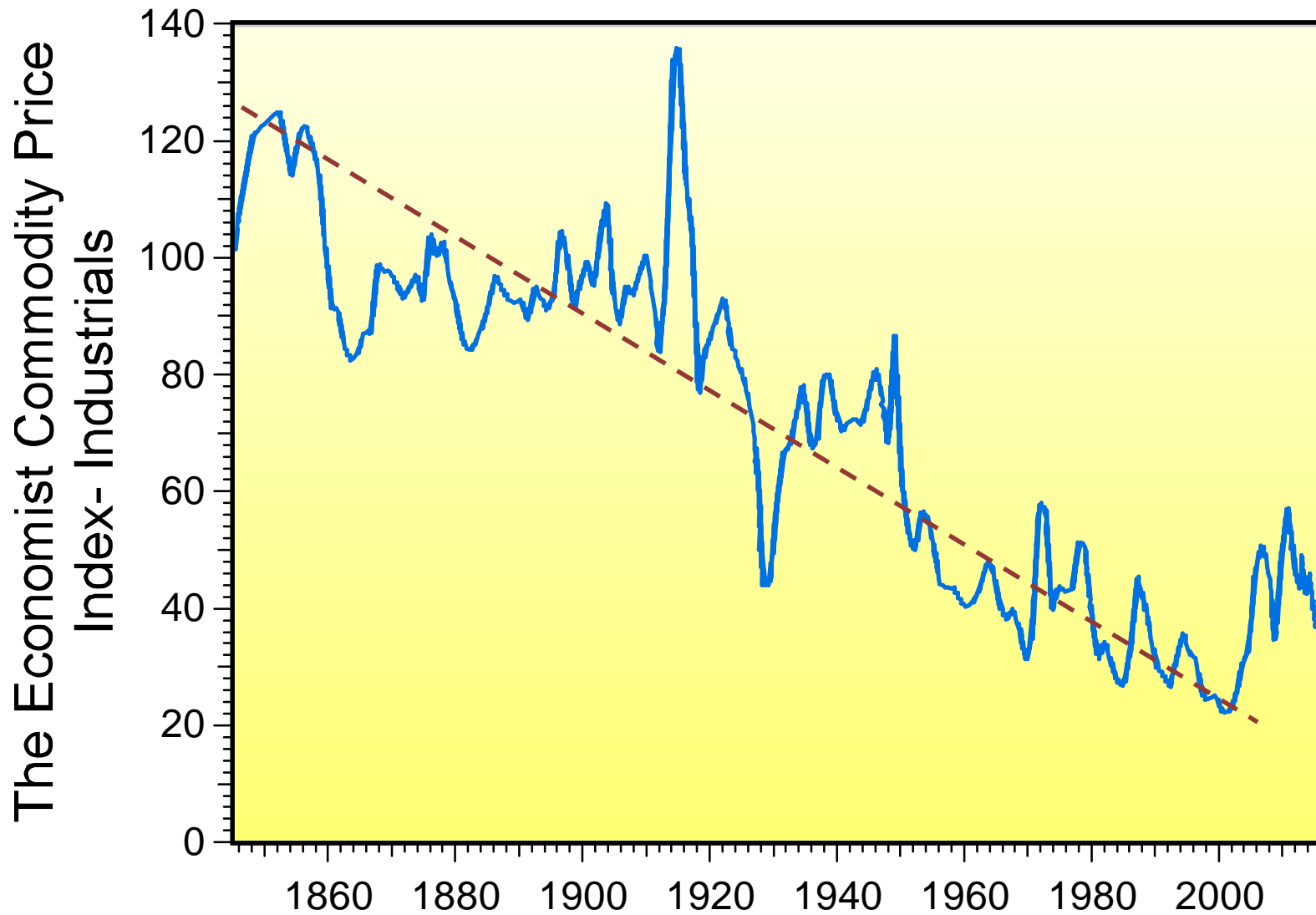
# The Linear Economy



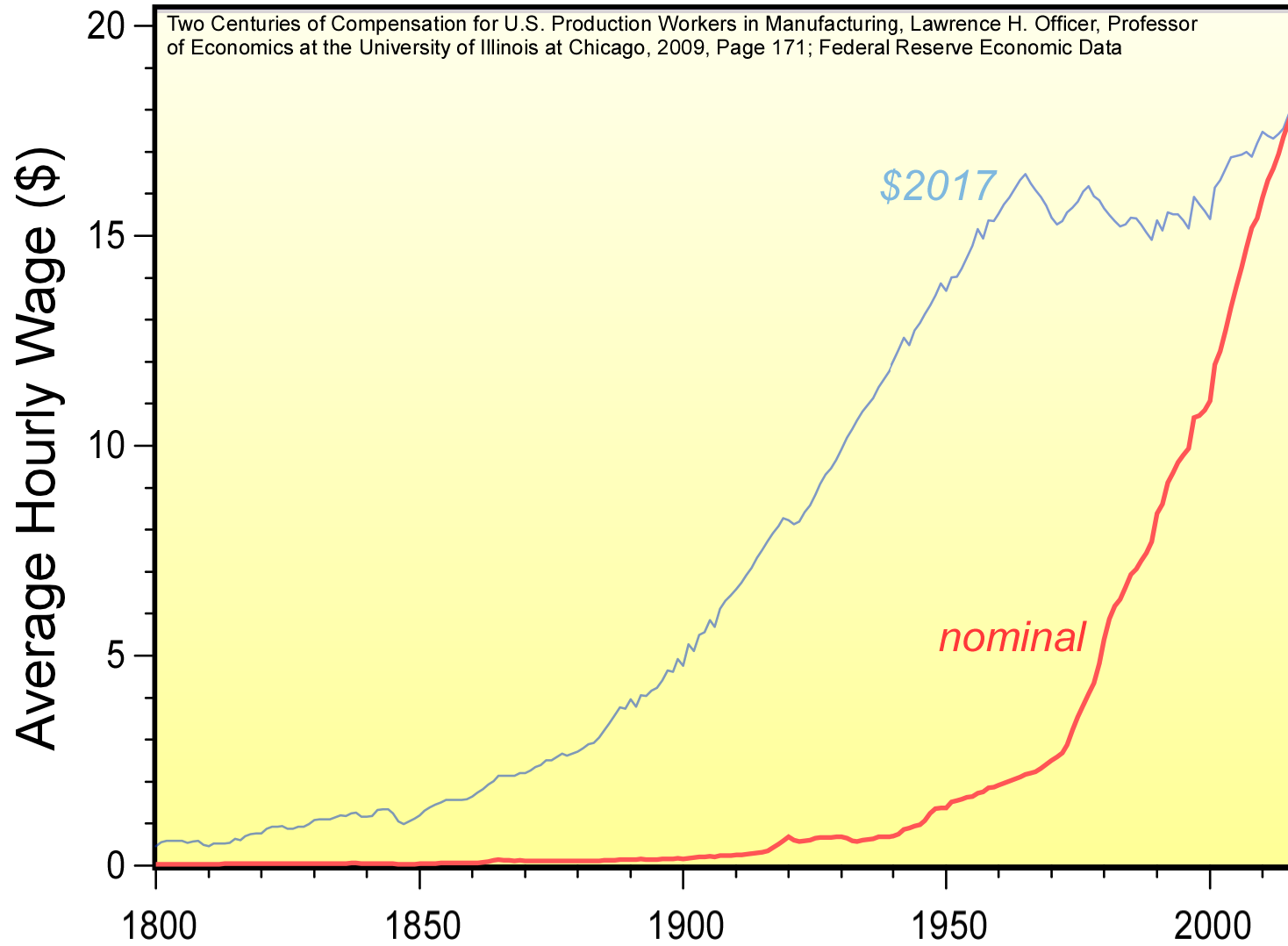
Value



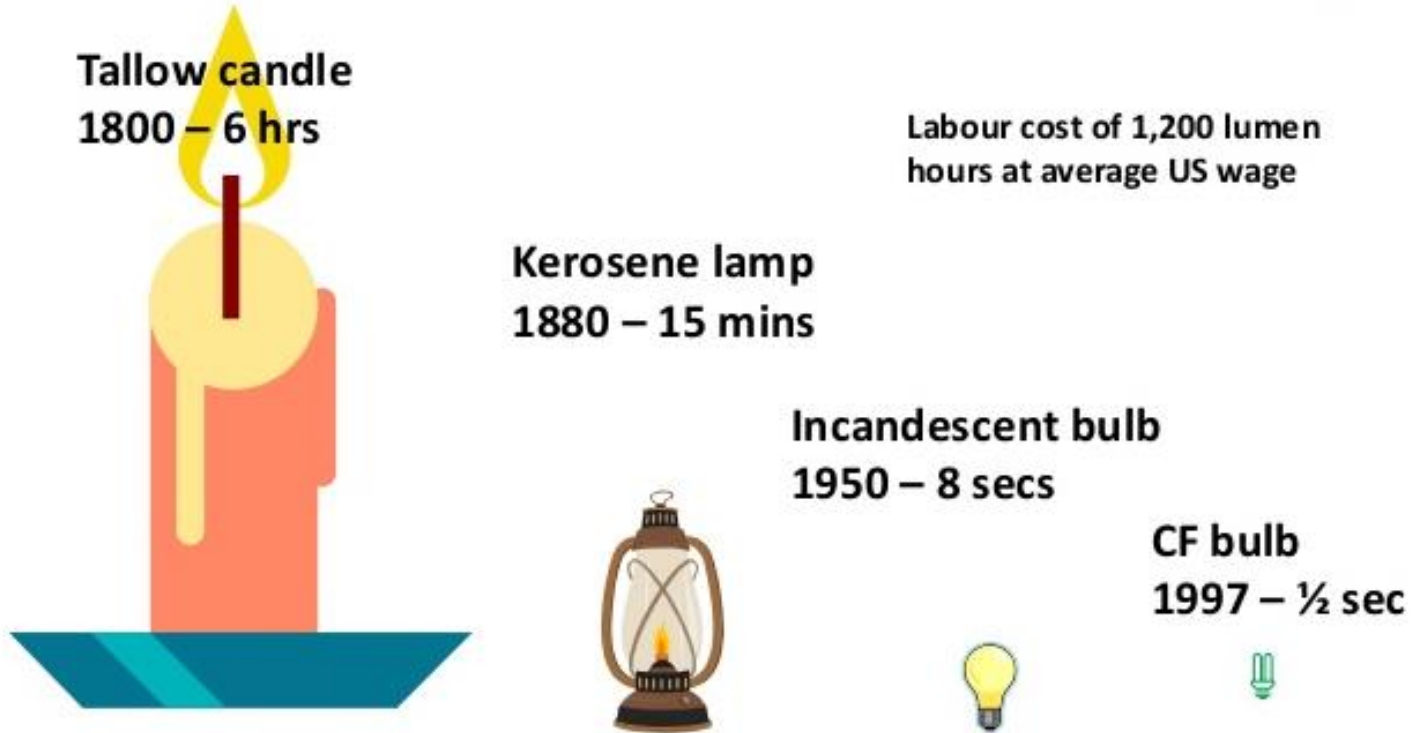
## Commodity Prices



## Wages Over Time



## How long does it take to earn an hour of reading light?

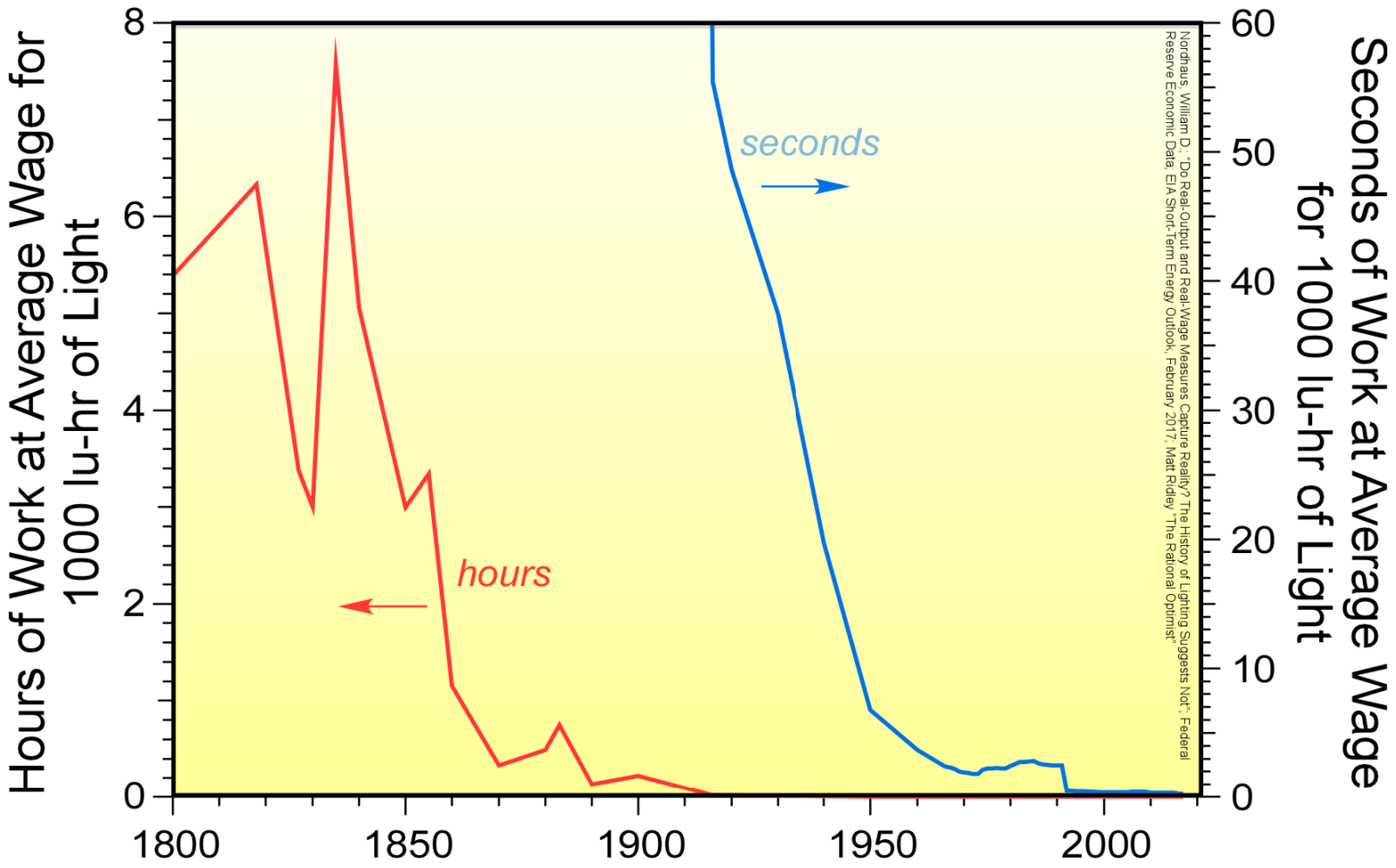


Nordhaus 1997: <http://www.nber.org/chapters/c6064.pdf>

K2 London Keynote: Where Does Innovation Come From? - Lord Matt Ridley <http://kenshoo.com/k2-london-keynote-matt-ridley/>



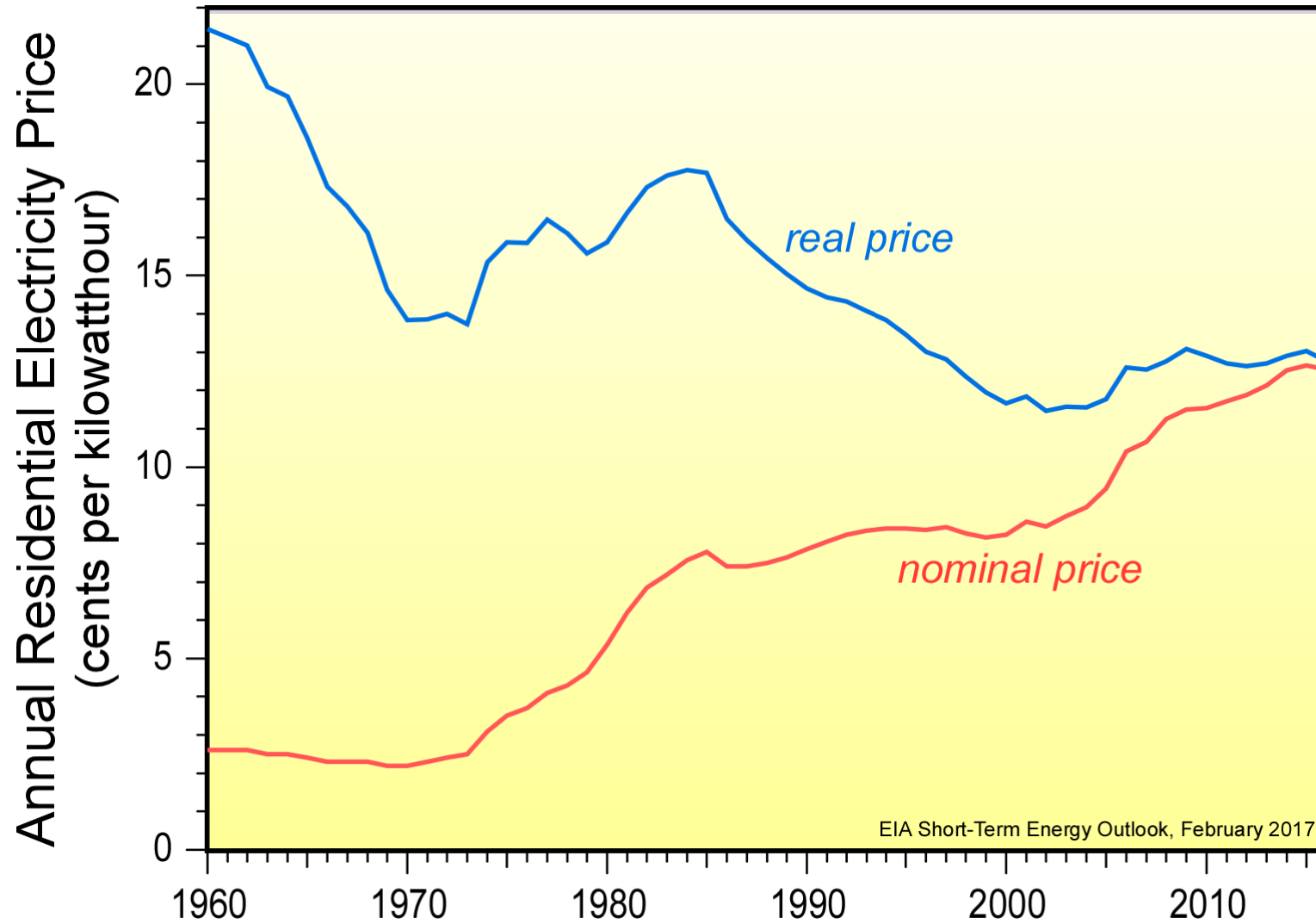
# Work Needed to Supply Light



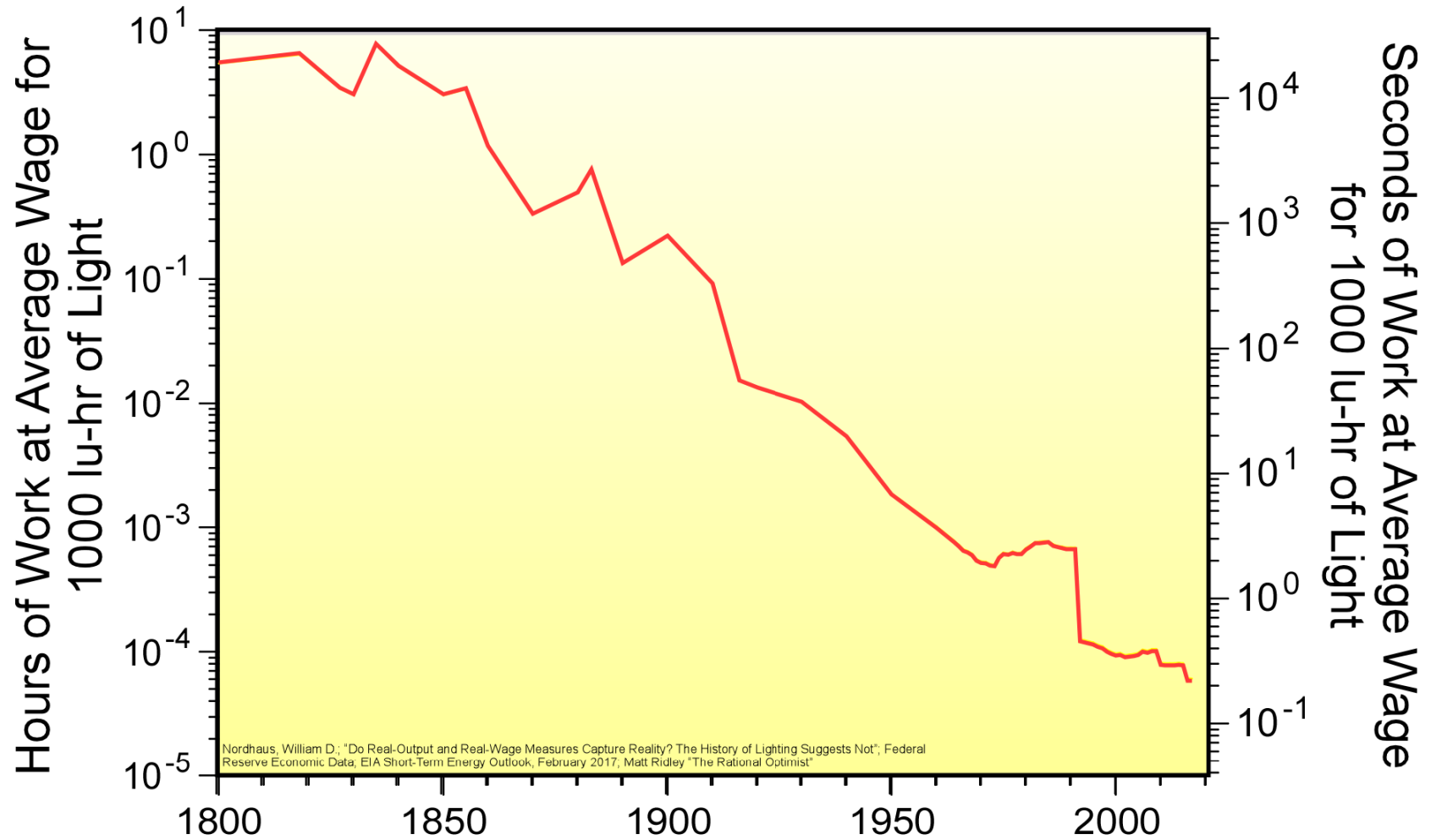
Northaus, William D. "Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not." Federal Reserve Economic Data. EIA Short-Term Energy Outlook, February 2017. Matt Ridley, "The Rational Optimist"



## Combining Impacts

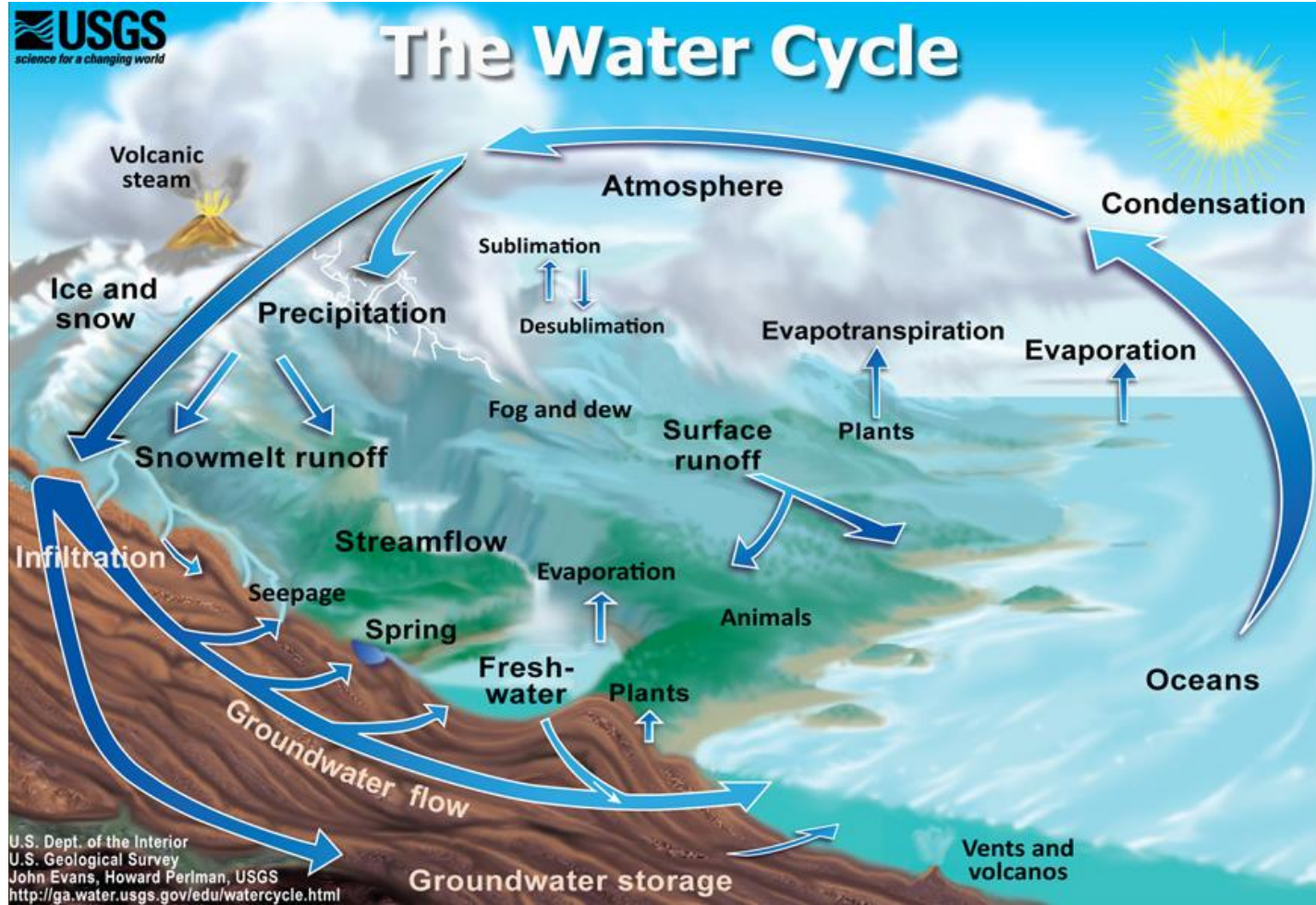


## Work Needed to Supply Light



What is the circular economy?

# Natural Cycles



# Natural Cycles

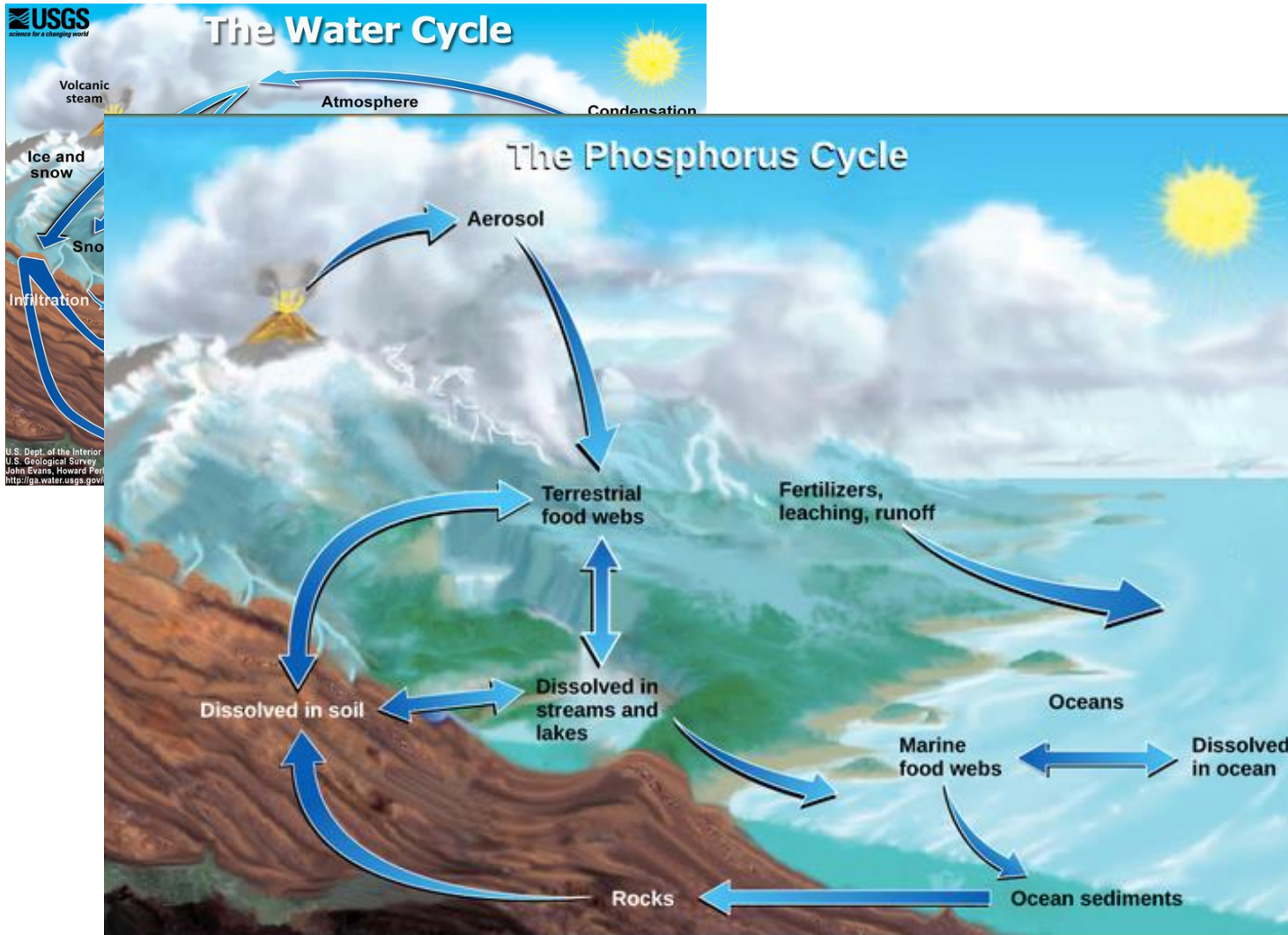
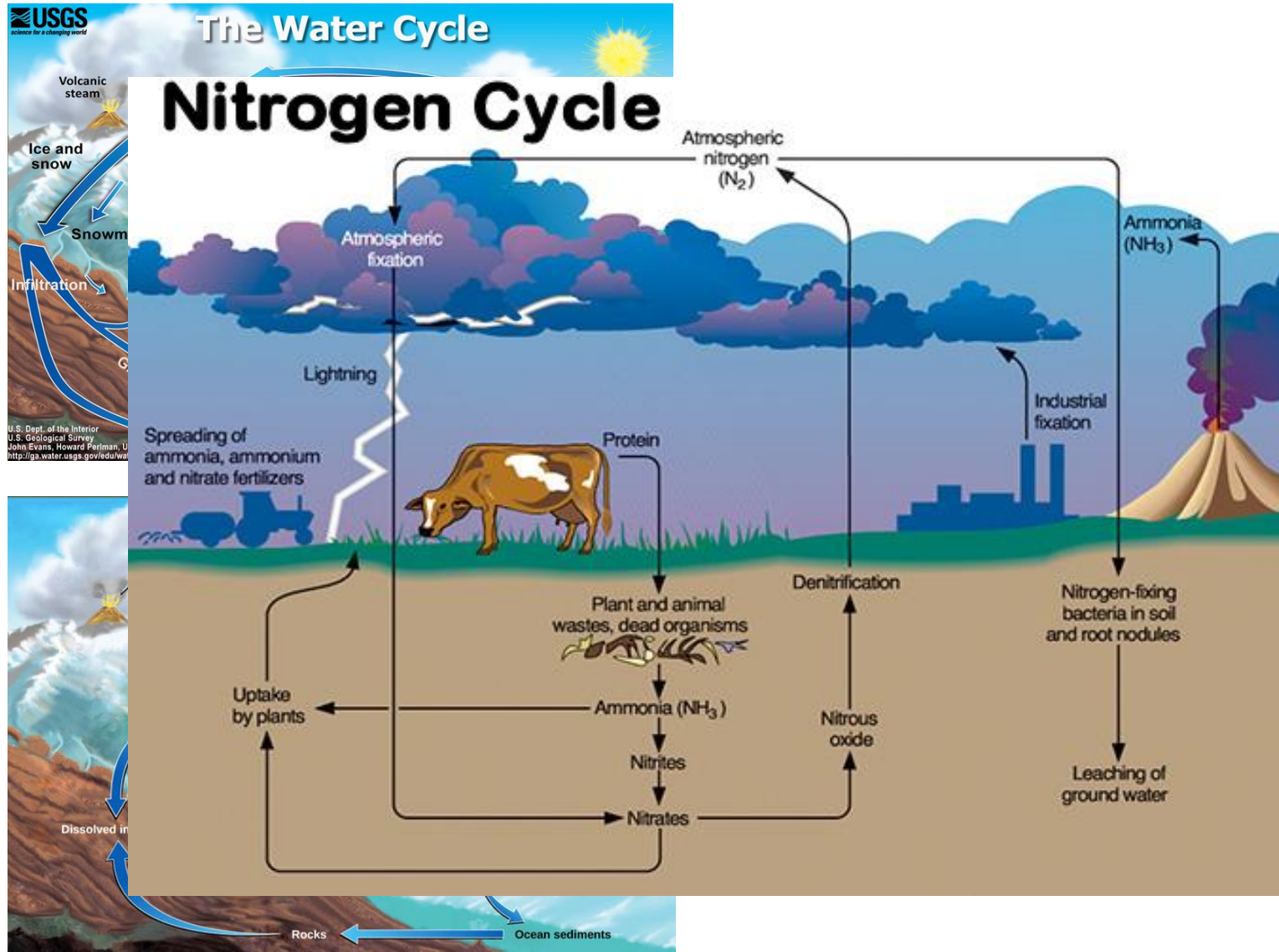


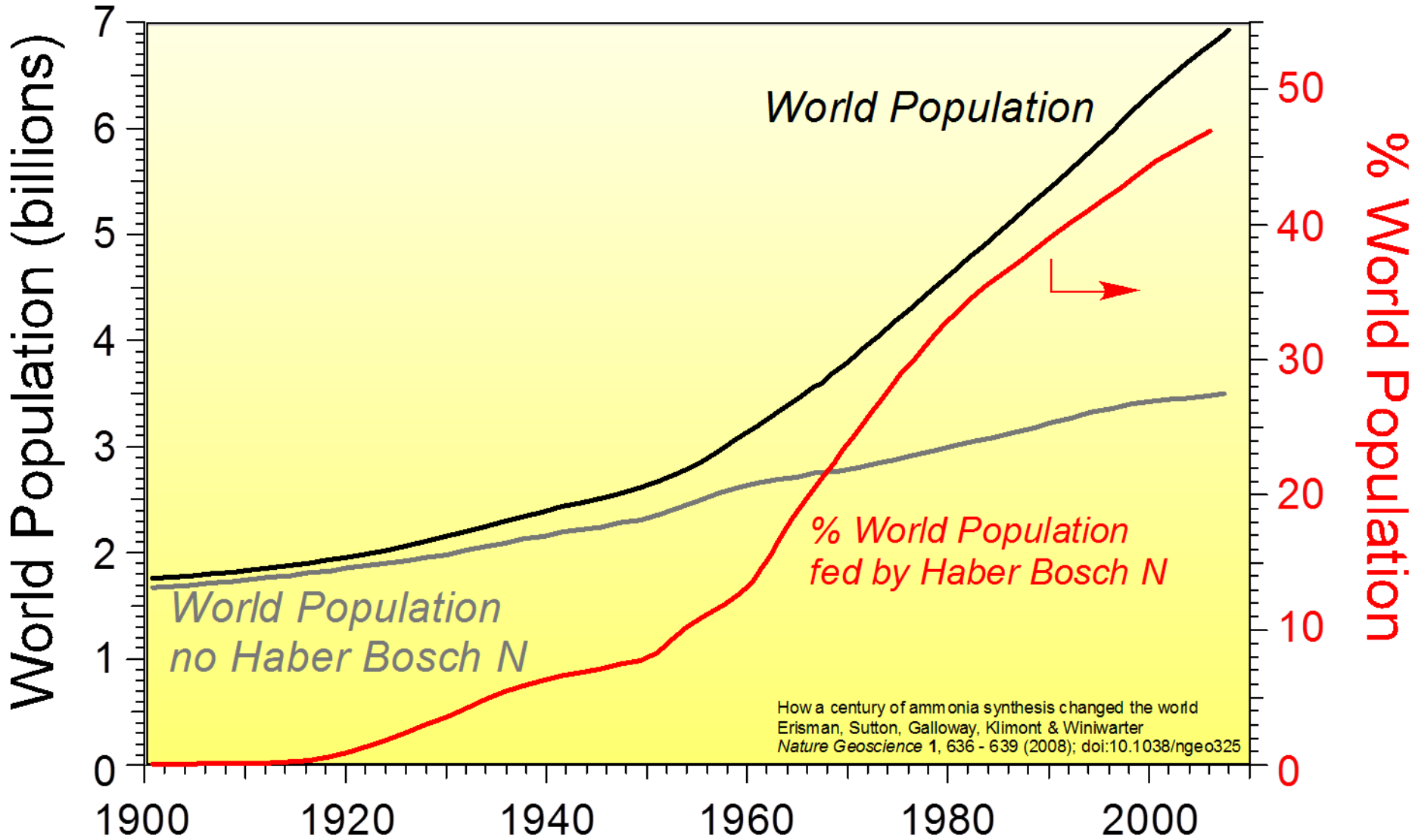
Image credit: Biogeochemical cycles: Figure 6 by OpenStax College, Concepts of Biology, CC BY 4.0; modification of work by John W. Bass and Howard Perkins, USGS

# Natural Cycles









# Natural Cycles

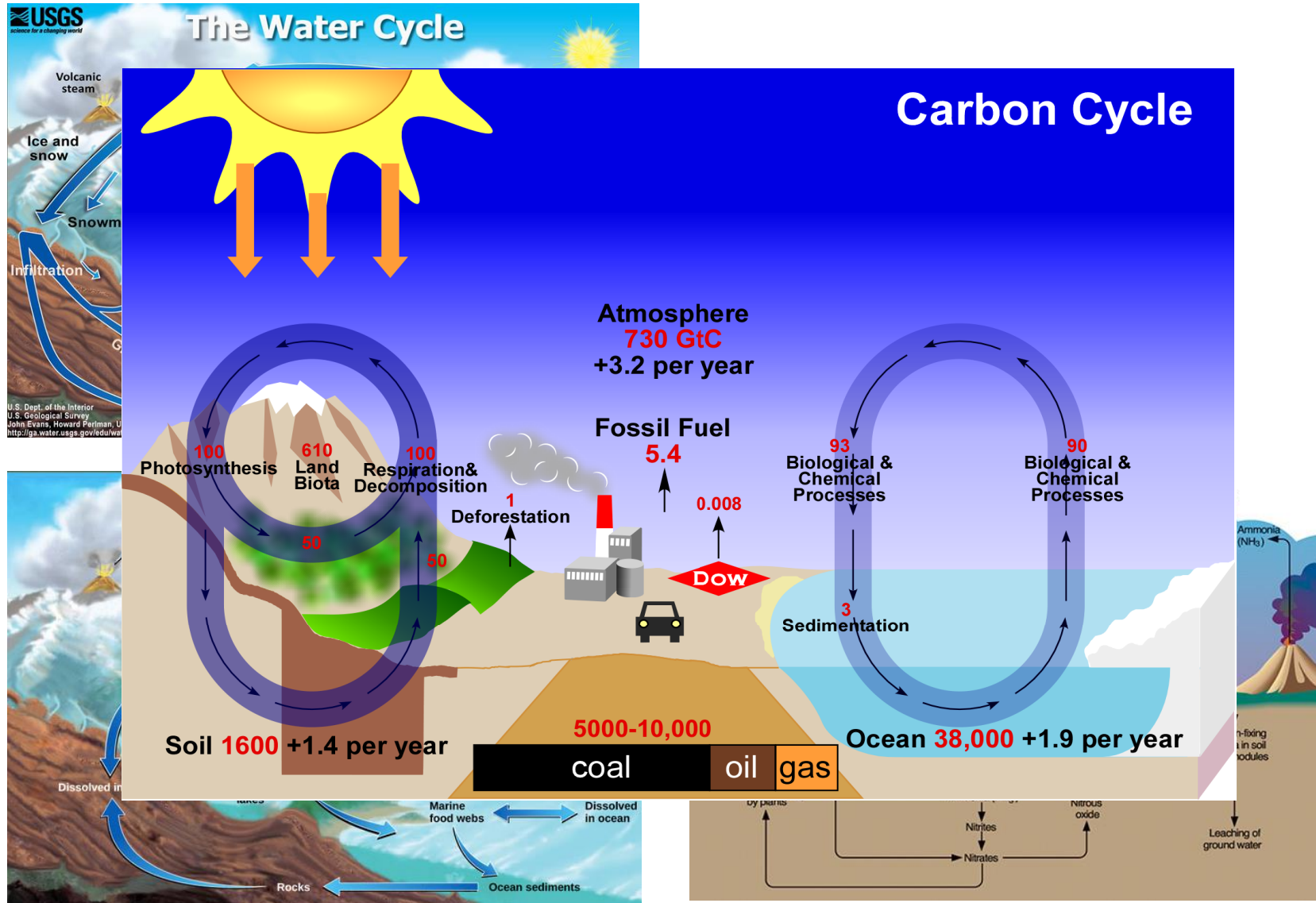
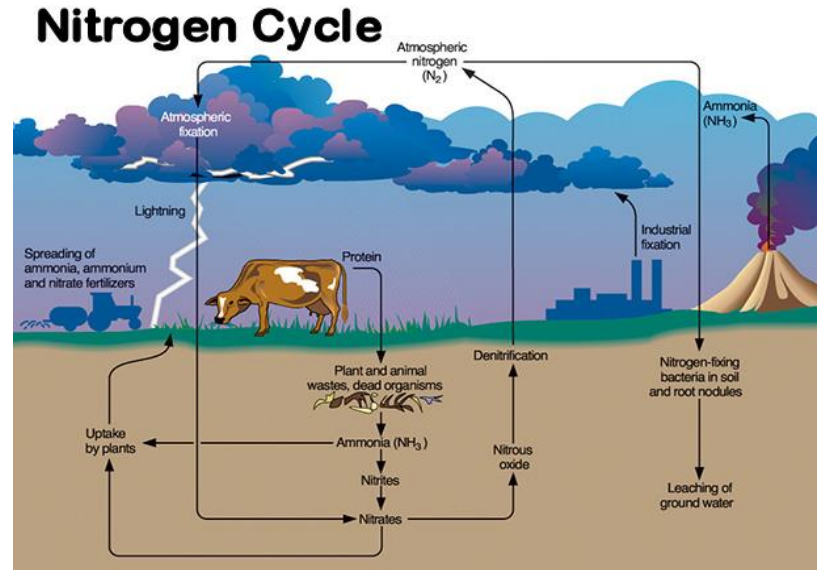
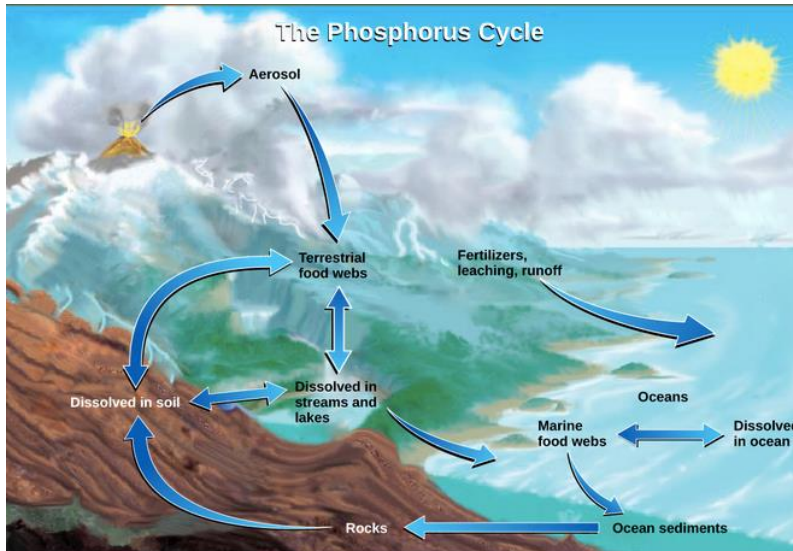
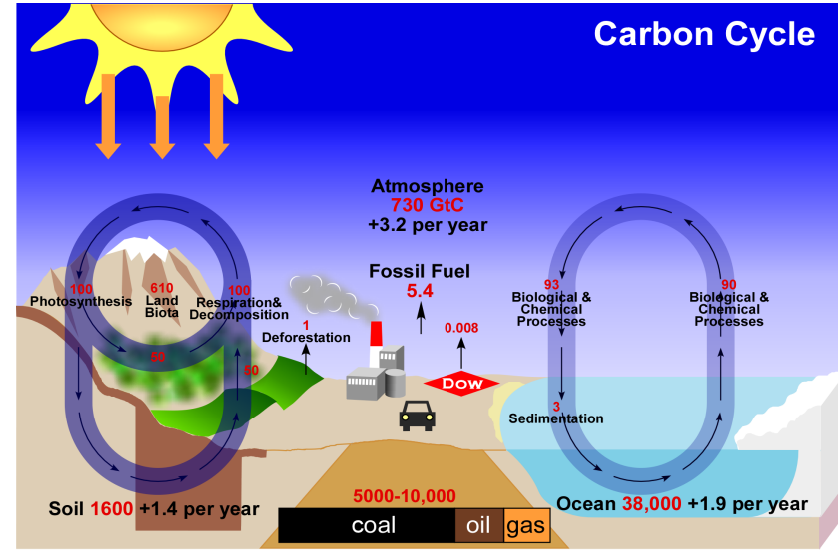
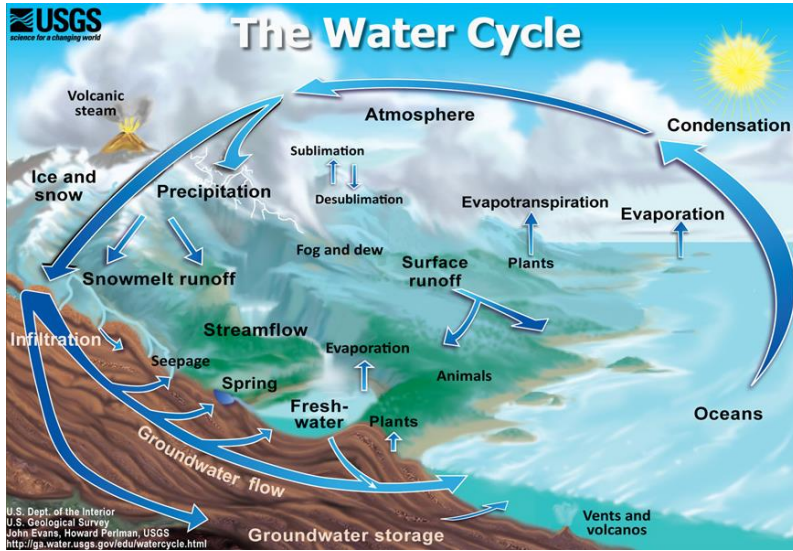


Image credit: Biogeoscience cycle: Figure 6 by OpenStax College, Concepts of Biology, CC BY 4.0; modification of work by John B. Essig and Howard Perlman, USGS



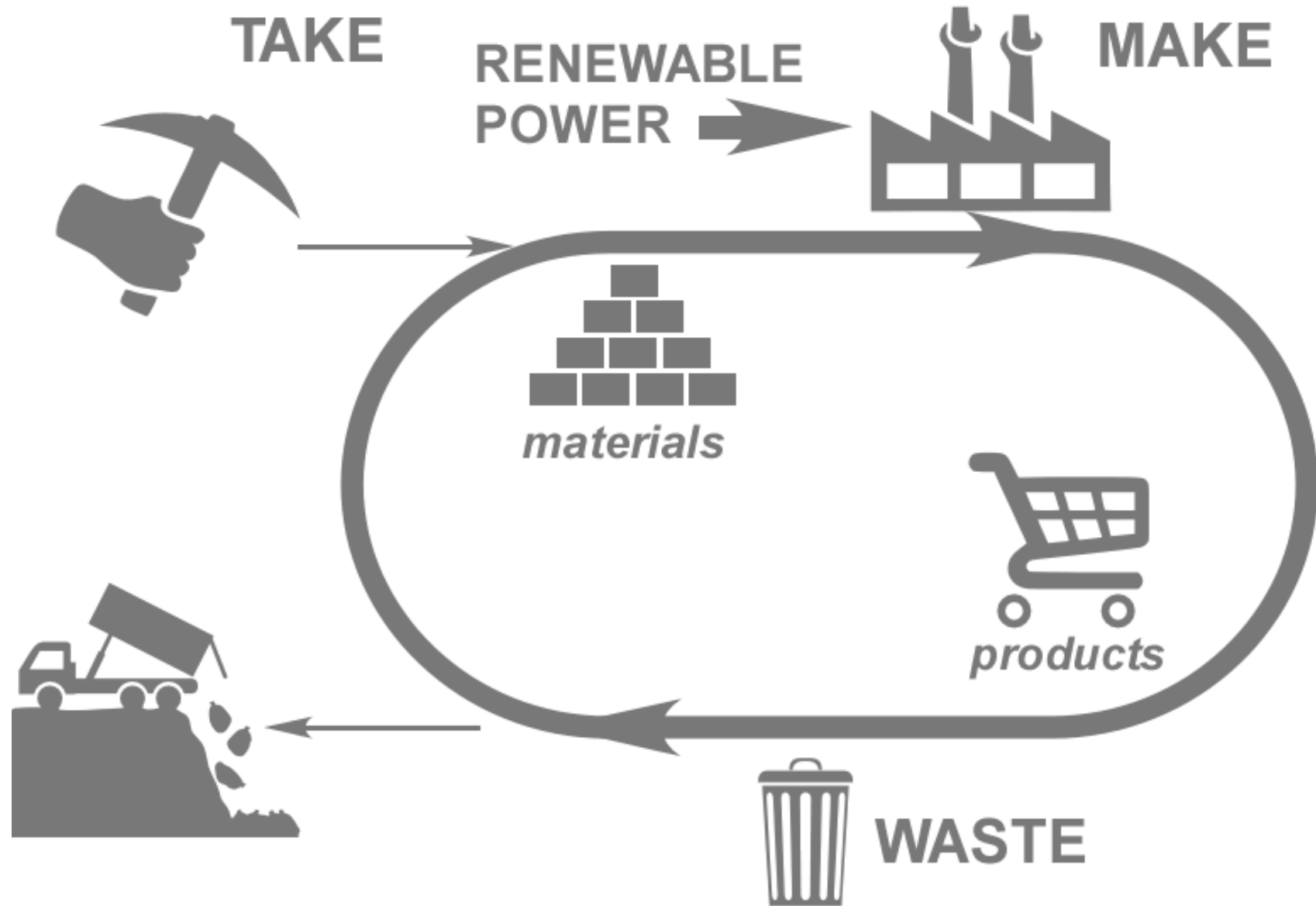
# Natural Cycles



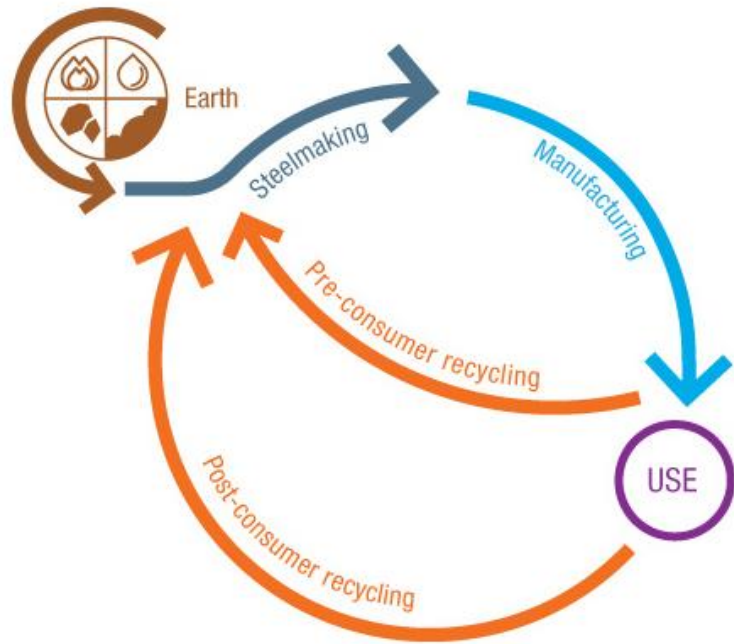




# The Circular Economy



# Already Circular - Metals



## Steel attributes



Infinite recycling without loss of properties



Permanent material



Easy magnetic separation and recovery

## Benefits of steel recycling

Raw materials conservation



One tonne of steel recycled saves on average :  
1,400 kg iron ore  
740 kg coal  
120 kg limestone

70% Energy saving



Recycling a single steel can saves :  
1 laundry load, or  
1 hour TV, or  
4 hours lighting (60 watt bulb)

Job creation



Jobs required for scrap collection, separation and recycling

<http://circulareconomy-worldsteel.org/>

Challenges



Cu

CIRCULAR ECONOMY

RETURN

MAKE

USE

Being 100% recyclable, copper can be used again and again with no loss of properties.

Copper is a naturally occurring mineral resource in the earth's crust.

4,100,000  
Tonnes of copper products made by the EU industry



50%  
Of the EU demand for copper is met through recycling

The superior electrical and thermal conductivities of 1 tonne of copper can deliver lifetime savings of:

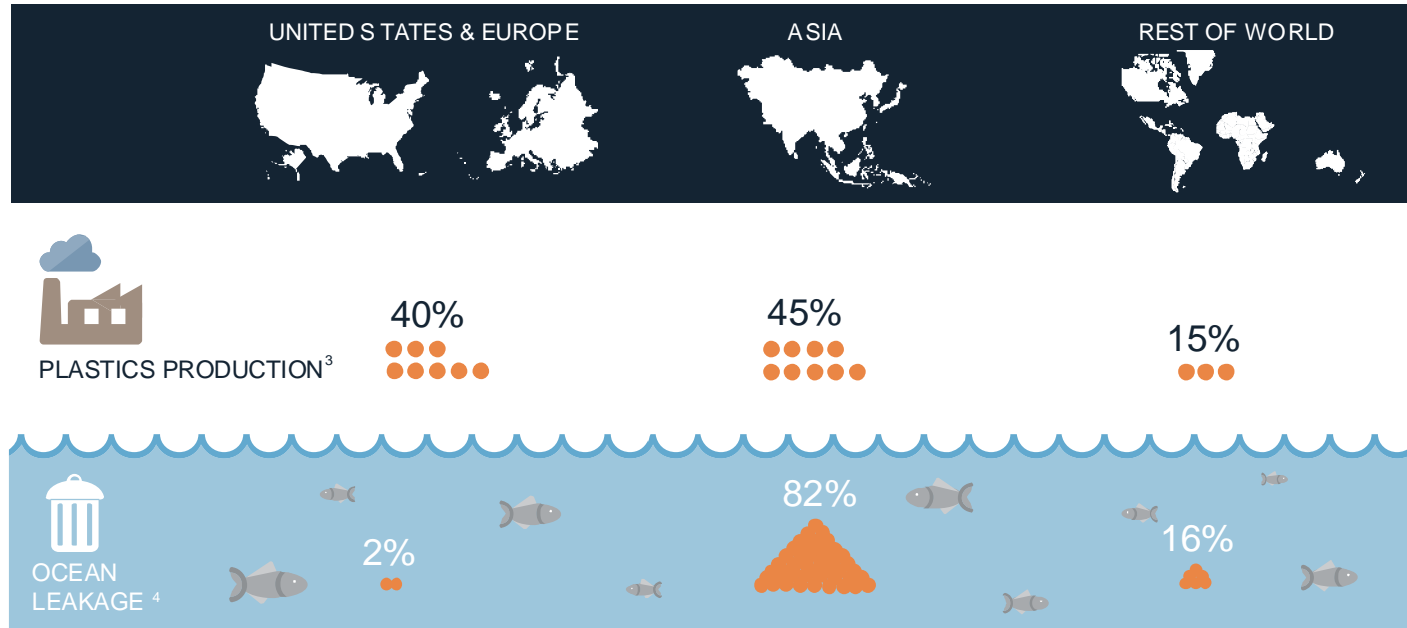




# Current Plastic Flow



# Where Does Plastic Waste Come From?



<sup>3</sup> Production of plastics material volumes (excluding thermoplastics and polyurethanes)

<sup>4</sup> Source of plastics leaked into the oceans (proportion of the total global leakage measured in million tonnes of plastic marine debris leaked per year)

Source: PlasticsEurope, Plastics – the Facts 2015 (2015); Statista; ICIS Supply and Demand; J. R. Jambeck et al., Plastic waste inputs from land into the ocean (Science, 13 February 2015)

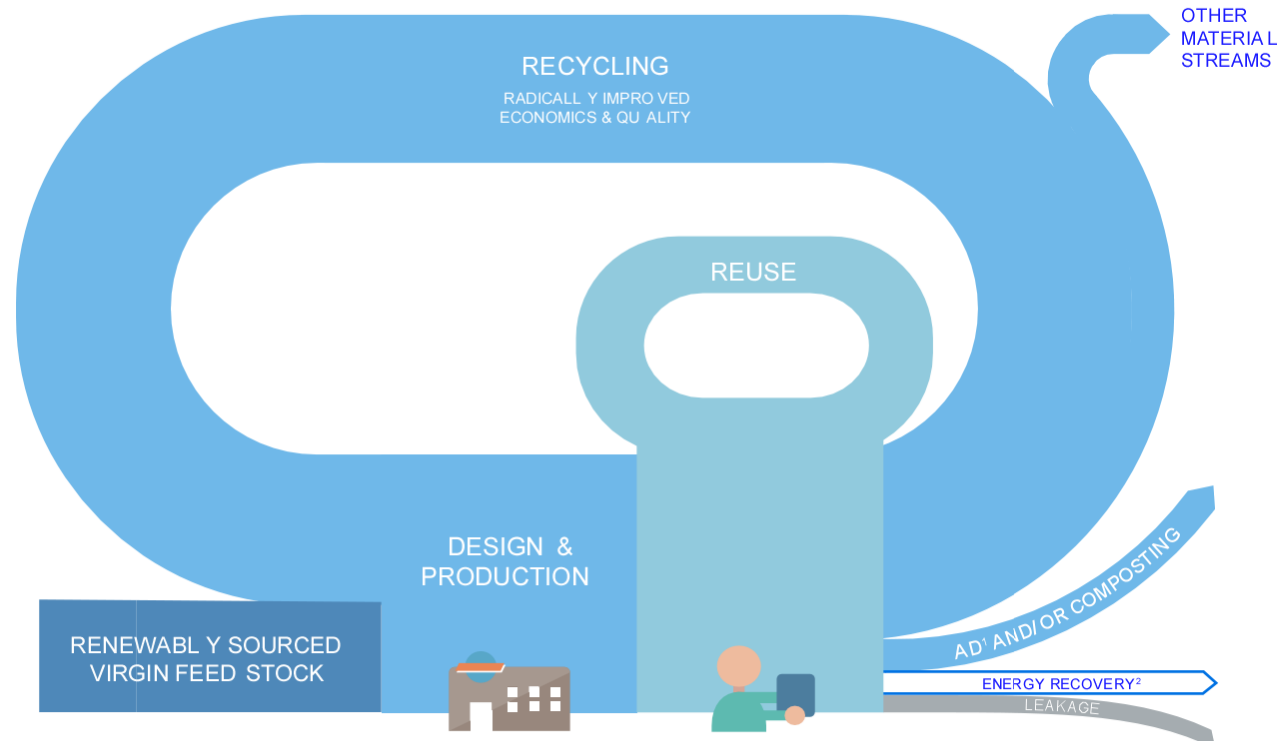
Source: World Economic Forum

## Where Does Plastic Waste Come From?



# The Circular Economy

## 1 CREATE AN EFFECTIVE AFTER-USE PLASTICS ECONOMY



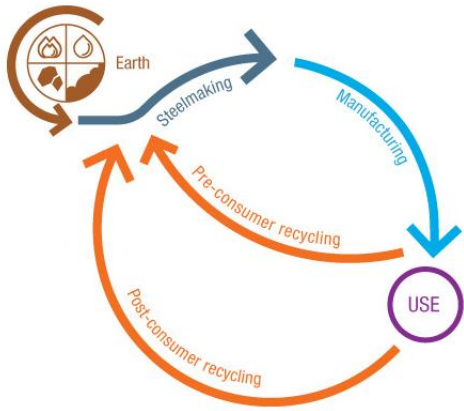
## 3 DECOUPLE PLASTICS FROM FOSSIL FEED STOCKS

## 2 DRASTICALLY REDUCE THE LEAKAGE OF PLASTICS INTO NATURAL SYSTEMS & OTHER NEGATIVE EXTERNALITIES

Source: The New Plastics Economy – Rethinking the future of plastics

Source: World Economic Forum

# What's Missing?



**Steel attributes — Benefits of steel recycling**

- Infinite recycling without loss of properties** (Icon: two interlocking circles)
- Raw materials conservation** (Icon: globe with arrows)
 

One tonne of steel recycled saves on average:

  - 1,400 kg iron ore
  - 740 kg coal
  - 120 kg limestone
- Permanent material** (Icon: spiral)
- Easy magnetic separation and recycling** (Icon: magnet)

Recycling a steel can

Challenges

Urbanisation, Population growth, Infrastructure, Greenhouse gases, Precipitation, etc.

Being 100% recycled can be used with new steel

Copper is a naturally occurring mineral resource in the Earth's crust.

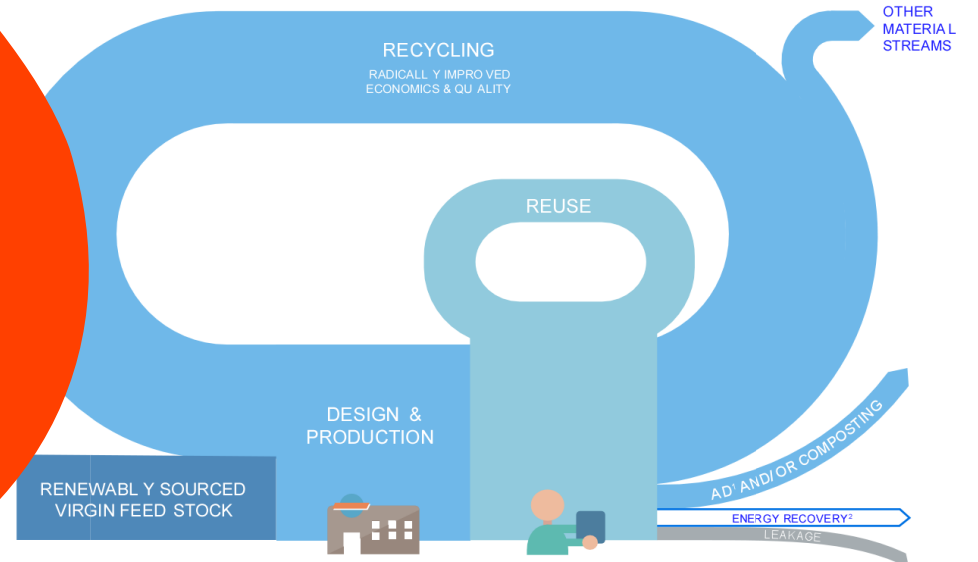
and thermal stability of copper alloys of:

50-7,500, 1000-2.4M, 50, 10,000

Cu, Ev, Co, Copper



**1** CREATE AN EFFECTIVE AFTER-USE PLASTICS ECONOMY



**3** DECOUPLE PLASTICS FROM FOSSIL FEED STOCKS

**2** DRASTICALLY REDUCE THE LEAKAGE OF PLASTICS INTO NATURAL SYSTEMS & OTHER NEGATIVE EXTERNALITIES

Source: The New Plastics Economy – Rethinking the future of plastics





The  
Economist

# FASHION'S **TOXIC THREADS**



Which is more sustainable?

*A meat-eater in a Prius*



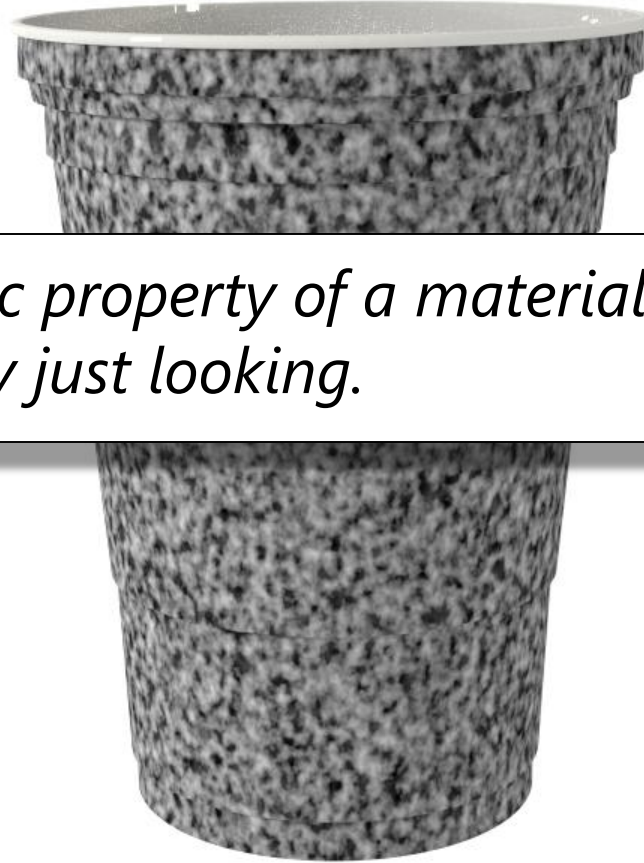
*A vegan in a Hummer*



Sustainable?



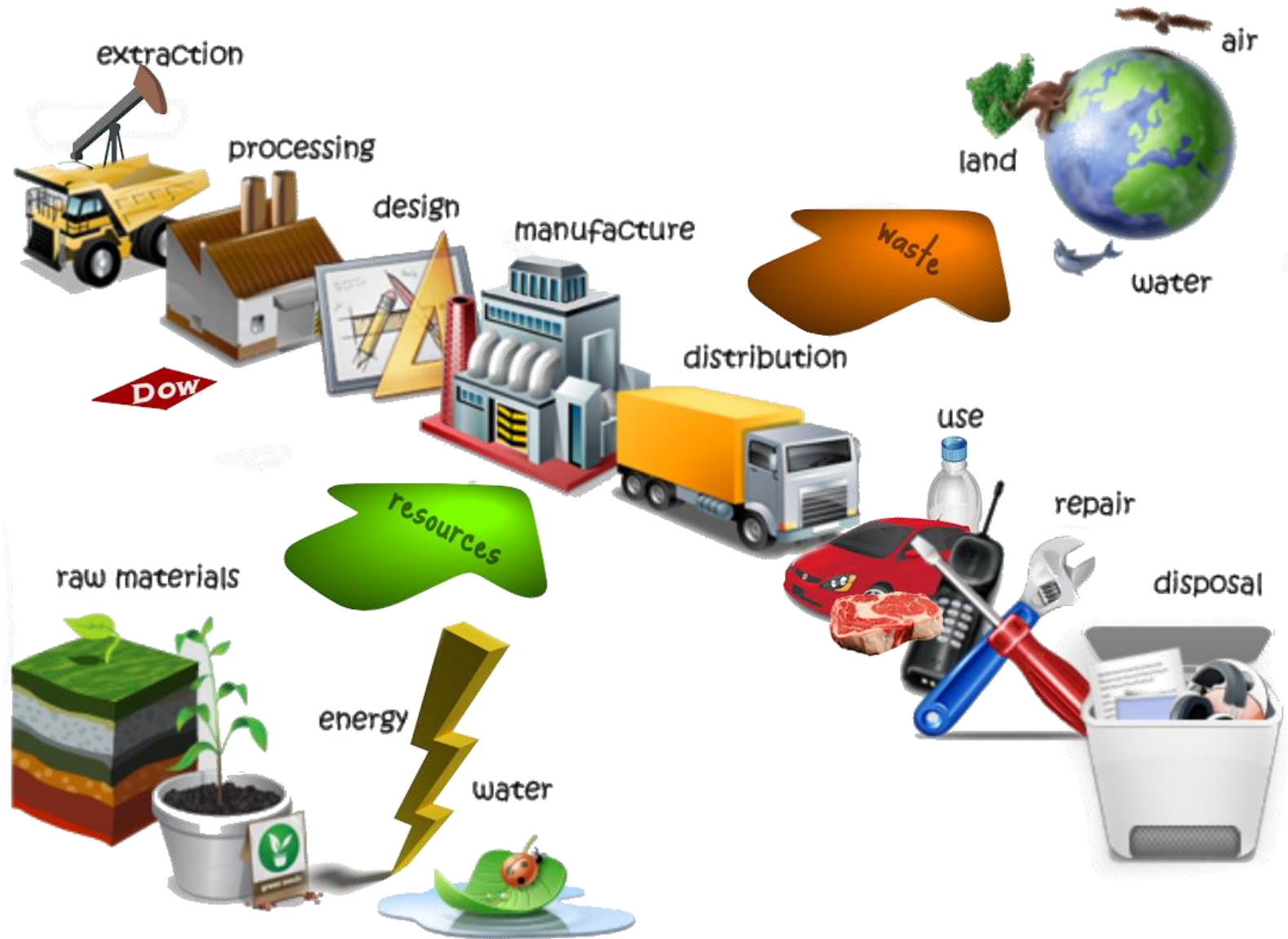
## Is this Cup Sustainable?



*Sustainable is not an intrinsic property of a material!  
You can't know by just looking.*

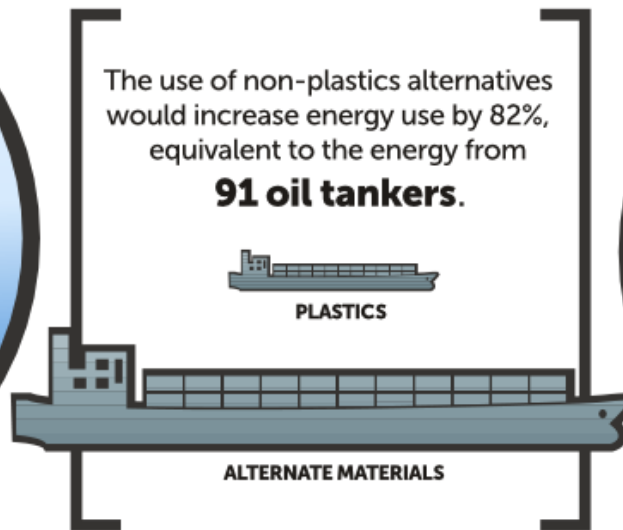
**How about this one?**

# Life Cycle Assessment



adapted from [sustainable-graphic-design.blogspot.com](http://sustainable-graphic-design.blogspot.com)

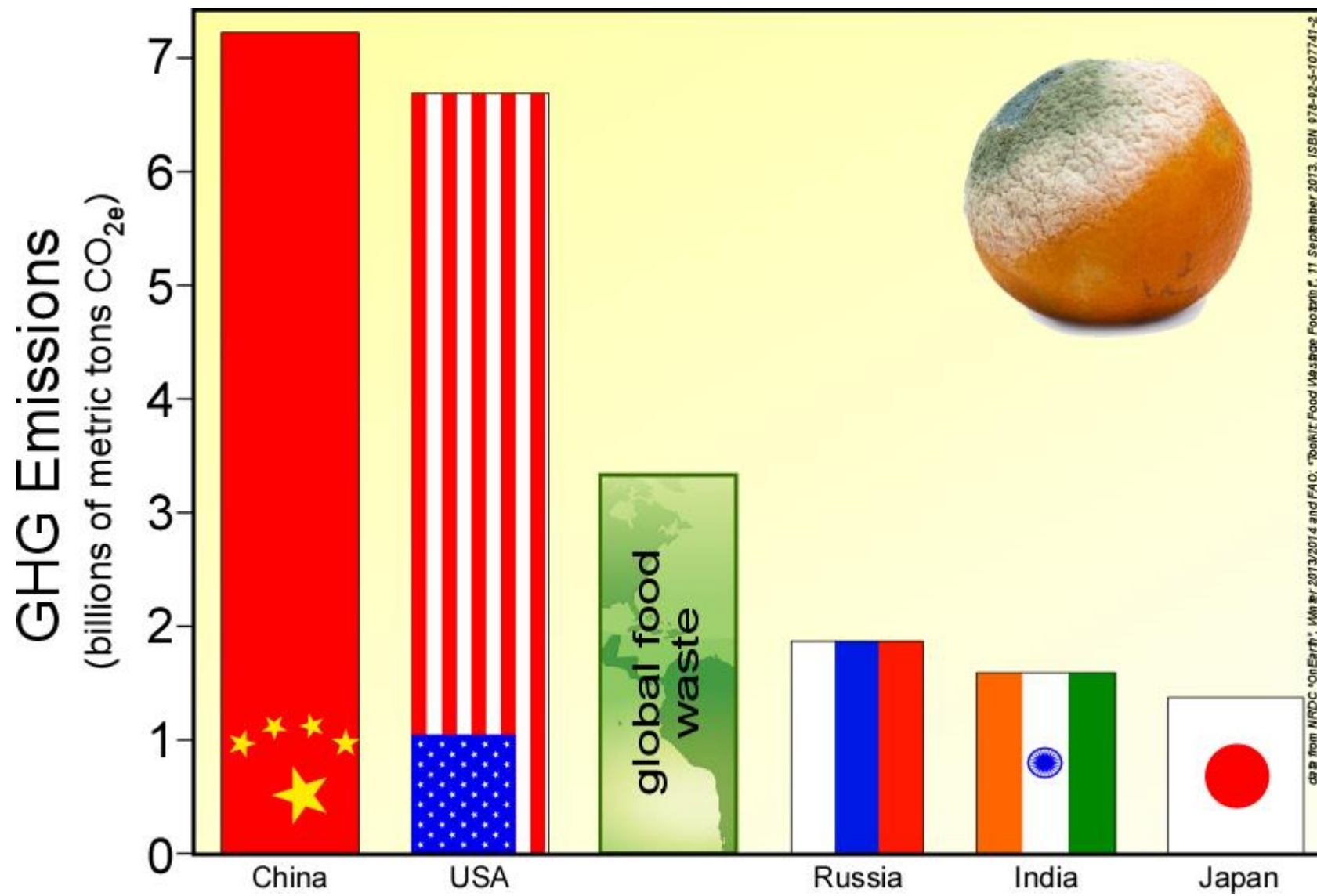
# Plastic Benefits



**Most plastics can be recycled**



30-40% food  
grown is wasted.  
Much of it to  
spoilage.



# World Without Packaging

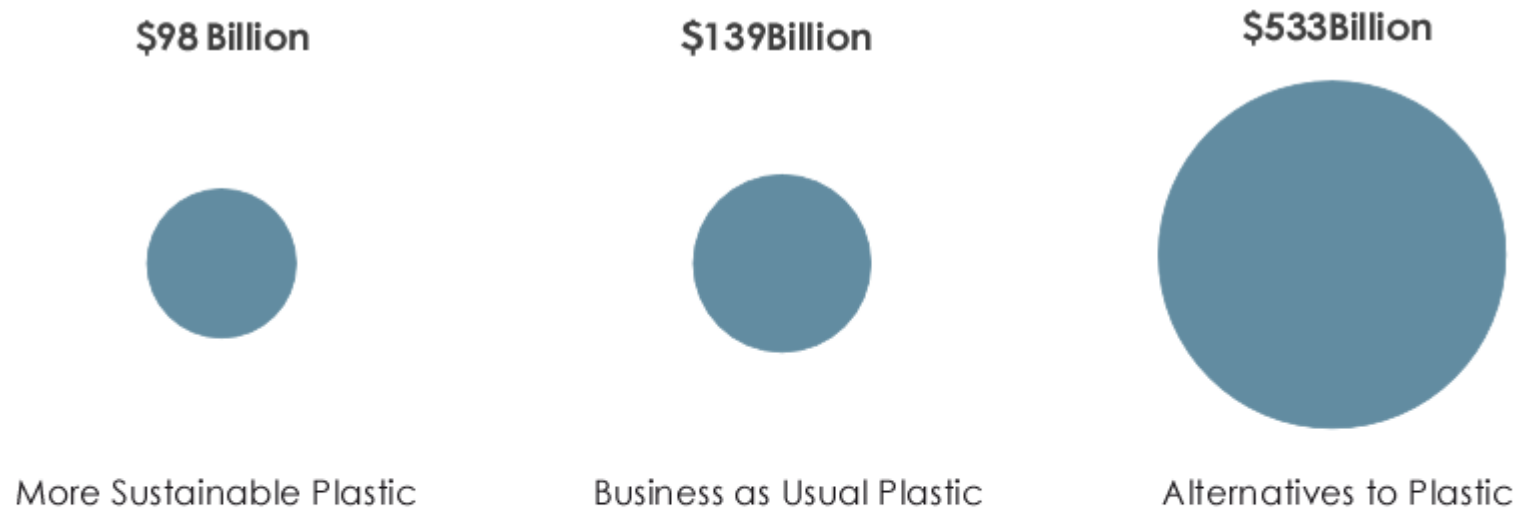


## Summary





## The Costs to Society and the Economy

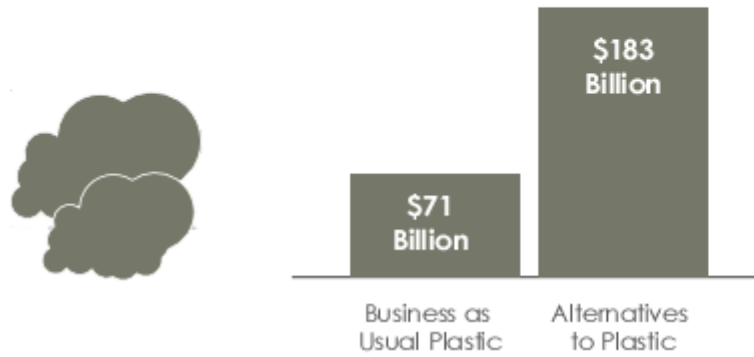


The cost of using alternative materials is approximately four times that of using plastic (in a business as usual scenario). We're producing more and more consumer goods, so choosing the material that creates the least impact is important.

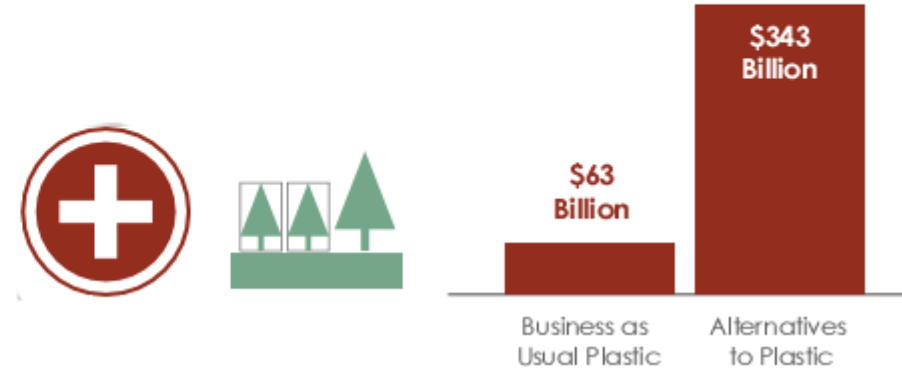
Source: Trucost

# TRUCOST Analysis

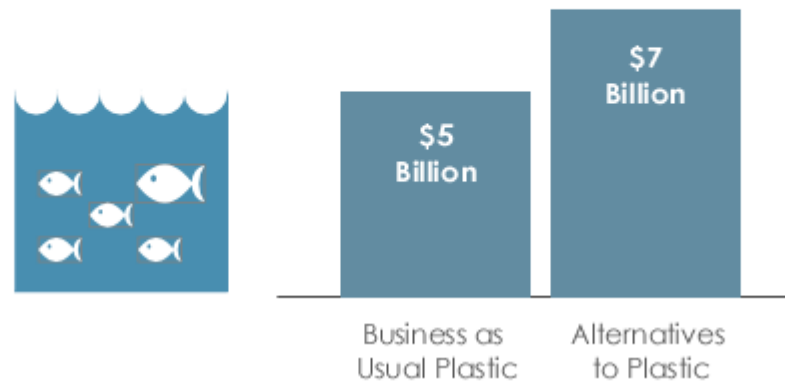
## Climate change



## Damage to the health of humans and ecosystems

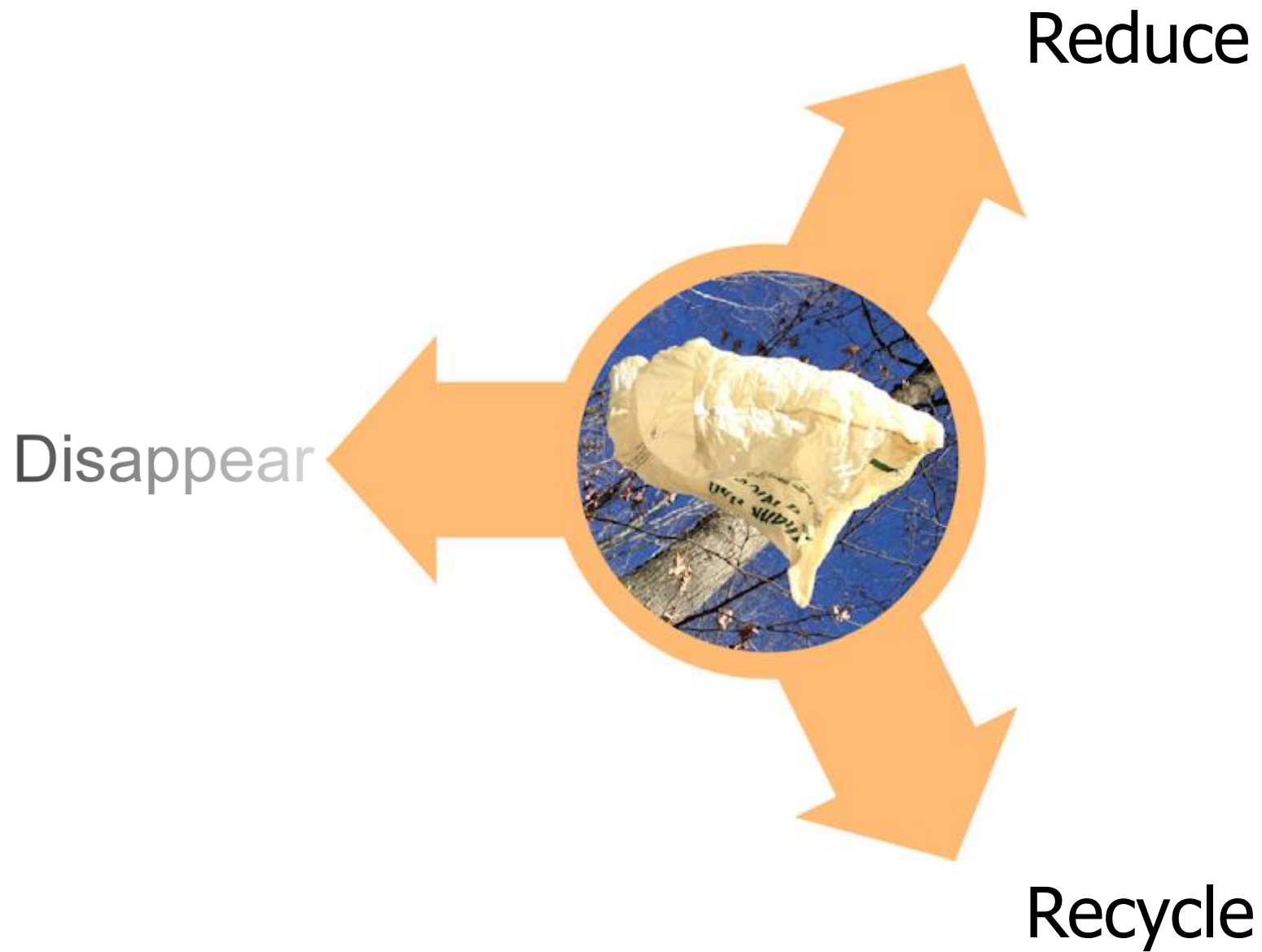


## Damage to the oceans

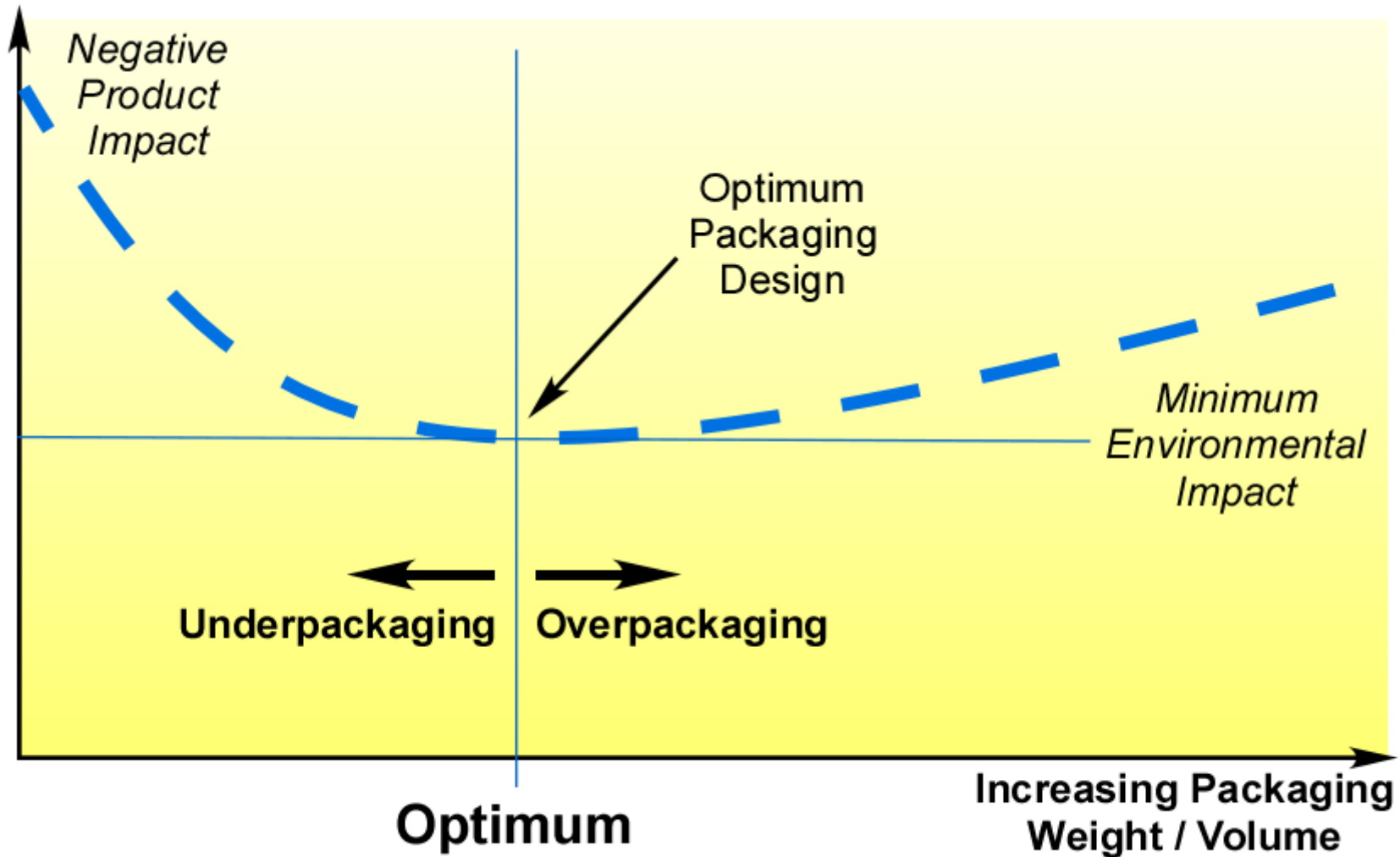


All dollar values are in USD  
Source: Trucost





## Optimizing Packaging



adapted from *Optimal Packaging* (The Consumer Goods Forum, Global Packaging Project, 2011)

## Resource Efficient Packaging



### EDIBLES

Edible Oils  
Ketchup & Other  
Condiments  
Sauces  
Soups  
Honey & Syrups  
Water & Juices  
Dry Pet Food  
or Treats

Rice & Grains  
Breakfast Cereal  
Dry Baking Products  
(flour, sugar, etc.)  
Ground Coffee  
Snack foods

### NON-EDIBLES

Paint & Coatings  
Detergents &  
Cleaning Products  
Motor Oil & Fuel  
Additives  
Seeds  
Cat Litter  
De-icer Pellets  
Fine Aggregates  
(filter sand, etc.)



EDISON AWARDS  
2015



2015  
R&D 100 Winner

### **Re-Closable Cap**

- Precision pouring
- Maximum filling content utilization

### **Flexible Design**

- Four Print Surfaces
- Superior drop resistance
- Reduce excess head space
- Improved dispensing
- Collapses easily

### **Top and Bottom Handles**

- Easy handling

### **Cubic Shape**

- Shelf Stable & Maximizes Shipping Efficiency

### **Space Saving**

- Ships and Stores Flat when Unfilled



# Recycling



# Enabling Recycling

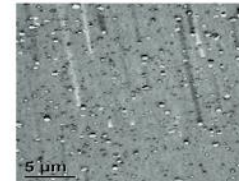


**R&D  
100**  
54 Years of Invention

Transmission Electron Microscopy

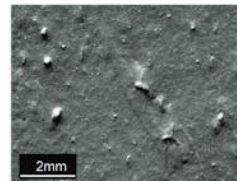


No Compatibilizer  
Large EVOH domains

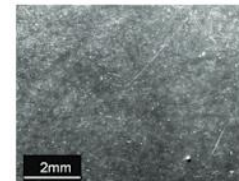


XUS 69 108.01<sup>(1)</sup>  
Modifier Polymer  
Small, uniform EVOH domains

Optical Microscopy



No Compatibilizer  
Large EVOH domains



XUS 69 108.01<sup>(1)</sup>  
Modifier Polymer  
Small, uniform EVOH domains

**Retain**  
polymer modifier by **Dow**

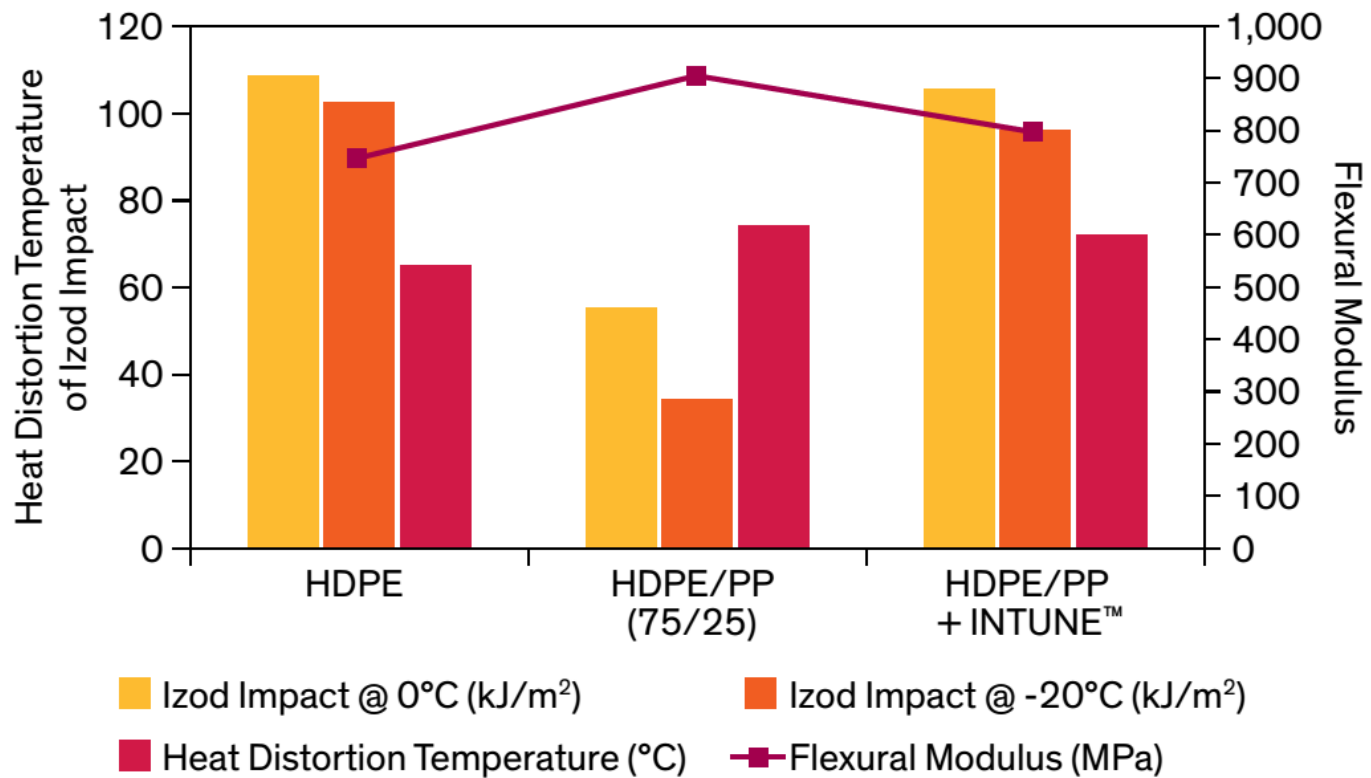


<sup>(1)</sup>Dow estimate per overall barrier figures from *Barrier Materials 2012-2015 Market Report*, Allied Development, 2013.

<sup>(2)</sup>Trademark of The Dow Chemical Company



## Enabling Recycling



**INTUNE™**  
OLEFIN BLOCK COPOLYMERS



Price?



1.6¢

Price?



4.2¢

1.6¢

Price?

0.61¢



0.01¢



4.2¢



0.22¢



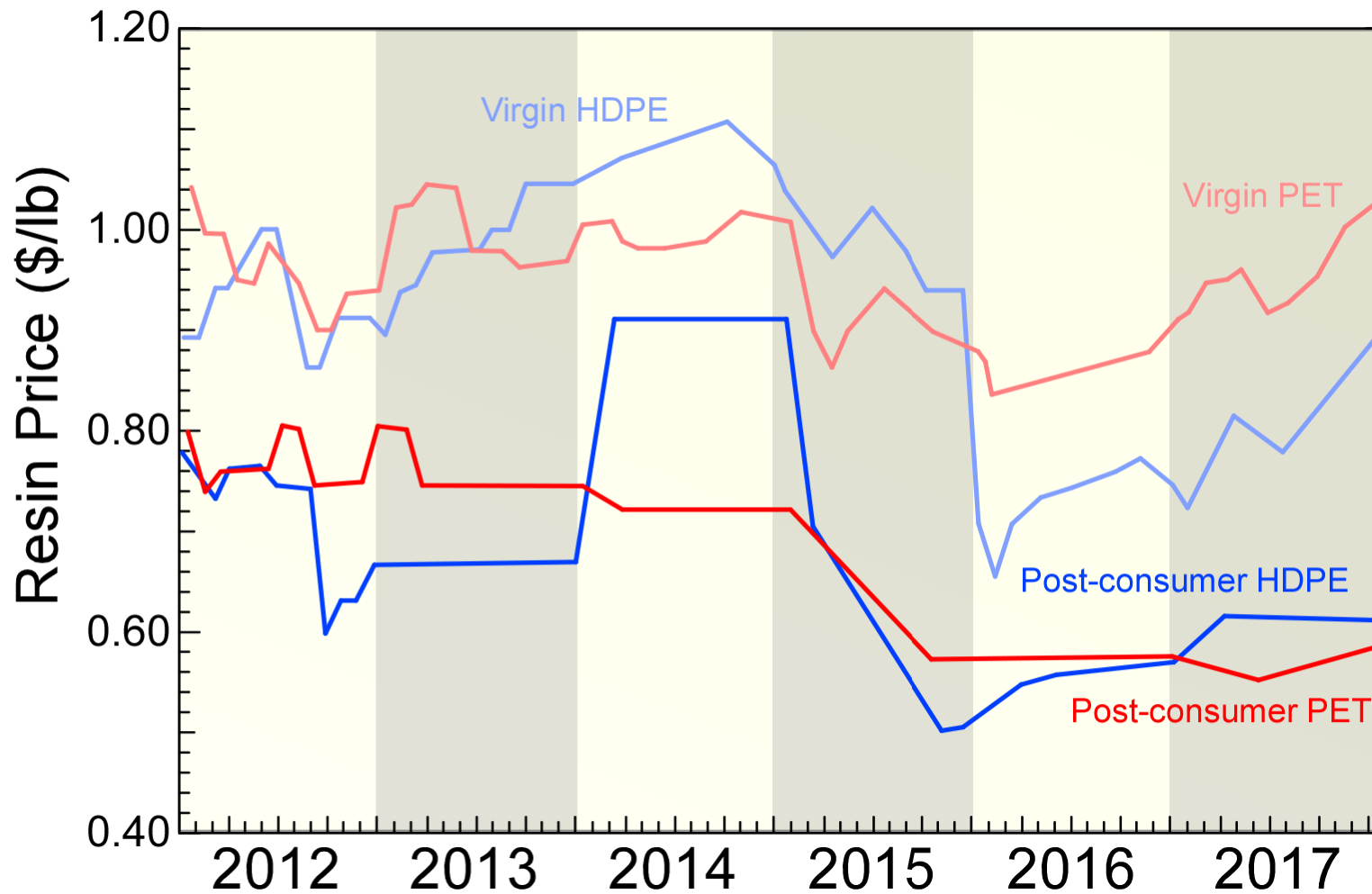
0.20¢



1.6¢



# Recycle Pricing



source: *Plastics News Market Databook, Dec 2017*



## Waste Reduction Hierarchy

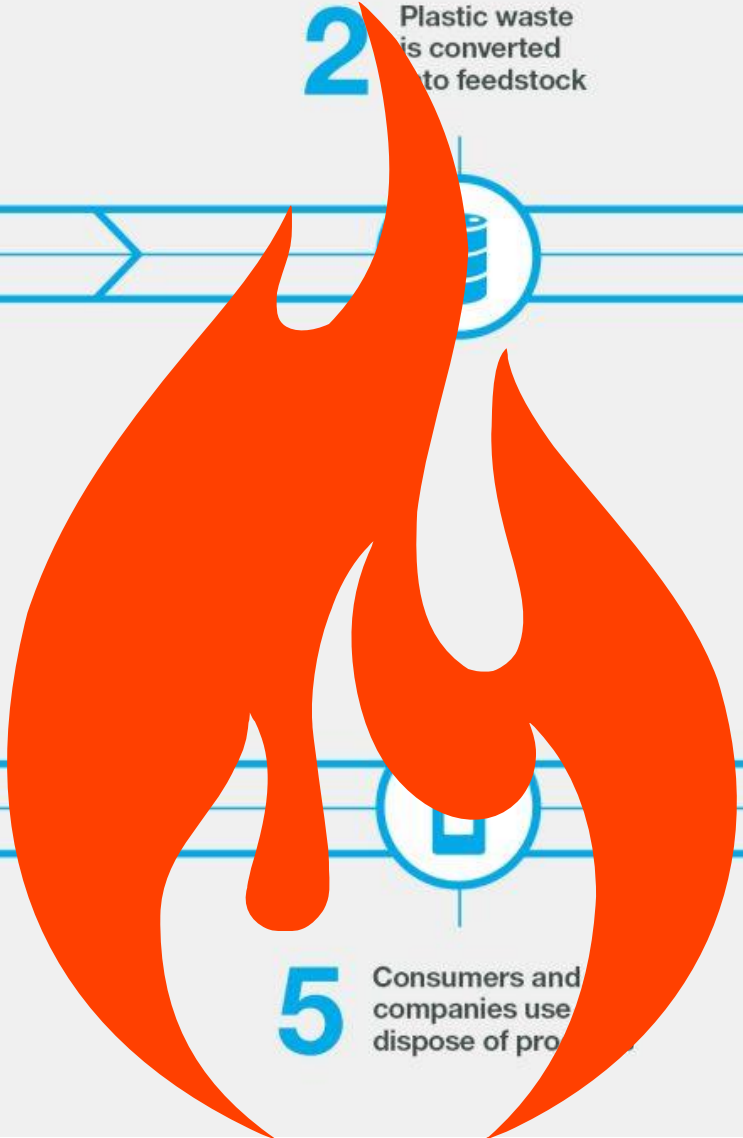
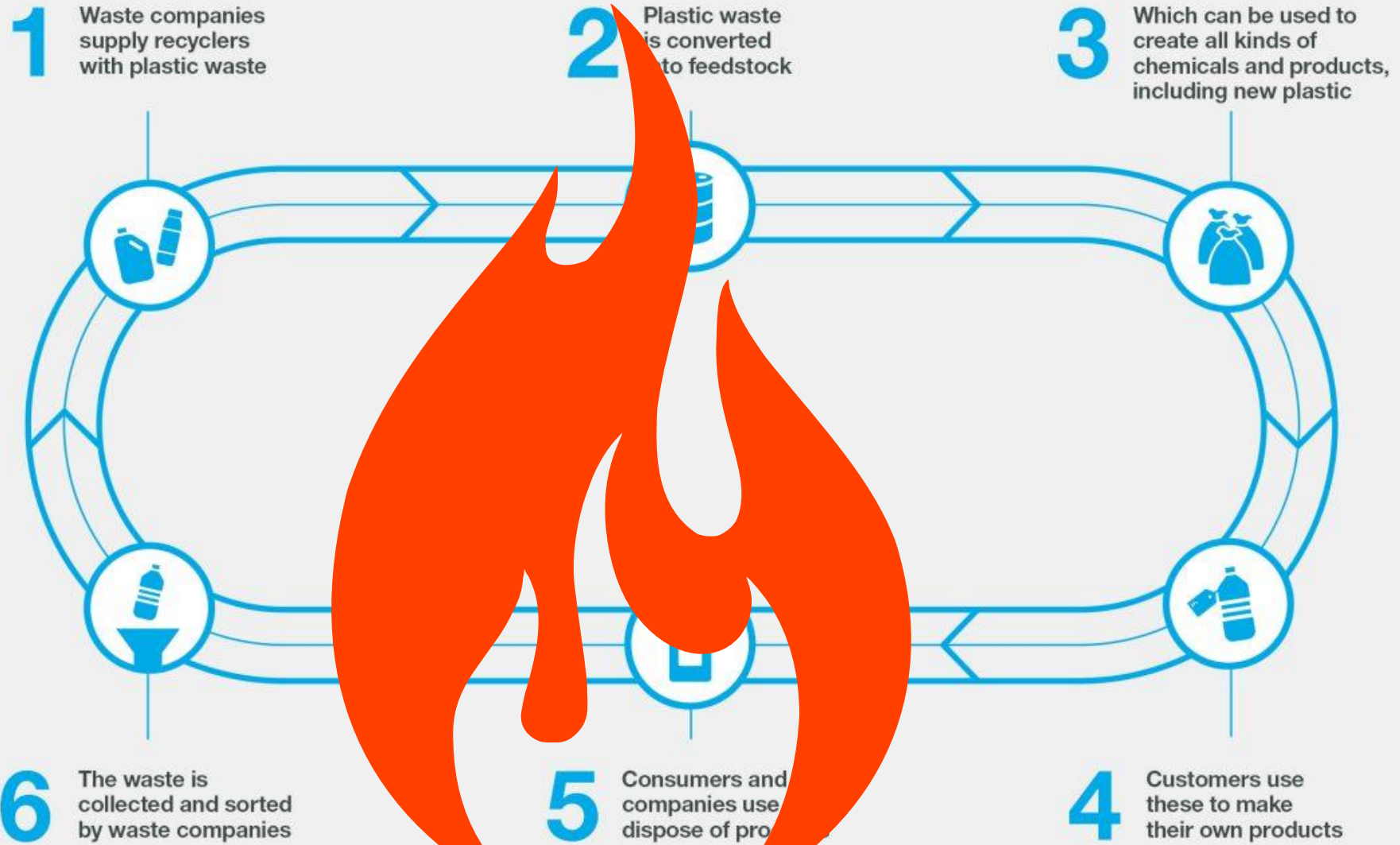


## Recycling









<https://www.basf.com/global/en/who-we-are/sustainability/management-and-instruments/circular-economy/chemcycling.html>





**head & shoulders**

Shampooing antipelliculaire + après-shampooing

**2en1**  
classic clean

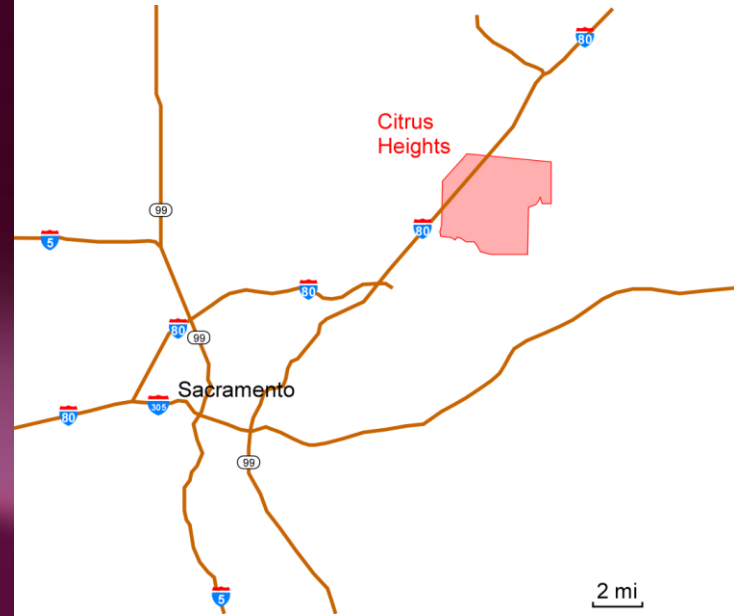


FABRIQUÉ À PARTIR DE  
PLASTIQUE COLLECTÉ  
SUR LA PLAGE

  
12345678



## Explore New End of Life Options



# Energy Bag



## Explore New End of Life Options



# THE PLASTICS THAT DON'T GO IN YOUR BIN GO IN YOUR BAG

- juice pouches
- snack bags
- microwavable pouches
- cake mix liners
- cereal box liners
- laundry pouches
- potato chip bags
- frozen vegetable & fruit bags
- plastic meat & cheese packaging
- squeezable pouches
- foam "to-go" boxes
- foam cups
- salad bags
- plastic cups, plates, bowls & serving ware
- dog & cat food bags
- candy wrappers
- pudding cups
- straws & stirrers
- all other non-recycled bags.

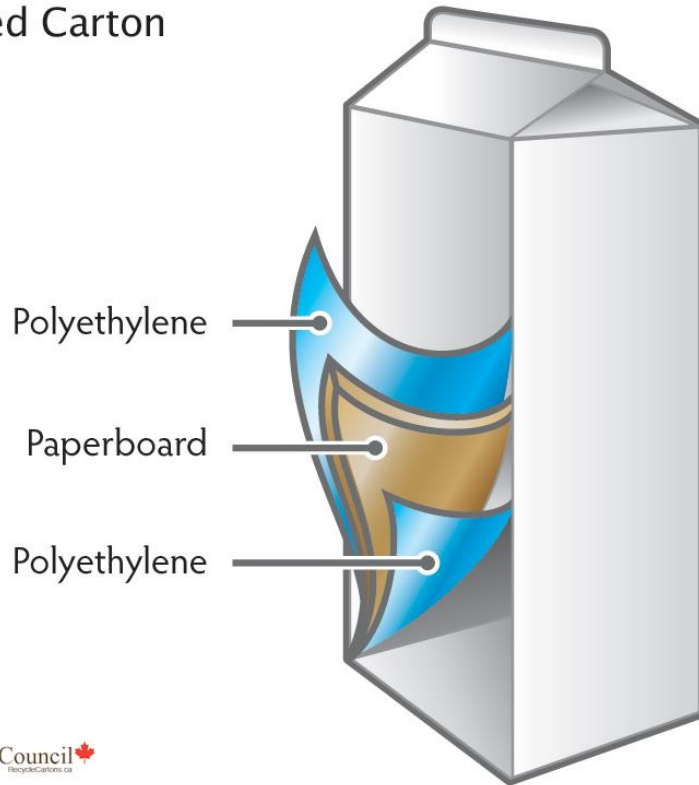


Disappear

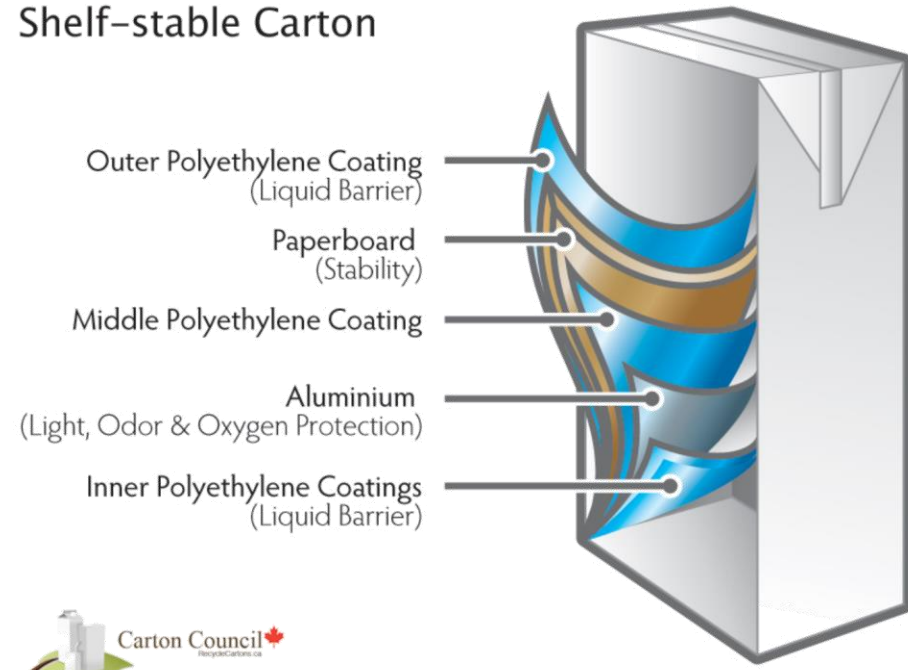


# Polyethylene Coats Paper

## Refrigerated Carton



## Shelf-stable Carton



February 22, 2018 UPDATED 9 HOURS AGO

## BP predicts plastics bans will impact oil demand

Plastics News Europe



Materials Public Policy Sustainability Materials Suppliers More +



BP plc has predicted that global demand for oil could be impacted by as much as 2 million barrels per day by 2040 due by governments' efforts to regulate products, including bans of single-use plastics.

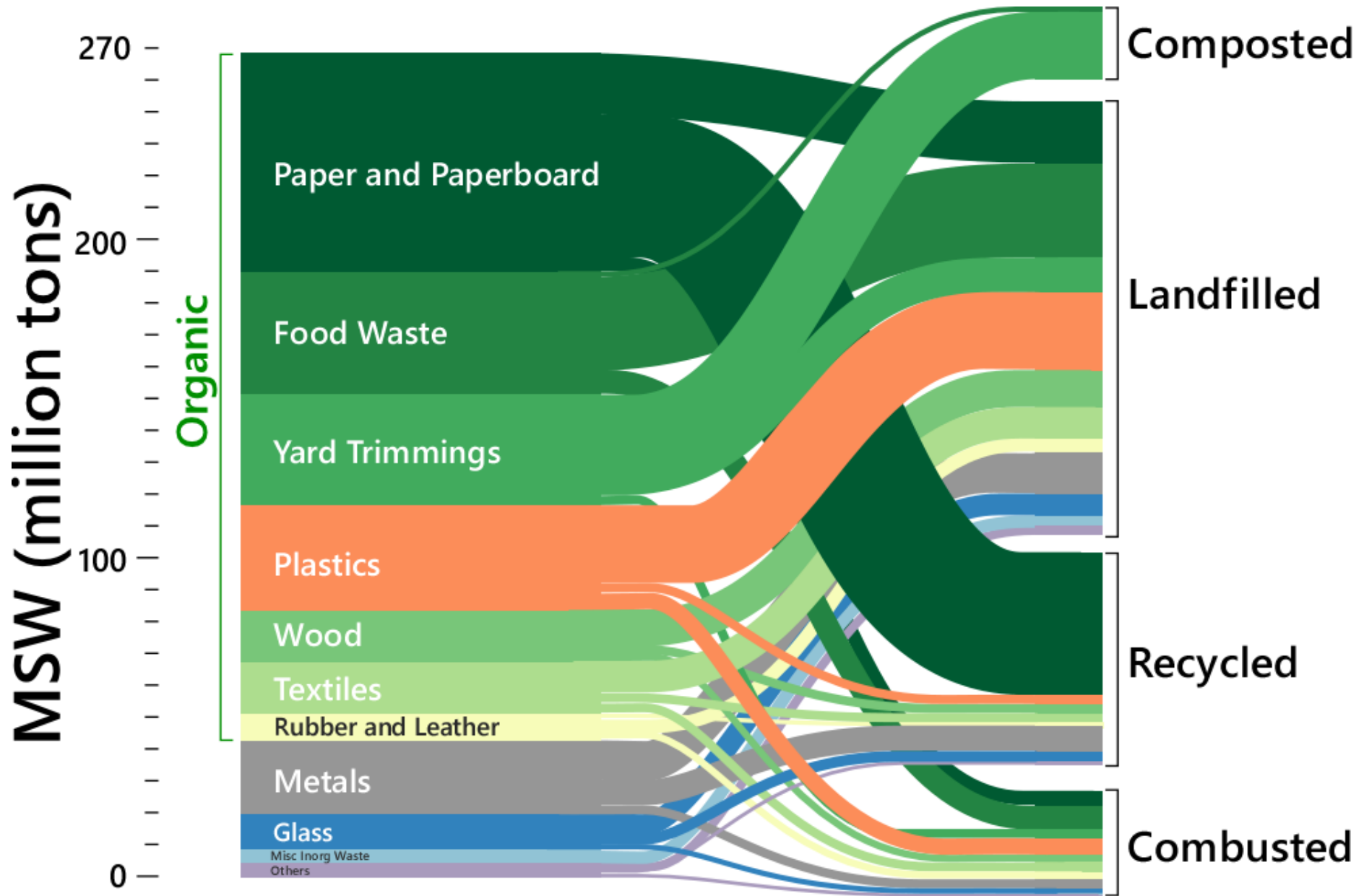
In its latest energy outlook unveiled Feb. 20, BP predicted that oil demand would continue to grow at about 0.5 percent annually through 2040.

According to the British press, commenting on the new outlook, BP's chief economist Spencer Dale said the company believed that regulation against some types of petrochemicals, particularly single-use plastics, would increase in the coming years.

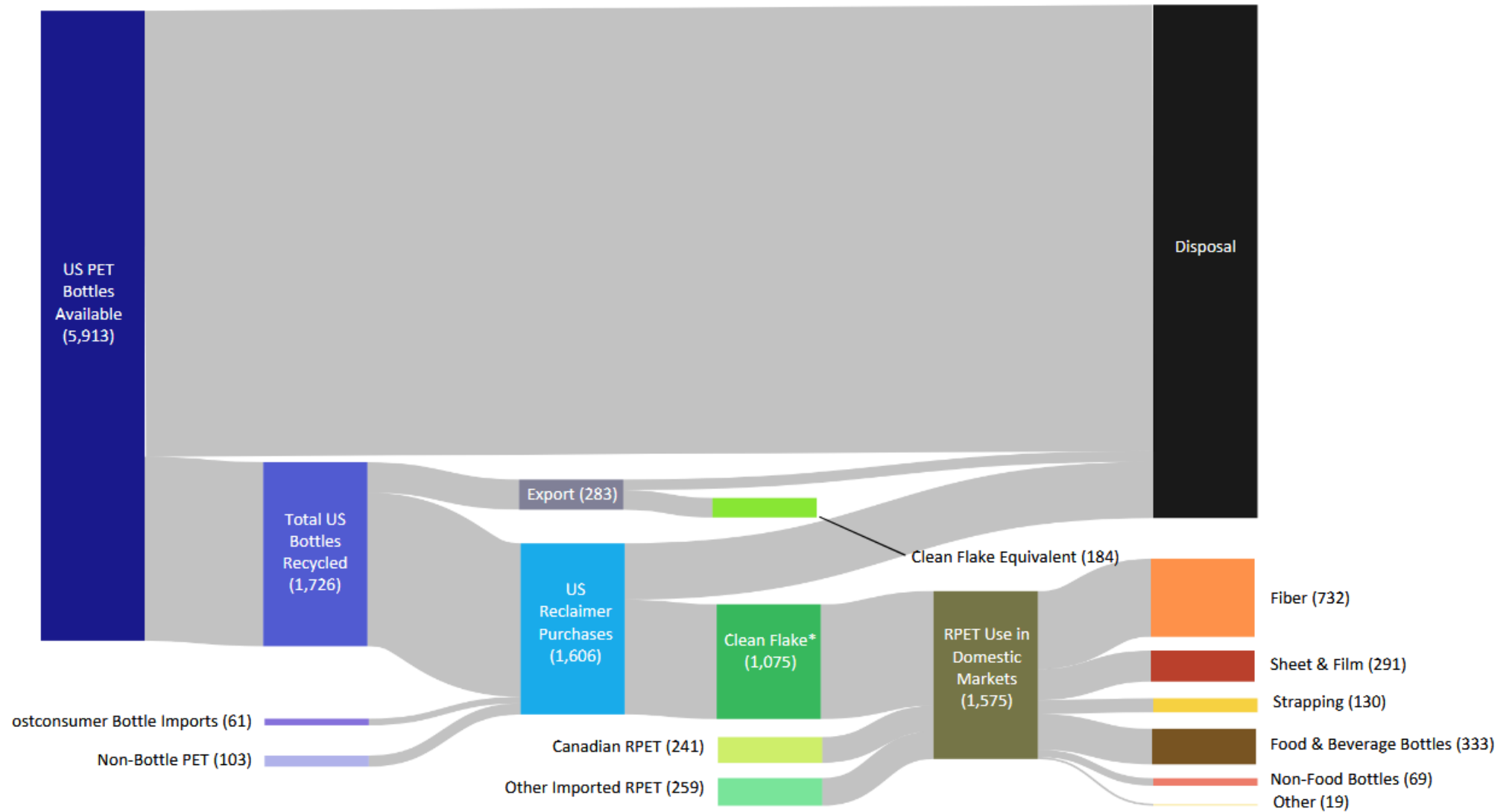


# Case Study





**FIGURE 1: PET Material Flows in the US (MMlbs)**

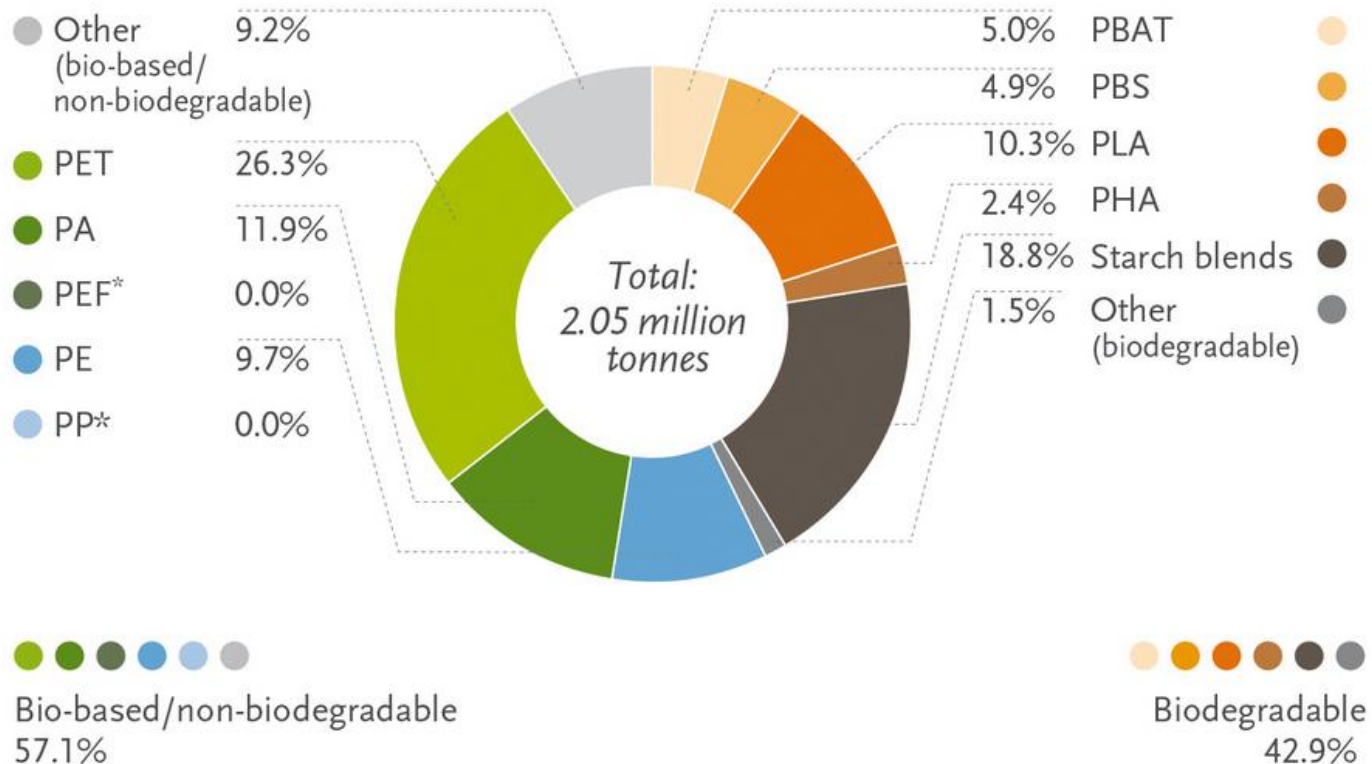


\* This total represents all clean flake sold into end markets by US reclaimers. See Figure 7 for detail on total flake produced by US reclaimers from bottles.



## Disappear – Option 2

### Global production capacities of bioplastics 2017 (by material type)

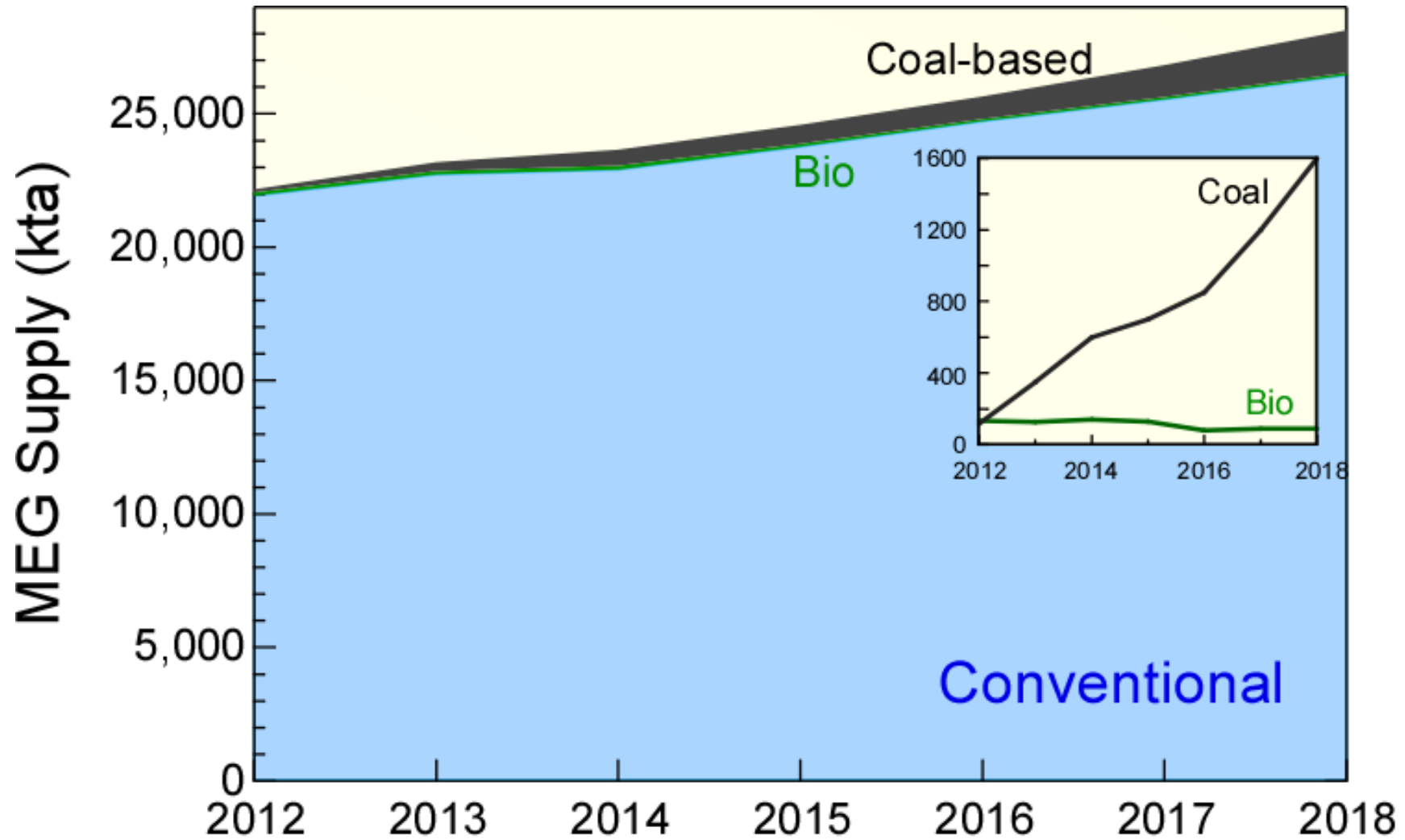


\*Bio-based PP and PEF are currently in development and predicted to be available in commercial scale in 2020.

Source: European Bioplastics, nova-Institute (2017).

More information: [www.bio-based.eu/markets](http://www.bio-based.eu/markets) and [www.european-bioplastics.org/market](http://www.european-bioplastics.org/market)

# Reality – MEG production for PET



# 2025 Sustainability Goals



## Leading the Blueprint

Dow leads in developing a societal blueprint that integrates public policy solutions, science and technology, and value chain innovation to facilitate the transition to a sustainable planet and society.



## Delivering Breakthrough Innovations

Dow delivers breakthrough sustainable chemistry innovations that advance the well-being of humanity.



## Advancing a Circular Economy

Dow advances a circular economy by delivering solutions to close the resource loops in key markets.



## Valuing Nature

Dow applies a business decision process that values nature, which will deliver business value and natural capital value through projects that are good for business and good for ecosystems.



## Increasing Confidence in Chemical Technology

Dow increases confidence in the safe use of chemical technology through transparency, dialogue, unprecedented collaboration, research and our own actions.



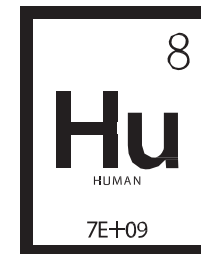
## Engaging Employees for Impact

Dow people worldwide directly apply their passion and expertise to advance the well-being of people and the planet.



## World-Leading Operations Performance

Dow maintains world-leading operations performance in natural resource efficiency, environment, health and safety.





ALLIANCE TO  
END PLASTIC WASTE

## THE GOAL

of the Alliance is to invest  
**\$1.5 billion** over the next five years  
toward eliminating plastic waste.







# Questions



# Main Sources Consulted



## Towards the Circular Economy: Accelerating the scale-up across global supply chains

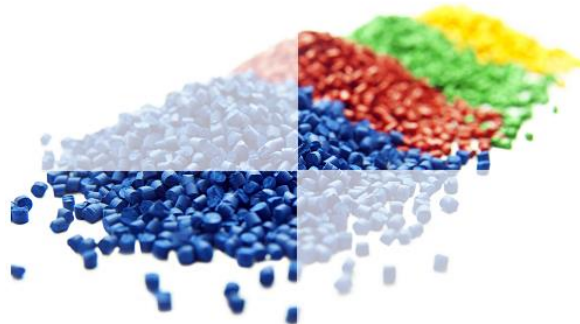
Prepared in collaboration with the Ellen MacArthur Foundation and McKinsey & Co  
January 2014



Industry Agenda

## The New Plastics Economy Rethinking the future of plastics

January 2016



## Plastics and Sustainability:



Environmental Benefits, Costs  
or Continuous Improver



System Initiative on Environment and Natural Resource Security

## The New Plastics Economy Catalysing action

In Collaboration with the Ellen MacArthur Foundation

January 2017



## American Chemistry Council Plastics Division Welcomes Recommendations for Innovation to Support Packaging Sustainability

Contact Us  
Jennifer Killinger  
(202) 249-6619

WASHINGTON (January 16, 2017)—*The Ellen Mac Arthur Foundation and World Economic Forum today released 'The New Plastics Economy: Catalysing Action,' which aims to address global plastics issues through innovation in packaging design, recycling, and delivery models. The American Chemistry Council (ACC) issued the following Statement, which may be attributed to Steve Russell, vice president, Plastics Division:*

"America's Plastics Makers™ welcome collaborative efforts such as the *Catalysing Action* report aimed at promoting innovation and advancing the sustainability of plastics.

"*Catalysing Action* recognizes that plastics combine 'unrivalled functional properties with low cost.' And every day plastics contribute to sustainability by reducing material use, energy use, waste, and greenhouse gas emissions in everything from packaging to transportation to homes and buildings. A recent study by TruCost found that switching from plastics to alternatives would quadruple environmental costs, causing them to grow from \$139 billion to \$533 billion annually.

