

# MJPhD

## SUSTAINABILITY AND ITS IMPACT ON THE CHEMICAL INDUSTRY

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MJPHD, LLC

*3 March 2022*



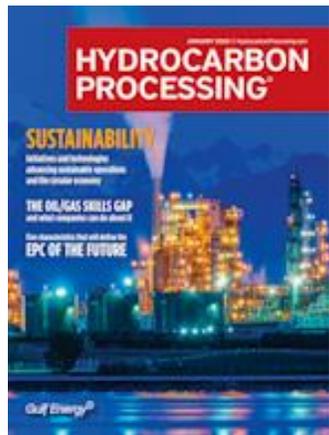


# SUSTAINABILITY DEFINITION

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The process of managing available resources, investments and technologies to maintain and optimize operations for greater safety, reliability, efficiency, and environmental and social awareness.



# SUSTAINABILITY DEFINITION

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Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs.

*Brundtland Commission*



## SUSTAINABILITY DEFINITION

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Sustainability is the ability to continue a defined behavior indefinitely. Environmental sustainability is the ability to maintain rates of renewable resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely.

*thwink.org*



# SUSTAINABILITY DEFINITION

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Sustainability is wondrously complicated. Every person will give you a slightly different definition of sustainability. That's because sustainability really can be applied to almost anything in life.

*Arizona State University School of Sustainability*



# SUSTAINABILITY DEFINITION

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Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs.

*Brundtland Commission*



# THREE PILLARS OF SUSTAINABILITY

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# UN SUSTAINABLE DEVELOPMENT GOALS

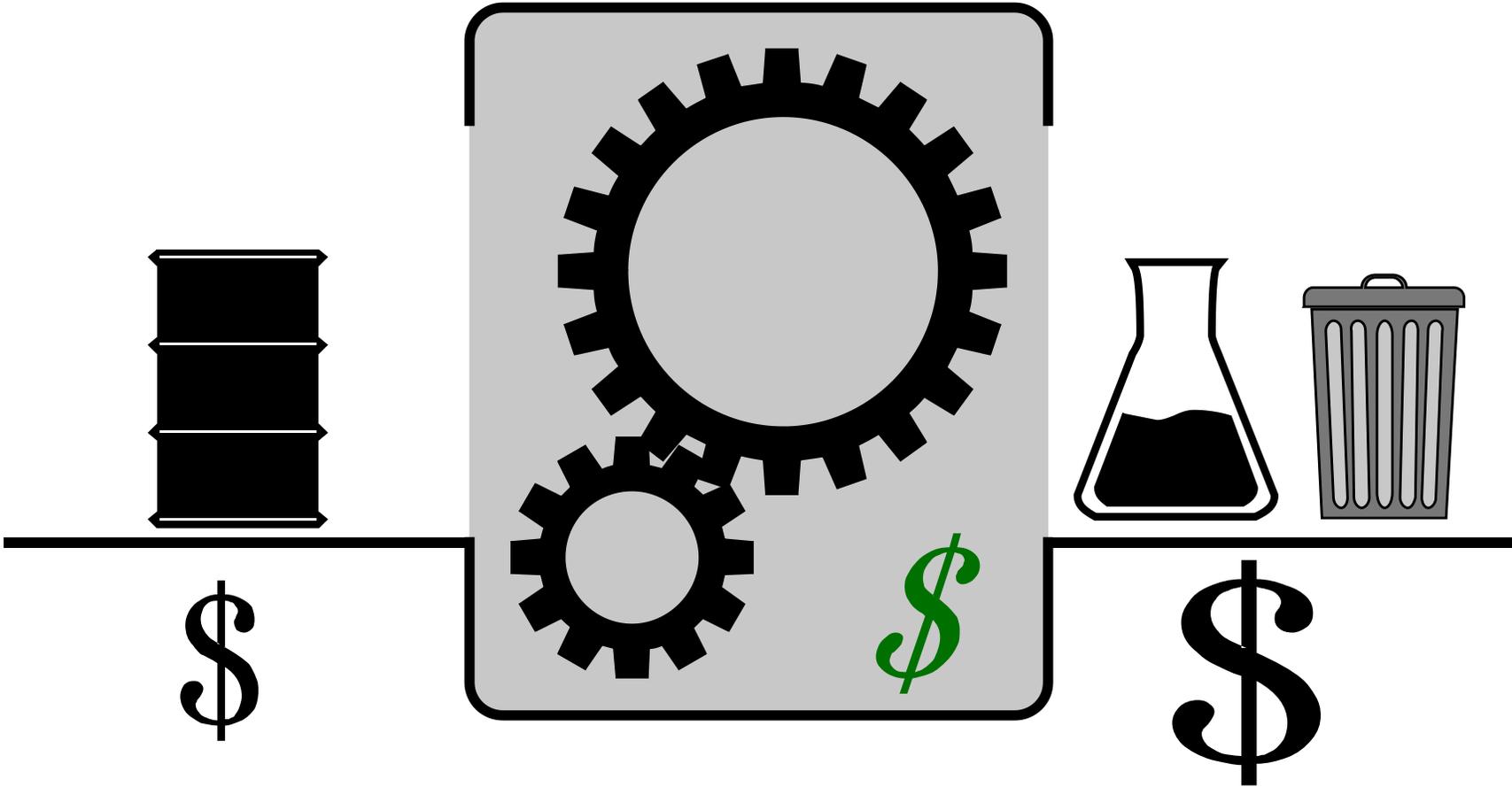


# UN SUSTAINABLE DEVELOPMENT GOALS

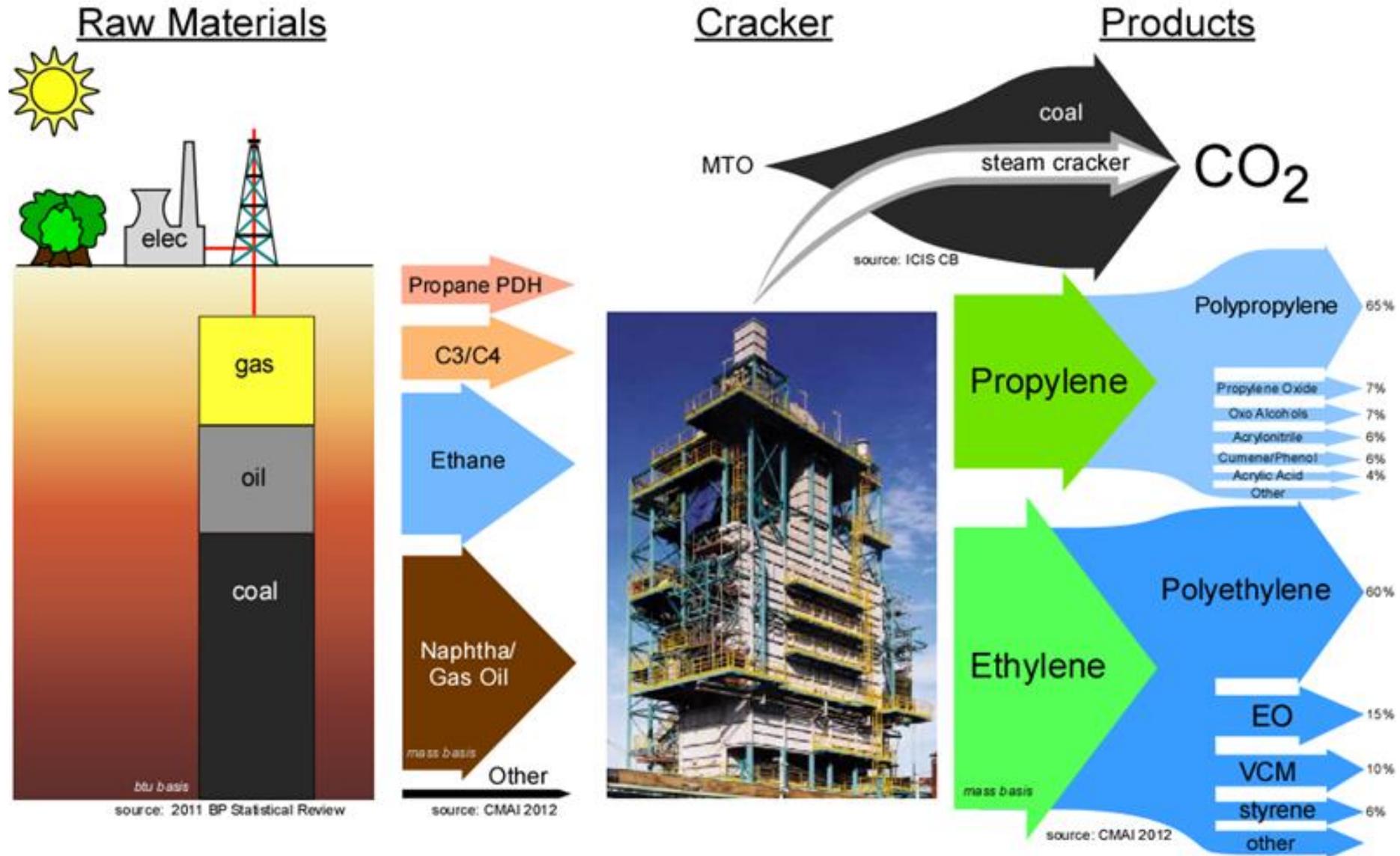


# SIMPLIFIED CHEMICAL INDUSTRY

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# MODERN CHEMICAL INDUSTRY



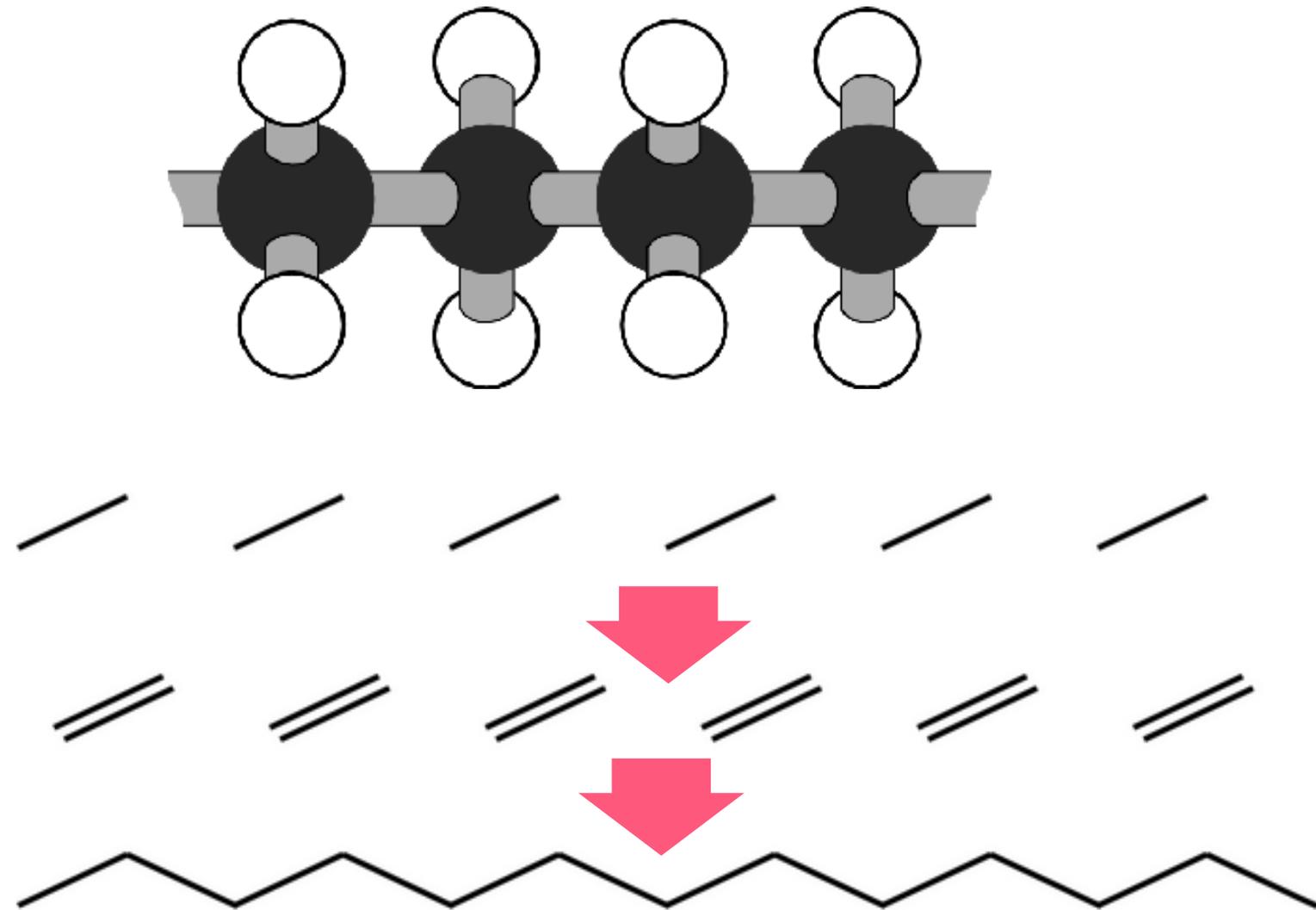
# ROUGH INDUSTRY MASS BALANCE

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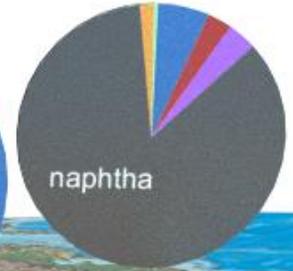
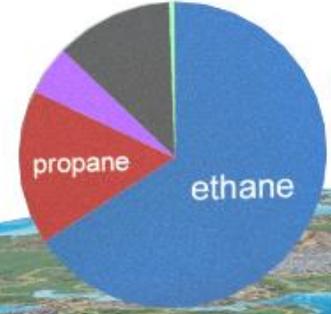
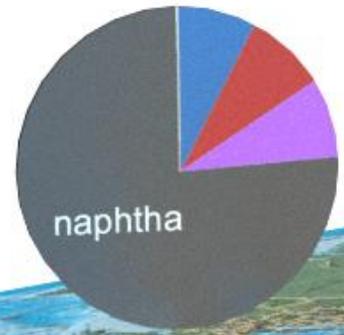
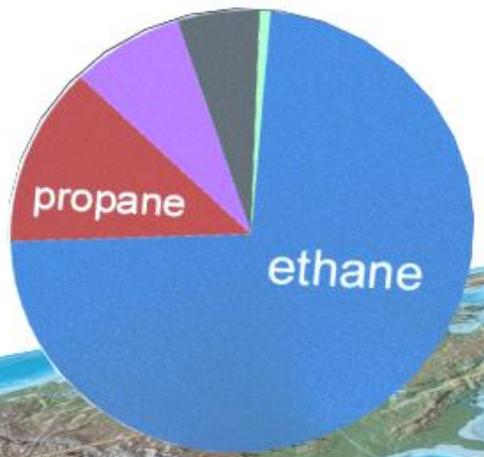
# CHEMICAL TRANSFORMATION

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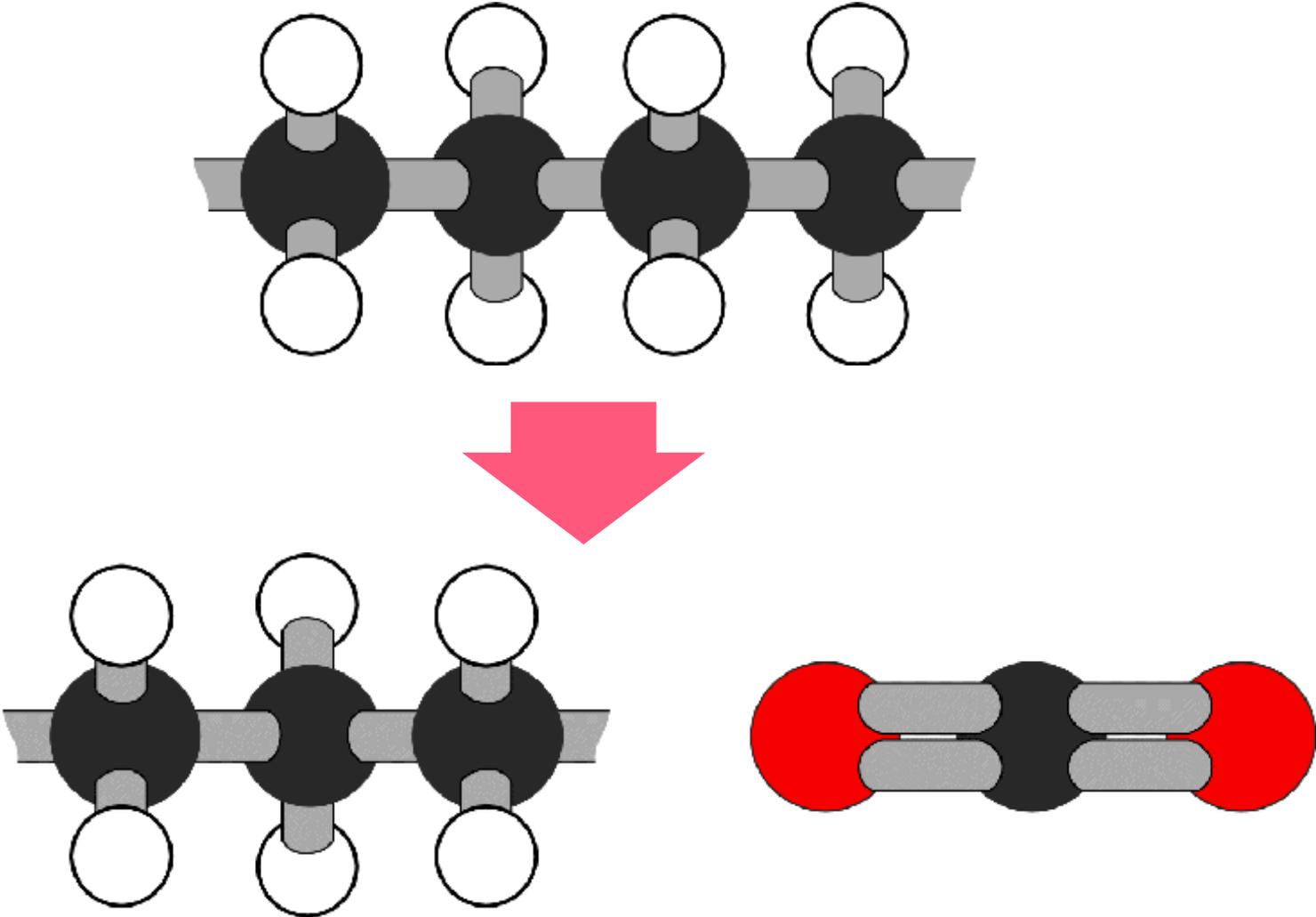
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■ ethane ■ propane ■ butane ■ naphtha ■ MTO/CTO ■ other



# ROUGH MASS BALANCE

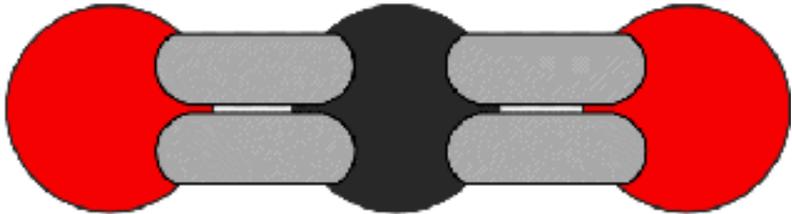
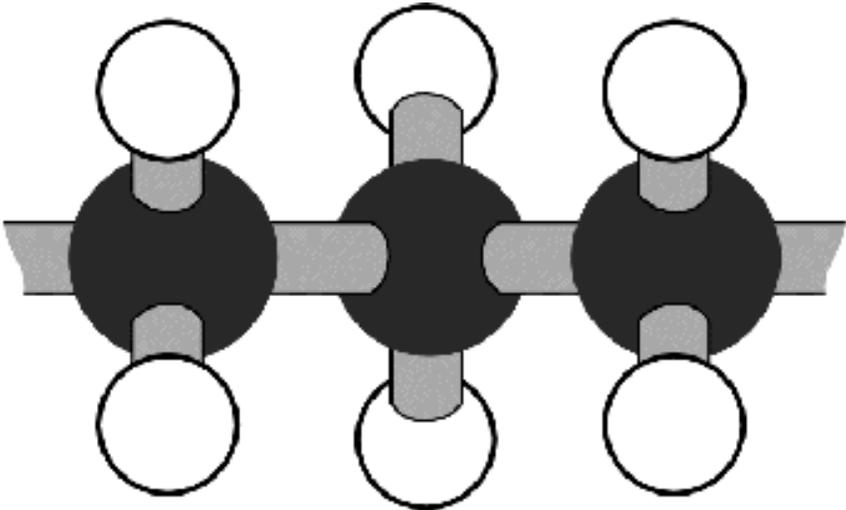
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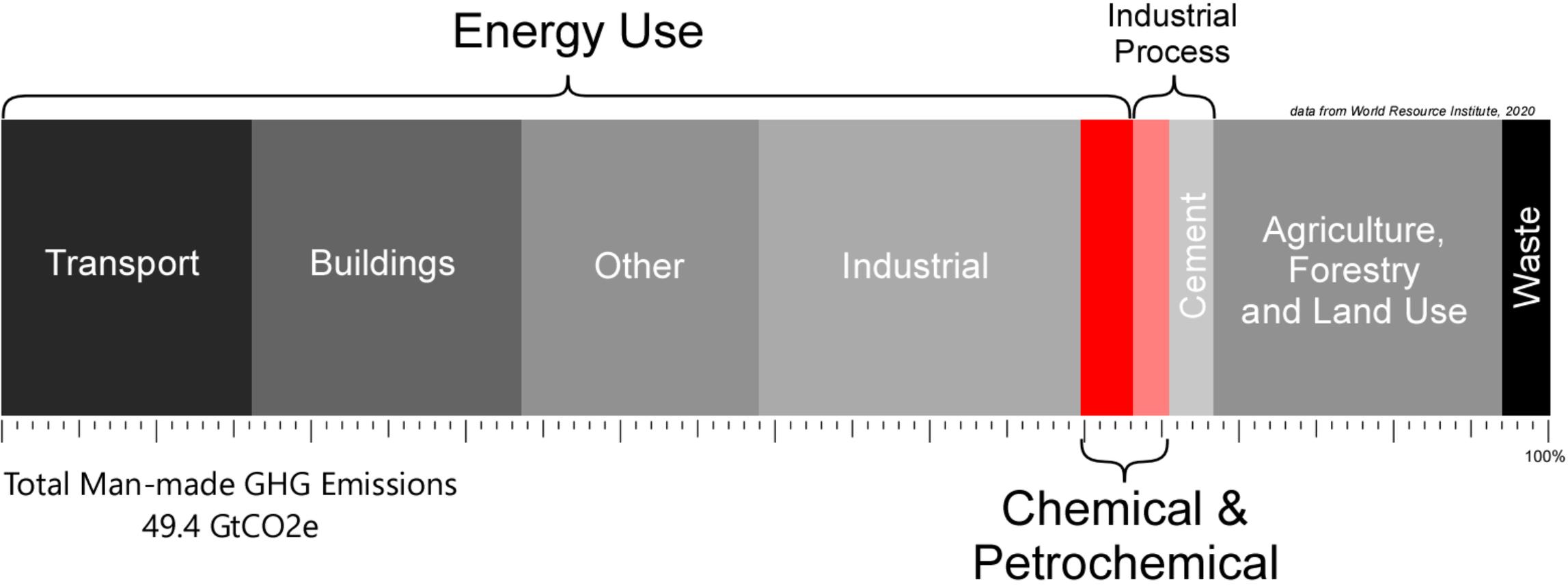
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# IMPLICATIONS

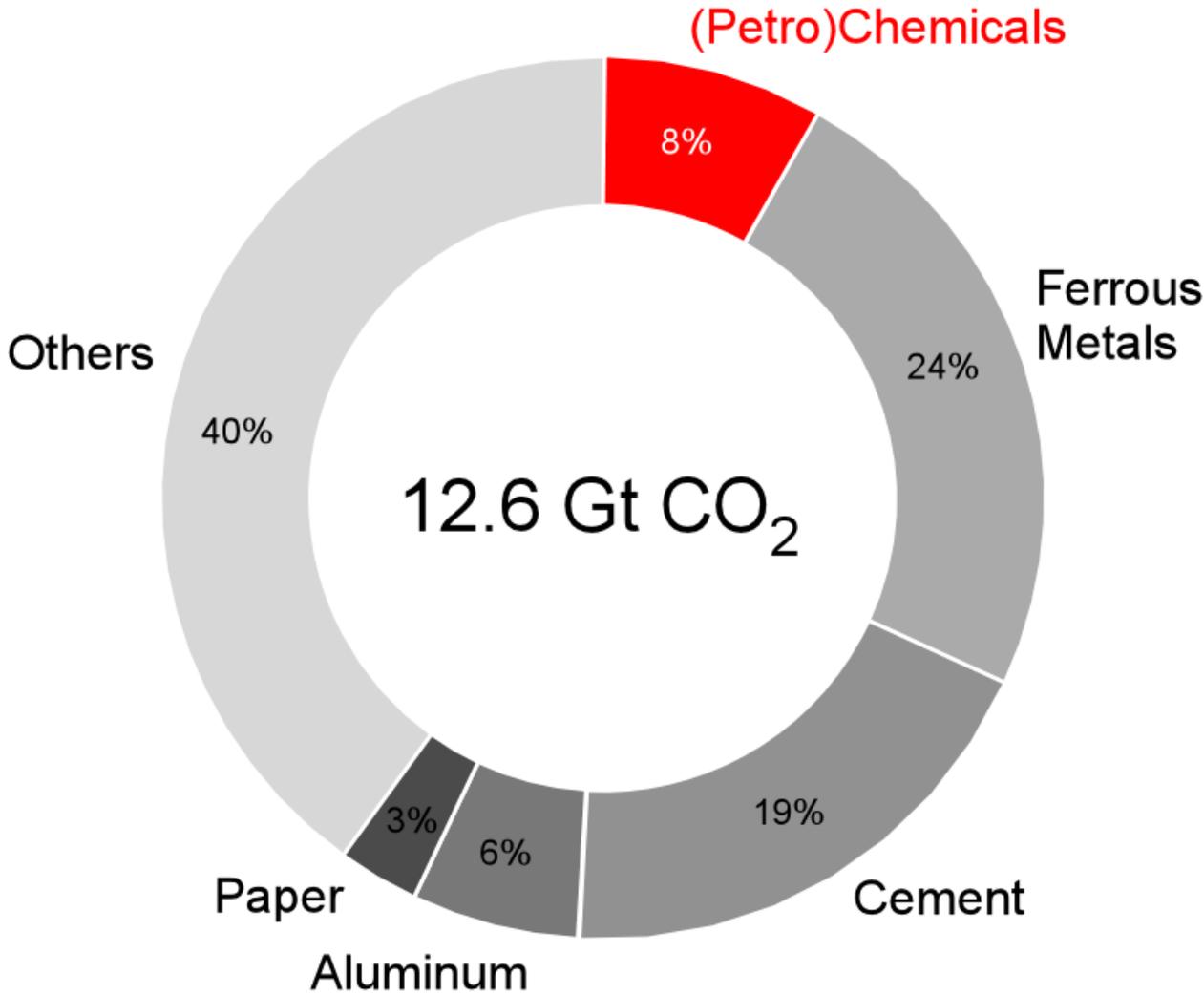
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# CARBON FOOTPRINT OF INDUSTRY



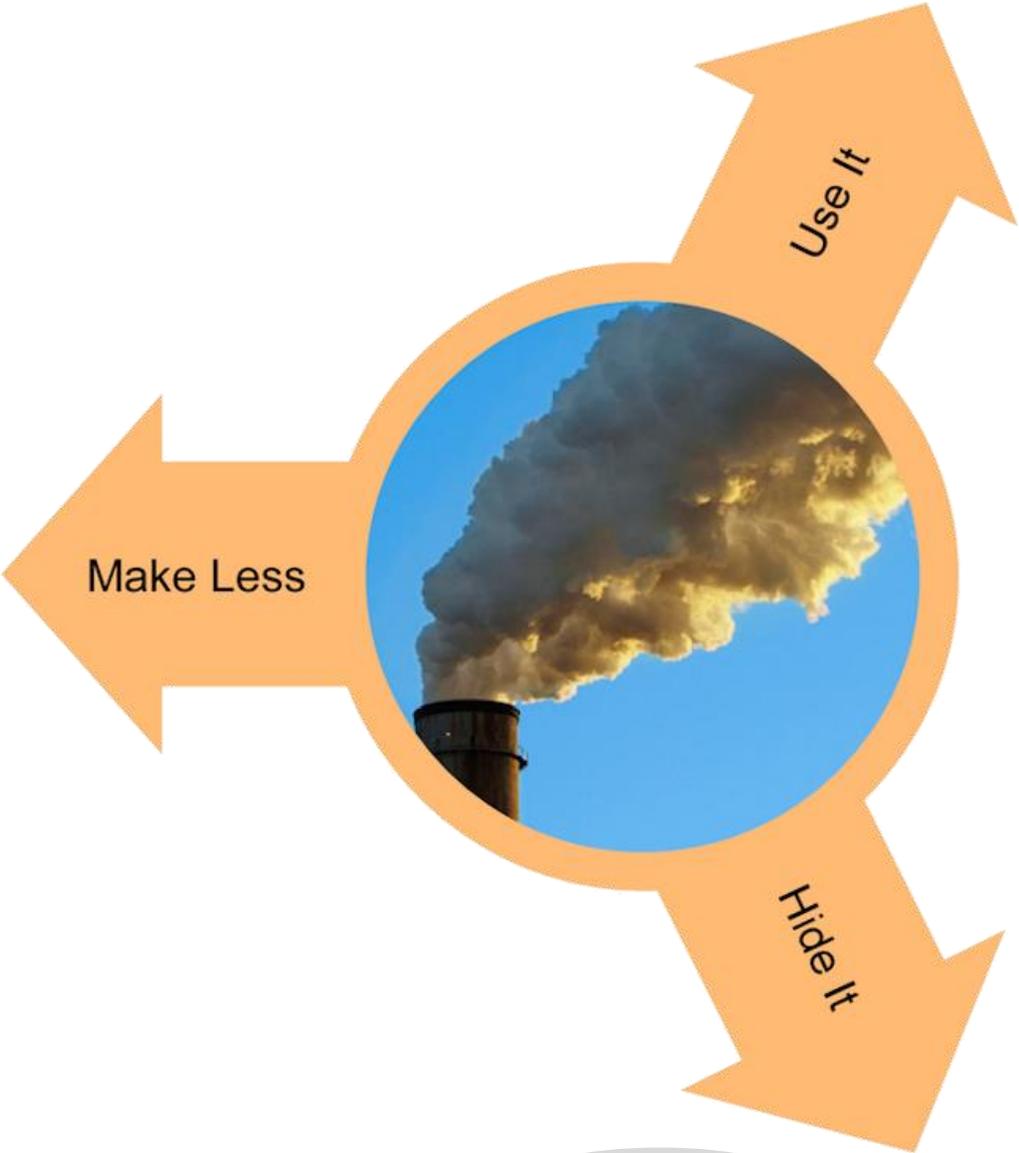
# GLOBAL CO2 EMISSIONS FROM INDUSTRY



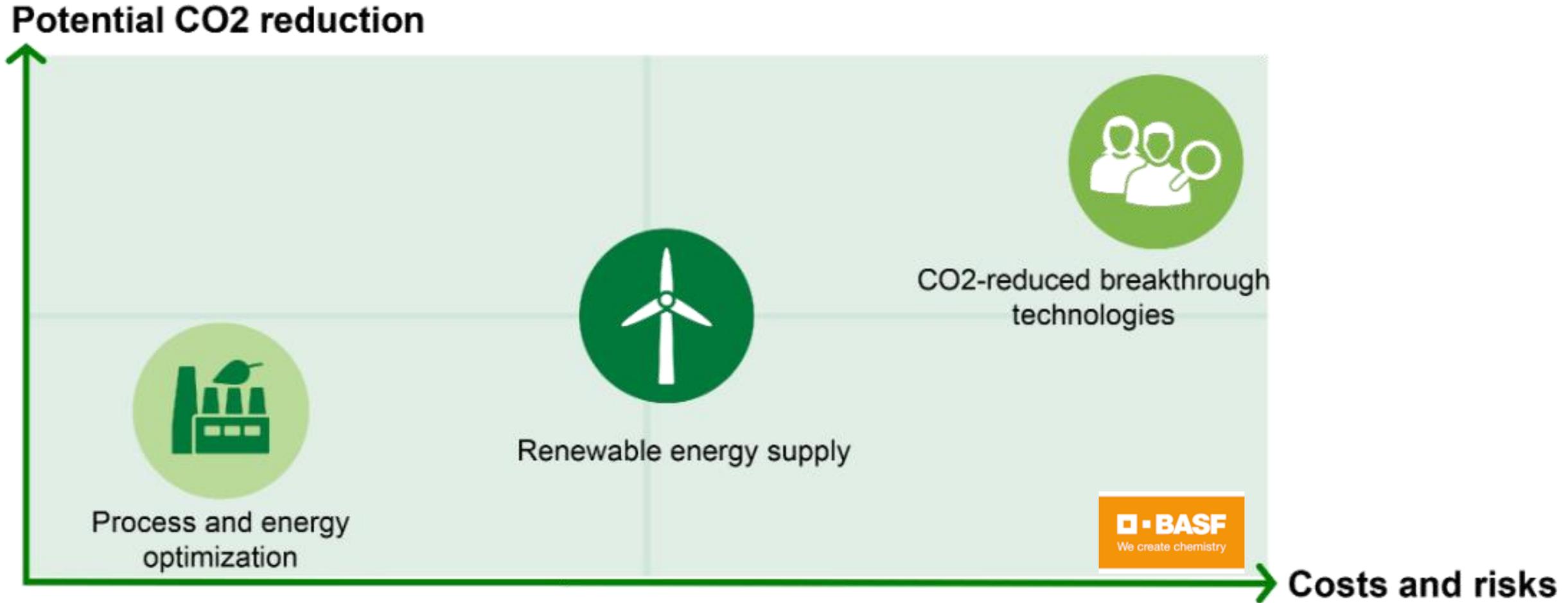
Martin Brudemuller, BASF at the World Economic Forum, 21 Jan 2020

# OPTIONS FOR CO<sub>2</sub>

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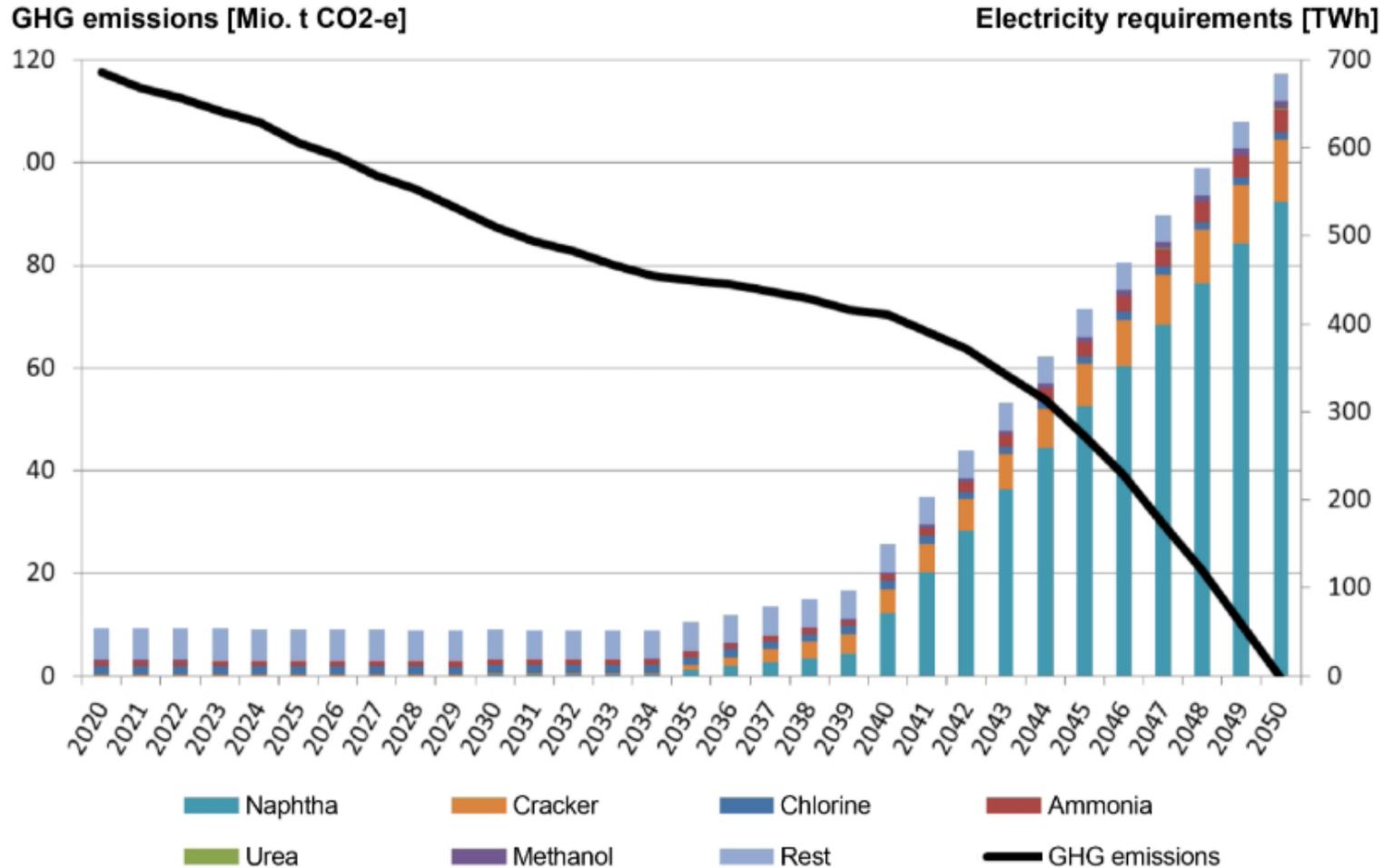
# POTENTIAL SOLUTIONS FOR DIRECT EMISSIONS



Martin Brudemüller, BASF at the World Economic Forum, 21 Jan 2020

# PLAN FOR ZERO EMISSIONS

## Electricity requirements to achieve greenhouse gas neutrality in the German chemical industry



490 for all Germany today

227 for all industry

Martin Brudemüller, BASF at the World Economic Forum, 21 Jan 2020

# MAIN FOCUS AREAS-2020 UPDATE

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**Protect the Climate** >>



**Stop the Waste** >>



**Close the Loop** >>

## 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.



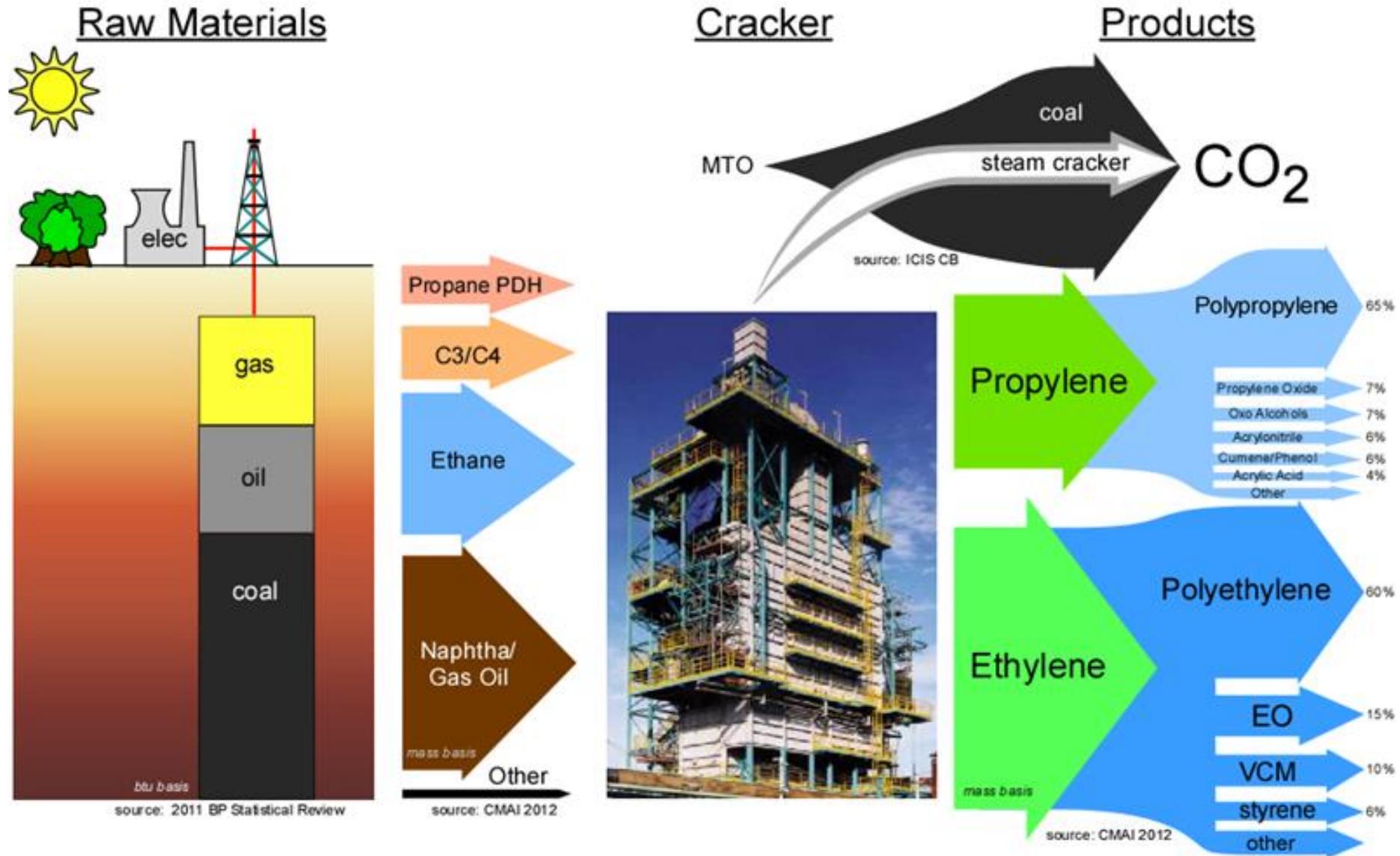
## SINGLE-USE

adj (sɪŋgəlˈjuːs)  
made to be used  
once only

#CollinsWOTY

**Collins**  
Pioneers in dictionary publishing since 1819

# MODERN CHEMICAL INDUSTRY



# OCEAN PLASTIC

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# 2014

PLASTICS  
PRODUCTION



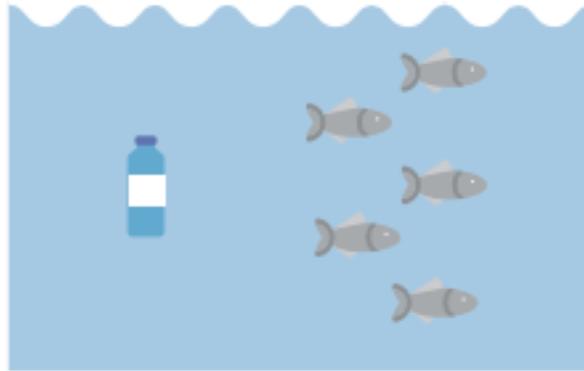
311 MT

# 2050

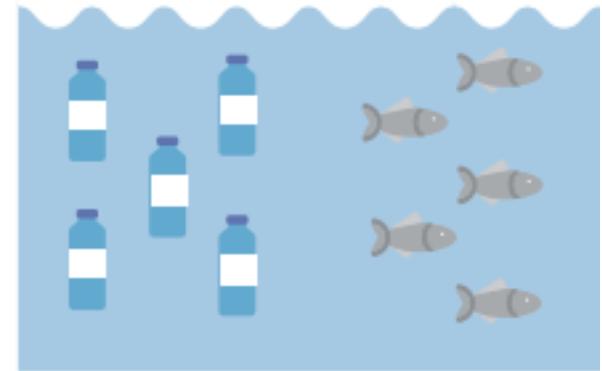


1,124 MT

RATIO OF PLASTICS TO  
FISH IN THE OCEAN  
(BY WEIGHT)

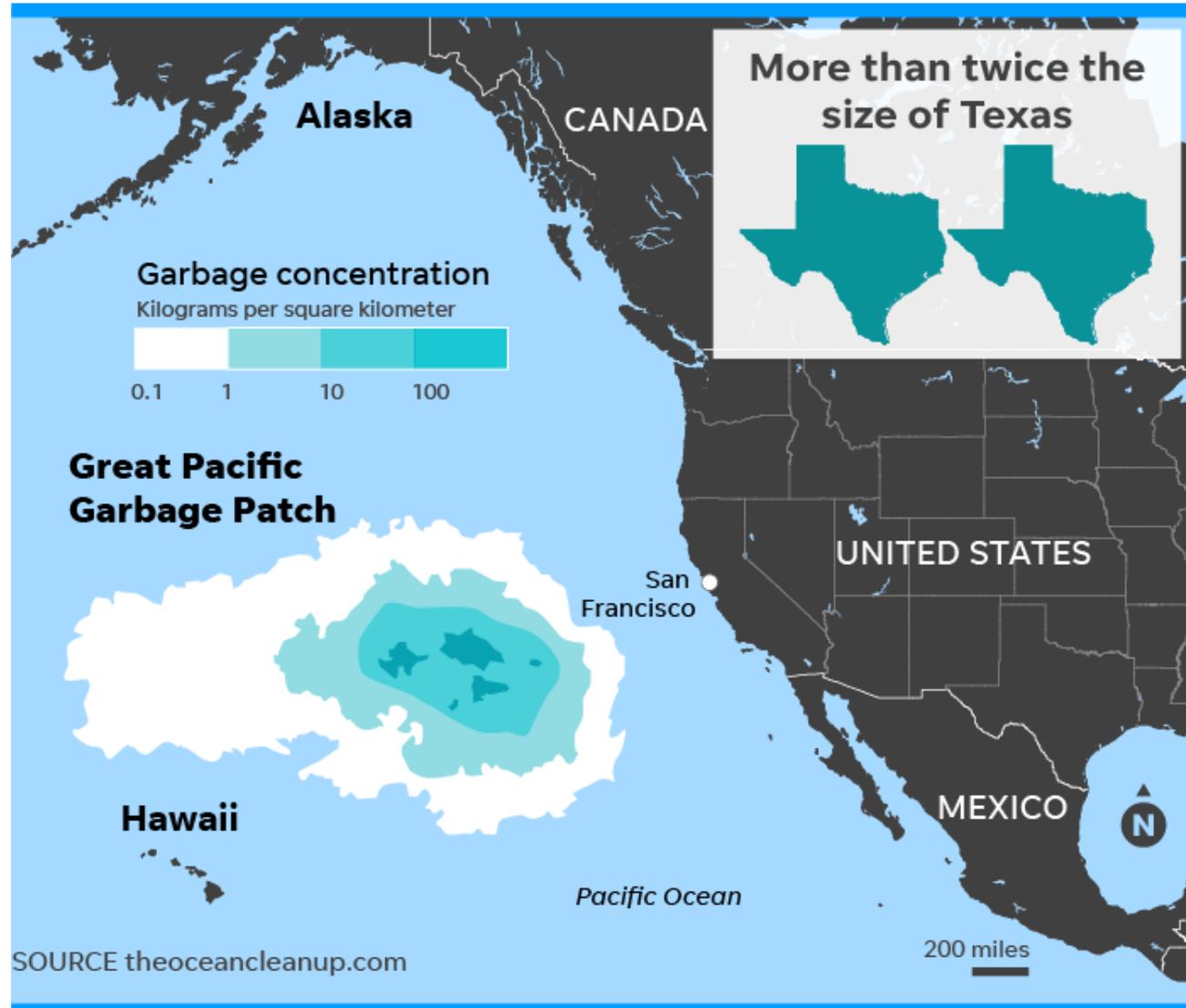


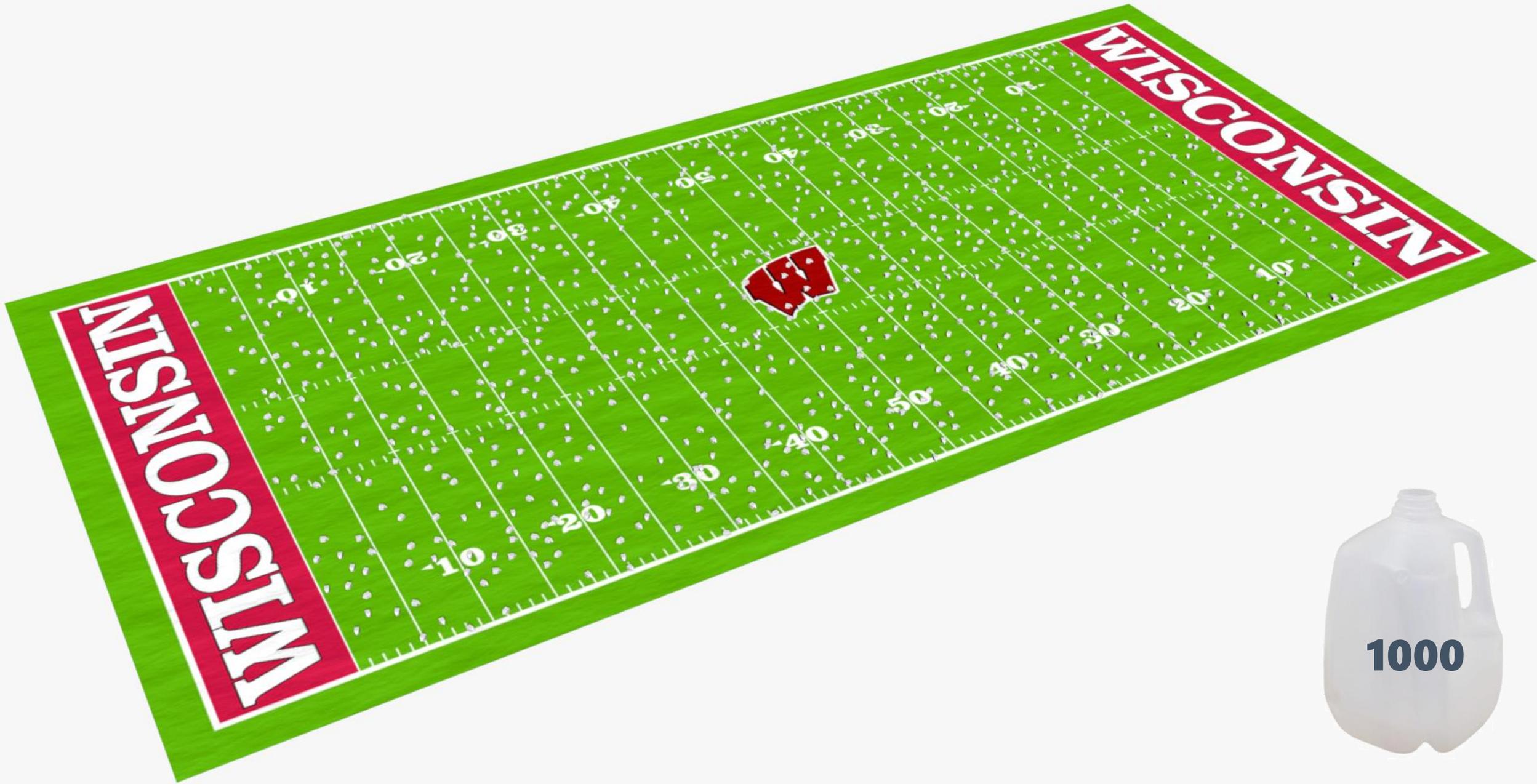
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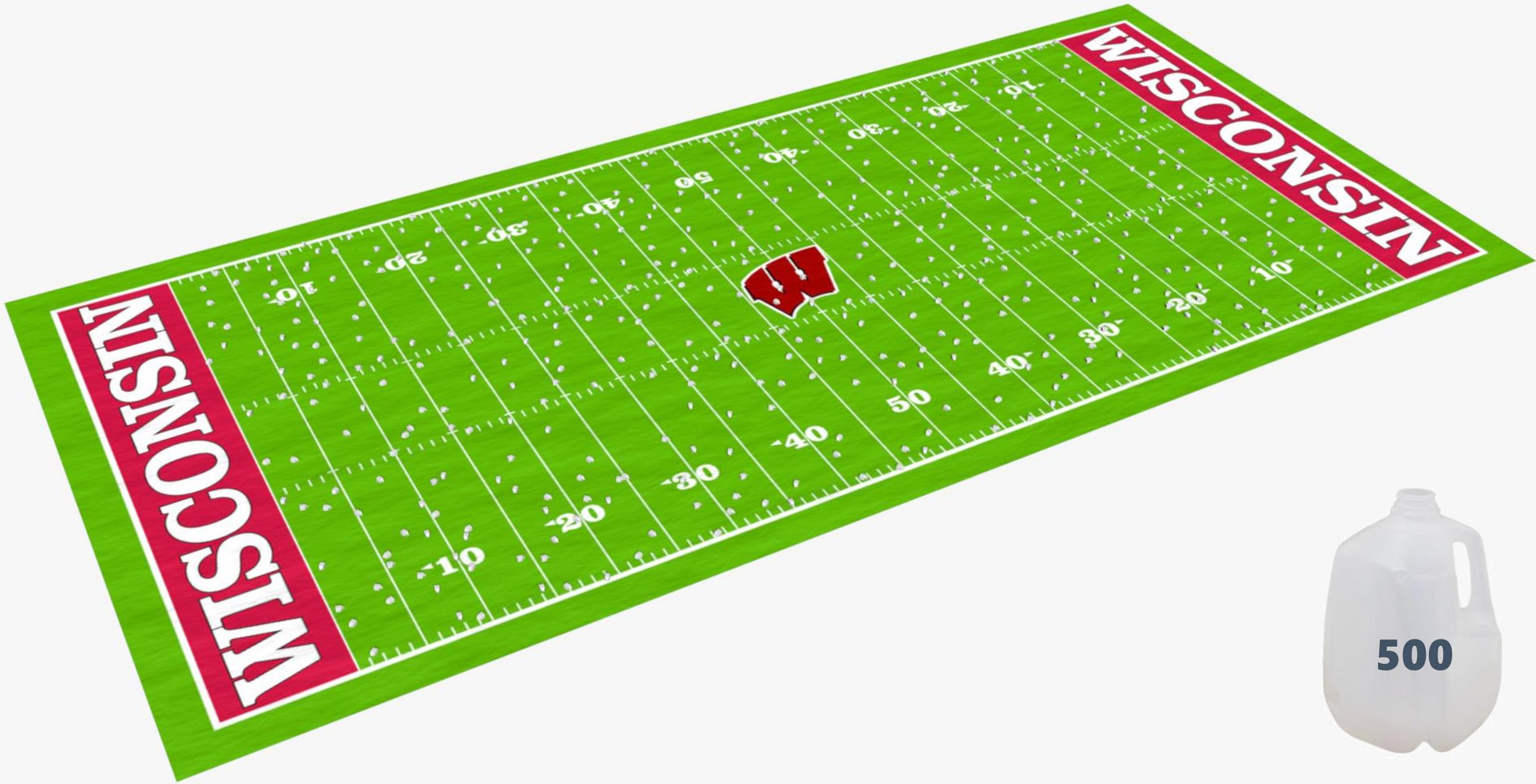
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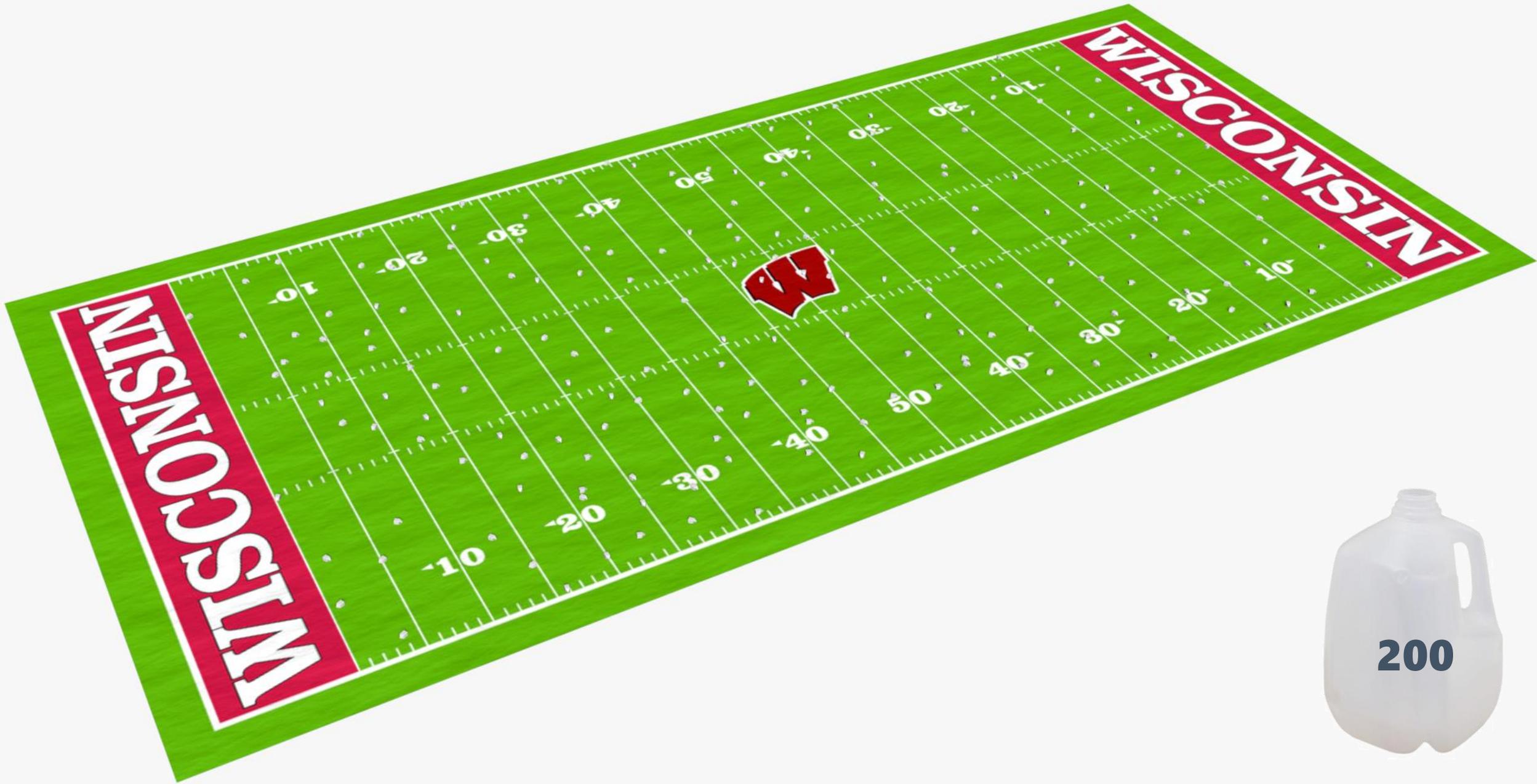
# THE PACIFIC GYRE



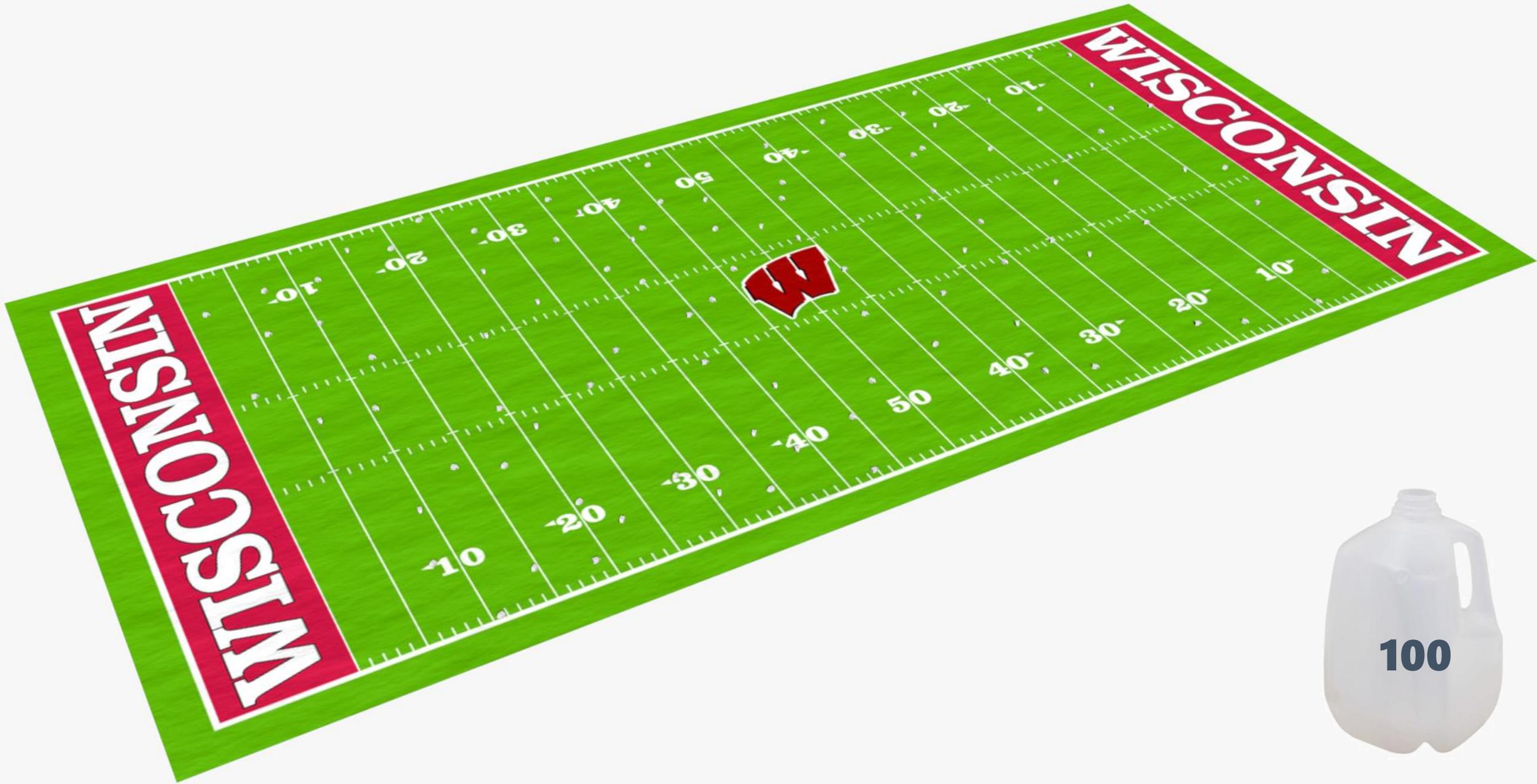


**1000**

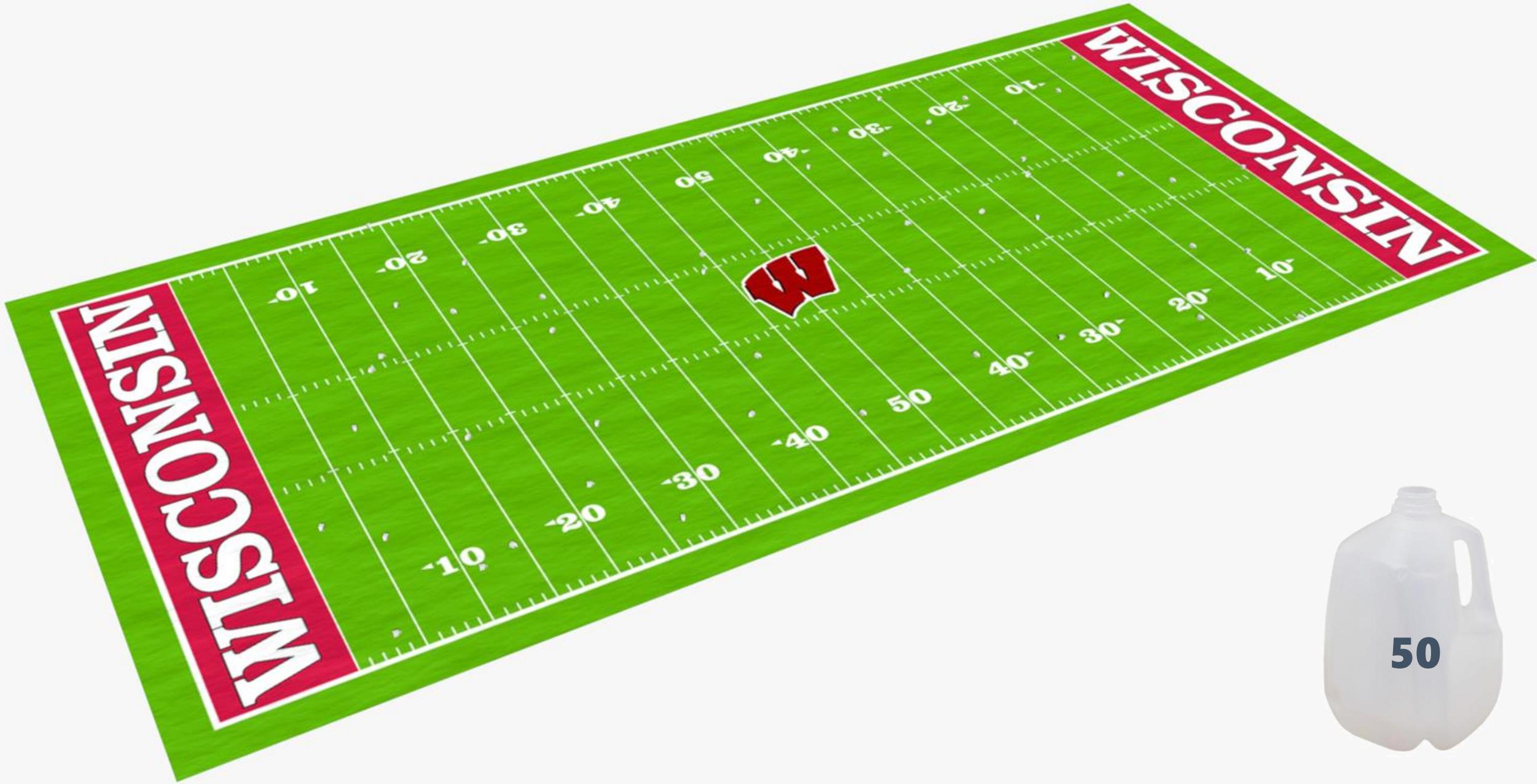


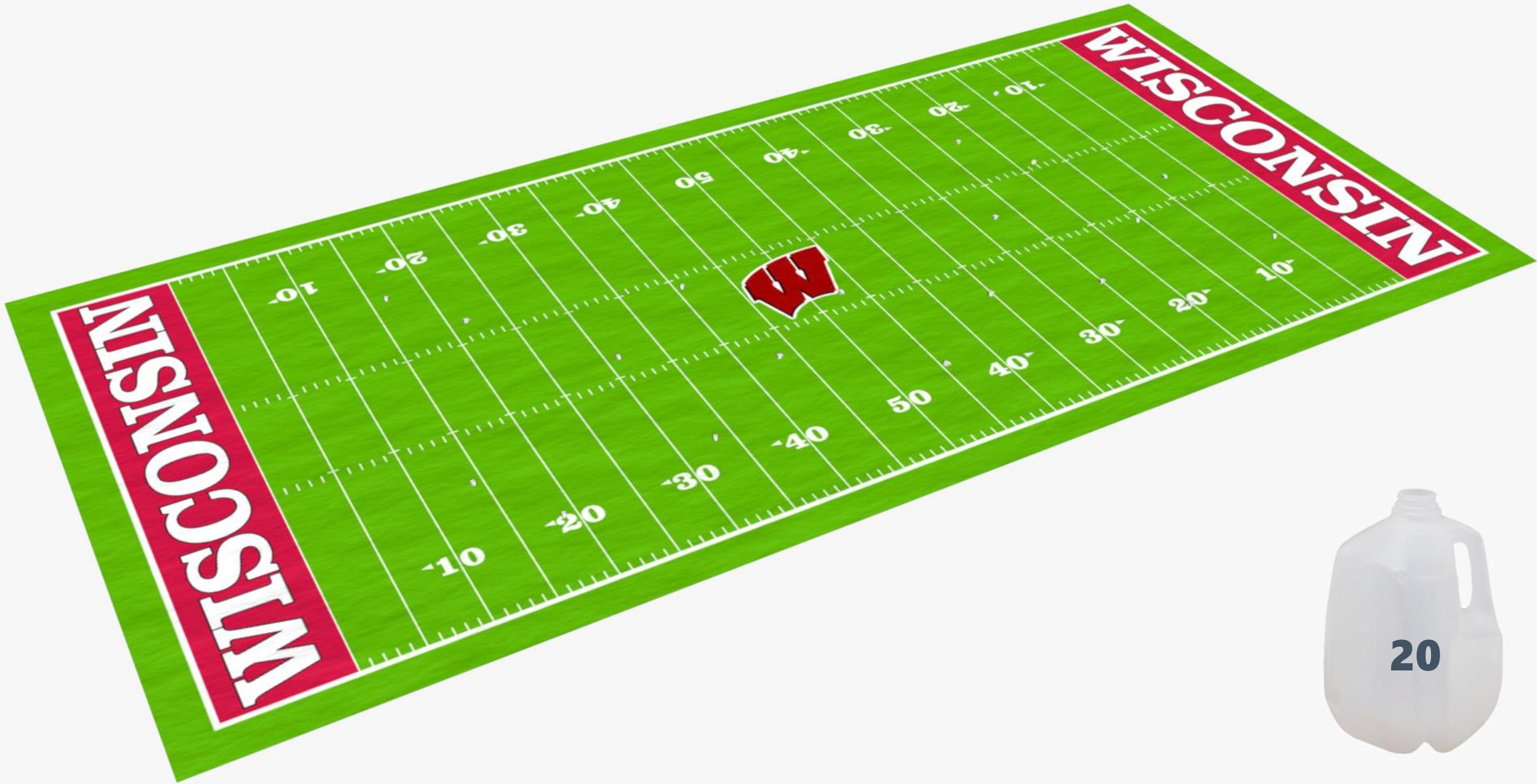


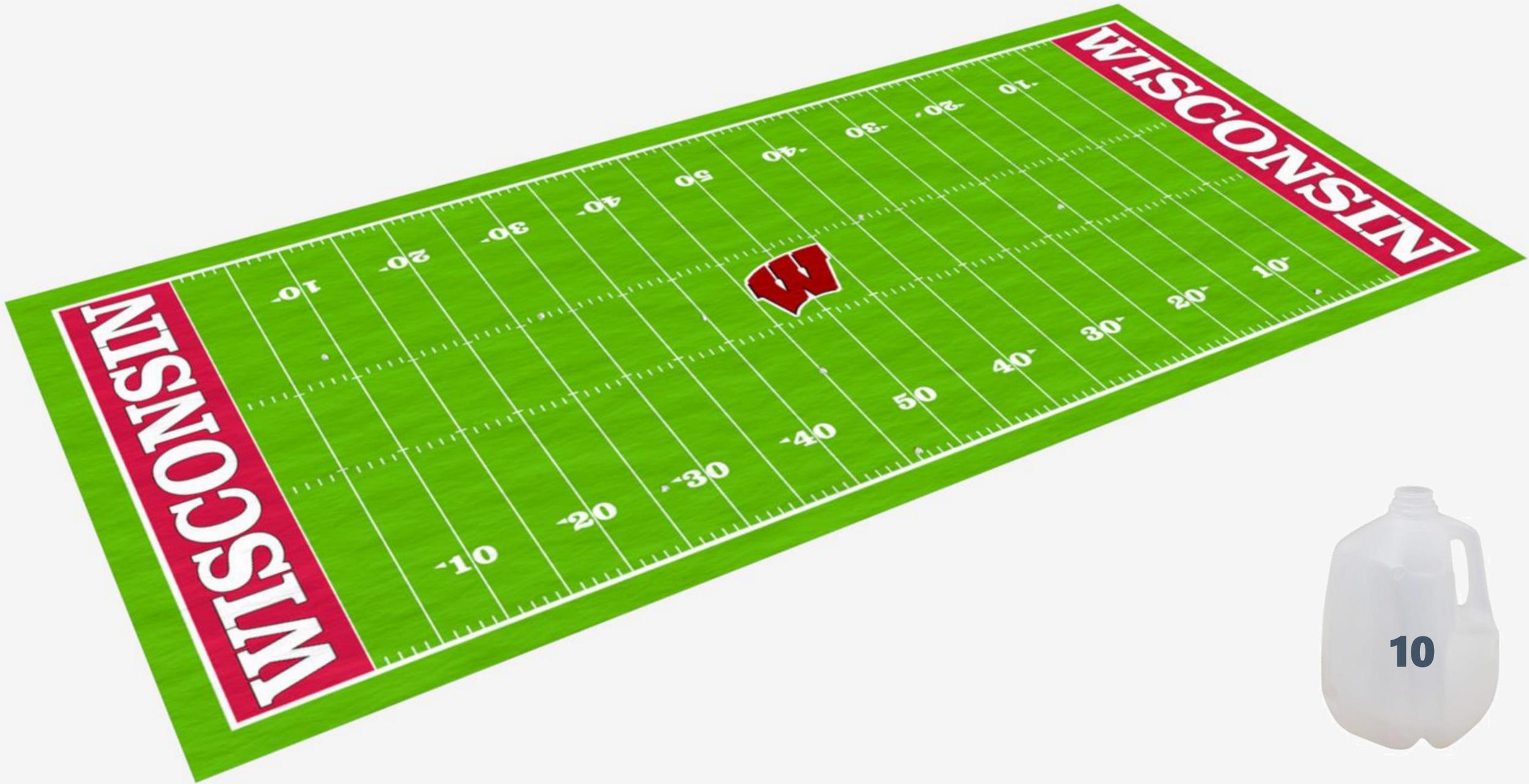
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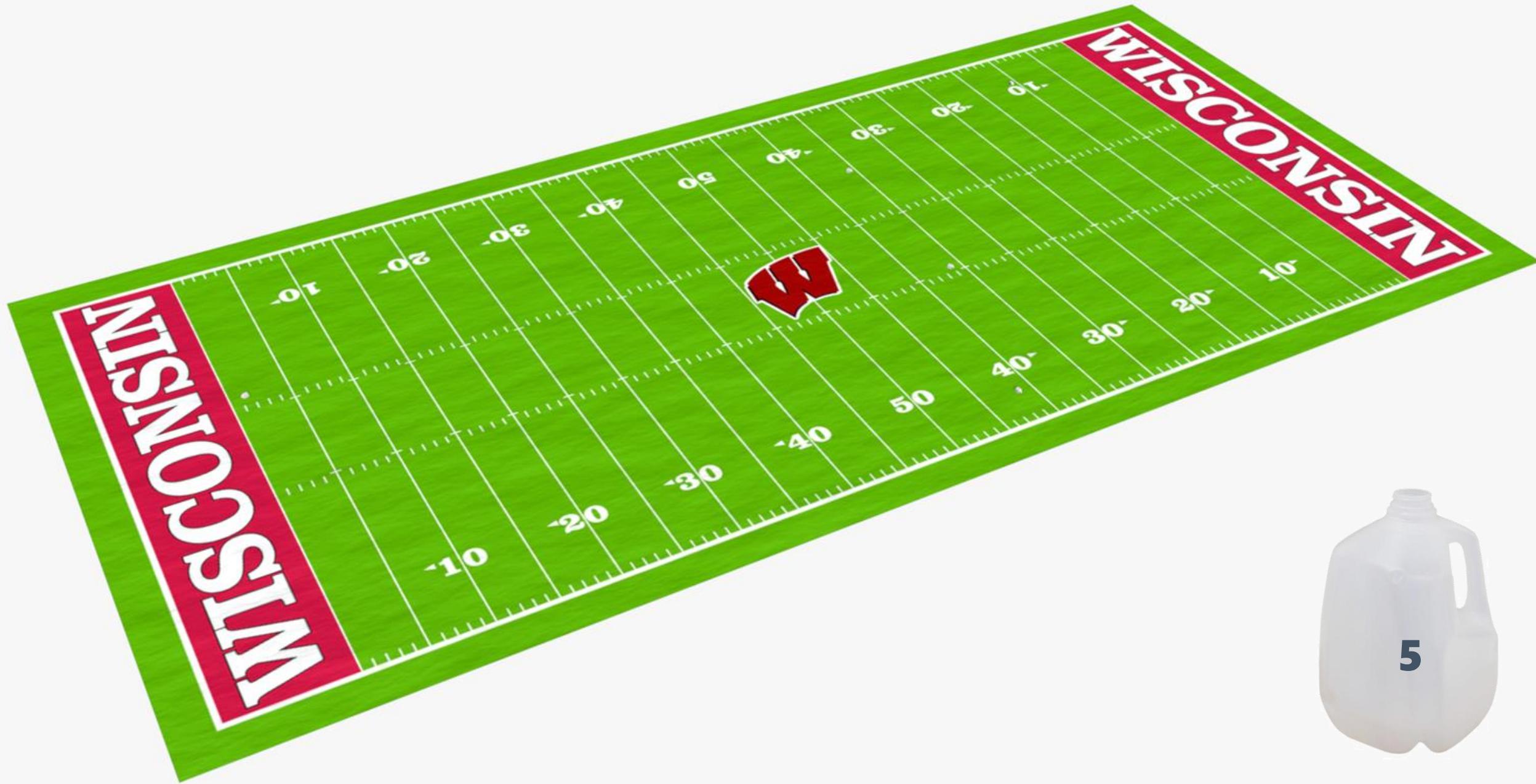


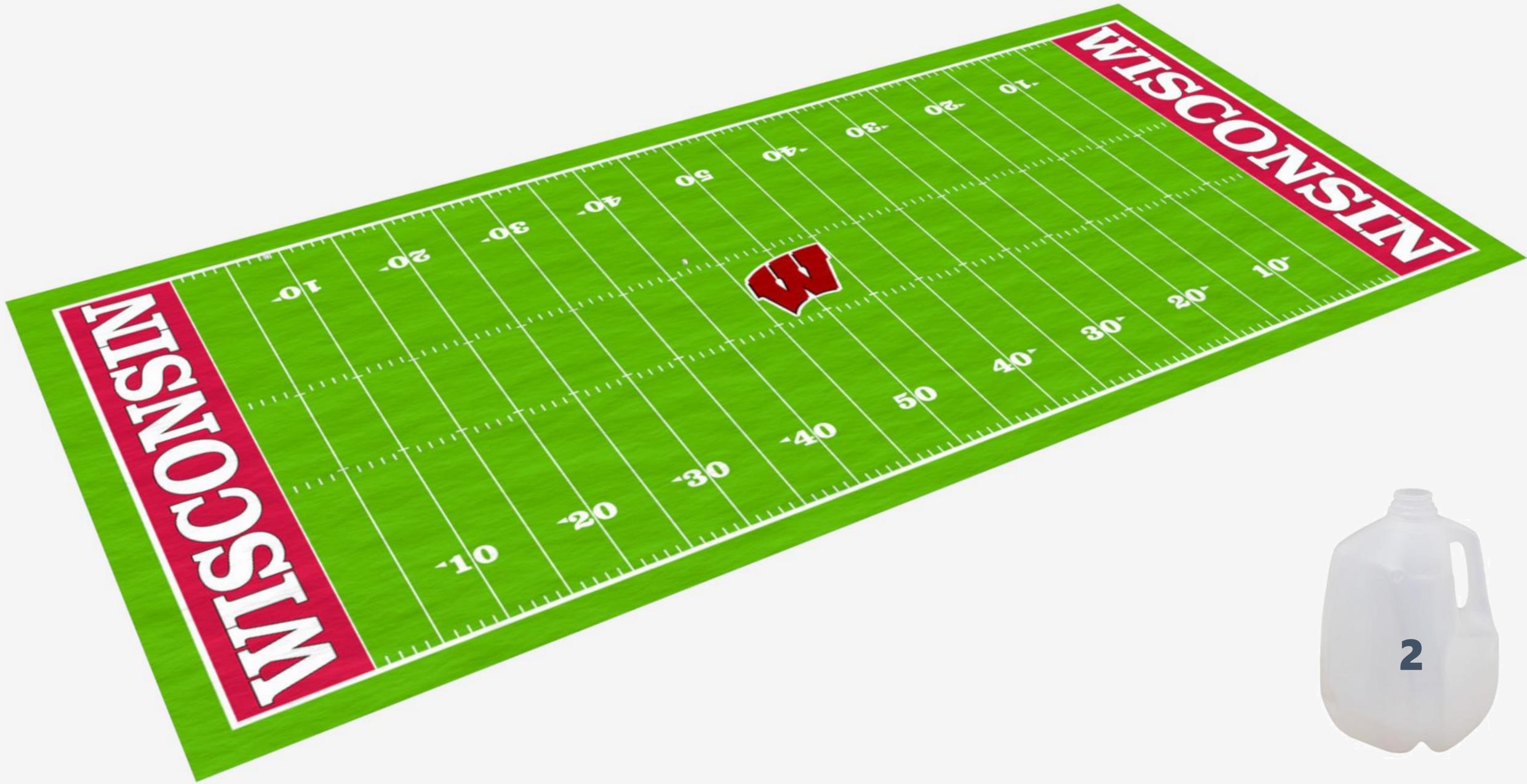
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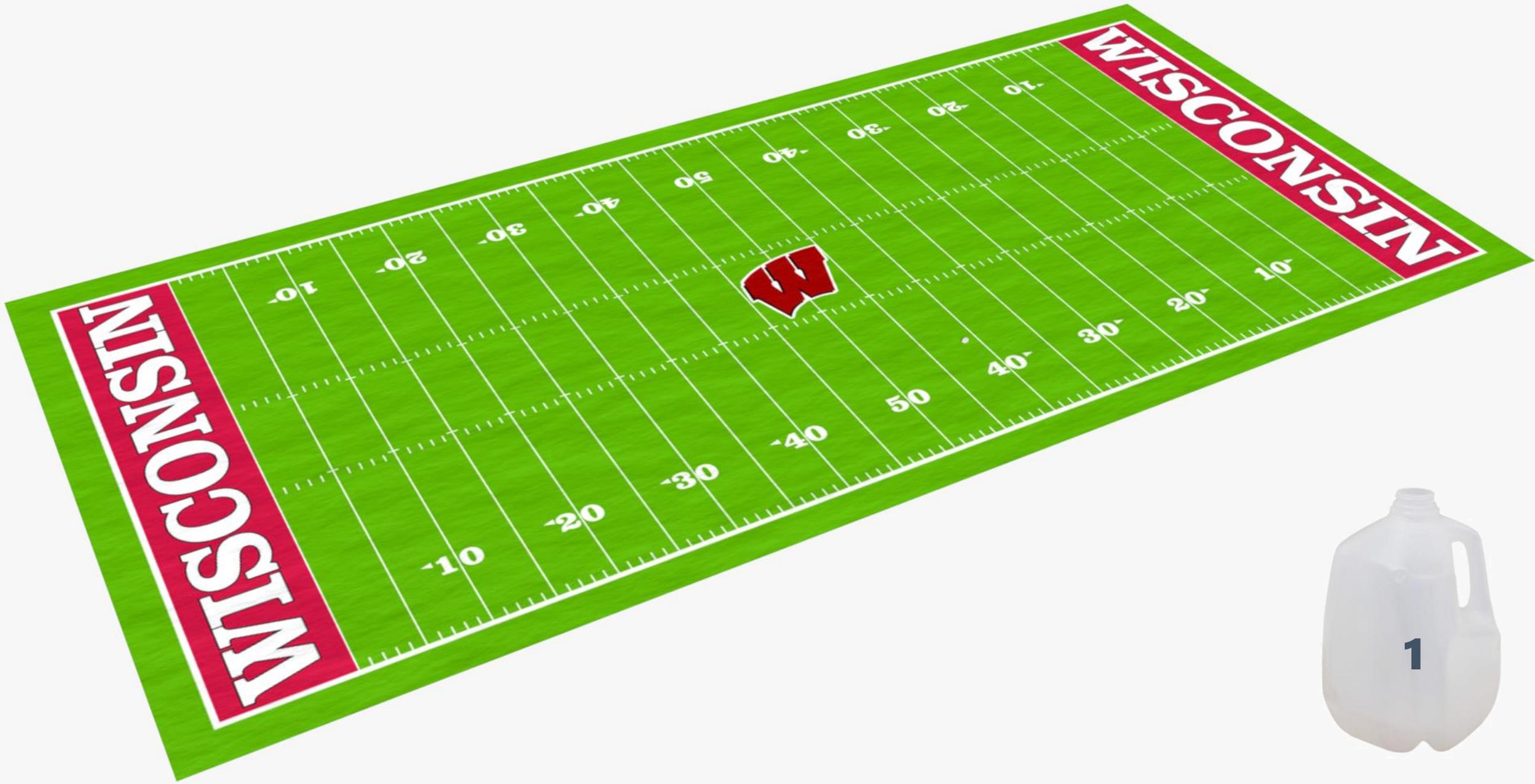








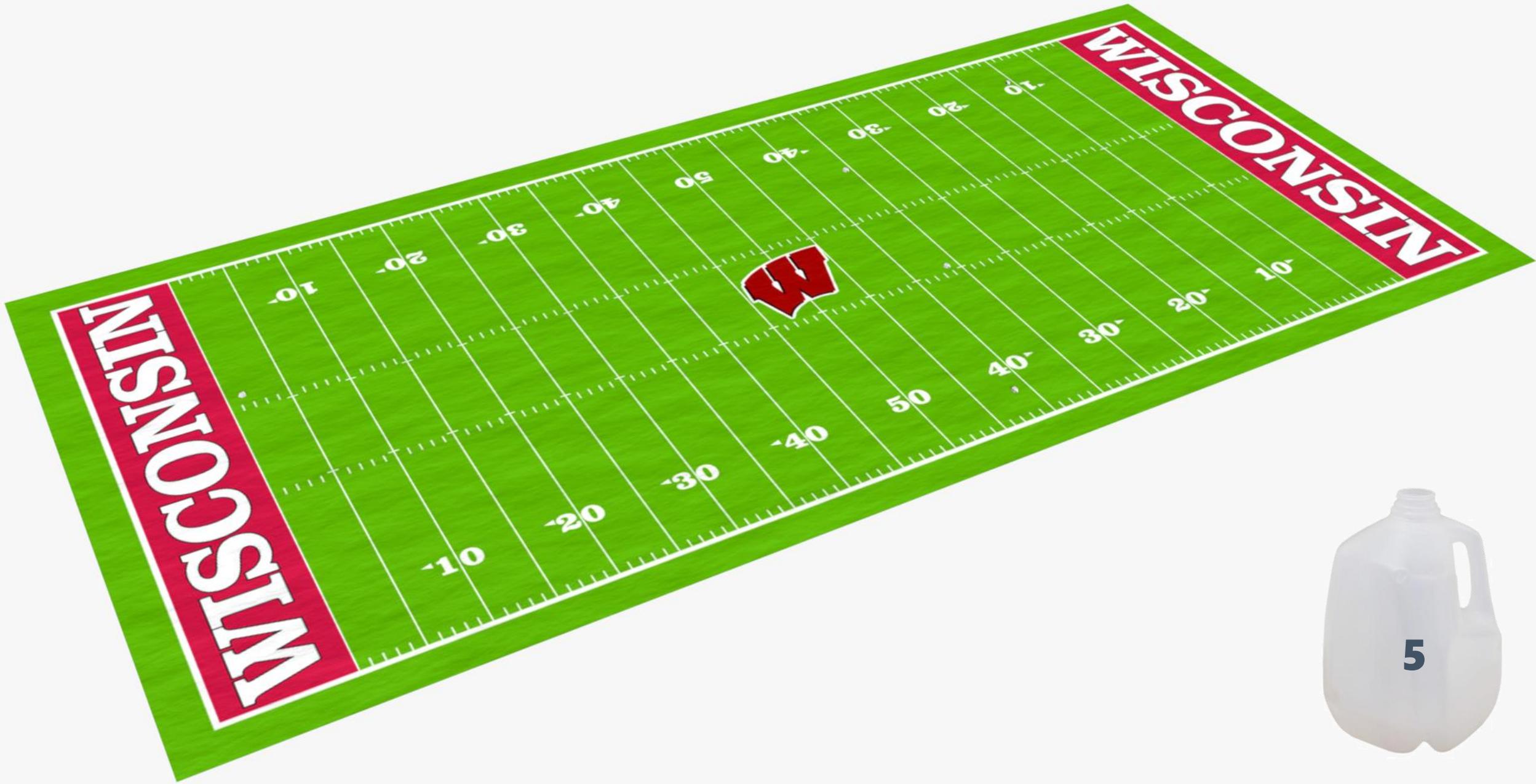




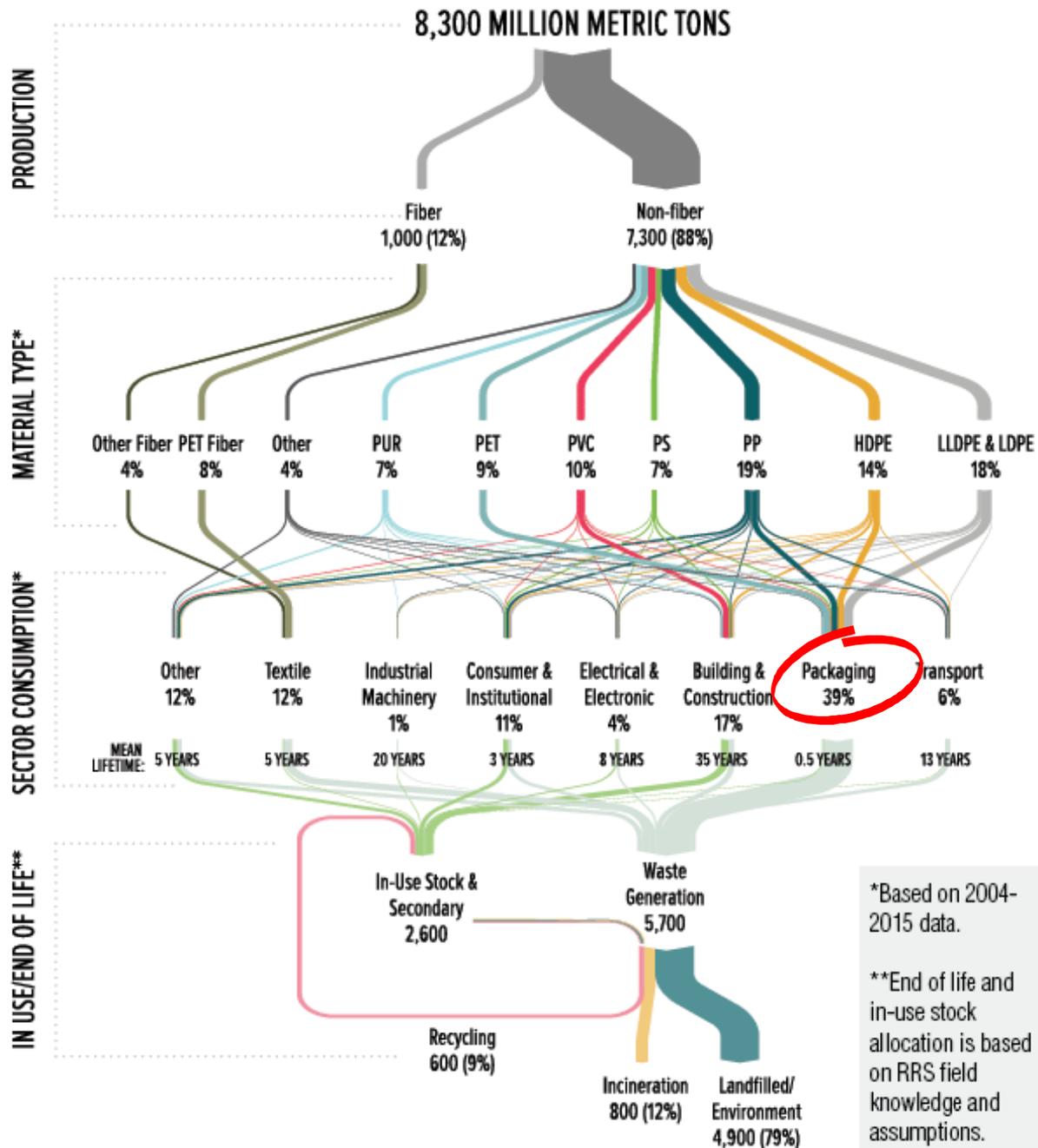


<https://media.greenpeace.org/archive/Arctic-Sunrise-s-Enters-the-Great-Pacific-Garbage-Patch---Web-Video--Clean--English--27MZIFJWHRHRH.html>

In The Pacific Gyre At Point of Highest Plastic Concentration







*packaging  
39%*

\*Based on 2004-2015 data.  
\*\*End of life and in-use stock allocation is based on RRS field knowledge and assumptions.

# PLASTIC PROVIDES BENEFITS

Shelf-life Comparison

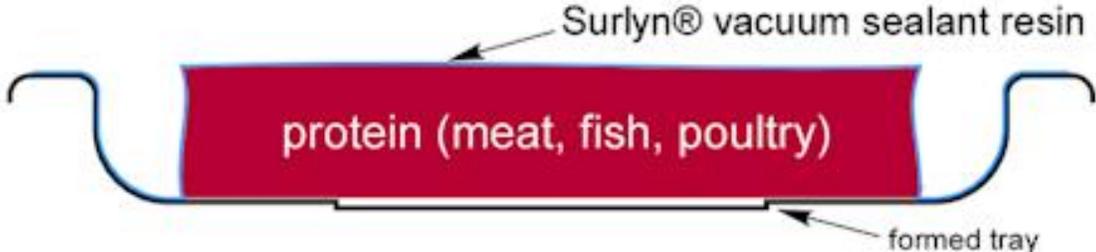
VSP with Surlyn®

21-35 days

MAP

12-15 days

stretch-wrap  
3-5 days

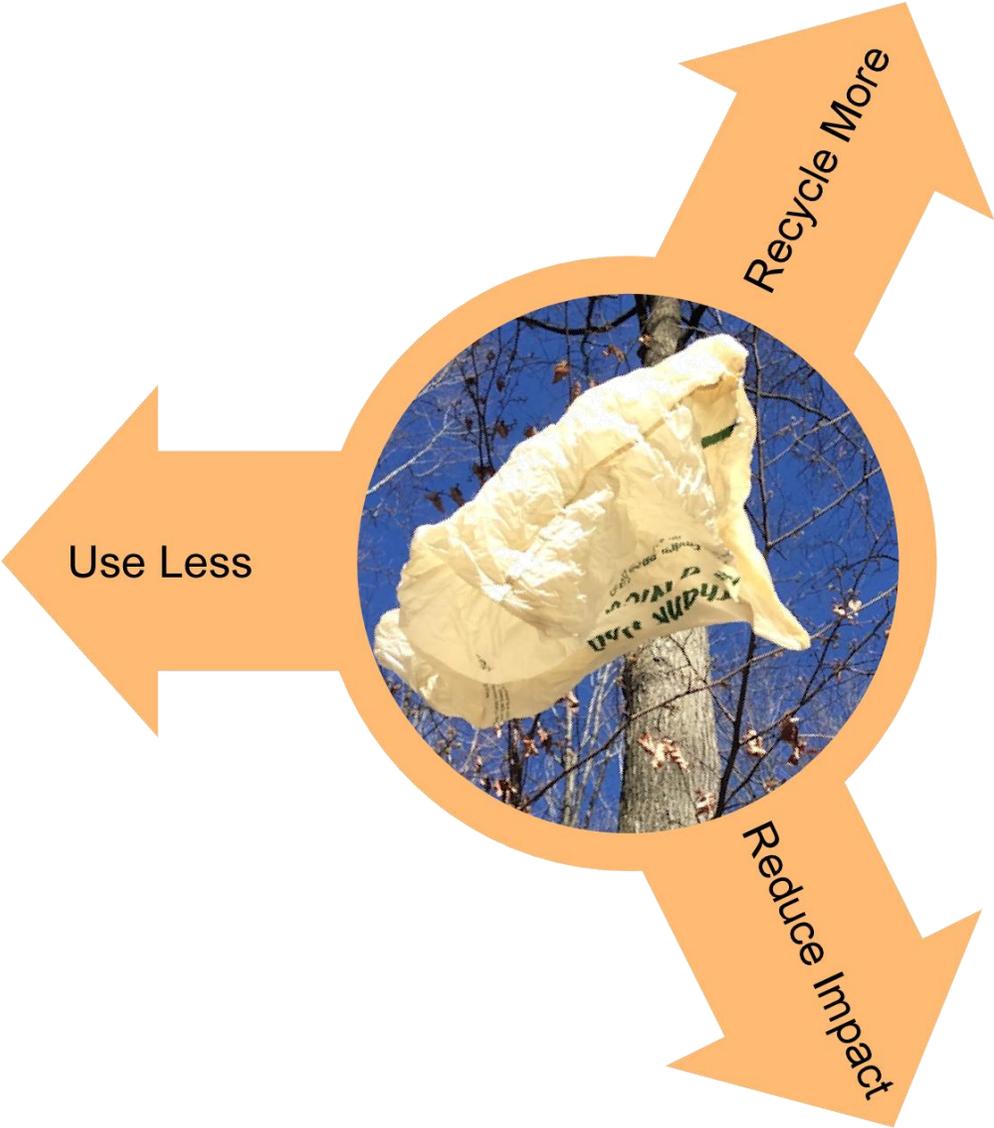


# PLASTIC PROVIDES BENEFITS



# POSSIBLE SOLUTIONS

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# WASTE REDUCTION HIERARCHY

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# USE LESS WITH MORE EFFICIENT PACKAGING



## EDIBLES

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

## 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

# ENABLE RECYCLING

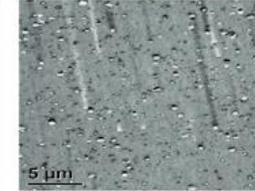


**R&D  
100**  
54 Years of Innovation

## Transmission Electron Microscopy

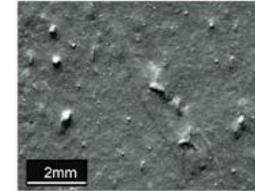


No Compatibilizer  
Large EVOH domains

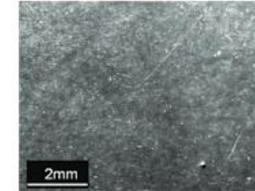


XUS 69 108.01<sup>(1)</sup>  
Modifier Polymer  
Small, uniform EVOH domains

## 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>™</sup>Trademark of The Dow Chemical Company

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## PROVIDE ALTERNATIVES

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# DISAPPEAR

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# RECYCLING PRICES

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0.61¢

0.01¢

9.16¢

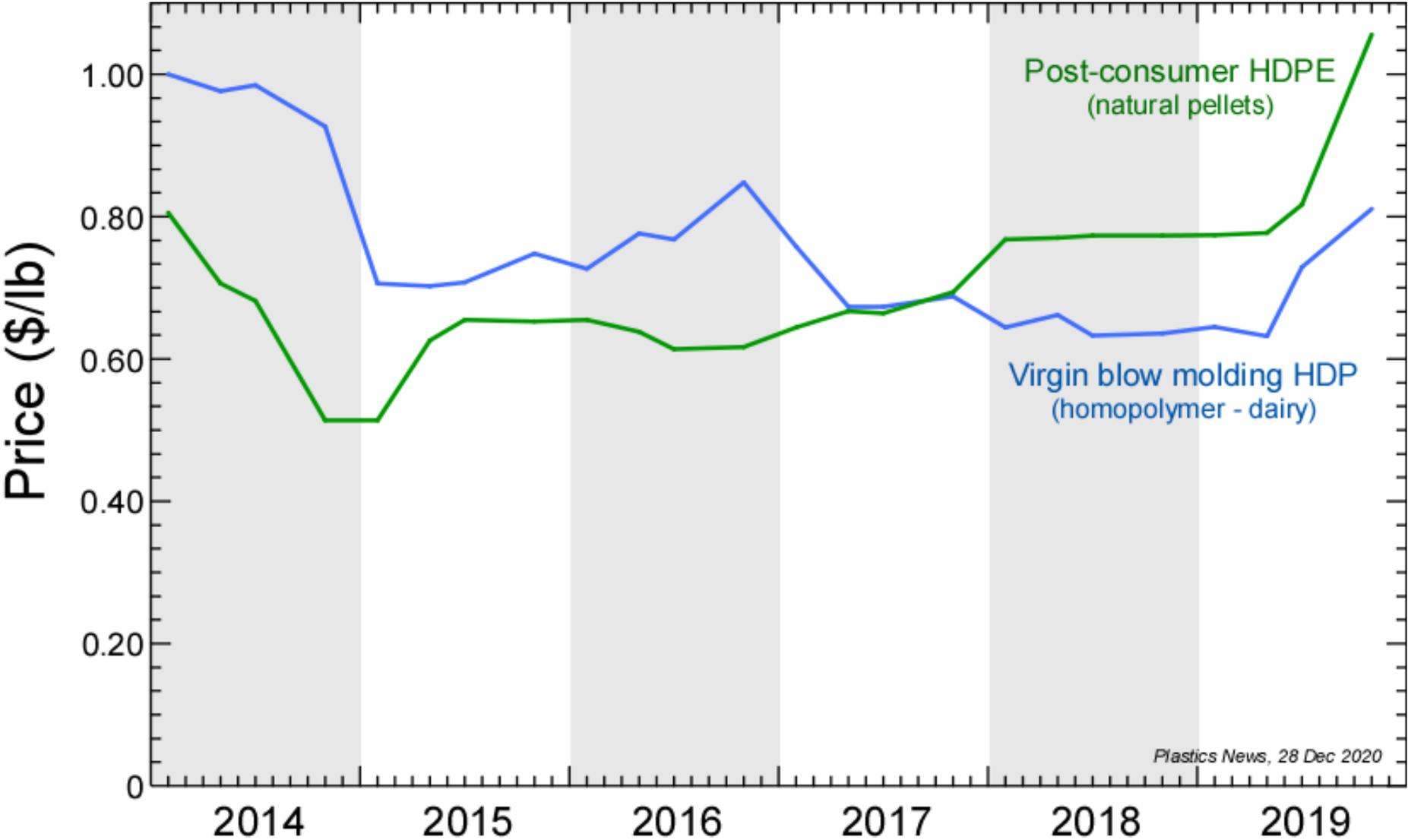
0.22¢

0.20¢



~2¢

# GOOD NEWS



Plastics News, 28 Dec 2020

# DOWNCYCLED PET



# MORE DOWNCYCLED CONTENT

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COMFORTGEL

Gillette®  
CustomPlus®  
3

1063A17400

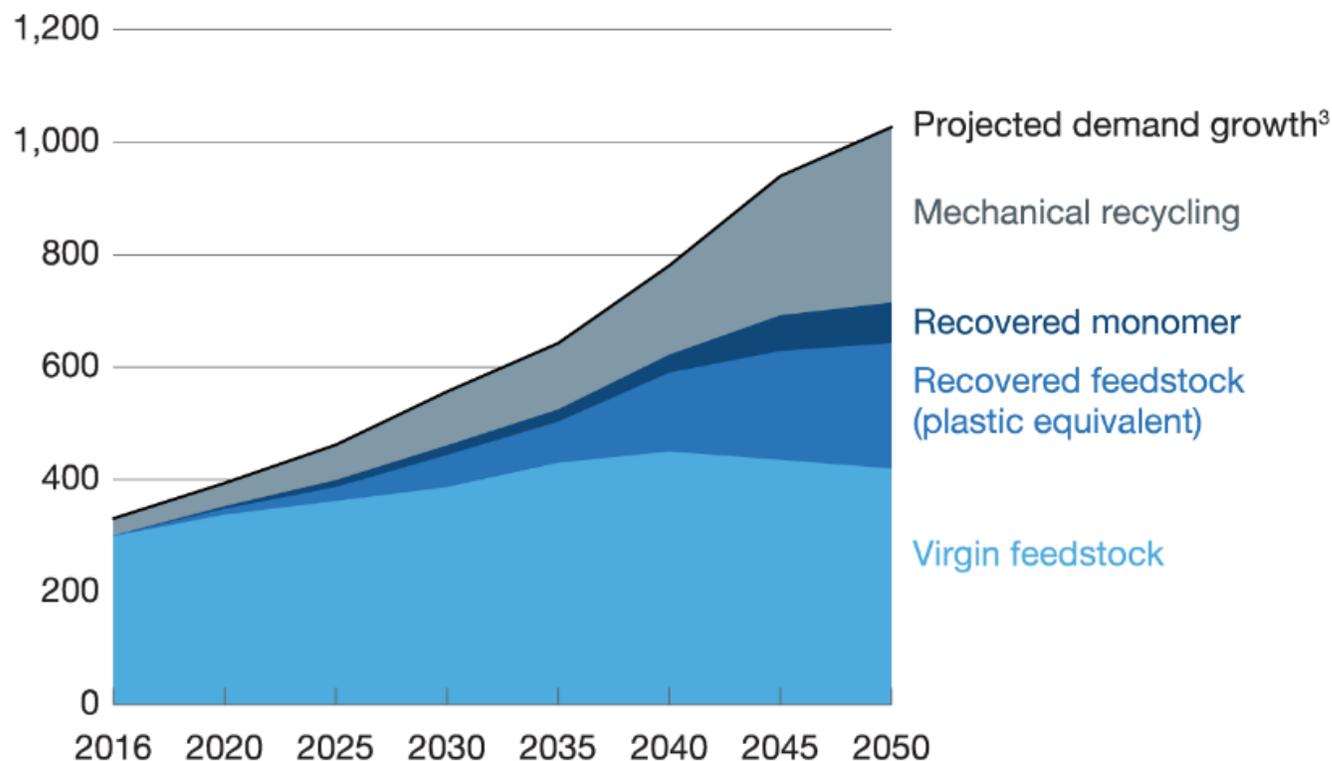
40° PIVOT

SAME GREAT SHAVE,  
MADE WITH  
60% RECYCLED  
PLASTIC HANDLE

The advertisement features a blue background with a green horizontal band at the bottom. On the left, a Gillette razor is shown with a water droplet icon above it labeled 'COMFORTGEL'. To the right of the razor is a yellow recycling symbol with the text '40° PIVOT' next to it. In the top right corner, the 'Gillette CustomPlus 3' logo is displayed, with the product code '1063A17400' below it. The main text at the bottom, set against the green band, reads 'SAME GREAT SHAVE, MADE WITH 60% RECYCLED PLASTIC HANDLE'.

By 2050, nearly 60 percent of plastics production could be based on plastics reuse and recycling.

Global polymer demand 2016–50 and how it could be covered, millions of metric tons<sup>1</sup>



CAGR  
2016–50,<sup>2</sup> %



<sup>1</sup>Scenario based on a multi-stakeholder push to boost recycling, regulatory measures to encourage recycling, consistent progress on technologies, and \$75-per-barrel oil price.

<sup>2</sup>Compound annual growth rate. Mechanical recycling limited by downcycling and applicable materials, monomerization limited by applicability to condensation polymers only, pyrolysis limited by likely rise in input costs.

<sup>3</sup>After demand reduction, assuming annual global GDP growth of 3.1%.

# CAUTIONARY TALE OF UNINTENDED CONSEQUENCES

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*Thomas Midgley, Jr.*

# WHAT IS THE SAFE LEVEL?

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