RFT Annual Conference

Florida Solid Waste Management: State of the State

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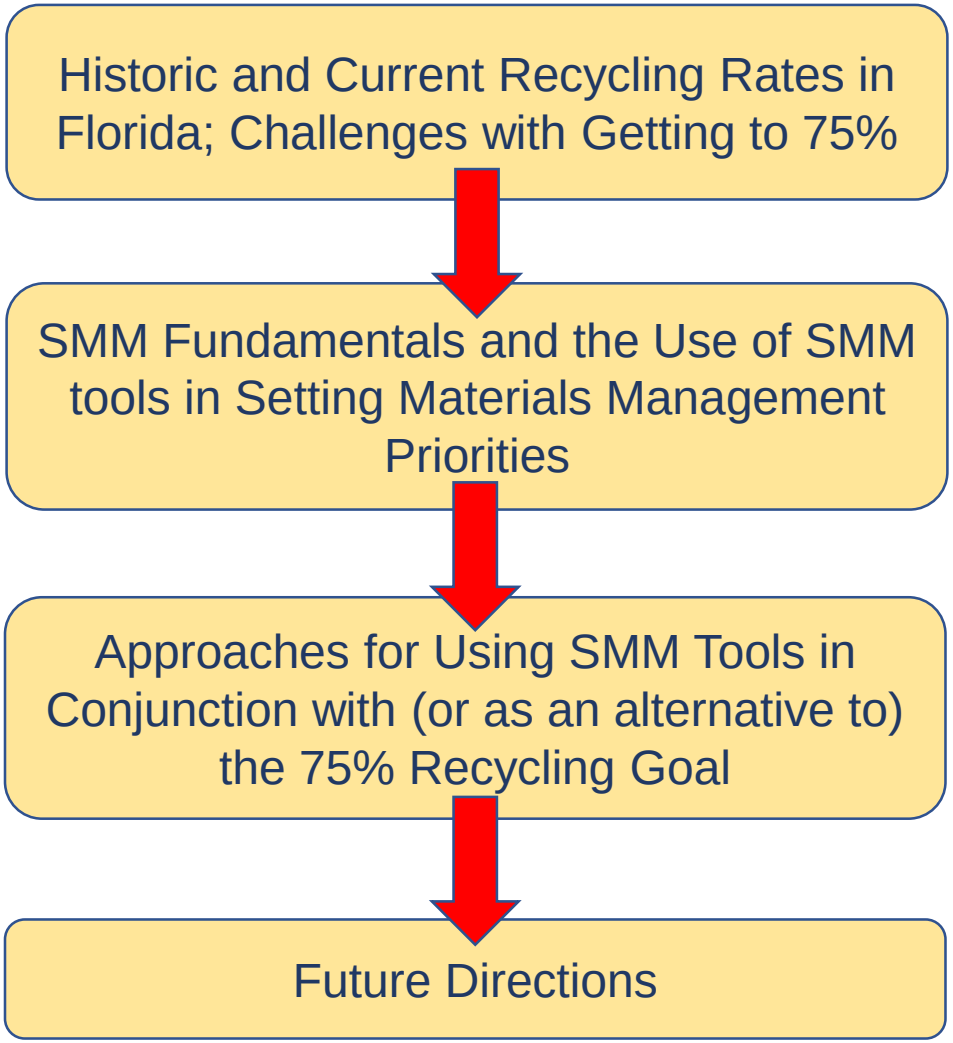
University of Florida

Motivation

- Hinkley Center Research Project
  →*Florida Solid Waste Management: State of the State*
- Motivated by numerous questions on HC 2016 research agenda regarding waste technologies, feasibility, economics, life cycle assessment, and future options for solid waste management in Florida.
- Additional support:
  - Alachua, Escambia, Palm Beach, Polk and Sarasota Counties

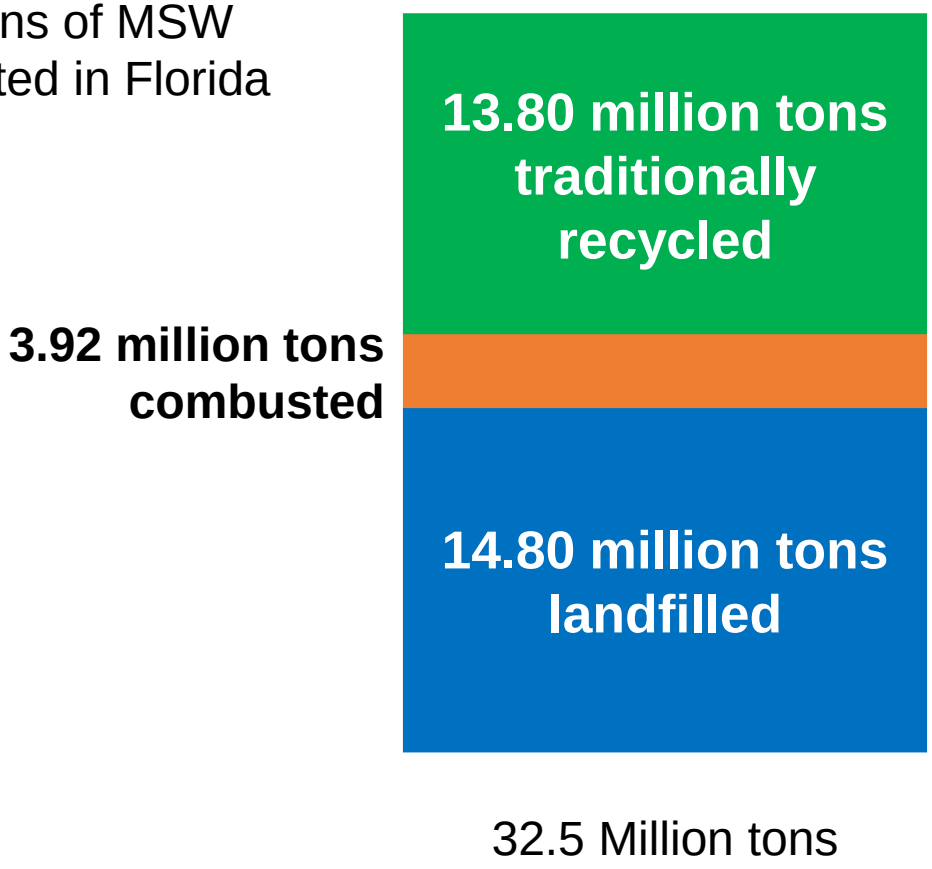
Presentation Agenda



Management and Disposition of Waste

Traditional Recycling Rate: 42%

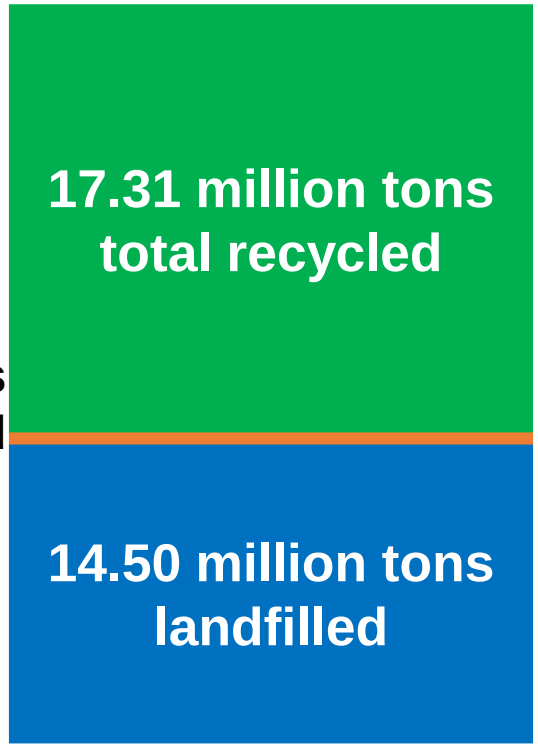
- Total tons of MSW generated in Florida in 2015



Management and Disposition of Waste

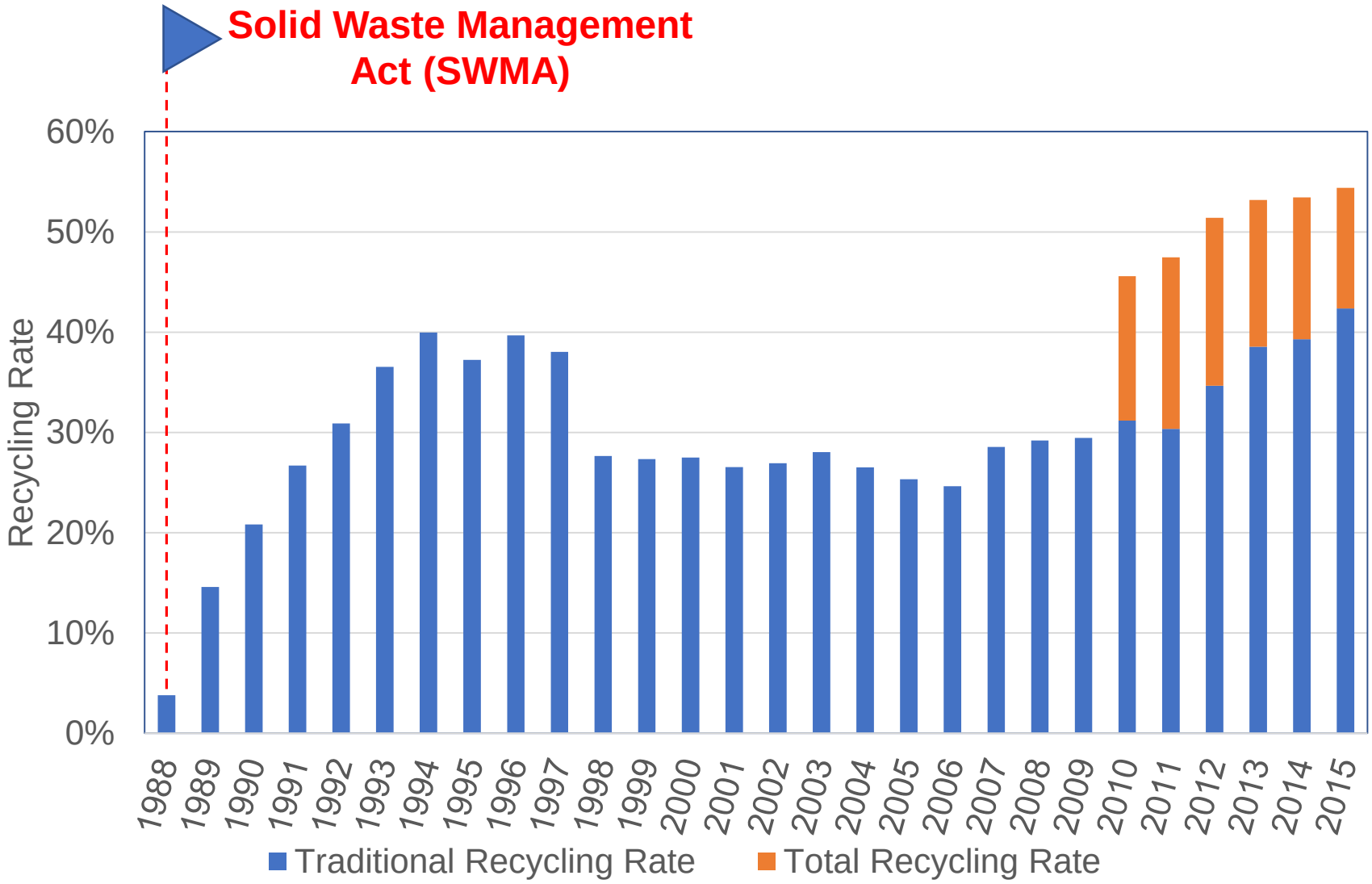
Total Recycling Rate: 54%

- Total tons of MSW generated in Florida in 2015

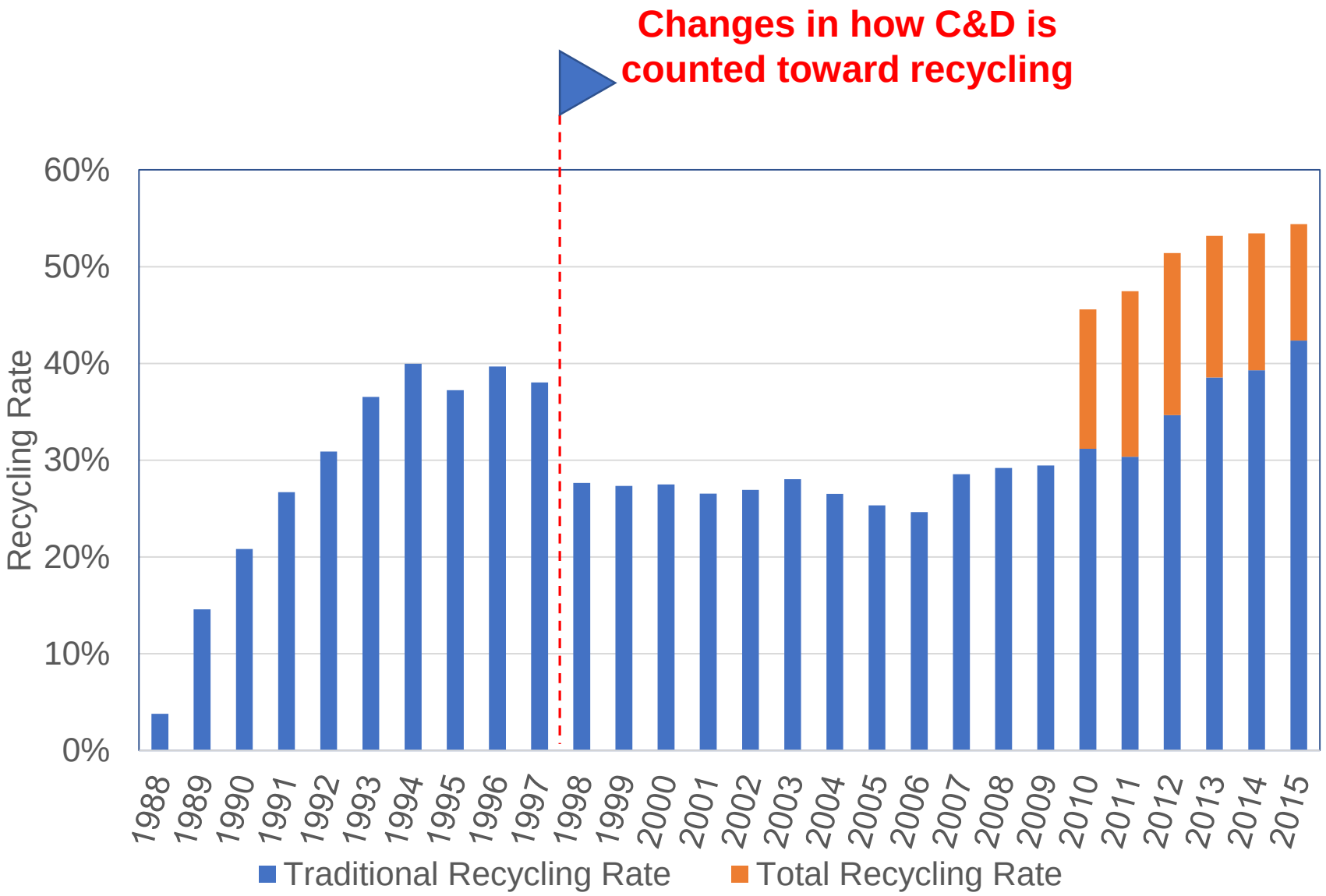


32.5 Million tons

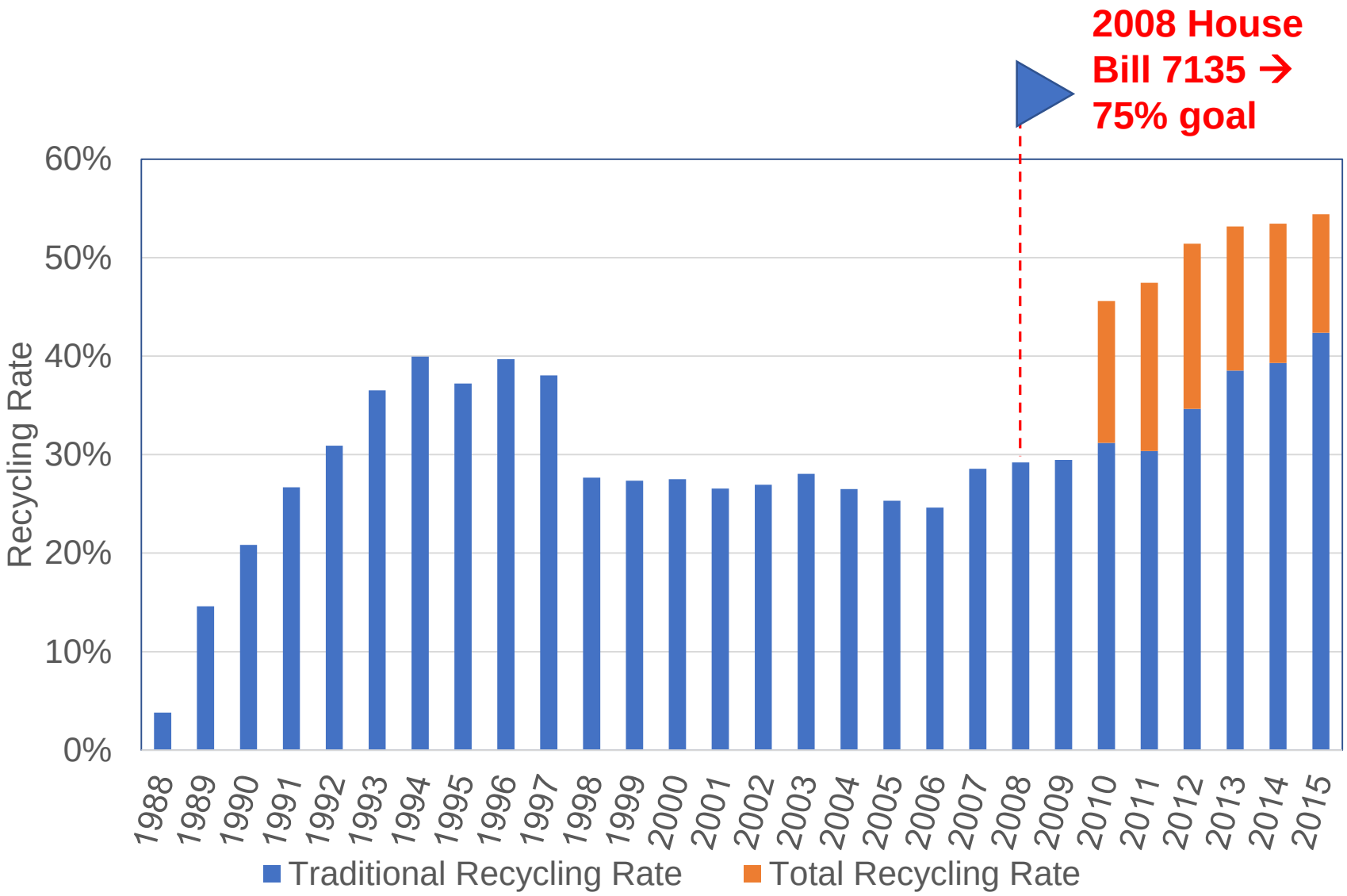
Florida Historic Recycling Rates



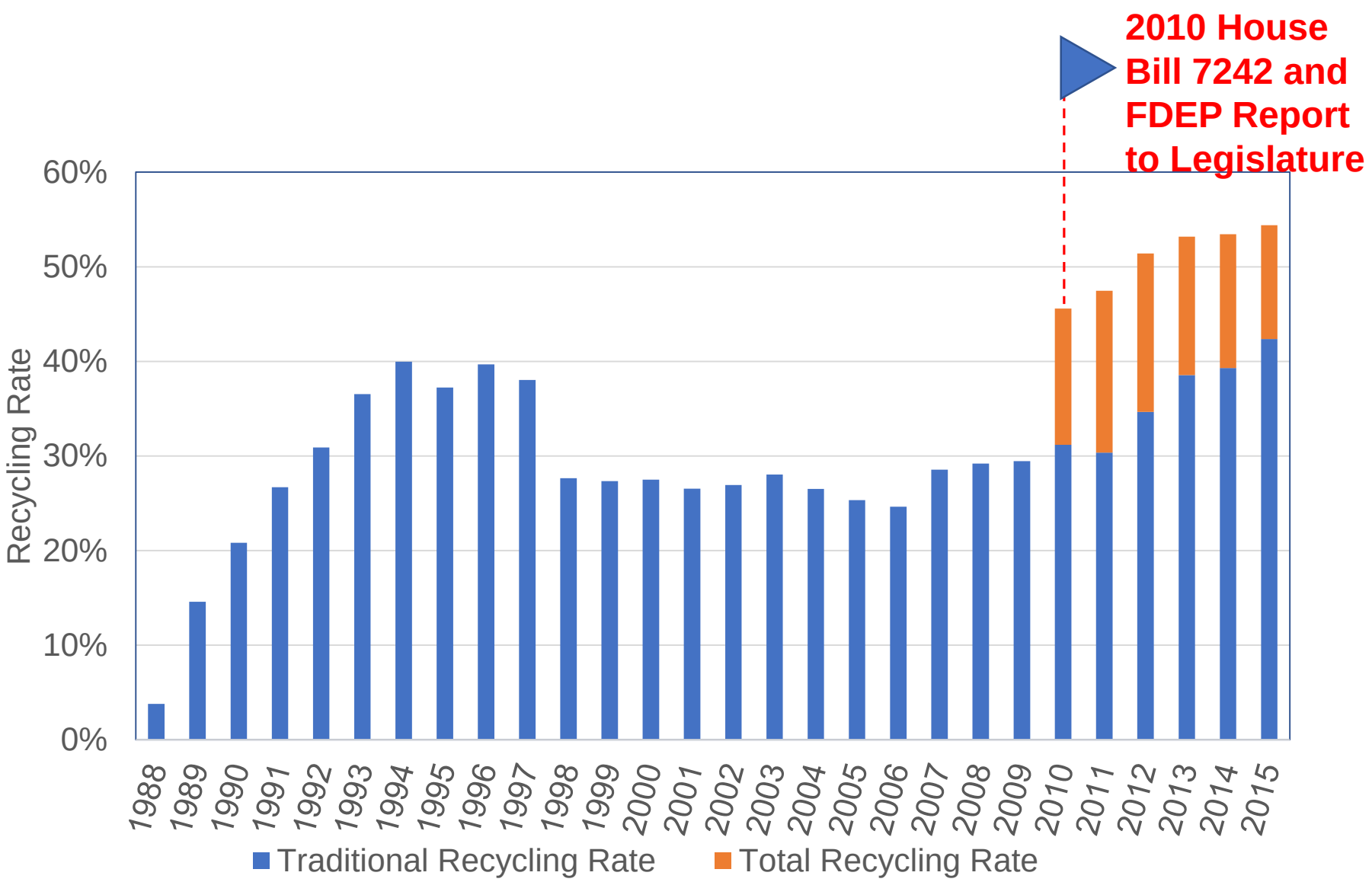
Florida Historic Recycling Rates



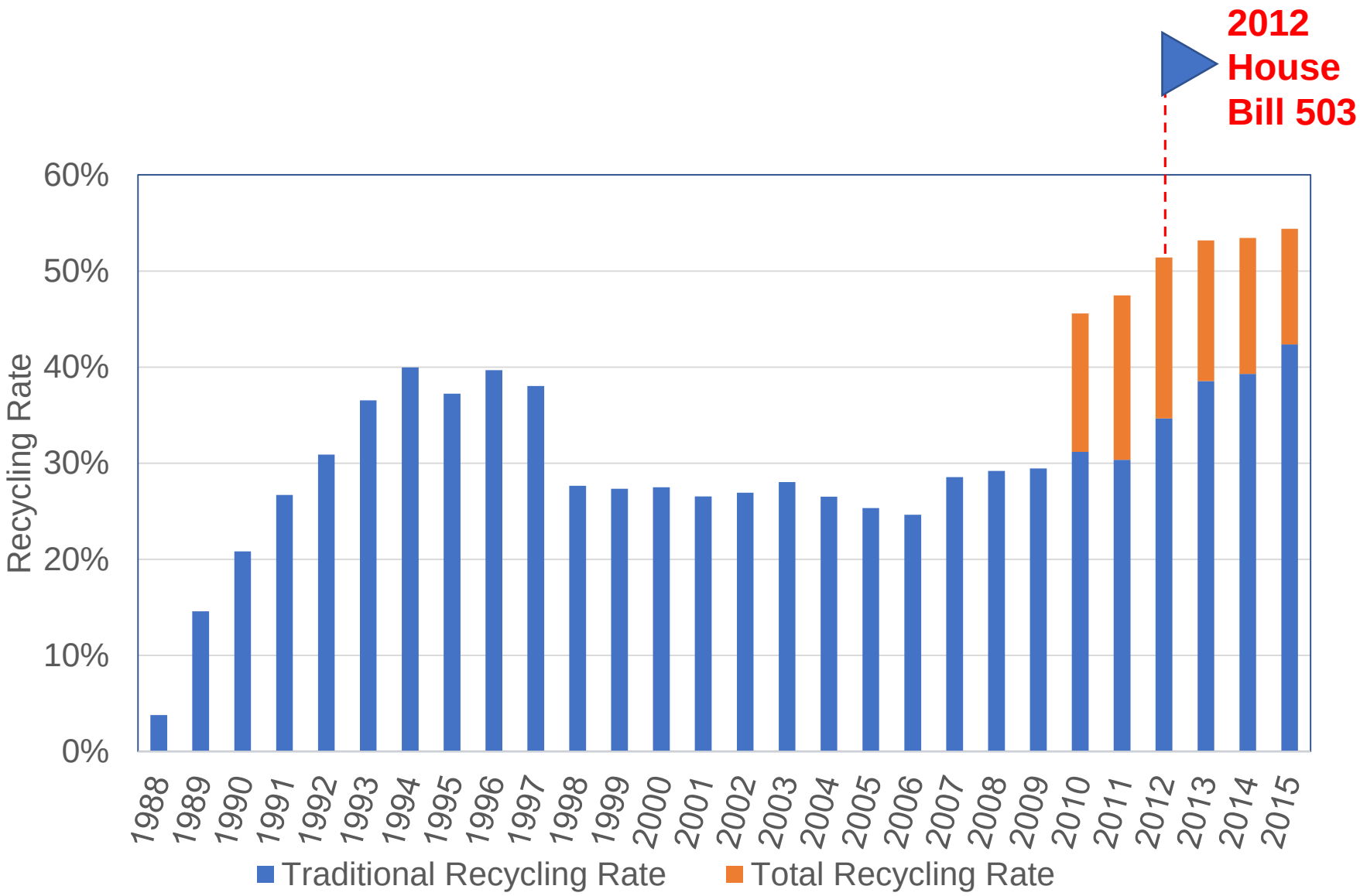
Florida Historic Recycling Rates



Florida Historic Recycling Rates

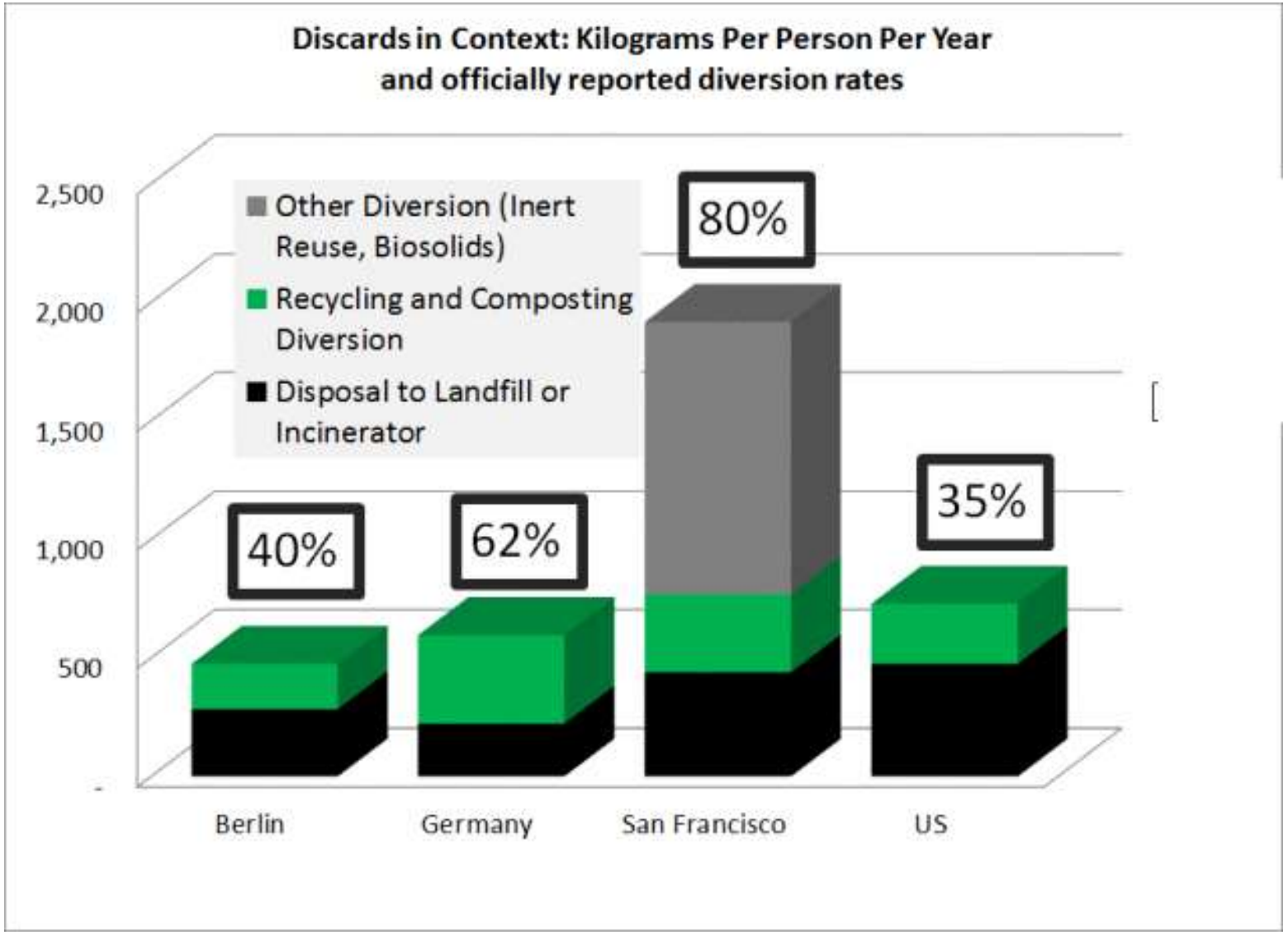


Florida Historic Recycling Rates



Recycling Rates Across the US

Location	Recycling Rate	Comment
San Francisco, CA	80%	Zero Waste Policies, ban on disposable plastic bas, mandatory recycling and composting
Los Angeles, CA	76%	Planning and implementation of programs to achieve the 2025 zero waste to landfill goal
Portland, OR	70%	Aggressive recycling and waste diversion program that requires more labor which increases the cost per ton of collecting MSW
San Antonio, TX	29%	Pilot Program for organic waste that focuses on composting
NYC, NY	19%	Low rate due to inefficiencies related to the performance of private companies
Atlanta, GA	12.5%	New residential recycling programs, “Cartlanta Program”
Chicago, IL	9%	Lack of recycling interest and public participation



https://discardstudies.com/2013/12/06/san-franciscos-famous-80-waste-diversion-rate-anatomy-of-an-exemplar/

Let’s look more closely at the recycling rate of different waste sources in Florida

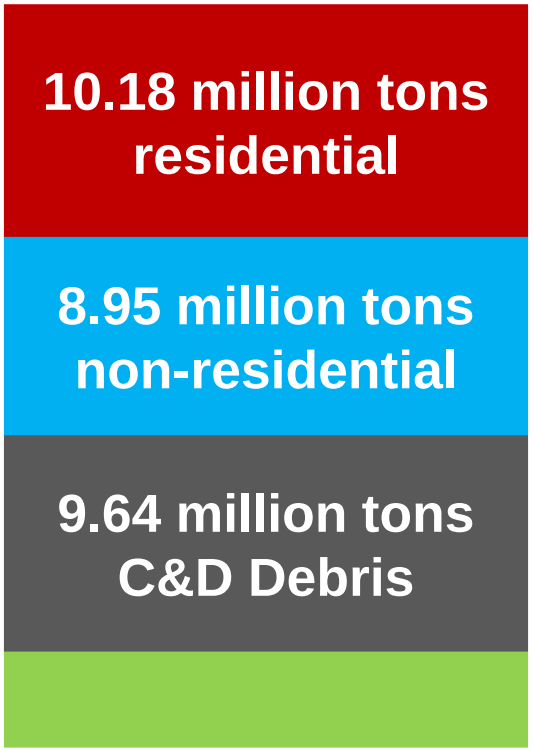
The Four Categories

1. Residential MSW*
2. Non-residential MSW*
3. C&D Debris
4. Yard Trash

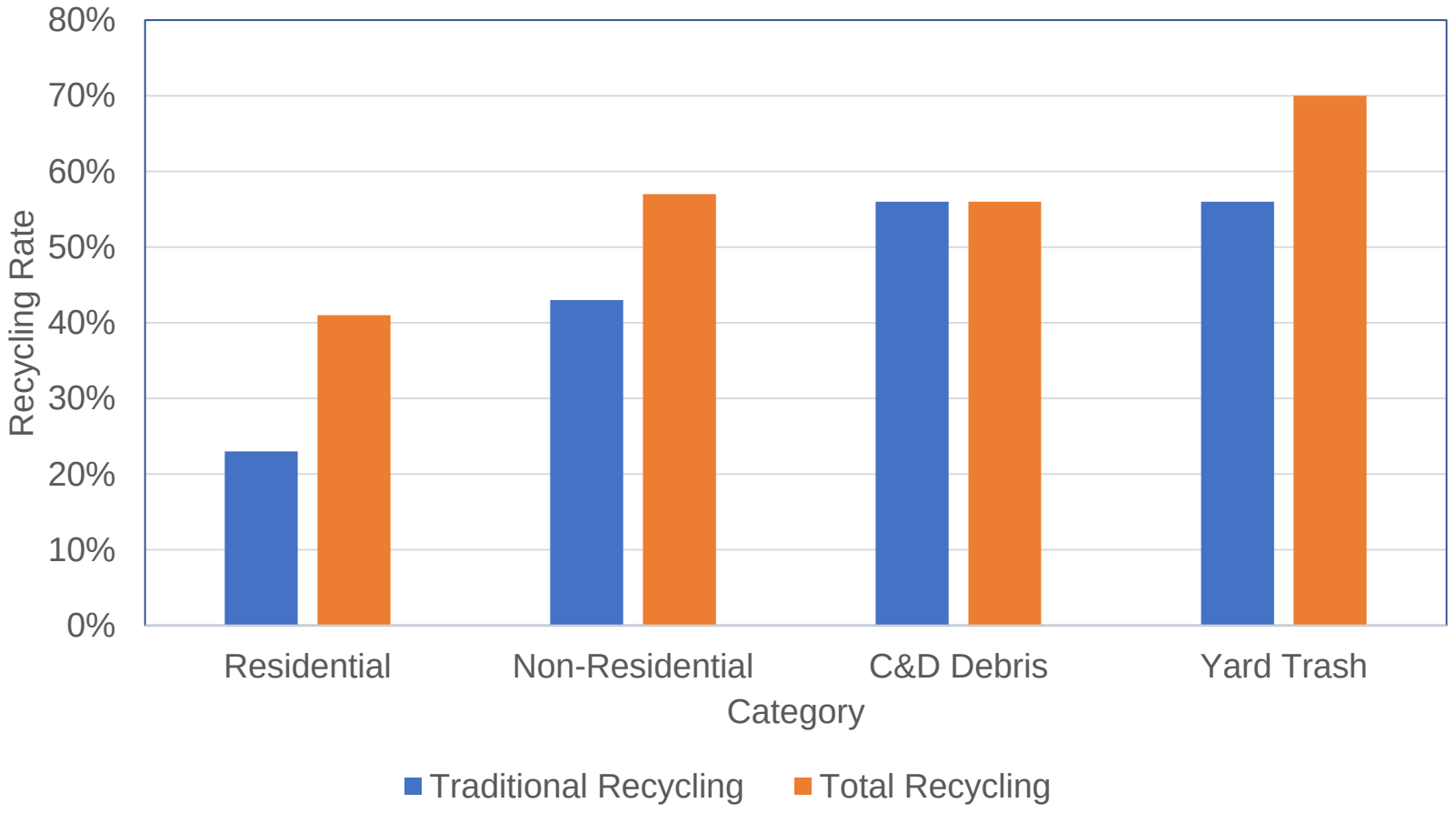
- *Not including yard trash or C&D debris.

State of Florida Total Waste Generation by Category

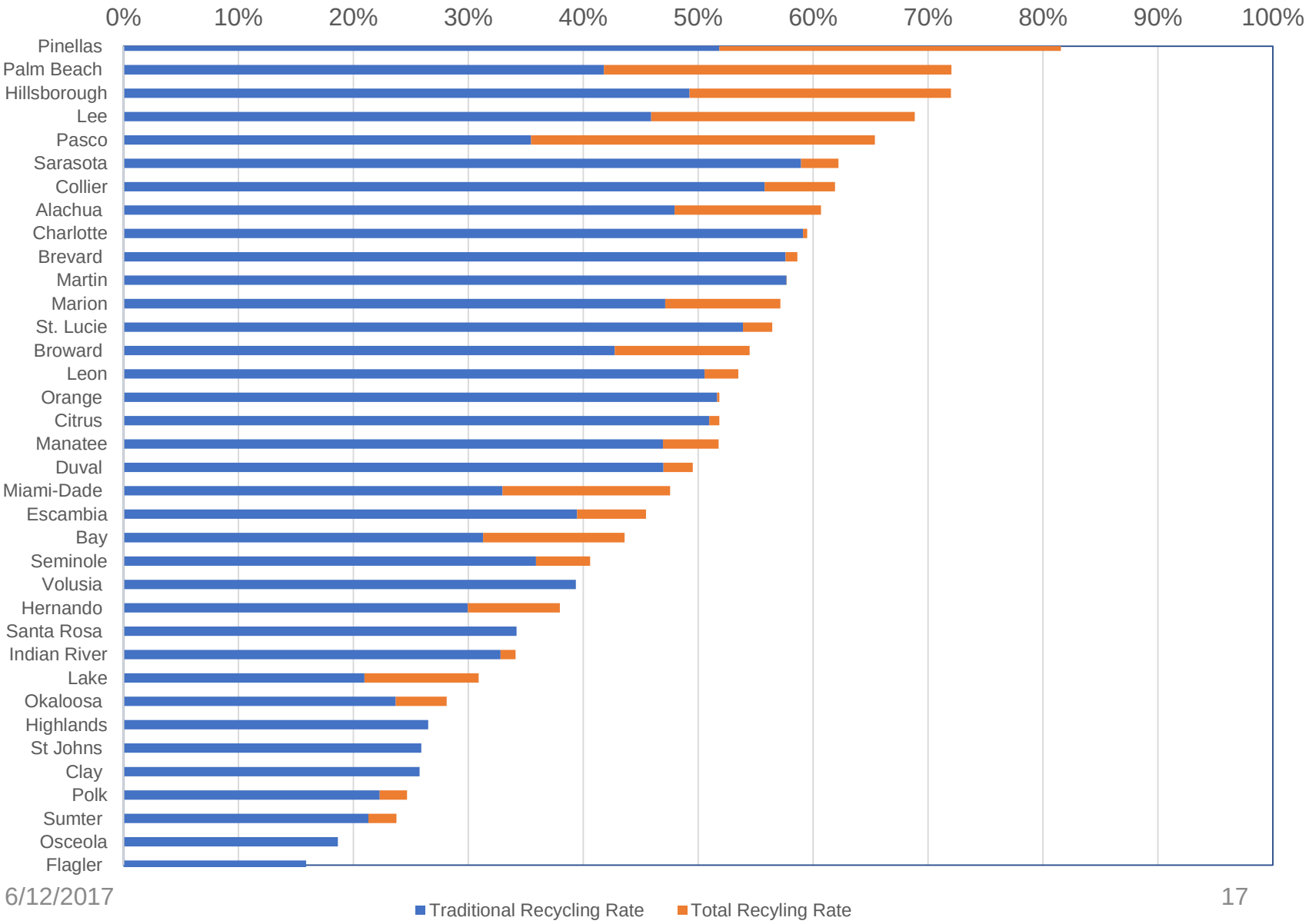
- Categorizing the total 32.5 million tons of collected MSW into the four categories



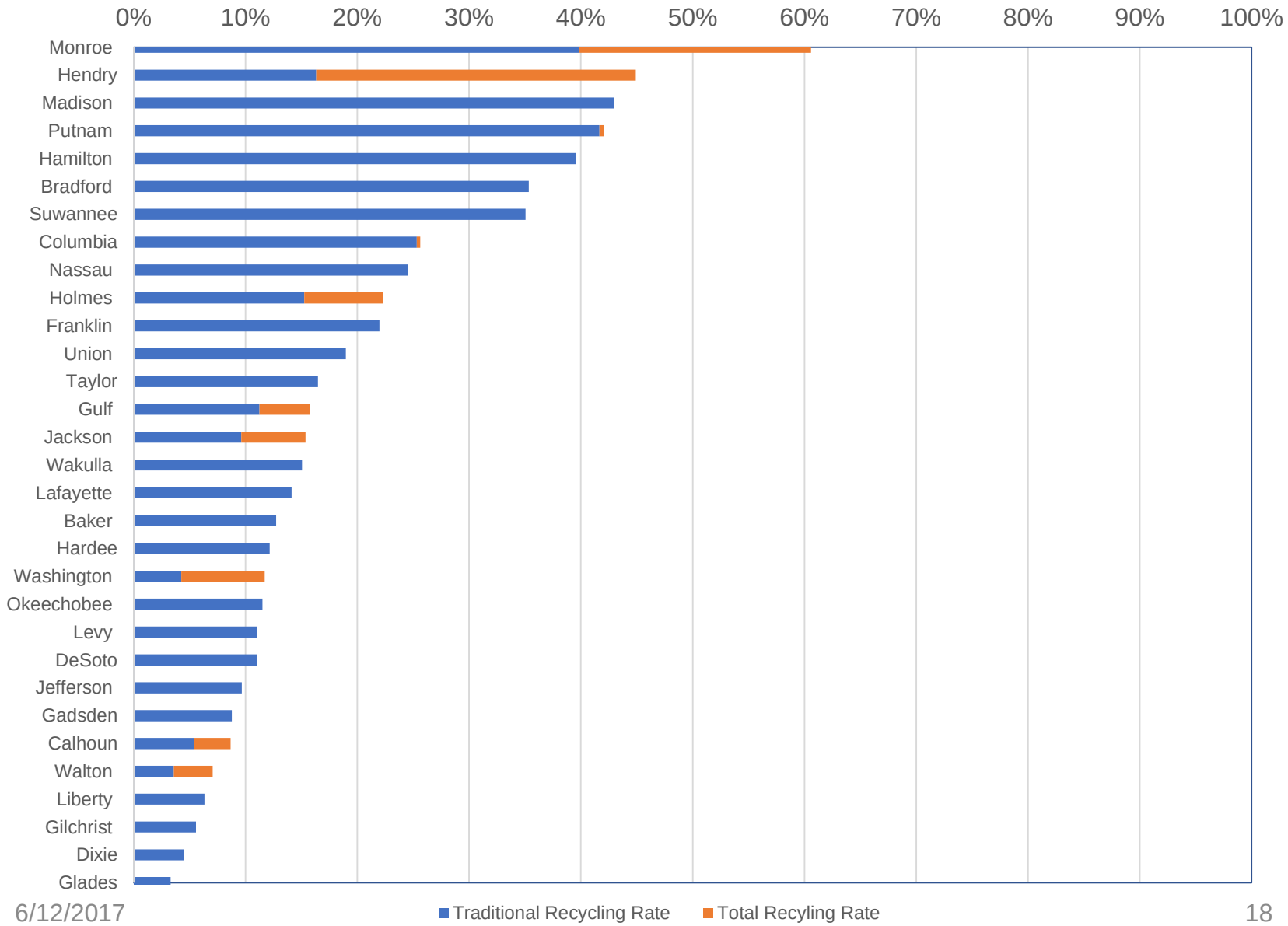
Recycling Rates by Category



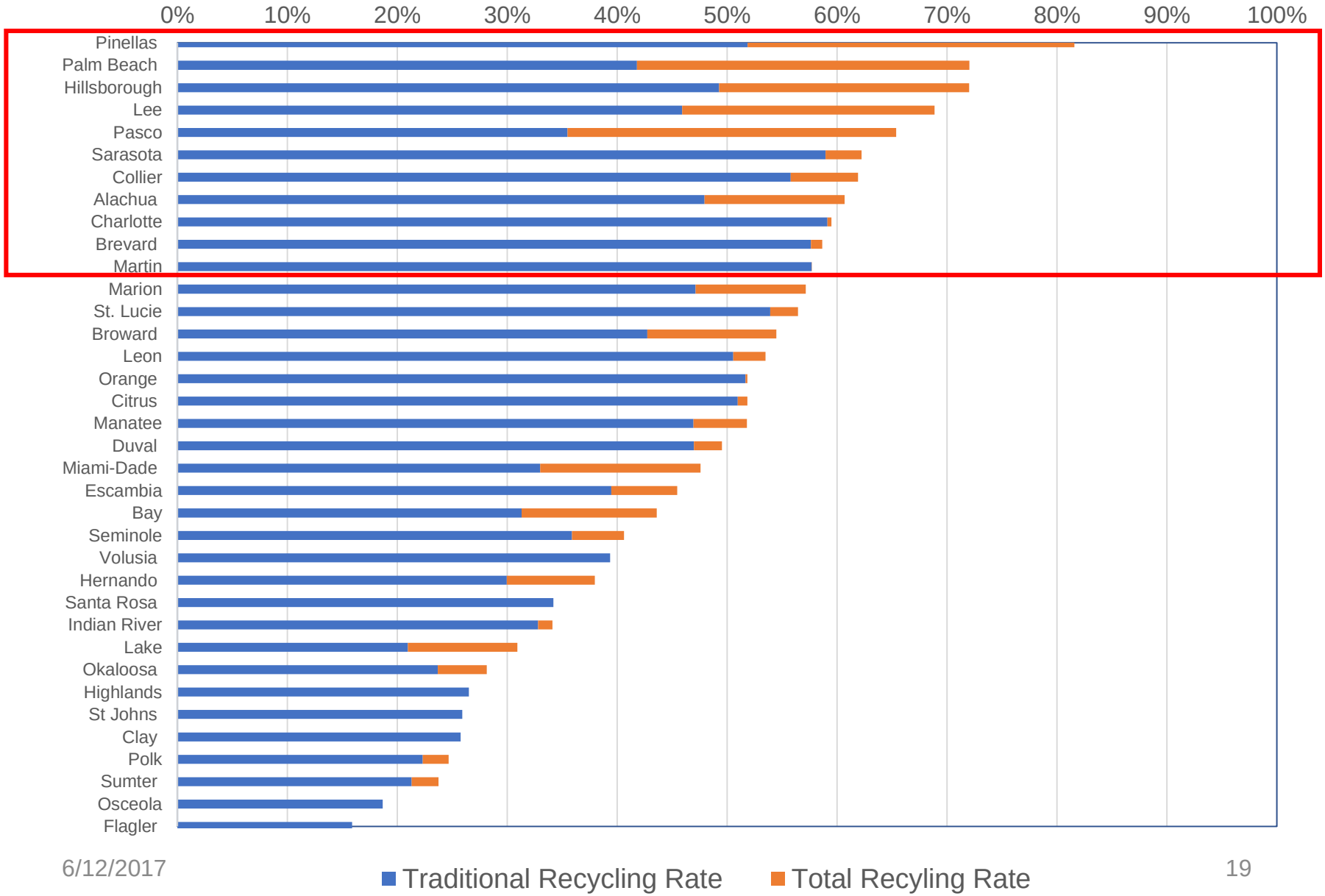
Large Counties 2015 Recycling Rate



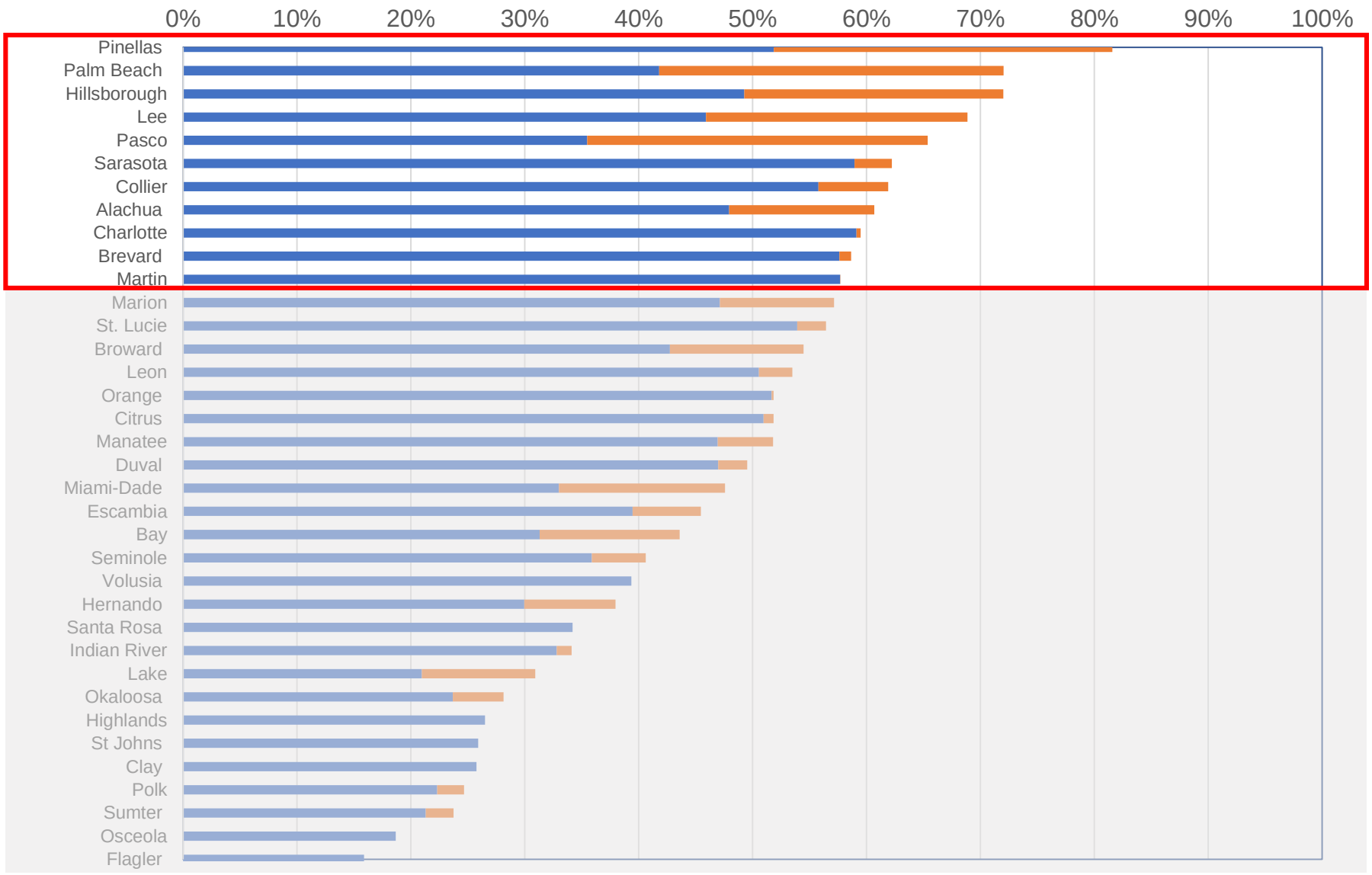
Small Counties 2015 Recycling Rate



Large Counties Recycling Rate



Large Counties Recycling Rate



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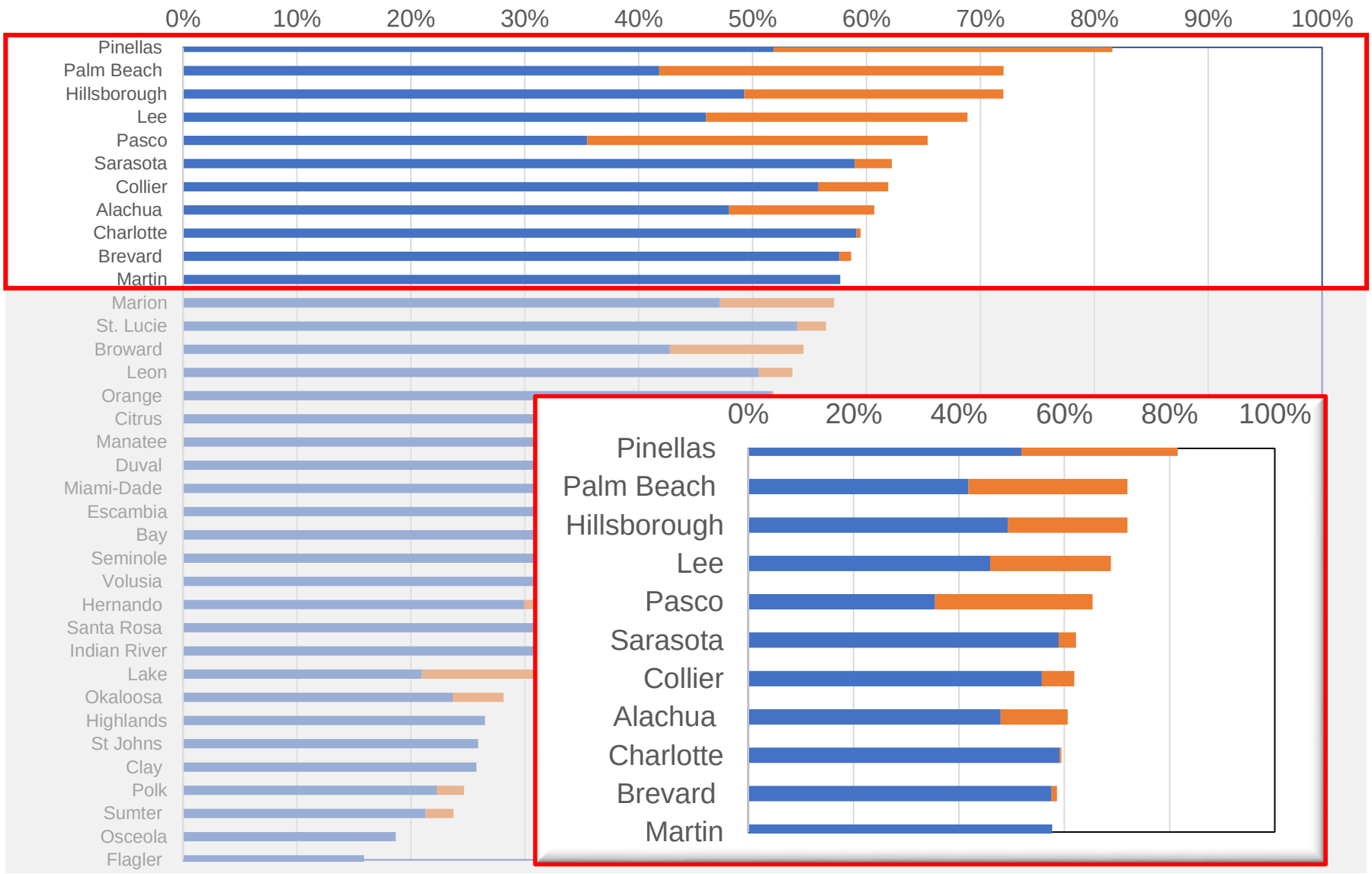
Traditional Recycling Rate Total Recyling Rate

Large Counties Recycling Rate



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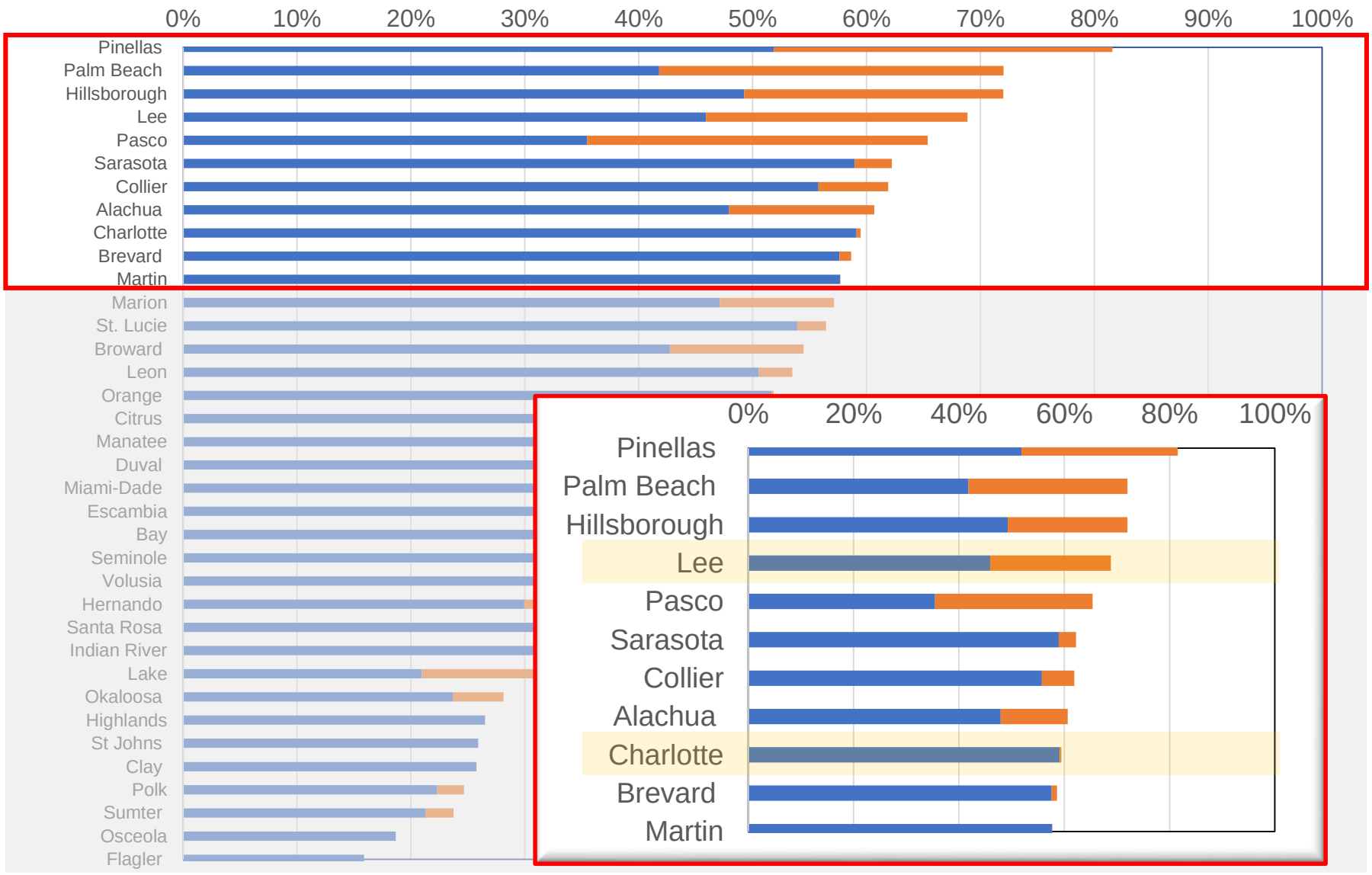
Large Counties Recycling Rate



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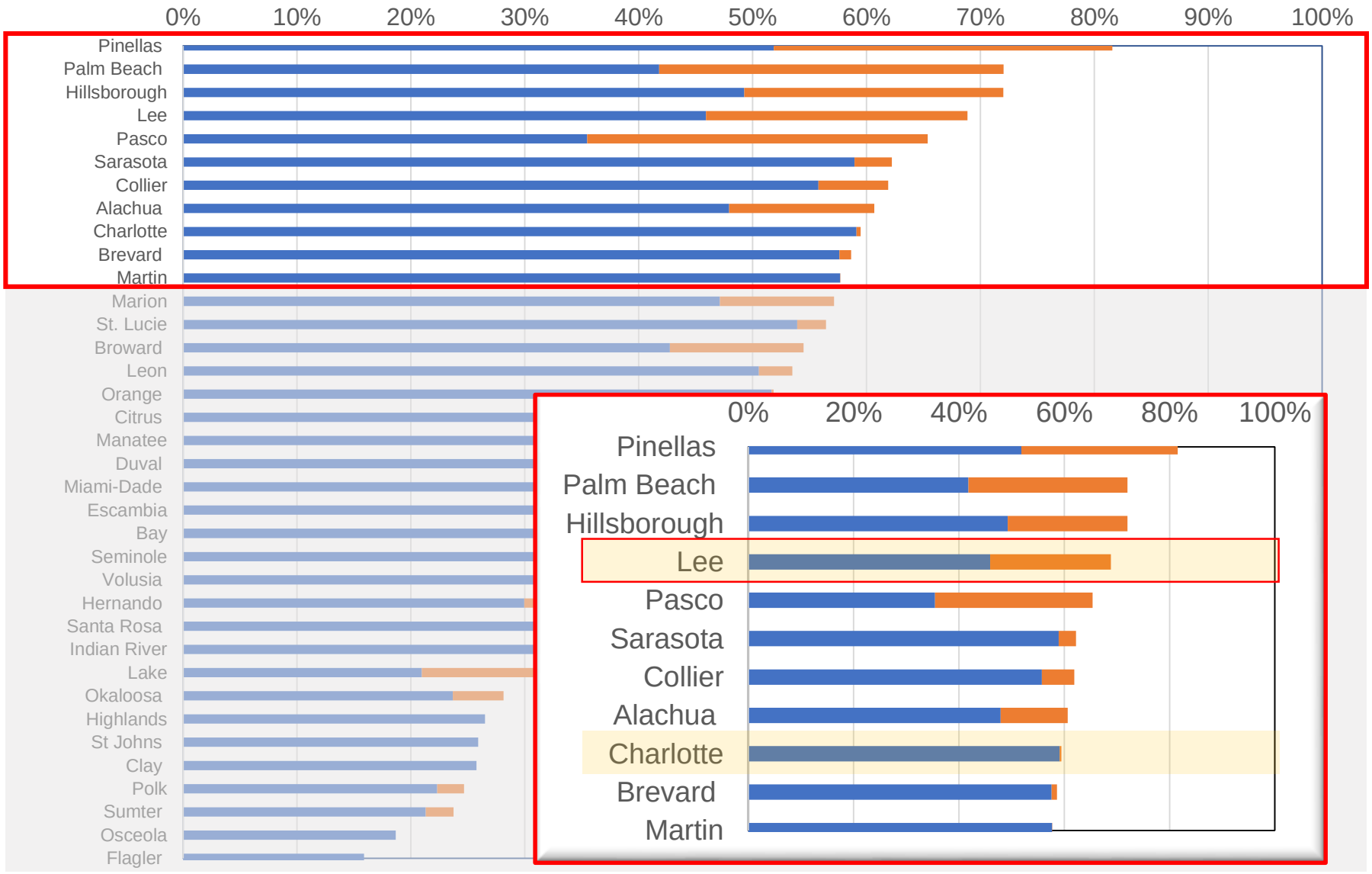
Large Counties Recycling Rate



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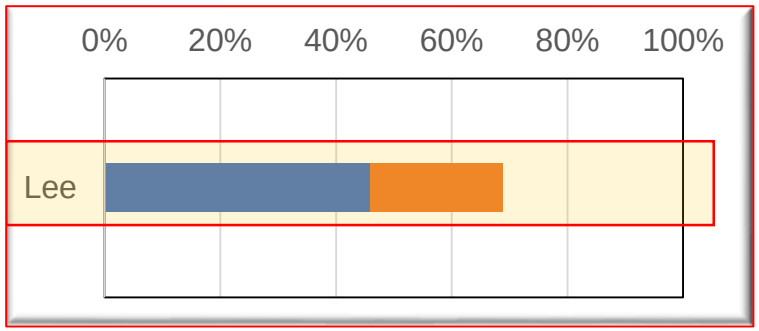
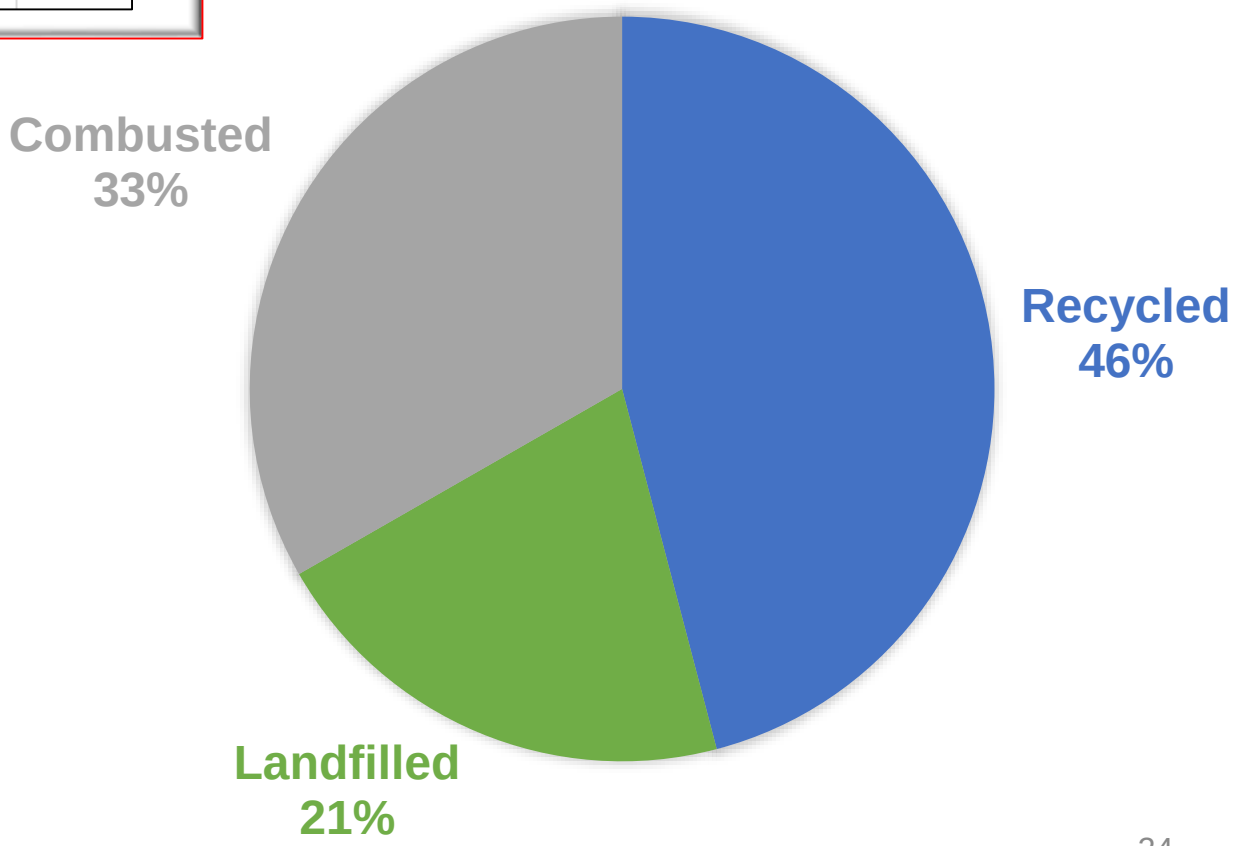
Lee County Recycling Rate Breakdown





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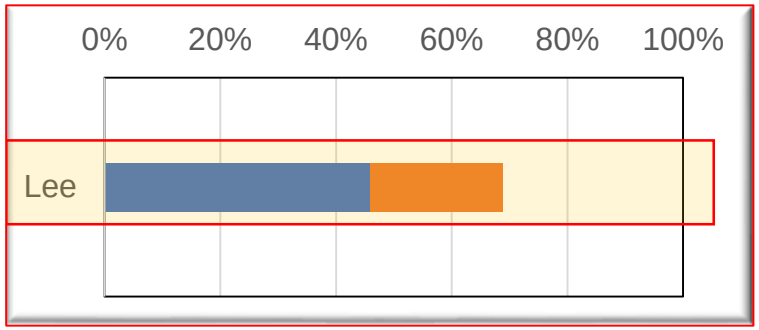
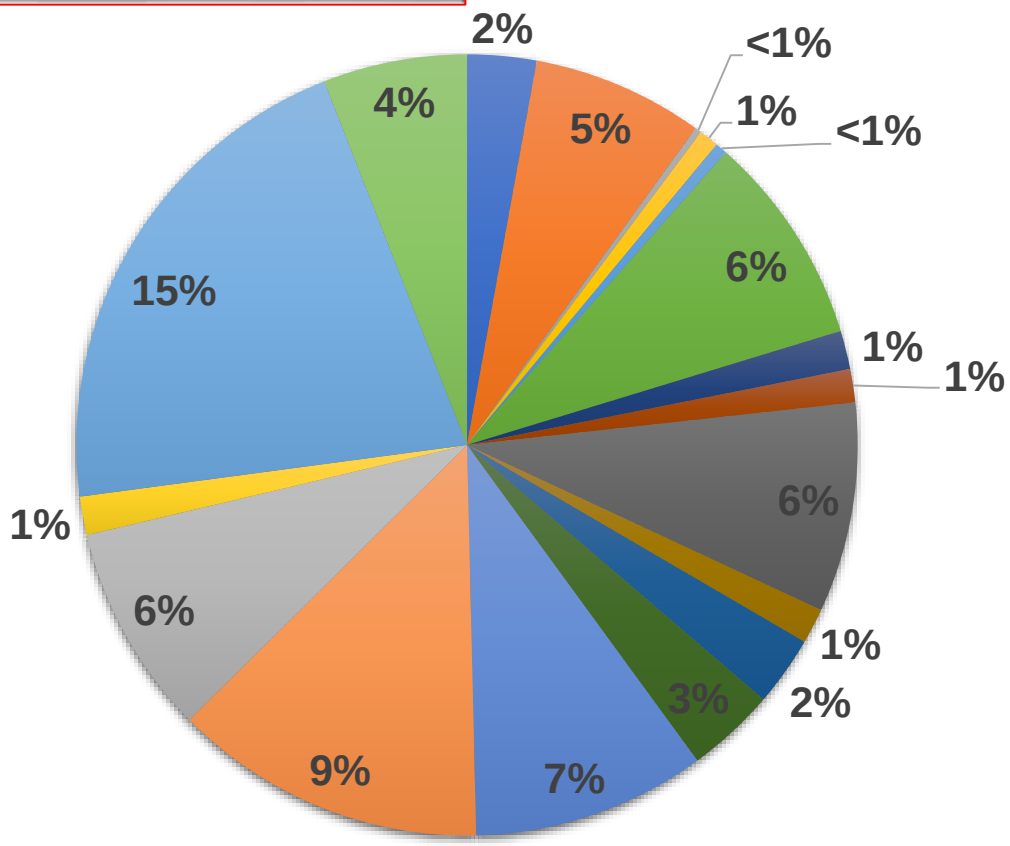
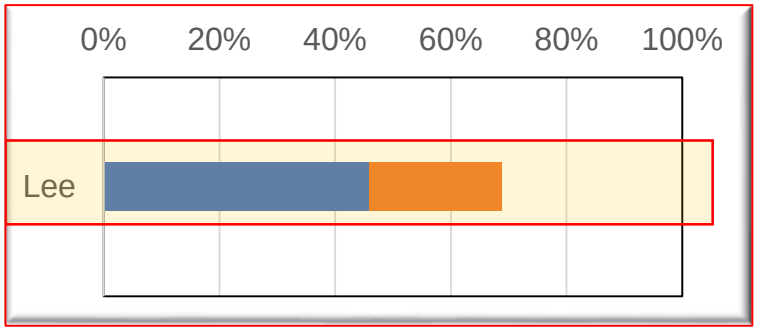
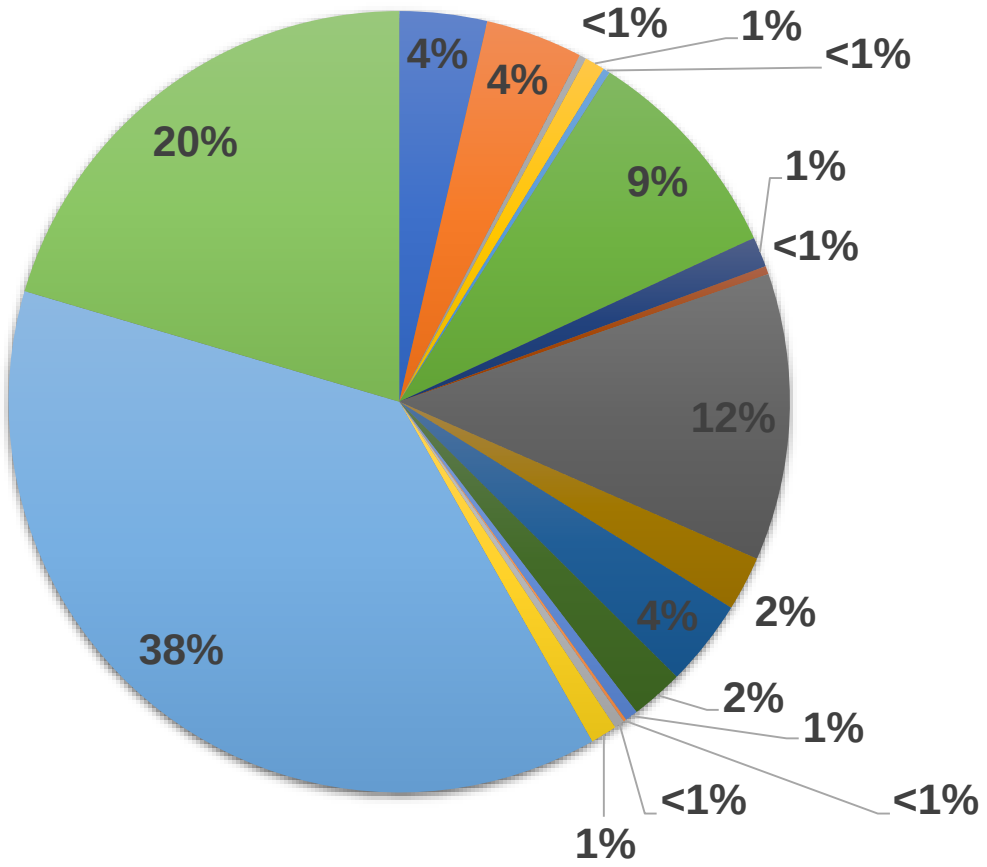




- Newspaper
- Glass
- Aluminum Cans
- Plastic Bottles
- Steel Cans
- Corrugated Paper
- Office Paper
- Other Plastics
- Ferrous Metals
- White Goods
- Non Ferrous Metal
- Other Paper
- Textiles
- Food
- Miscellaneous
- Tires
- C&D Debris
- Yard Trash

Lee County Recycling Rate Breakdown





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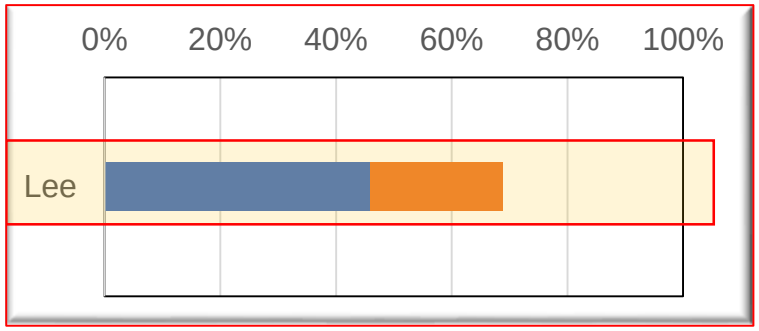

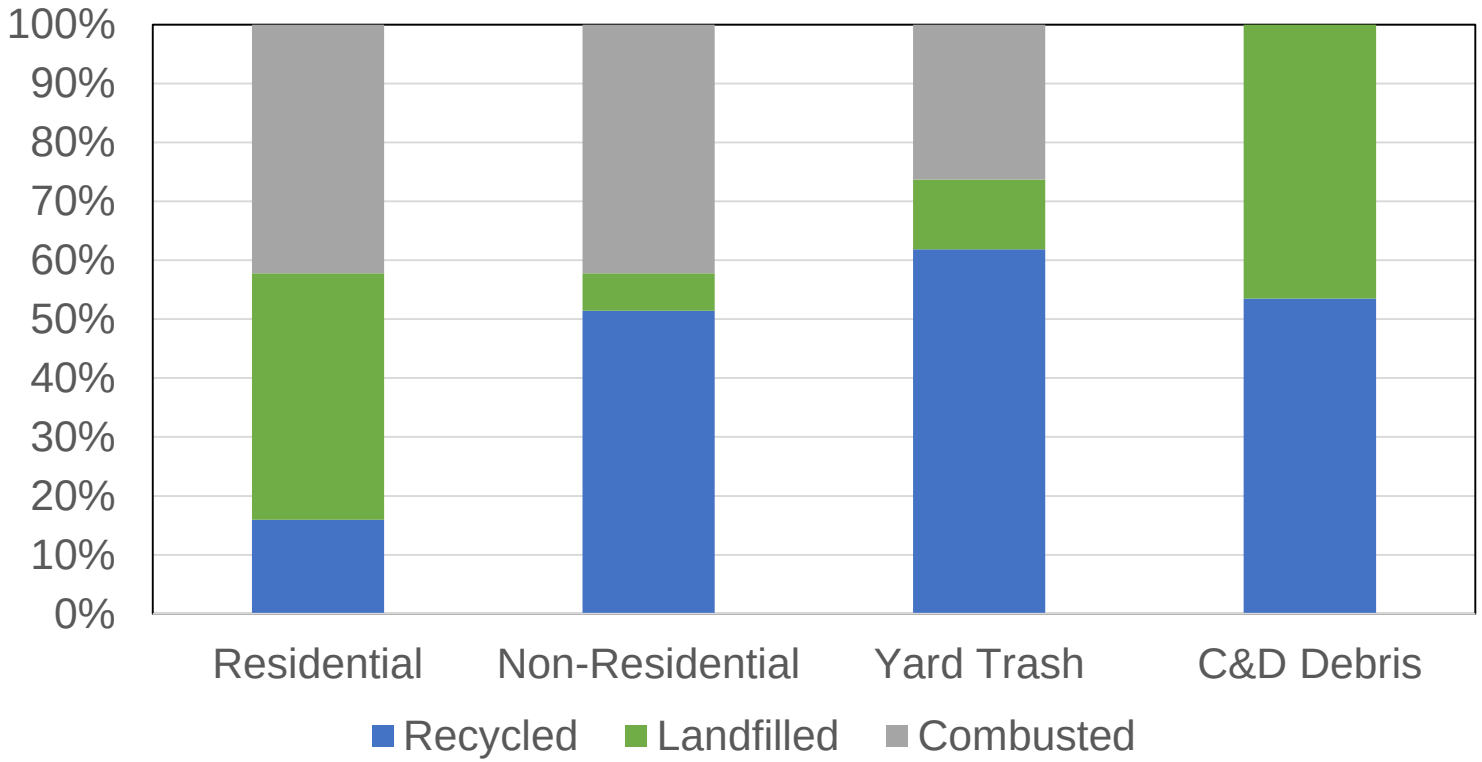

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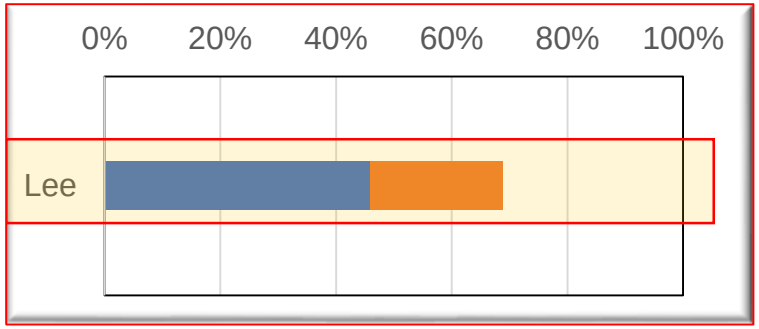
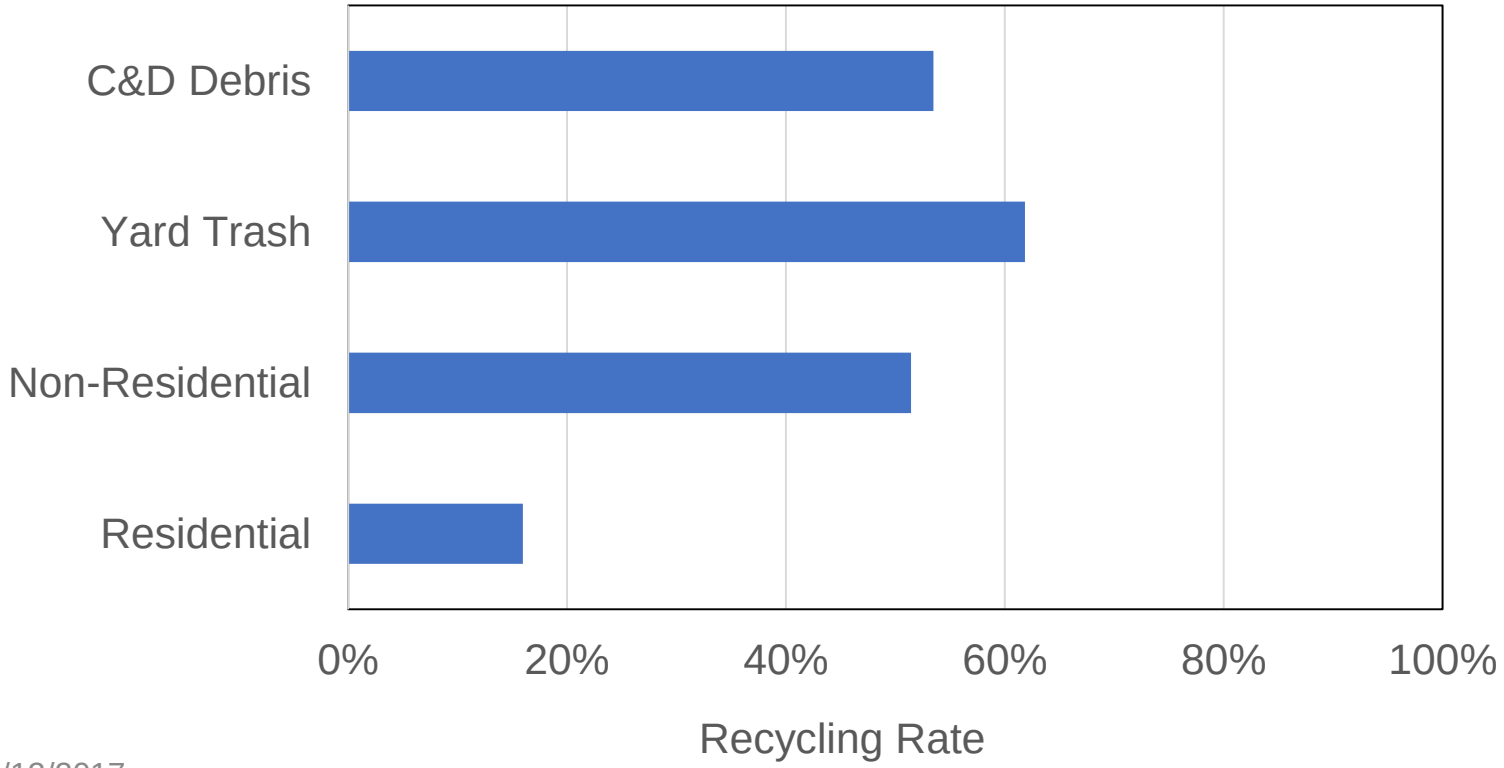
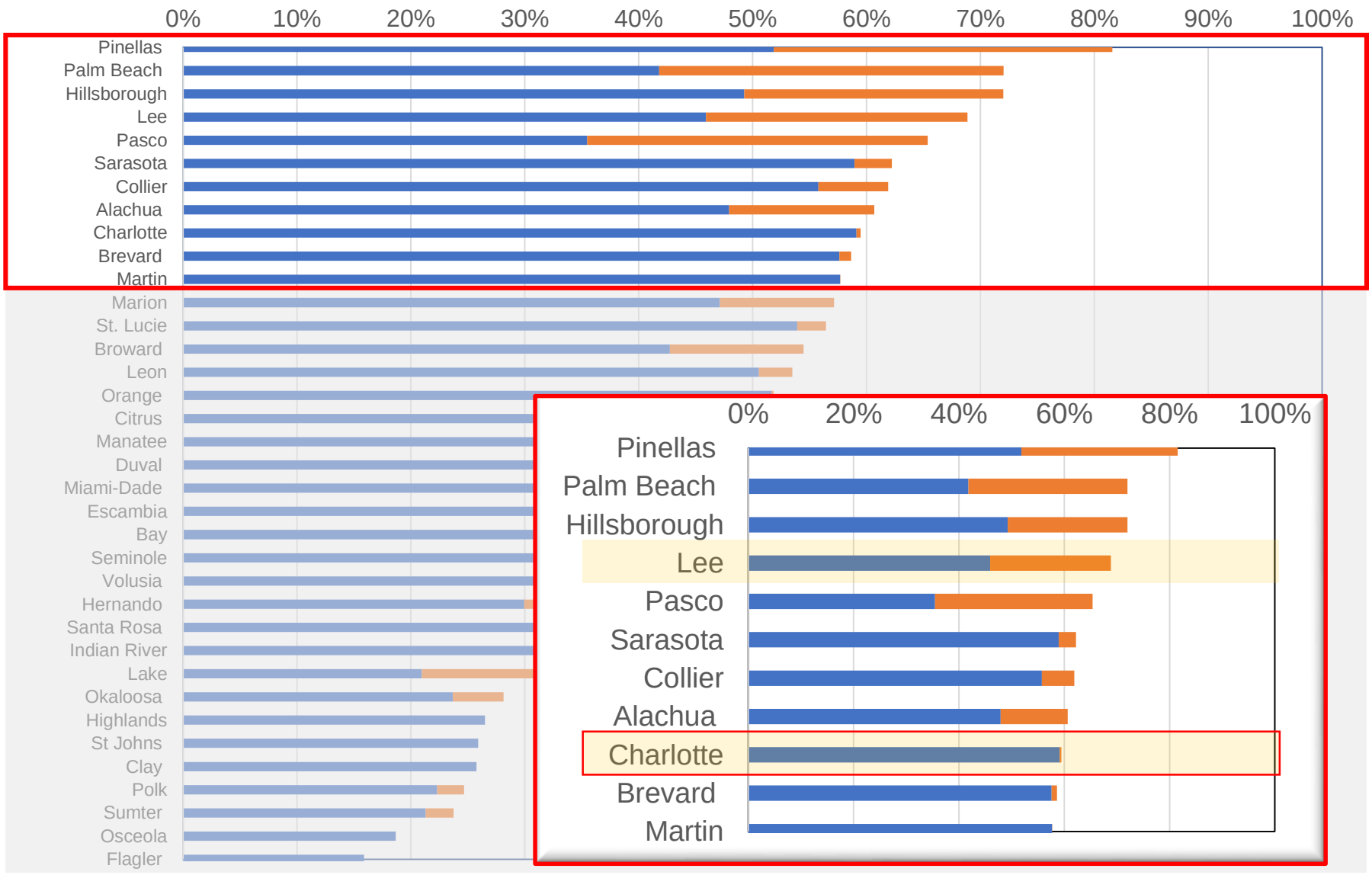




Large Counties Recycling Rate



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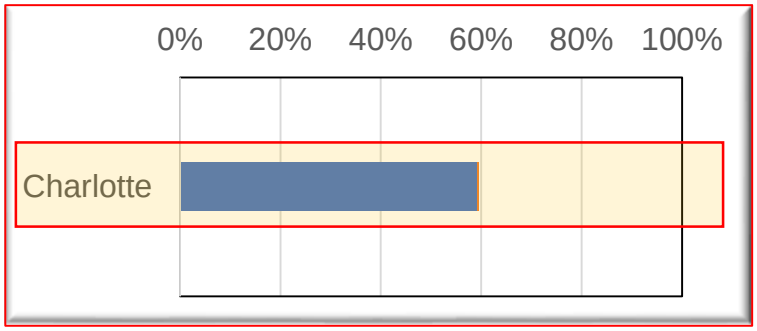
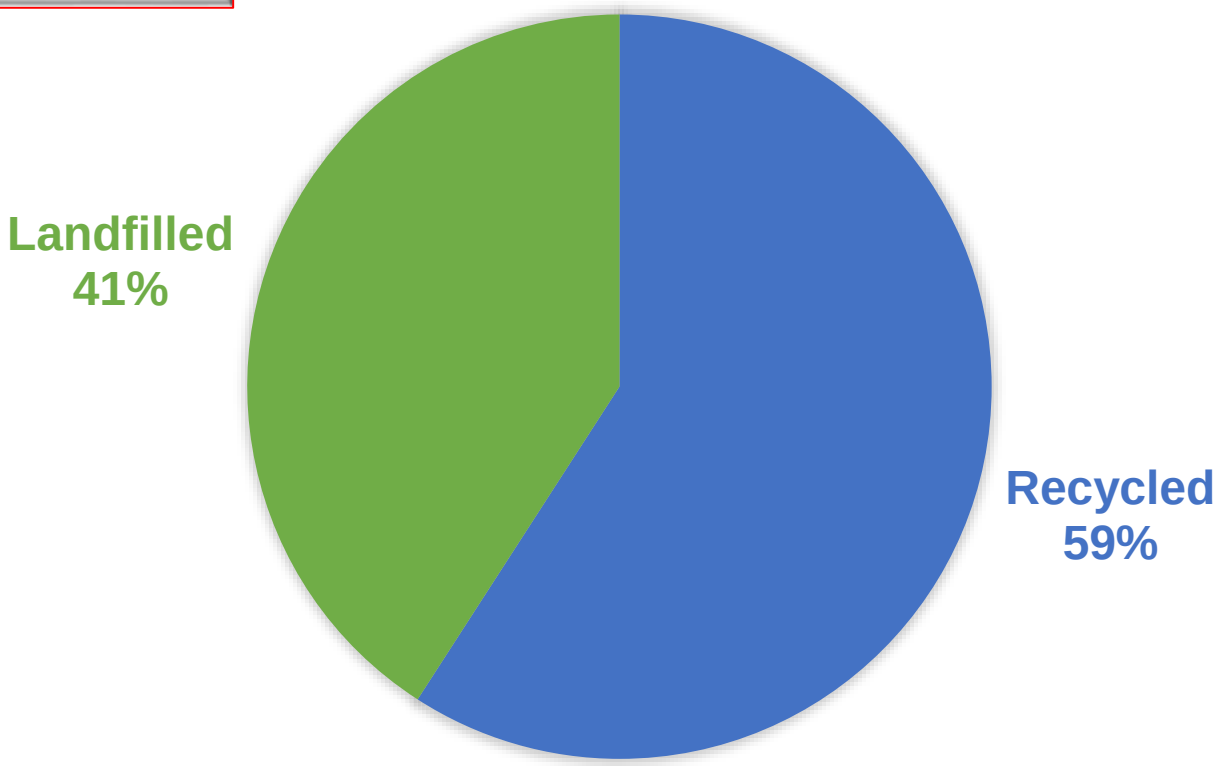
Charlotte County Recycling Rate Breakdown





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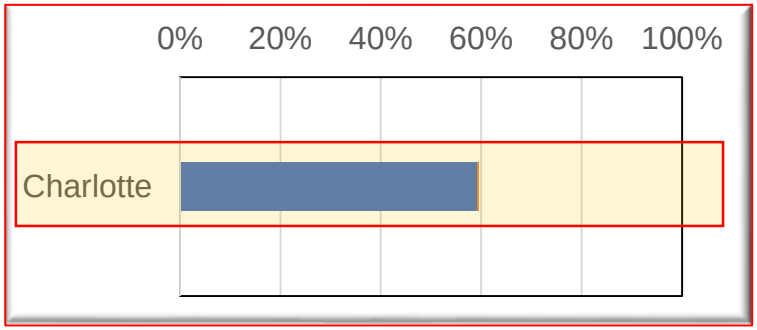

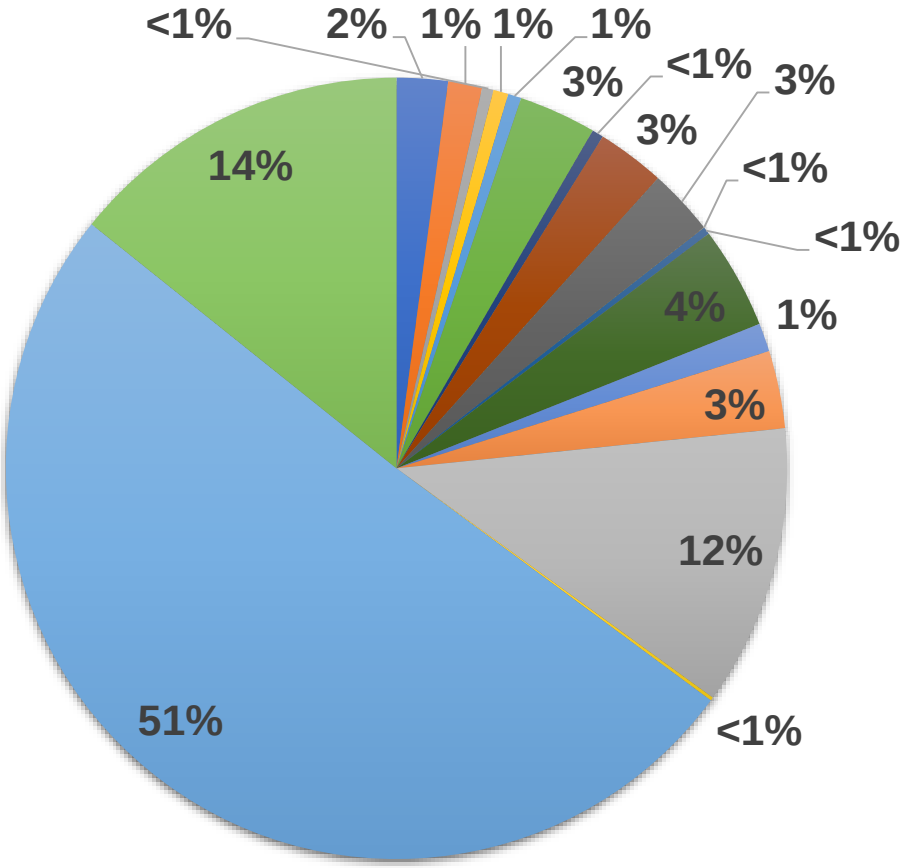

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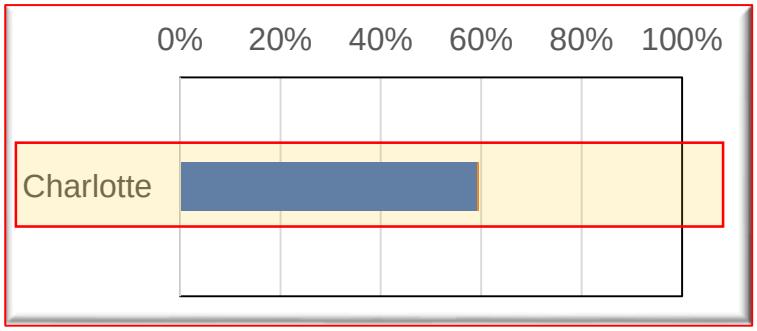

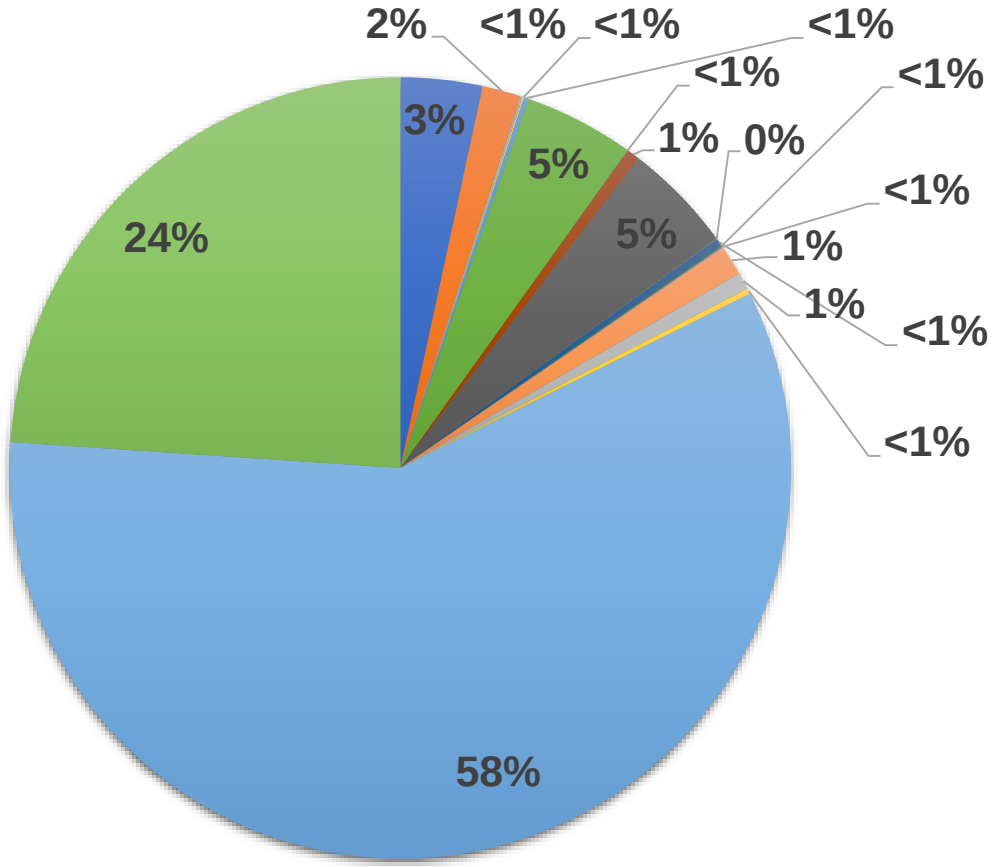

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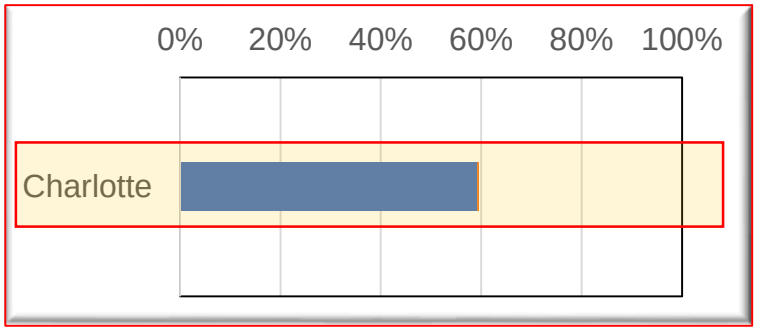
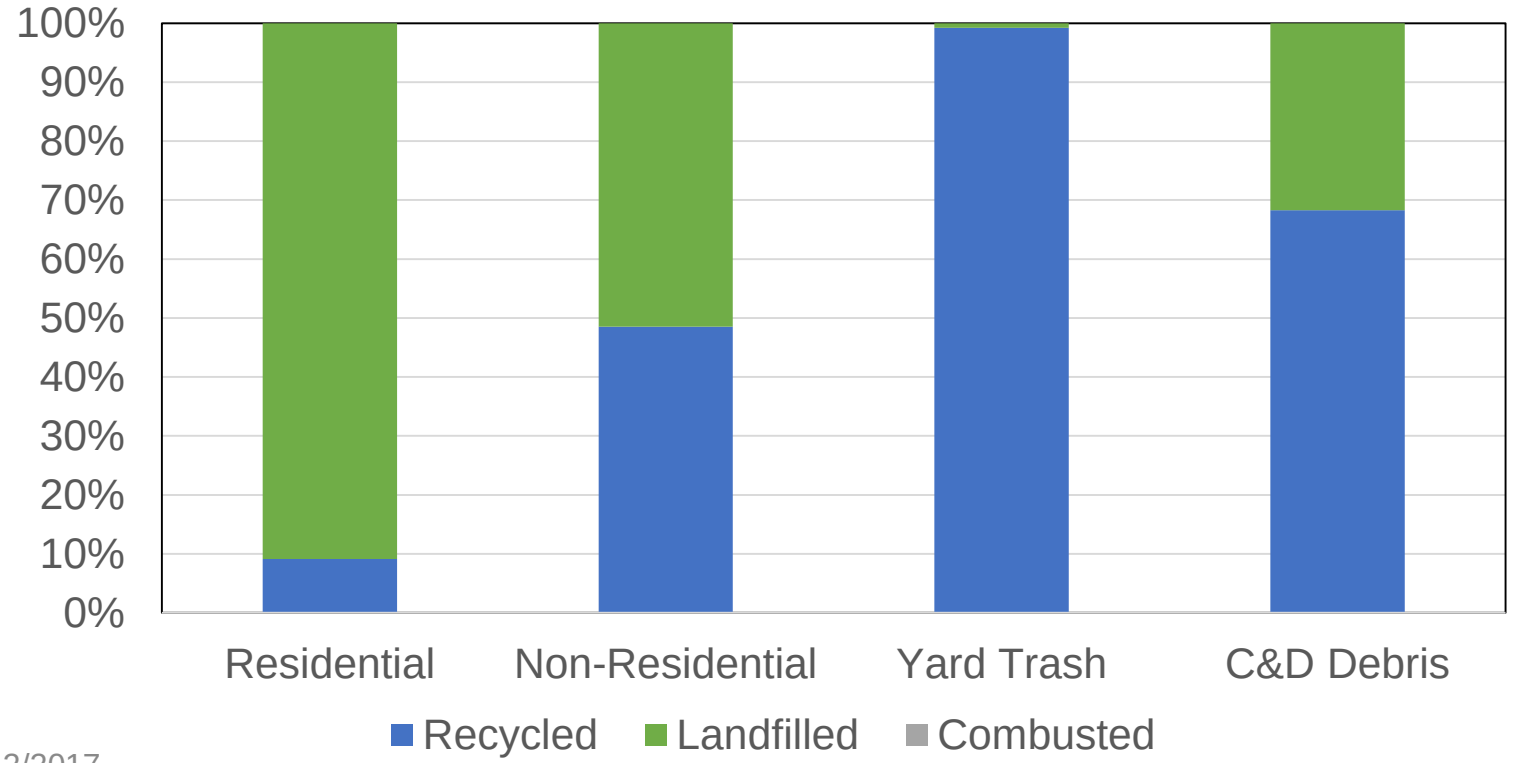
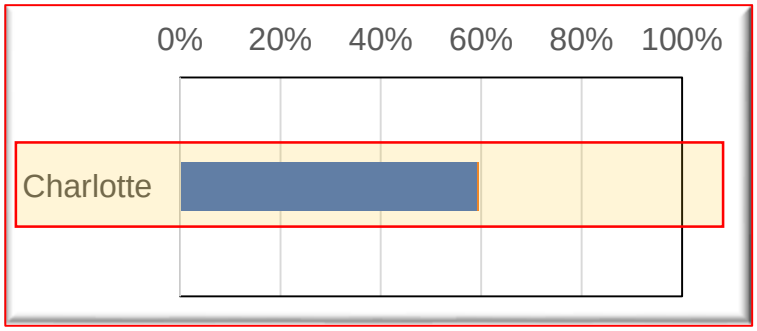
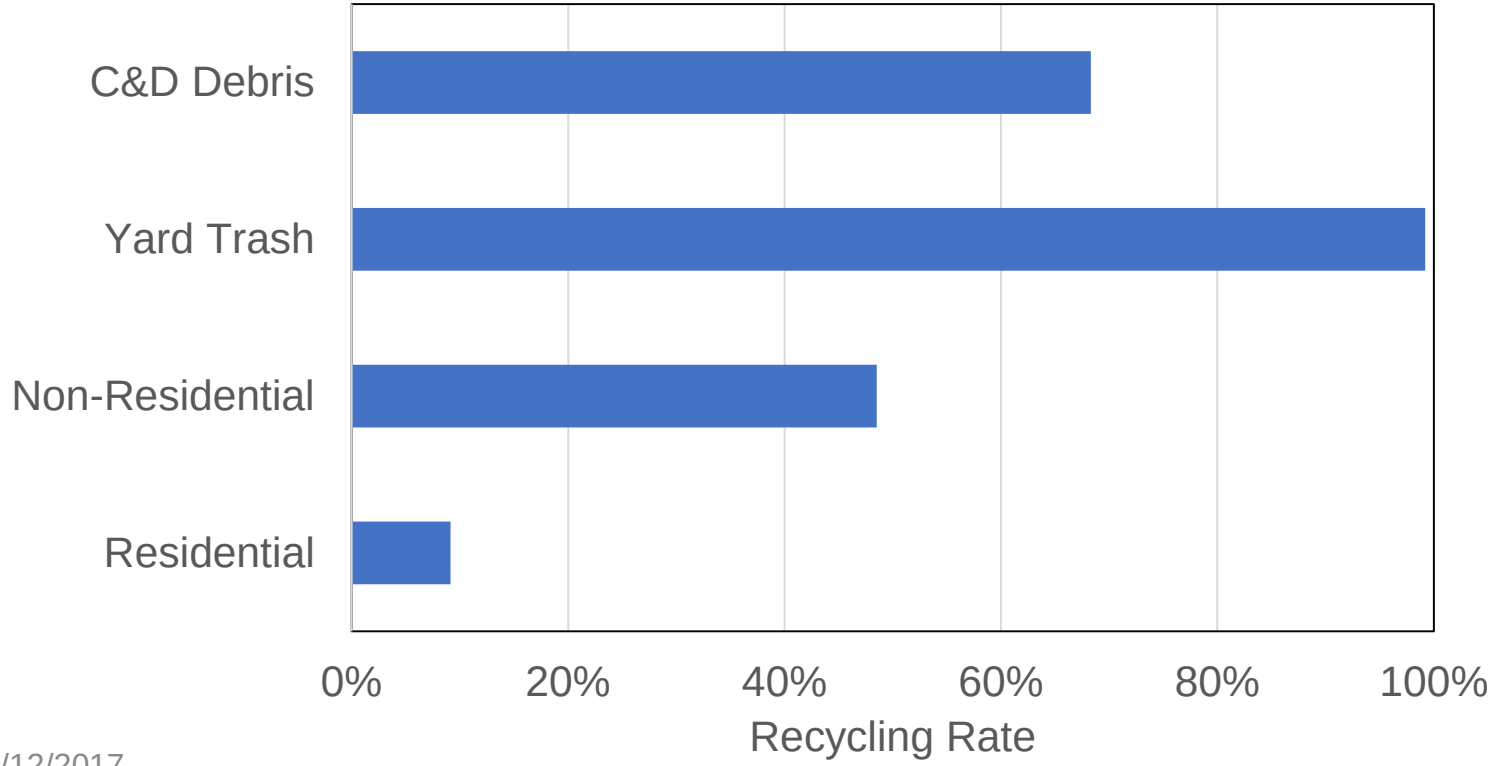


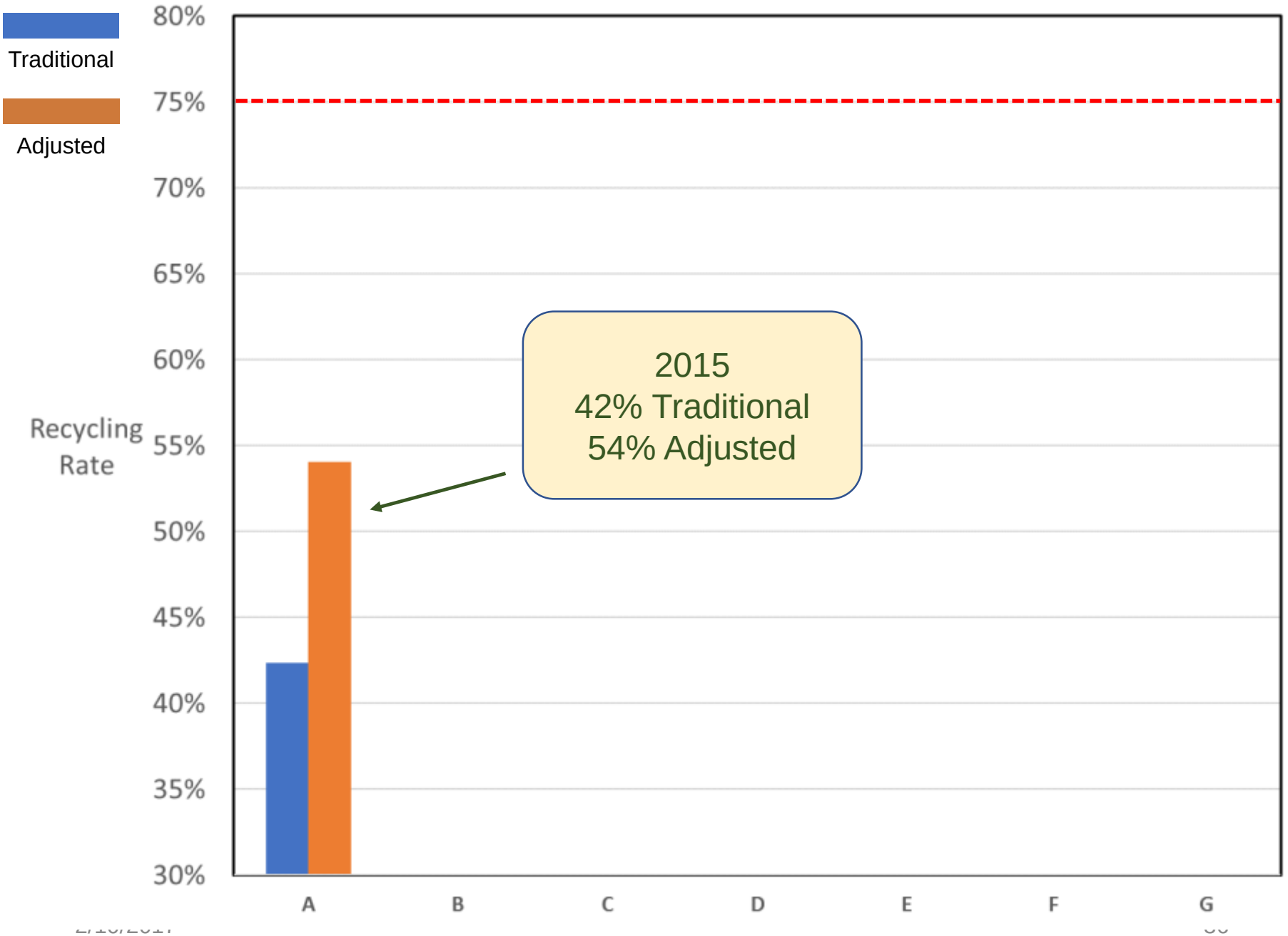


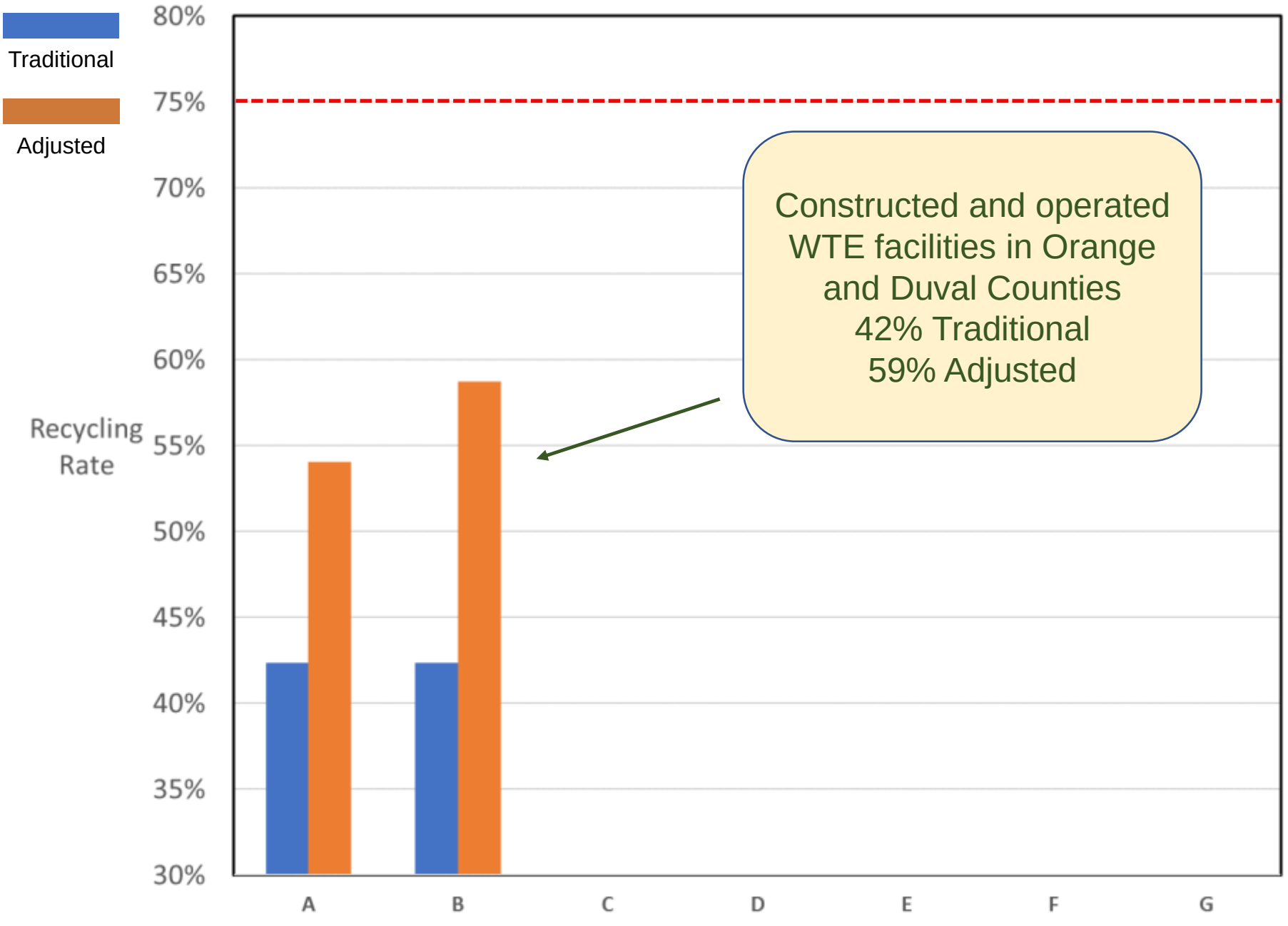
Charlotte County Recycling Rate Breakdown

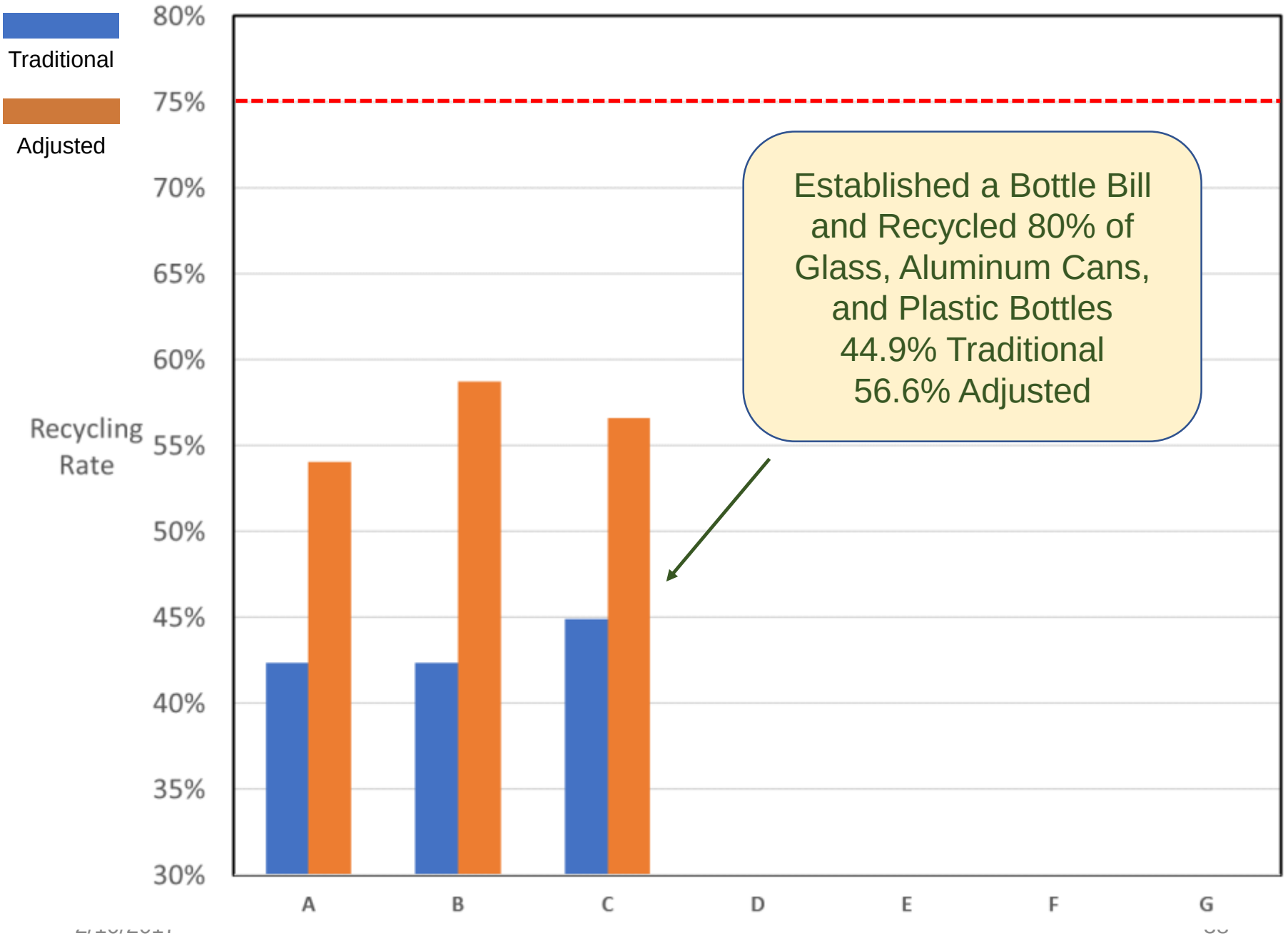


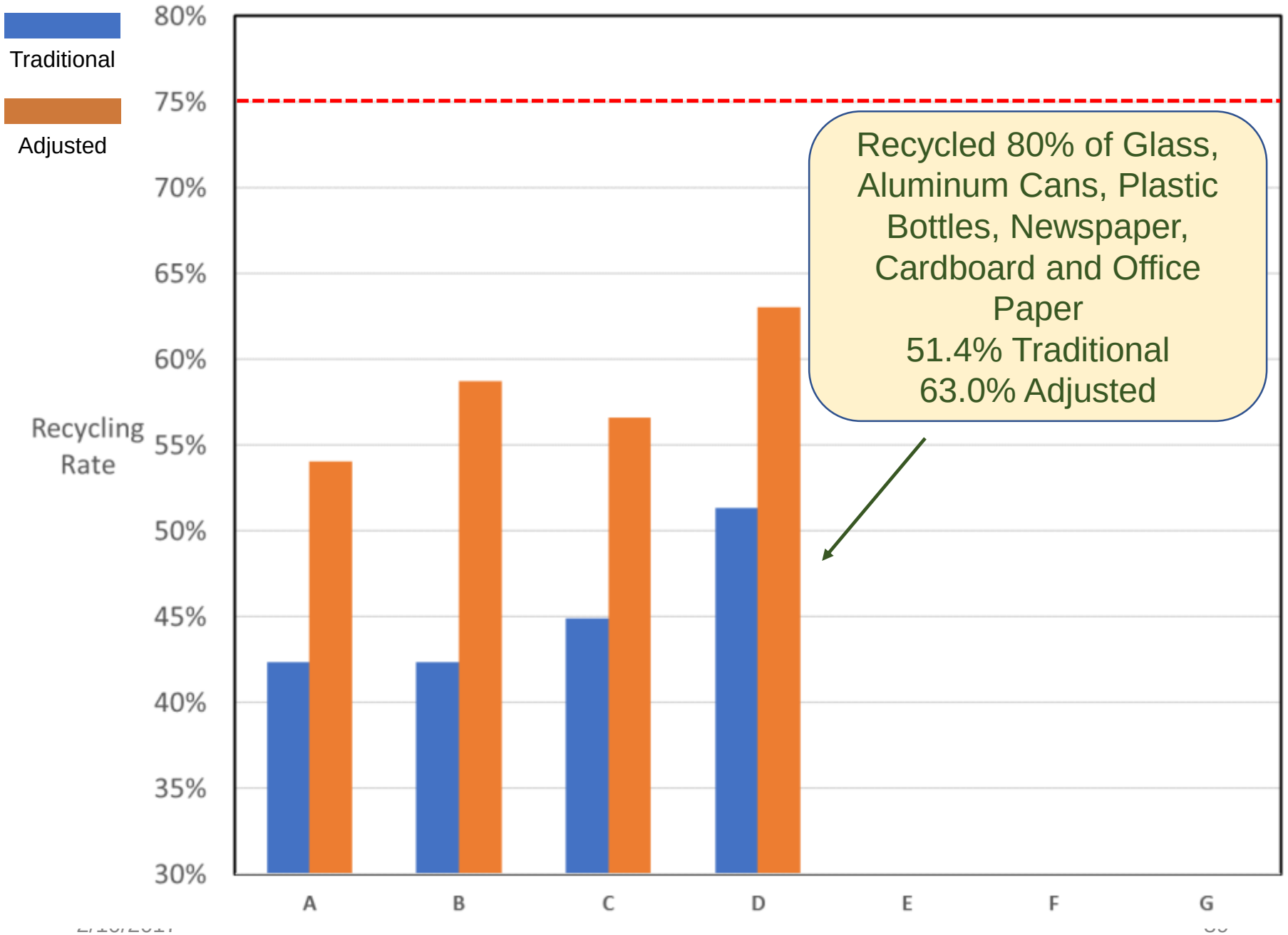


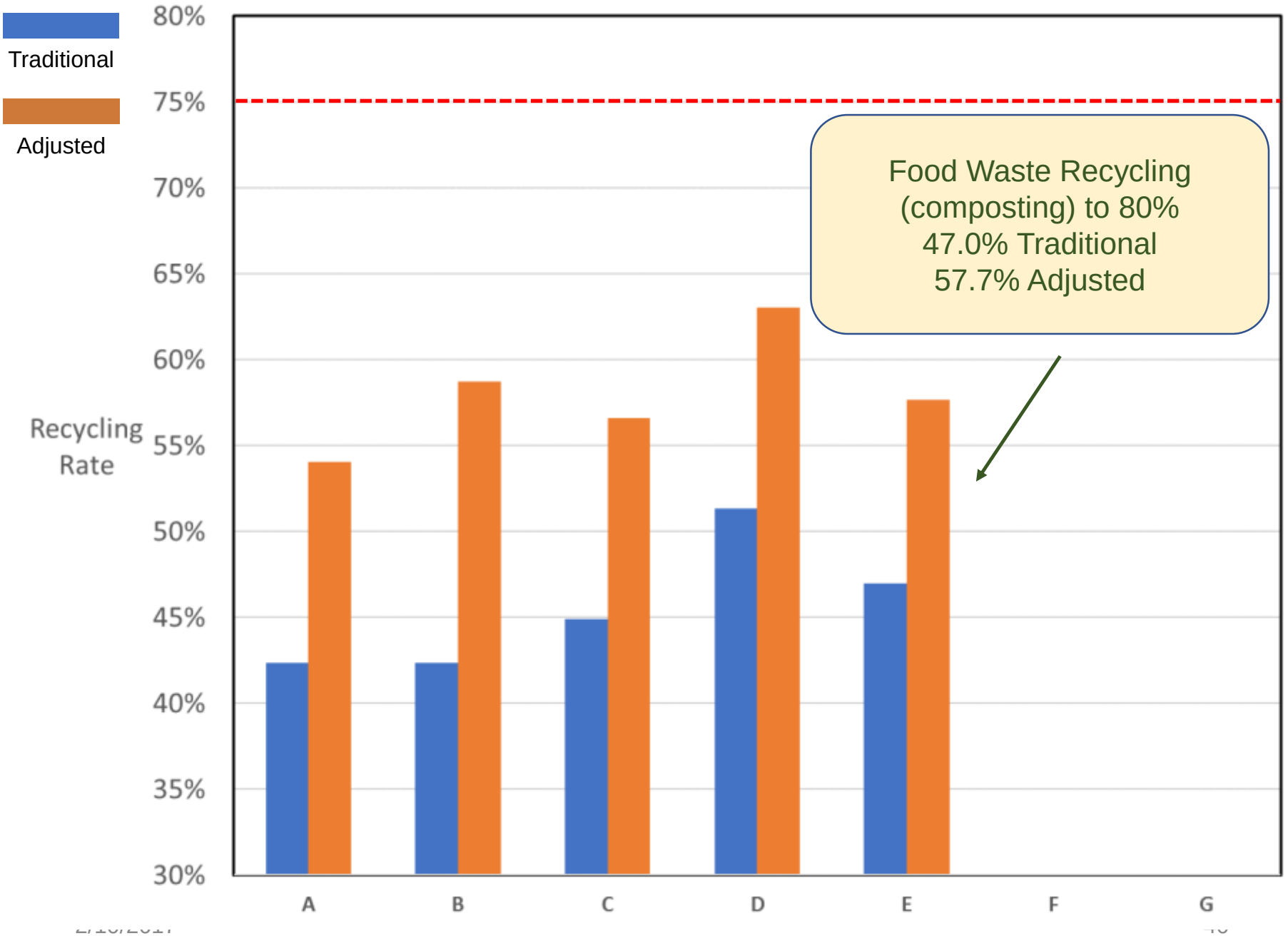
Getting to 75%

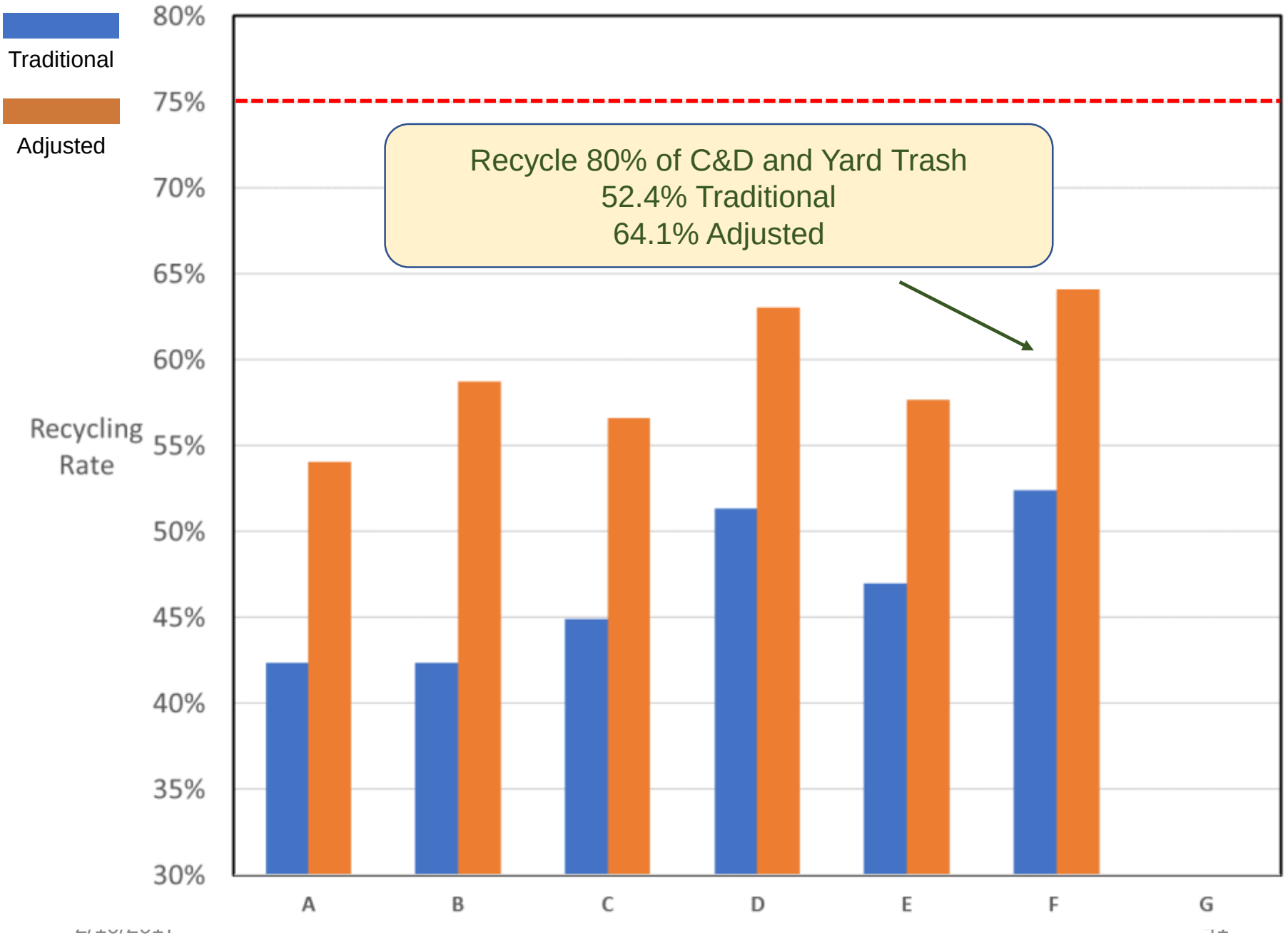

Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
2015
42% Traditional
54% Adjusted
A
B
C
D
E
F
G

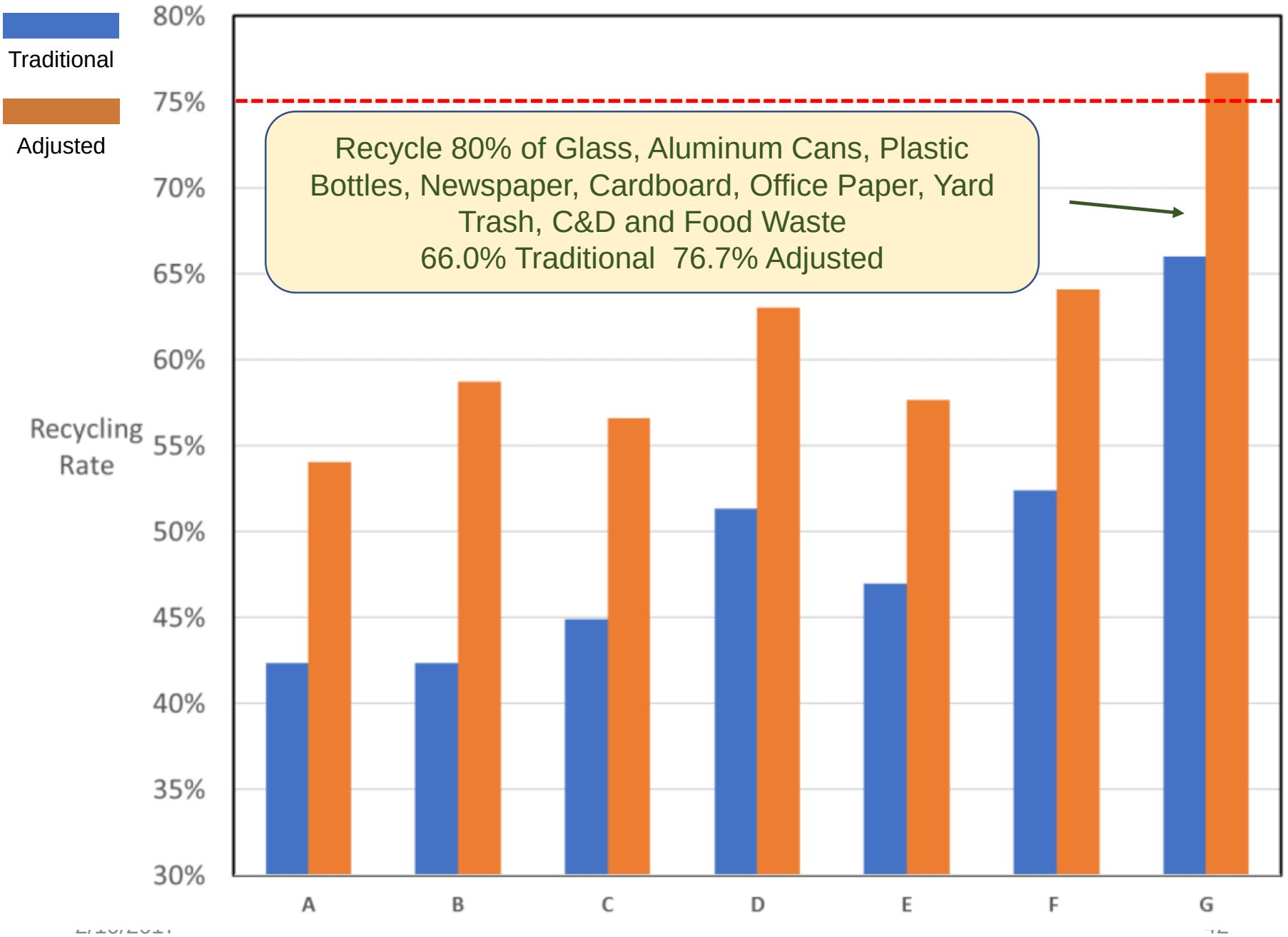

Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
A
B
C
D
E
F
G
Constructed and operated WTE facilities in Orange and Duval Counties
42% Traditional
59% Adjusted


Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
A
B
C
D
E
F
G
Established a Bottle Bill and Recycled 80% of Glass, Aluminum Cans, and Plastic Bottles
44.9% Traditional
56.6% Adjusted


Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
A
B
C
D
E
F
G
Recycled 80% of Glass, Aluminum Cans, Plastic Bottles, Newspaper, Cardboard and Office Paper
51.4% Traditional
63.0% Adjusted


Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
A
B
C
D
E
F
G
Food Waste Recycling (composting) to 80%
47.0% Traditional
57.7% Adjusted


Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
Recycle 80% of C&D and Yard Trash
52.4% Traditional
64.1% Adjusted
A
B
C
D
E
F
G


Traditional
Adjusted
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
Recycling Rate
Recycle 80% of Glass, Aluminum Cans, Plastic Bottles, Newspaper, Cardboard, Office Paper, Yard Trash, C&D and Food Waste
66.0% Traditional 76.7% Adjusted
A
B
C
D
E
F
G

The Challenge with Recycling Rates

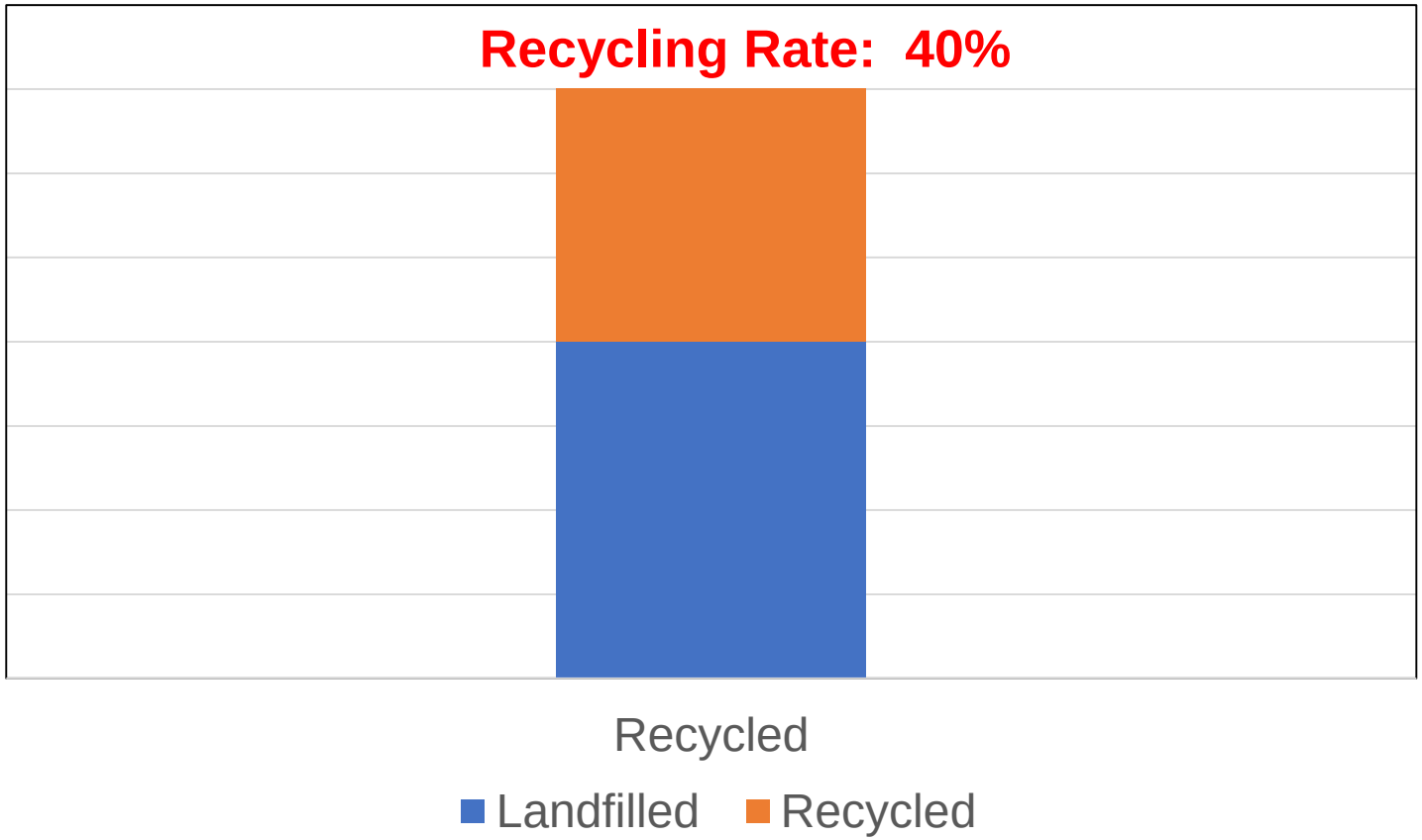
$$\text{Recycling Rate} = \frac{\text{Waste Recycled}}{\text{Waste Recycled} + \text{Waste Disposed}}$$

- Doesn't track efforts in reduction
- All materials are treated equal
- All recycling is treated equal

The Challenge with Recycling Rates

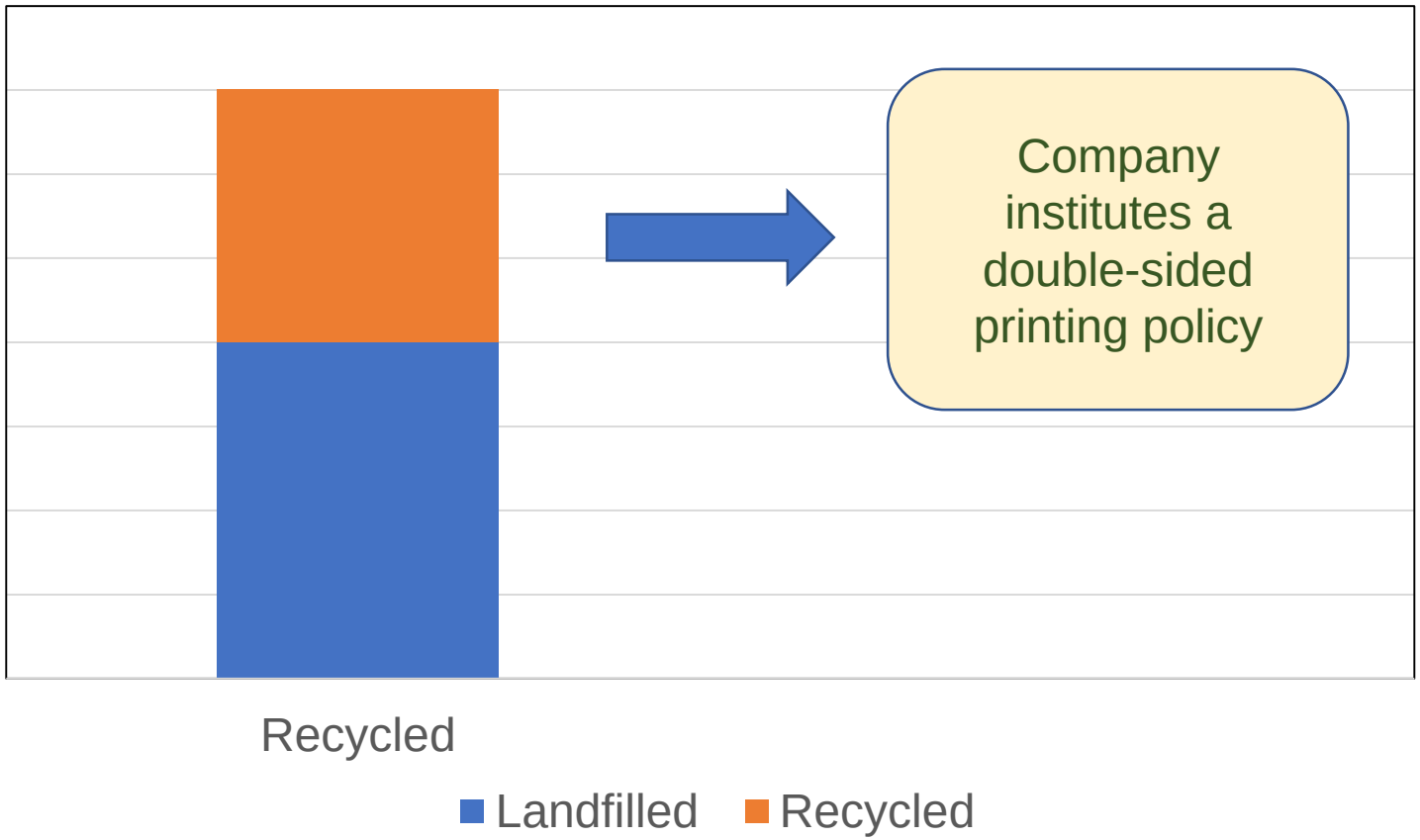
Consider this,

- A company currently has a heavy emphasis on recycling office paper:



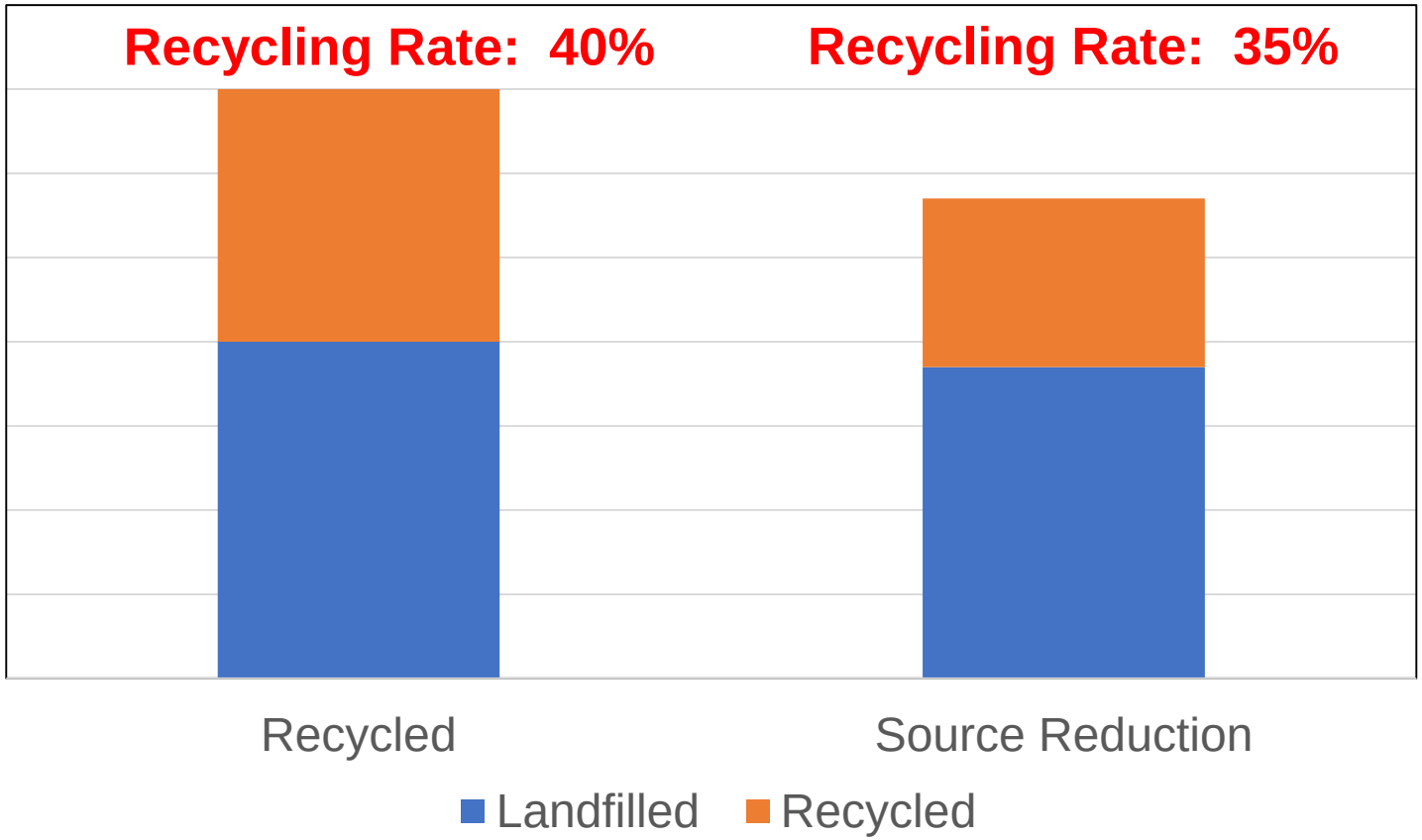
The Challenge with Recycling Rates

Doesn't track efforts in reduction



The Challenge with Recycling Rates

Doesn't track efforts in reduction



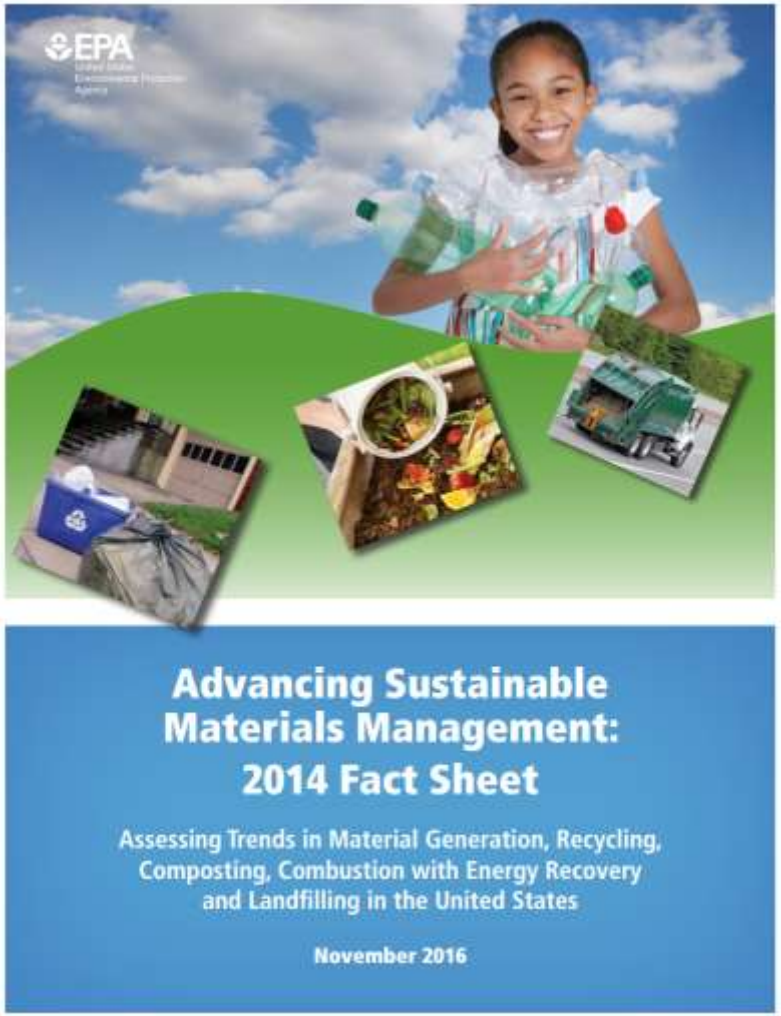


Sustainable Materials Management



Sustainable Materials Management

- SMM is a systemic approach to using and reusing materials more productively over their entire life cycles. It represents a change in how our society thinks about the use of natural resources and environmental protection. By looking at a product's entire lifecycle we can find new opportunities to reduce environmental impacts, conserve resources, and reduce costs.



https://www.epa.gov/smm


CAT
320C
CAT

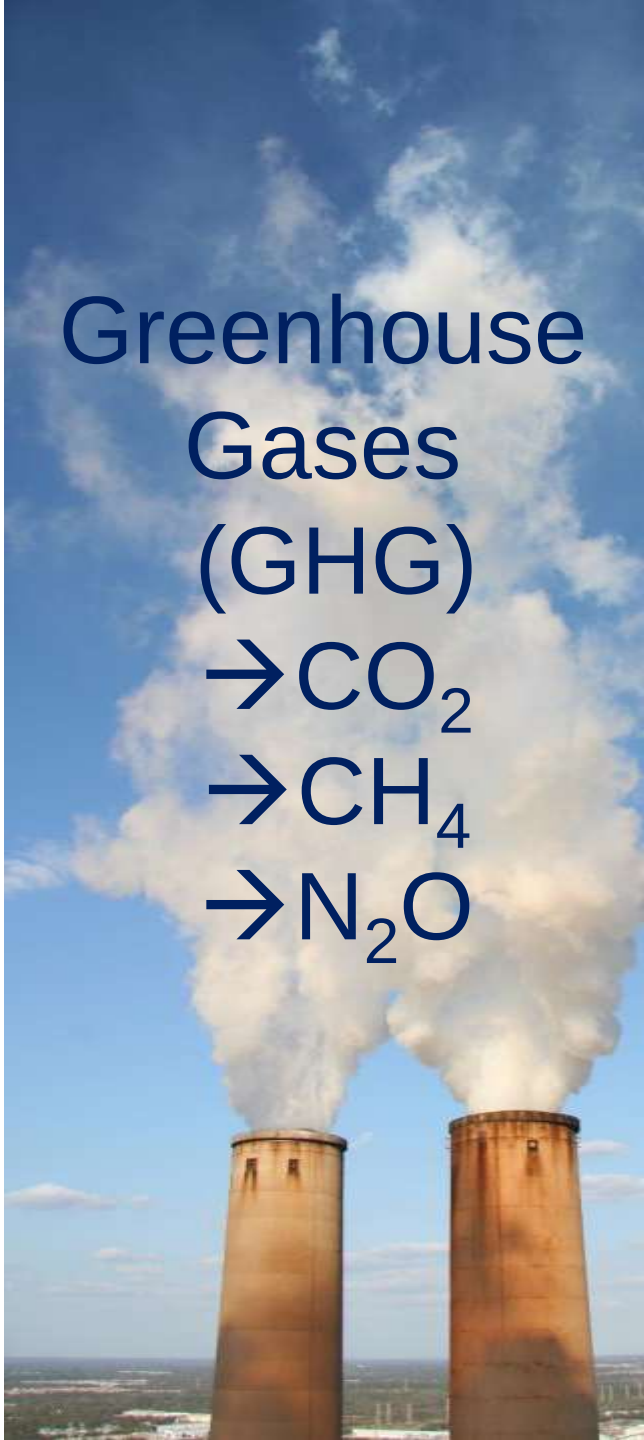
Tracking Life Cycle Impacts of Alternative Solid Waste Management Strategies

- Instead of looking at the % of material's mass recycled, why not look at the "environmental burden" associated with its waste management.
- Environmental burden categories:
  - Global warming
  - Energy consumption/production
  - Toxicity
  - Acidification
  - Eutrophication
  - Ozone depletion
  - Water consumption
- SMM tools
  - Open LCA
  - Municipal Solid Waste Decision Support Tool (MSW DST)
  - Waste Reduction Model (WARM)
  - Waste and Resources Assessment Tool for the Environment (WRATE; UK)

EPA WARM Model

Waste and Climate Change

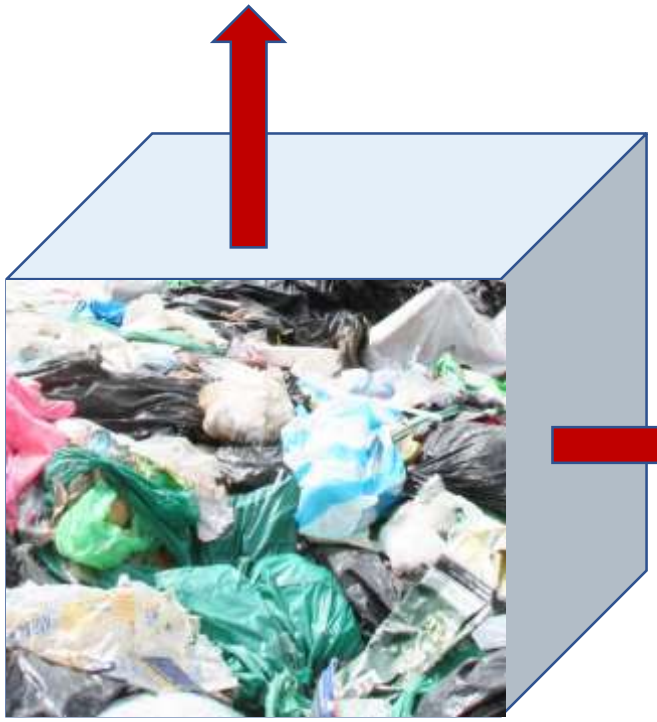
- The relationship of waste management to climate change
- Waste management alternatives
  - Source reduction
  - Recycling
  - Biological treatment
  - Thermal treatment
  - Land disposal
- Assessment tools
- Potential for outcomes



GHG Emission Factors

Net CO_2, CH_4, N_2O, …

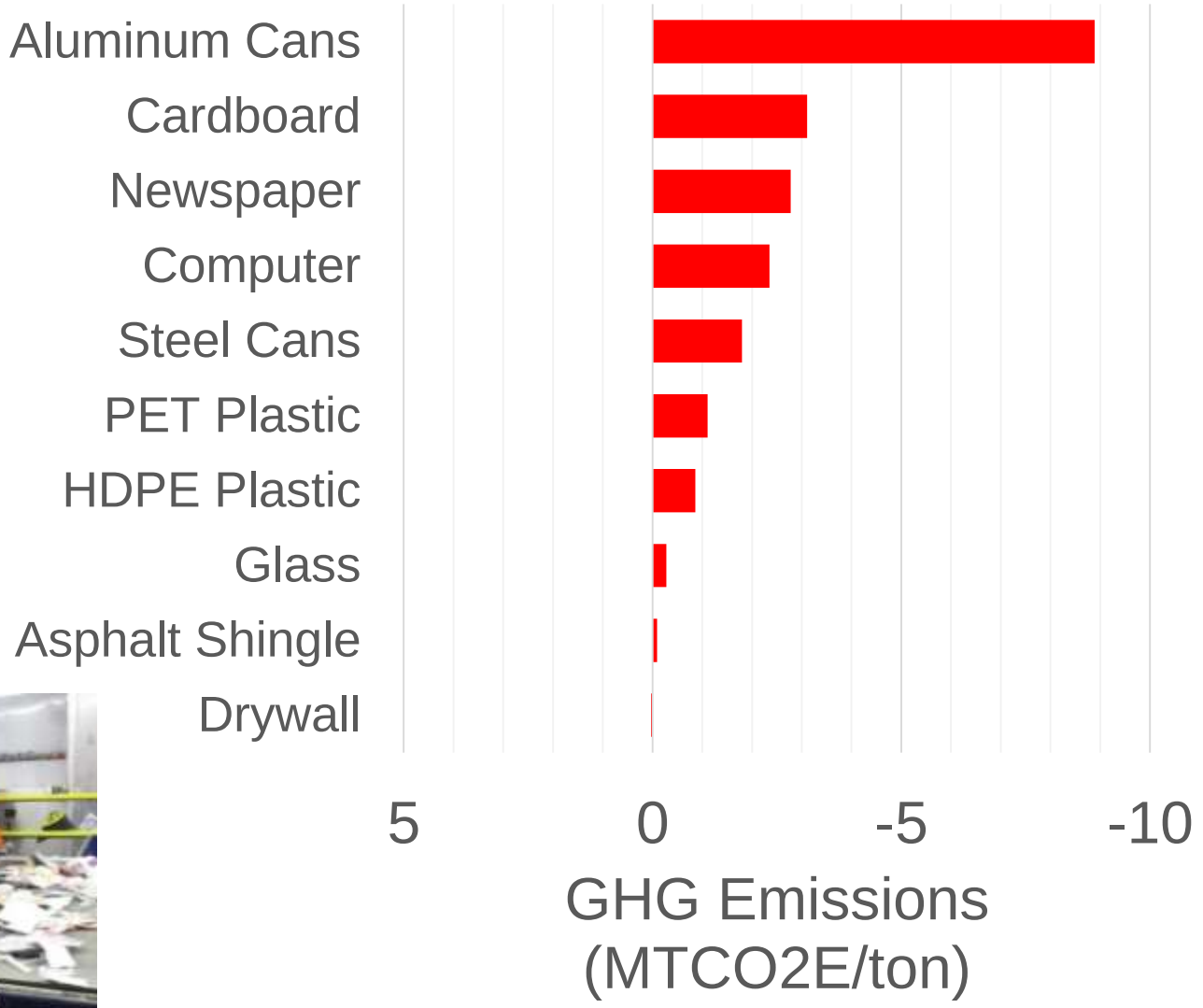
Metric Tons of CO_2 Equivalents ($MTCO_2E$)



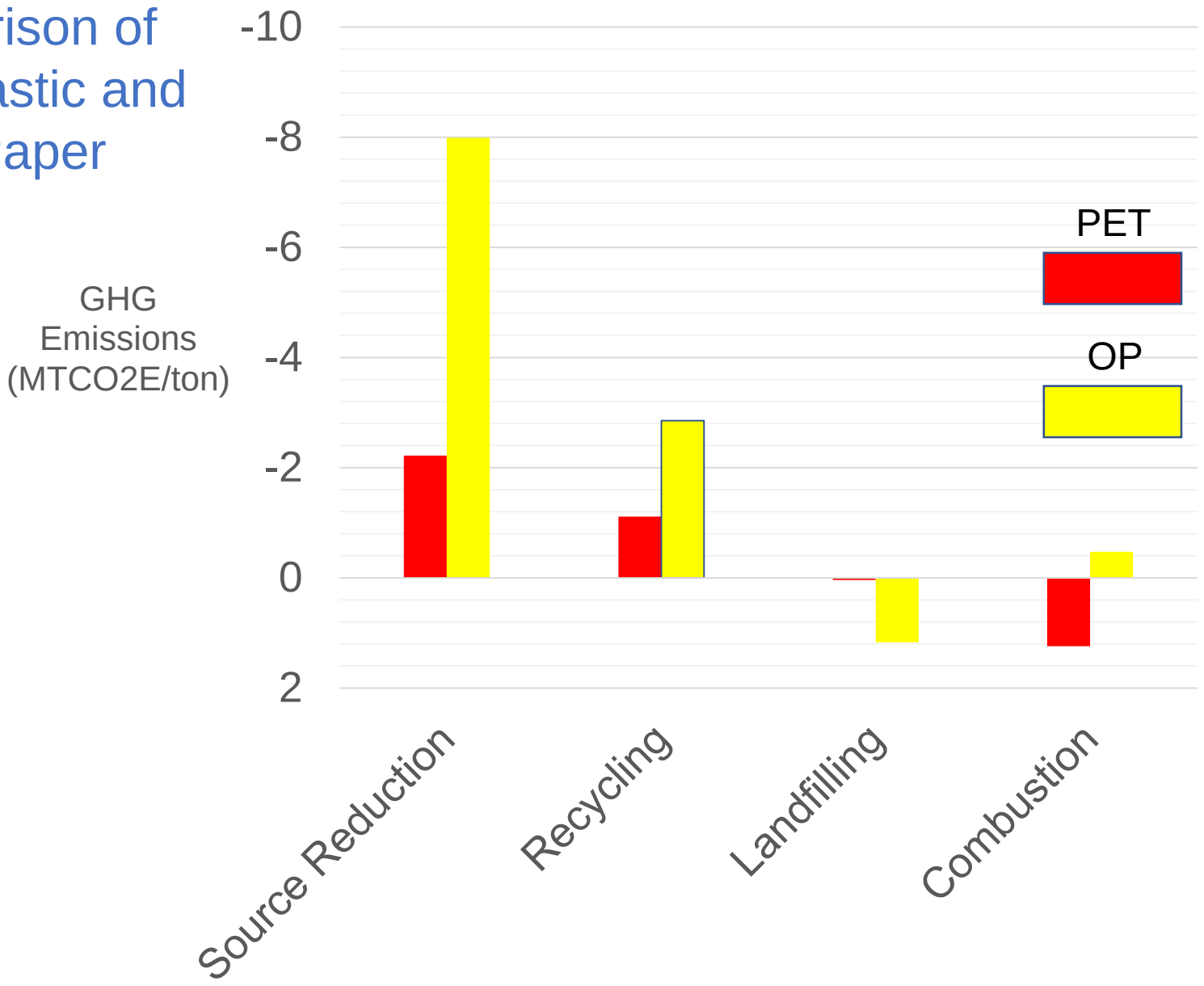
Mass of Waste

$$\frac{MTCO_2E}{Ton\ Waste}$$

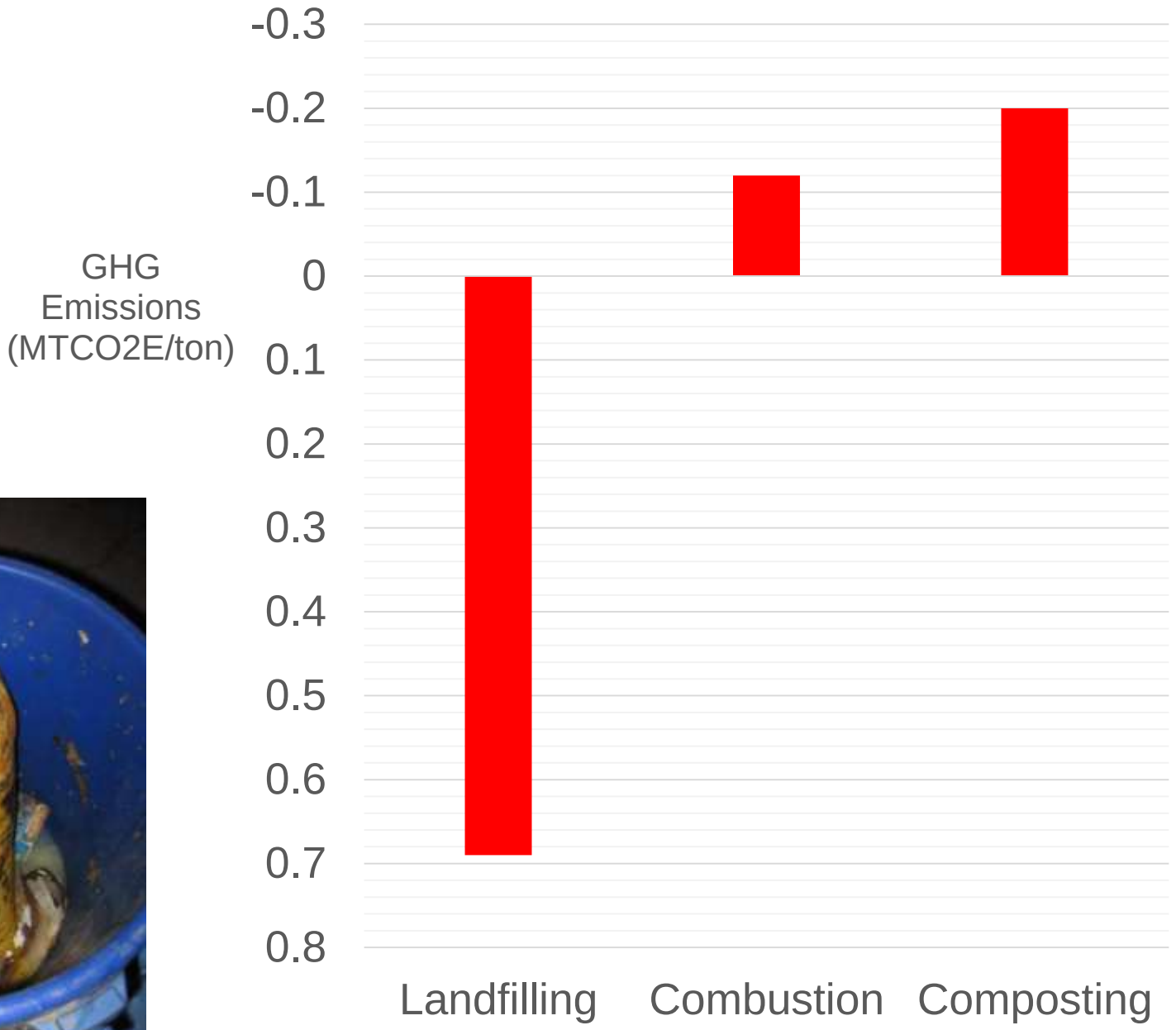
WARM GHG Emission Factors for Recycling



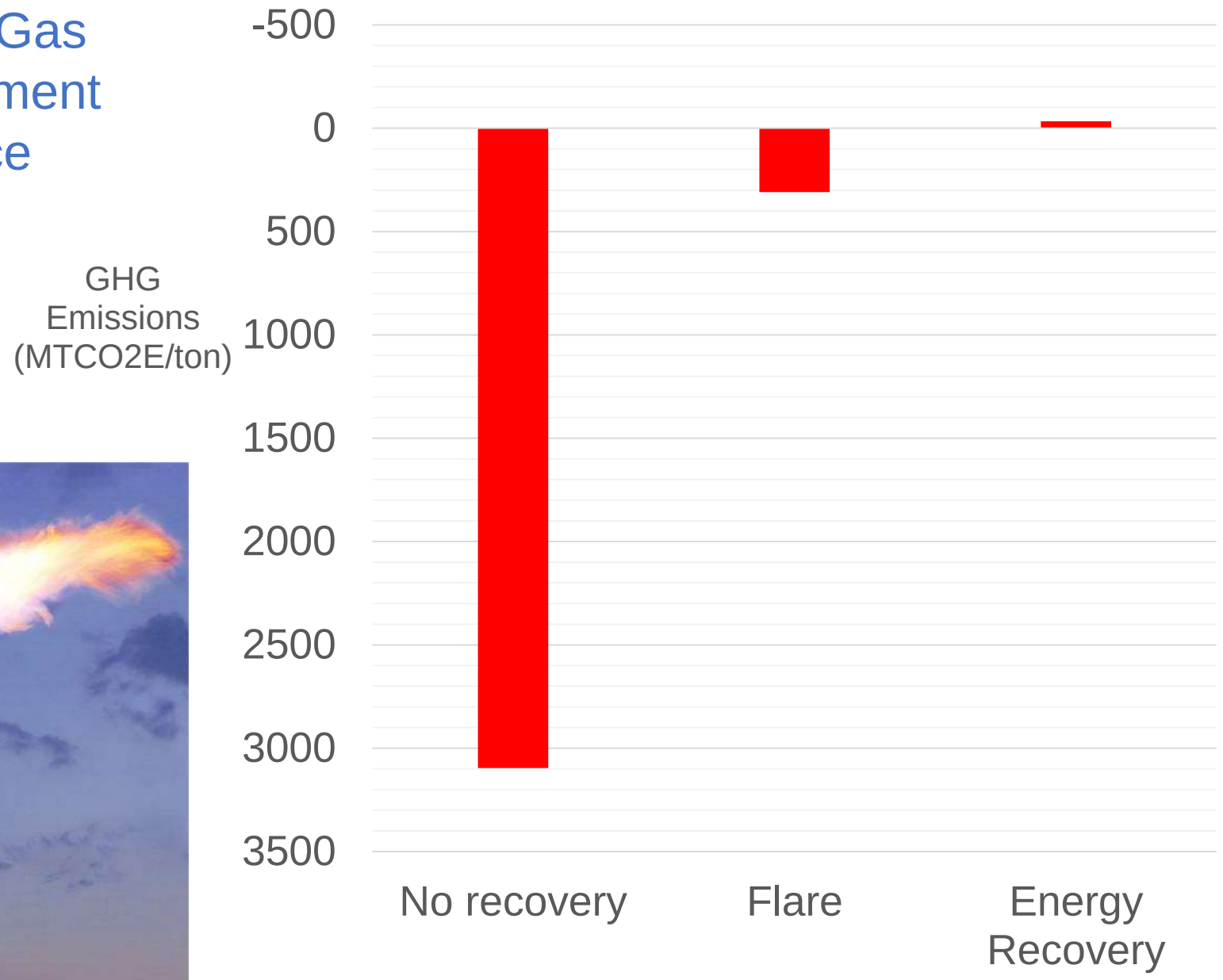
Comparison of PET Plastic and Office Paper



Food Waste

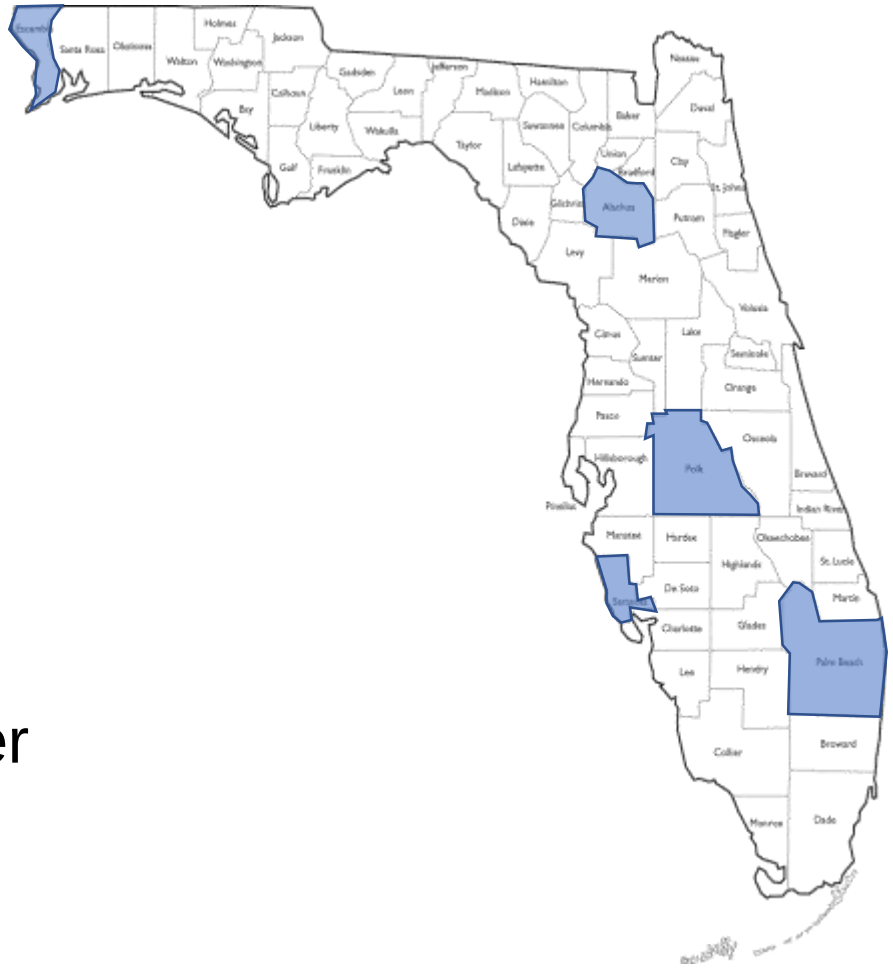

GHG Emissions (MTCO2E/ton)
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Landfilling
Combustion
Composting

Landfill Gas Management Choice

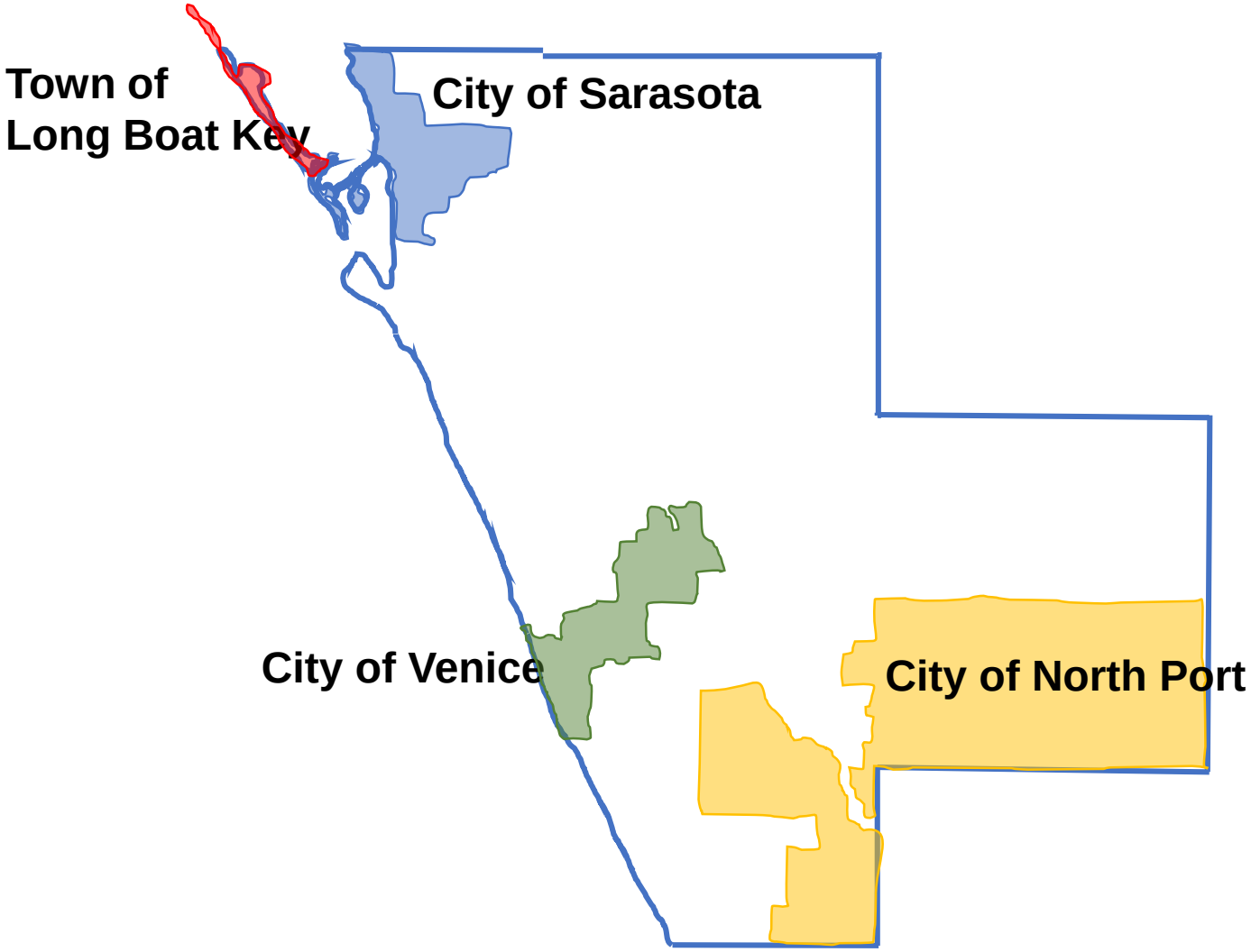


Opportunities to Apply SMM Tools and Principles to Waste Management Decision Making

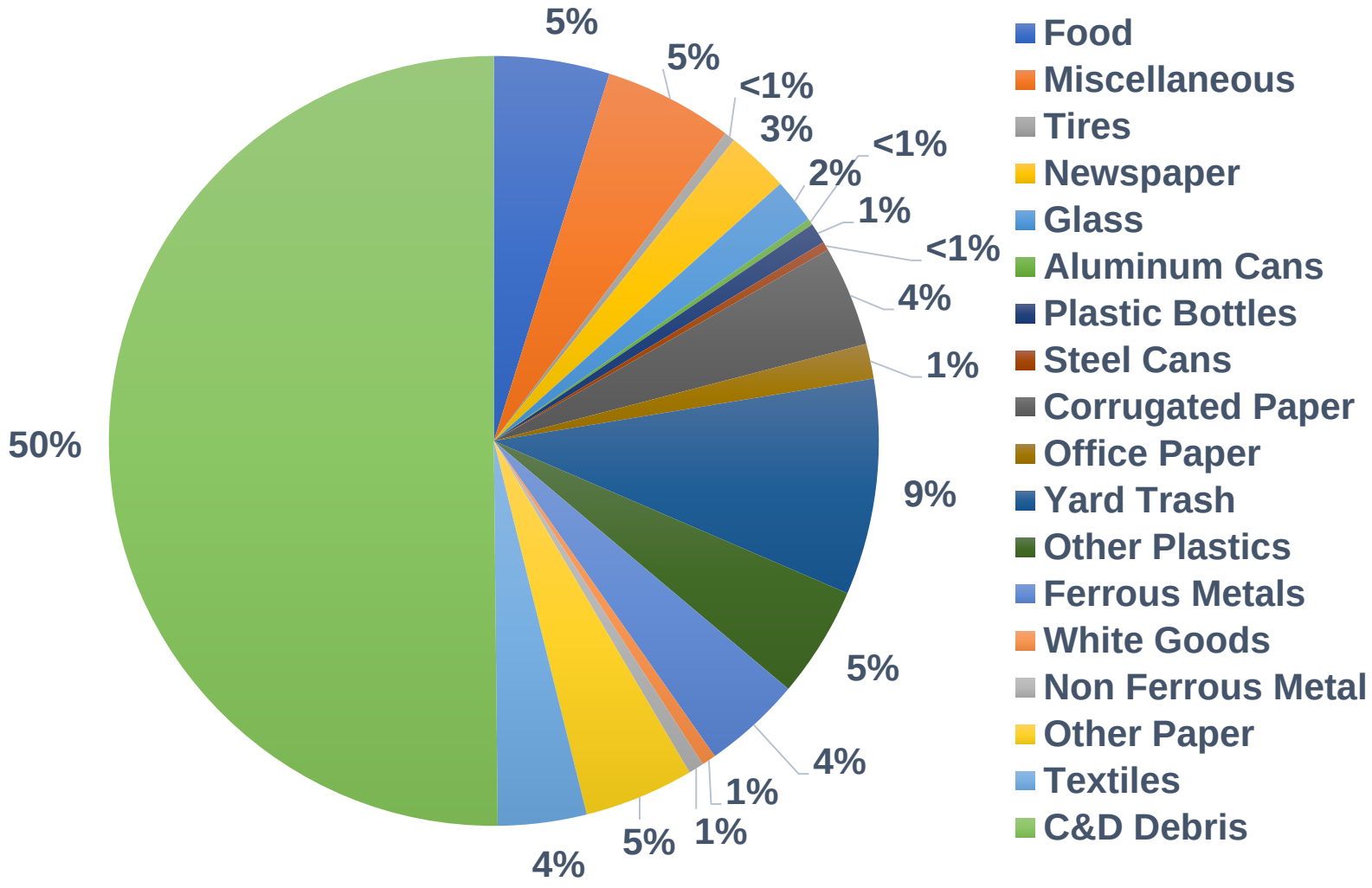
- A state or community could use a life cycle model to evaluate priorities for developing regulations or policies
  - Compare different scenarios (e.g., waste to energy versus SSO) to assess which approach provides the overall lower environmental burden.



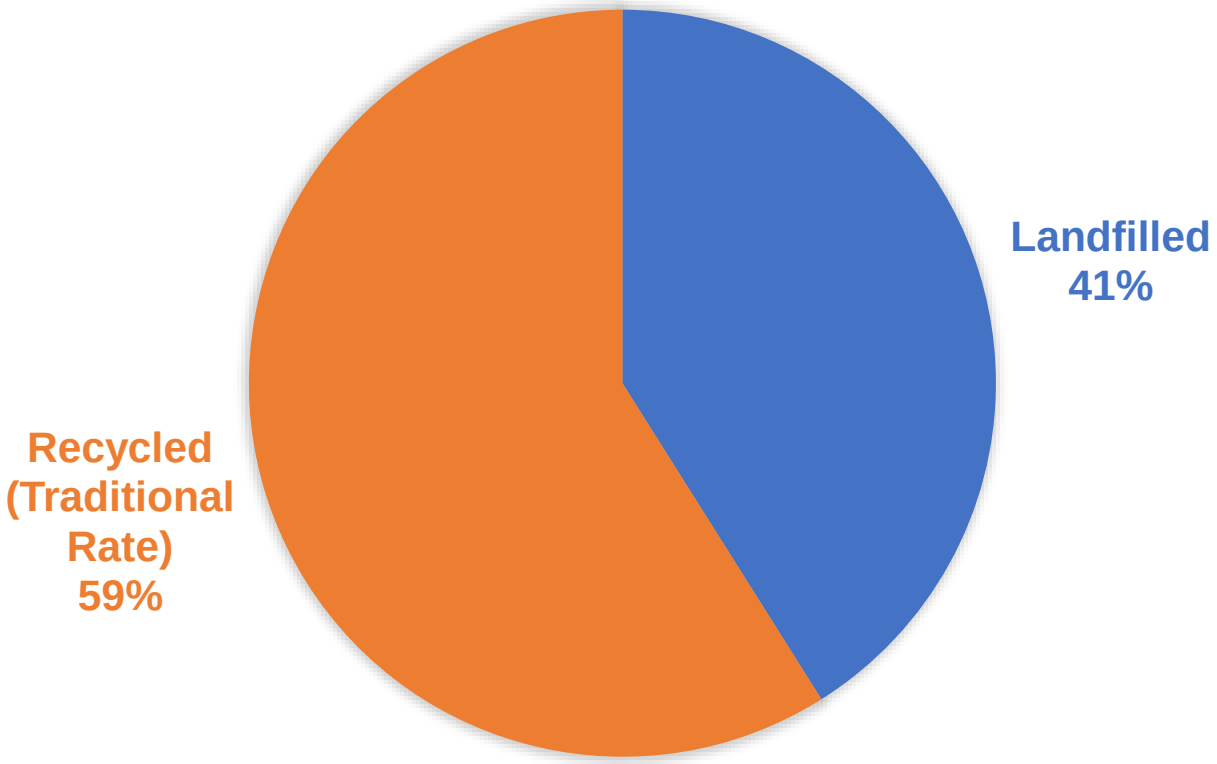
Sarasota County Case Study



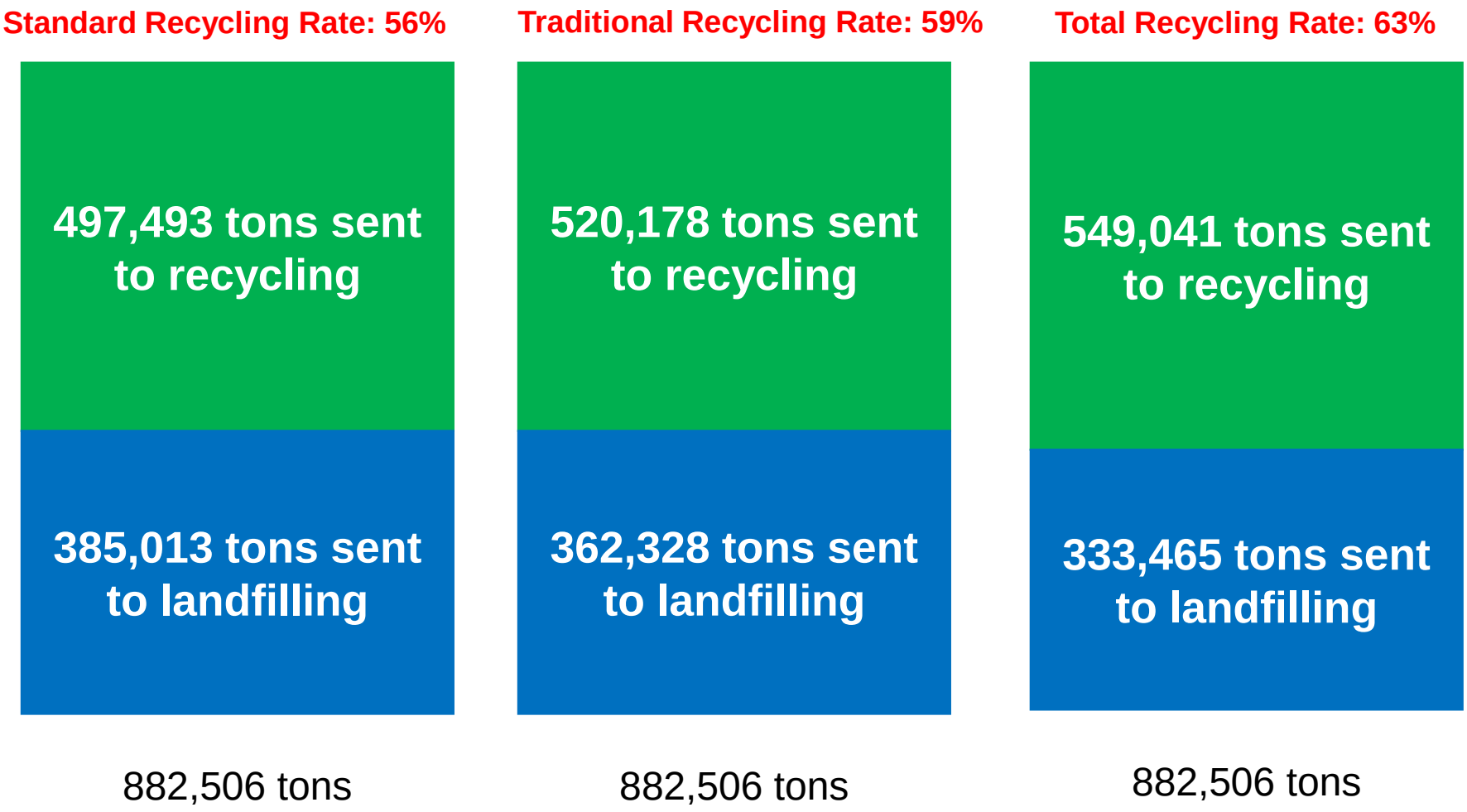
2015 Collection Solid Waste Composition



2015 Solid Waste Disposition

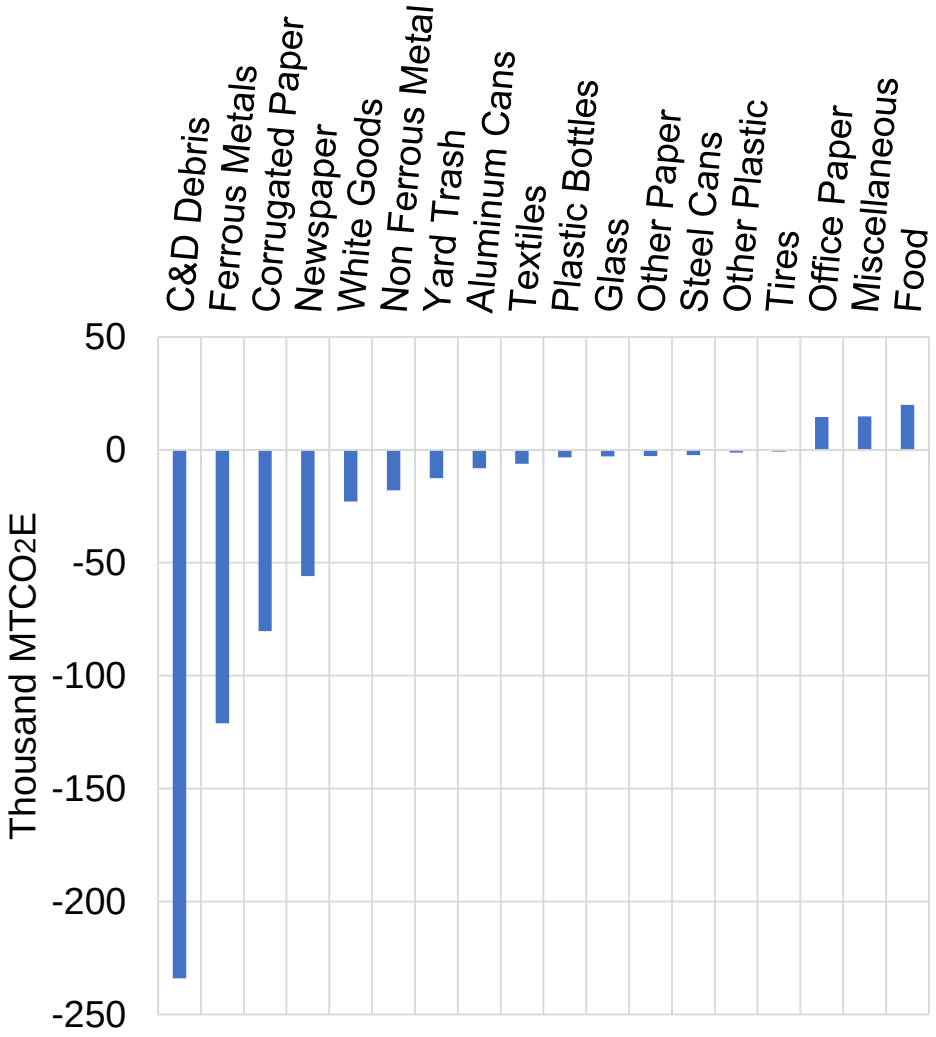


2015 Sarasota County Total Waste Generation



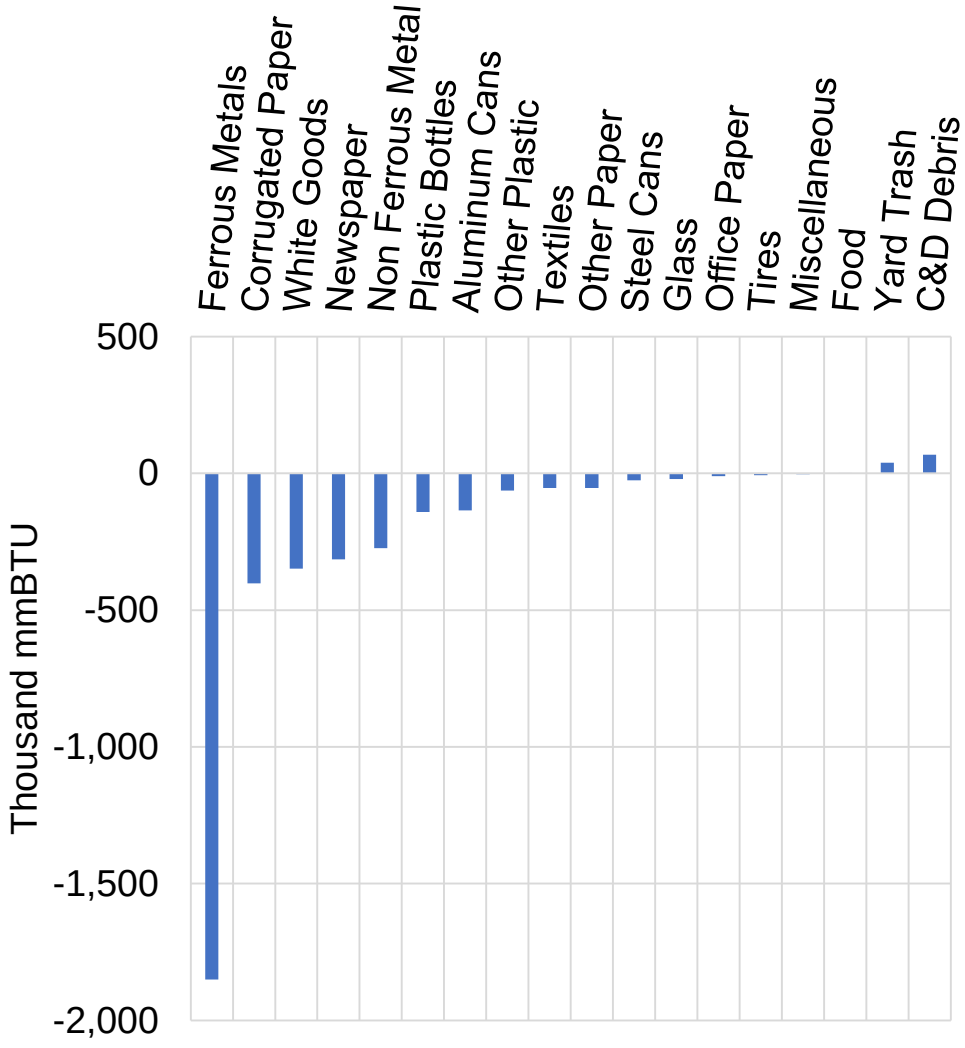
2015 WARM $MTCO_2E$ Savings

Material	Thousand $MTCO_2E$
C&D Debris	-234
Ferrous Metals	-121
Corrugated Paper	-80.2
Newspaper	-55.9
White Goods	-22.9
Non Ferrous Metal	-18.0
Yard Trash	-12.5
Aluminum Cans	-8.09
Textiles	-6.14
Plastic Bottles	-3.36
Glass	-2.87
Other Paper	-2.78
Steel Cans	-2.27
Other Plastic	-1.14
Tires	-0.723
Office Paper	14.5
Miscellaneous	14.8
Food	19.9

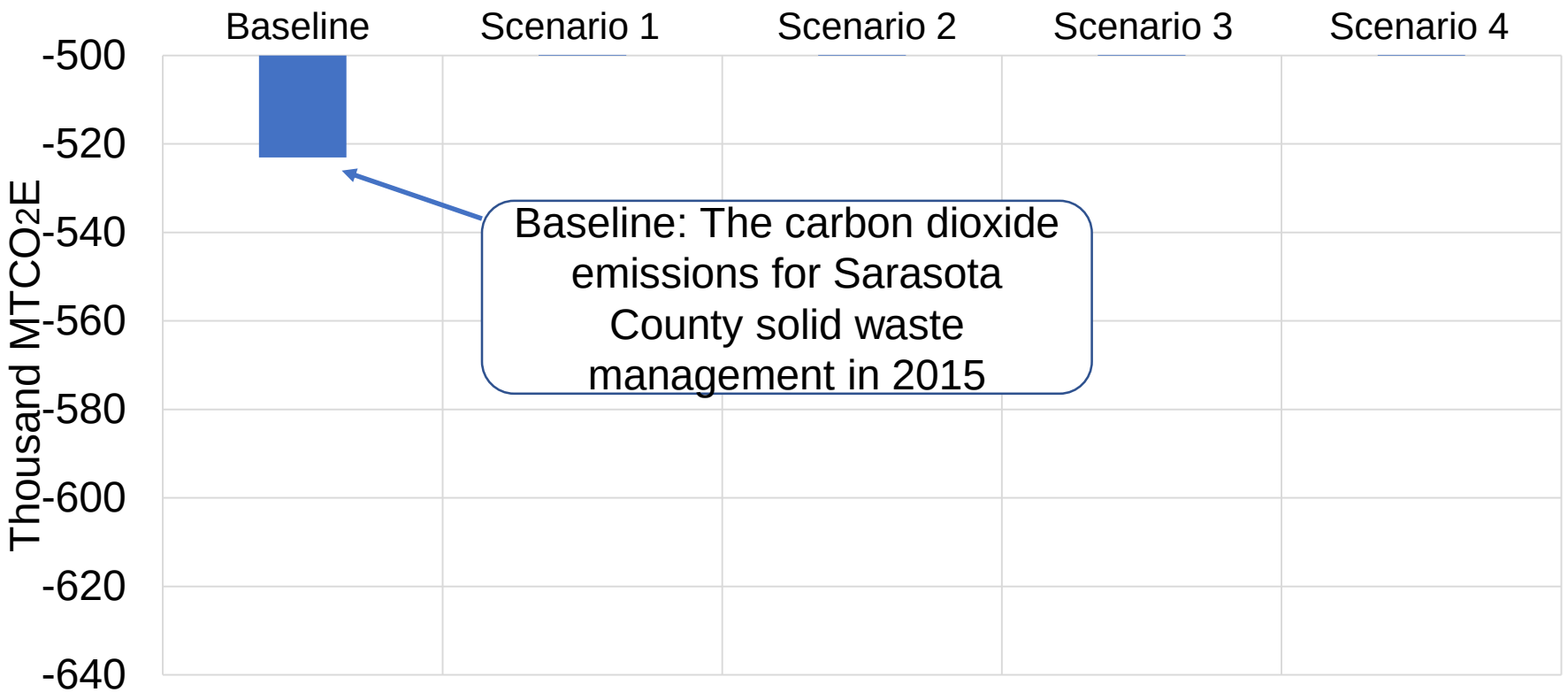


2015 WARM Energy Savings

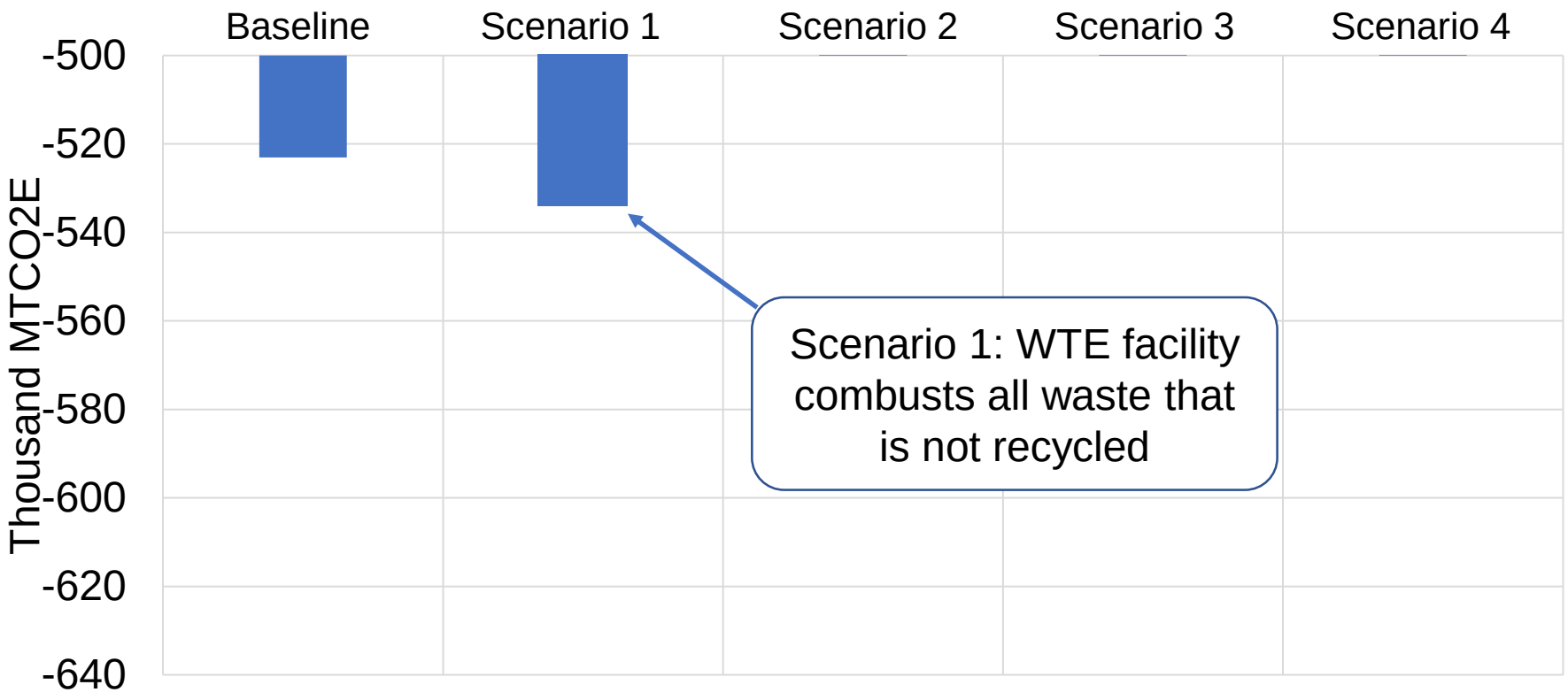
Material	Thousand mmBTU
Ferrous Metals	-1850
Corrugated Paper	-402
White Goods	-348
Newspaper	-315
Non Ferrous Metal	-273
Plastic Bottles	-141
Aluminum Cans	-136
Other Plastic	-62.5
Textiles	-53.3
Other Paper	-53.1
Steel Cans	-25.0
Glass	-21.1
Office Paper	-9.86
Tires	-6.61
Miscellaneous	-2.97
Food	1.80
Yard Trash	39.1
C&D Debris	68.2



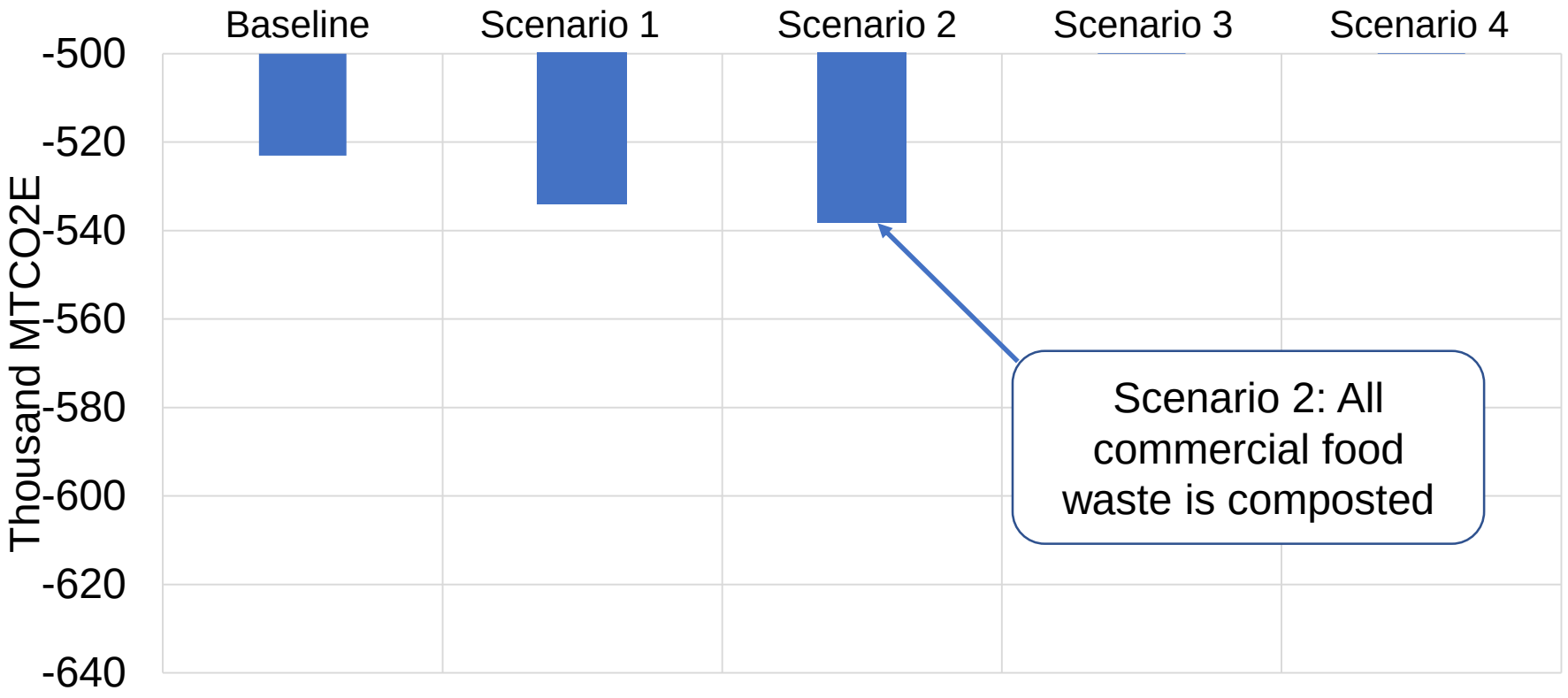
2015 WARM $MTCO_2E$ Scenarios



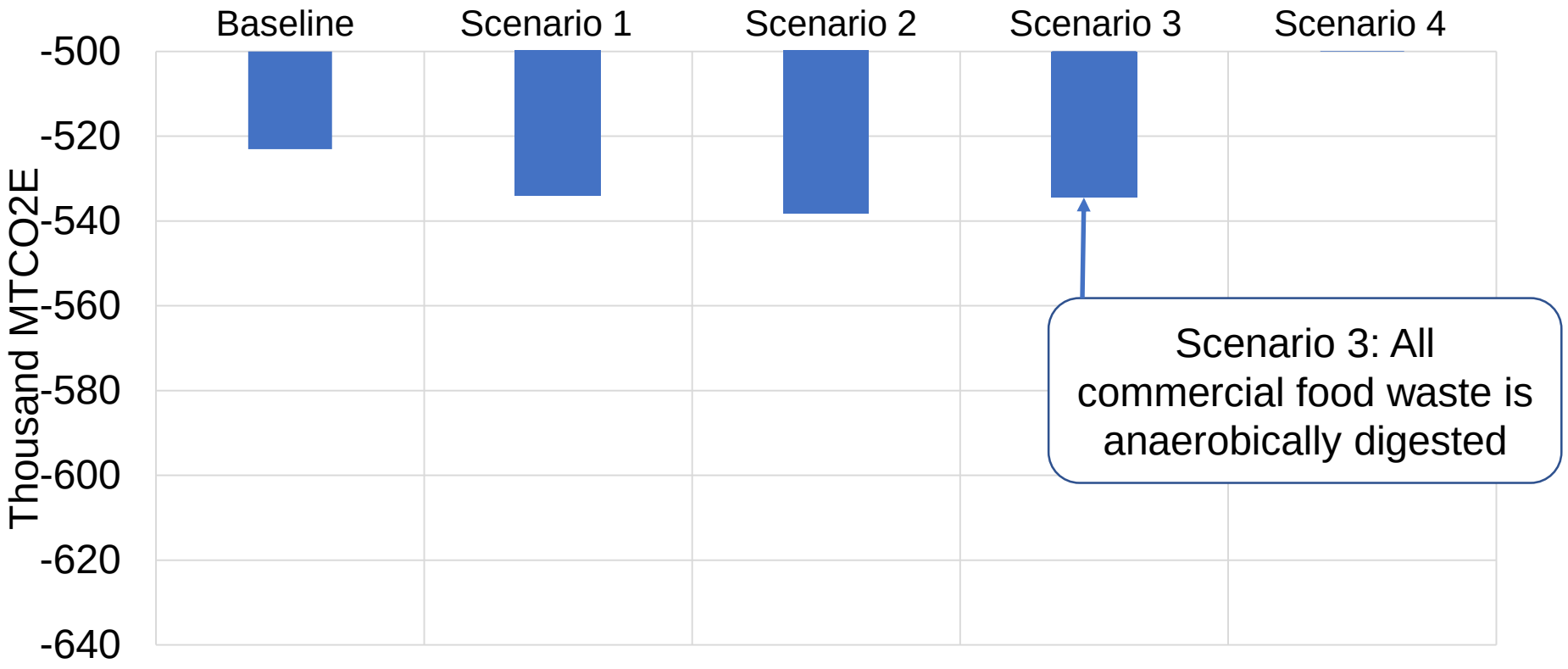
2015 WARM $MTCO_2E$ Scenarios



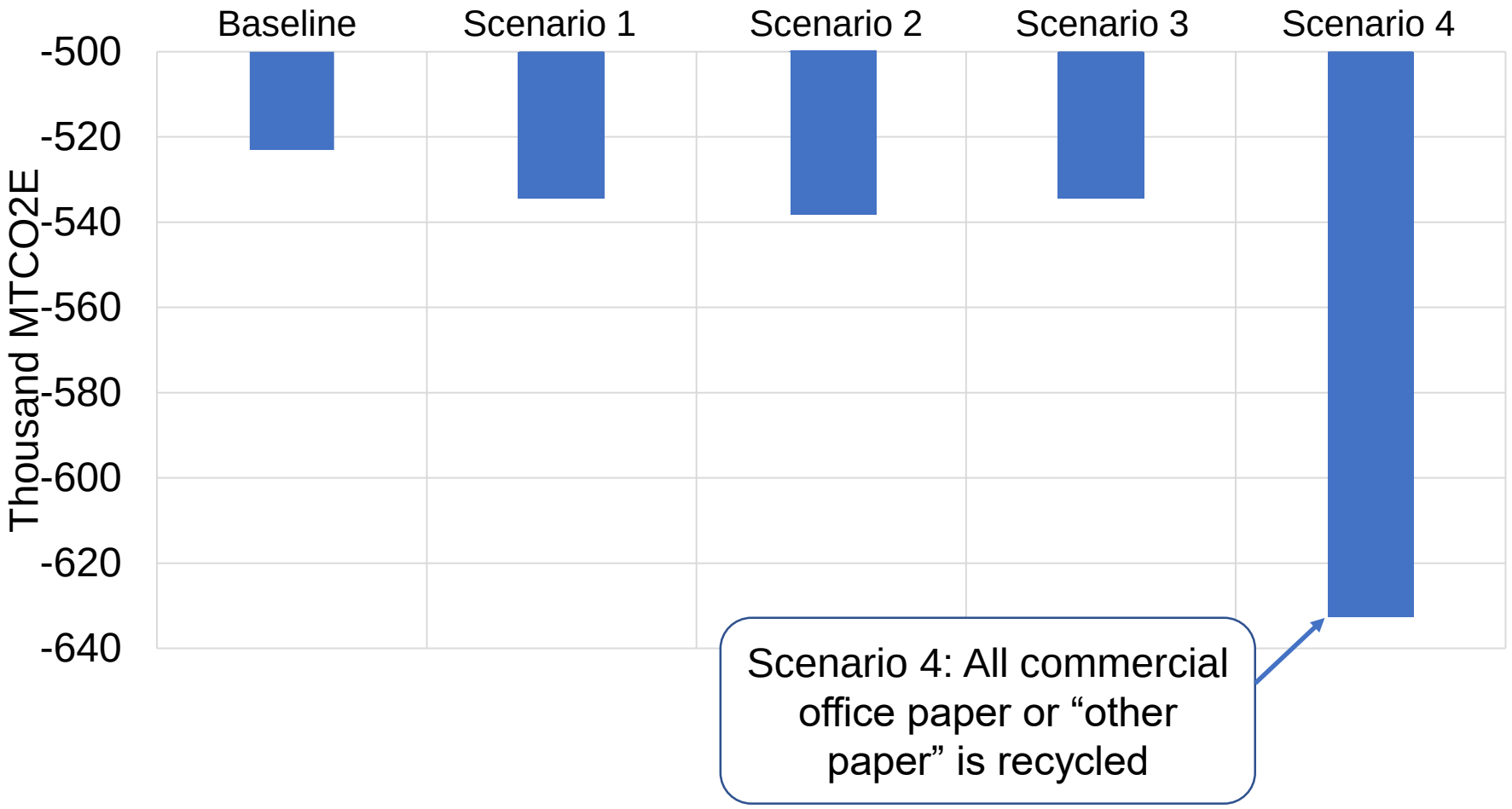
2015 WARM $MTCO_2E$ Scenarios



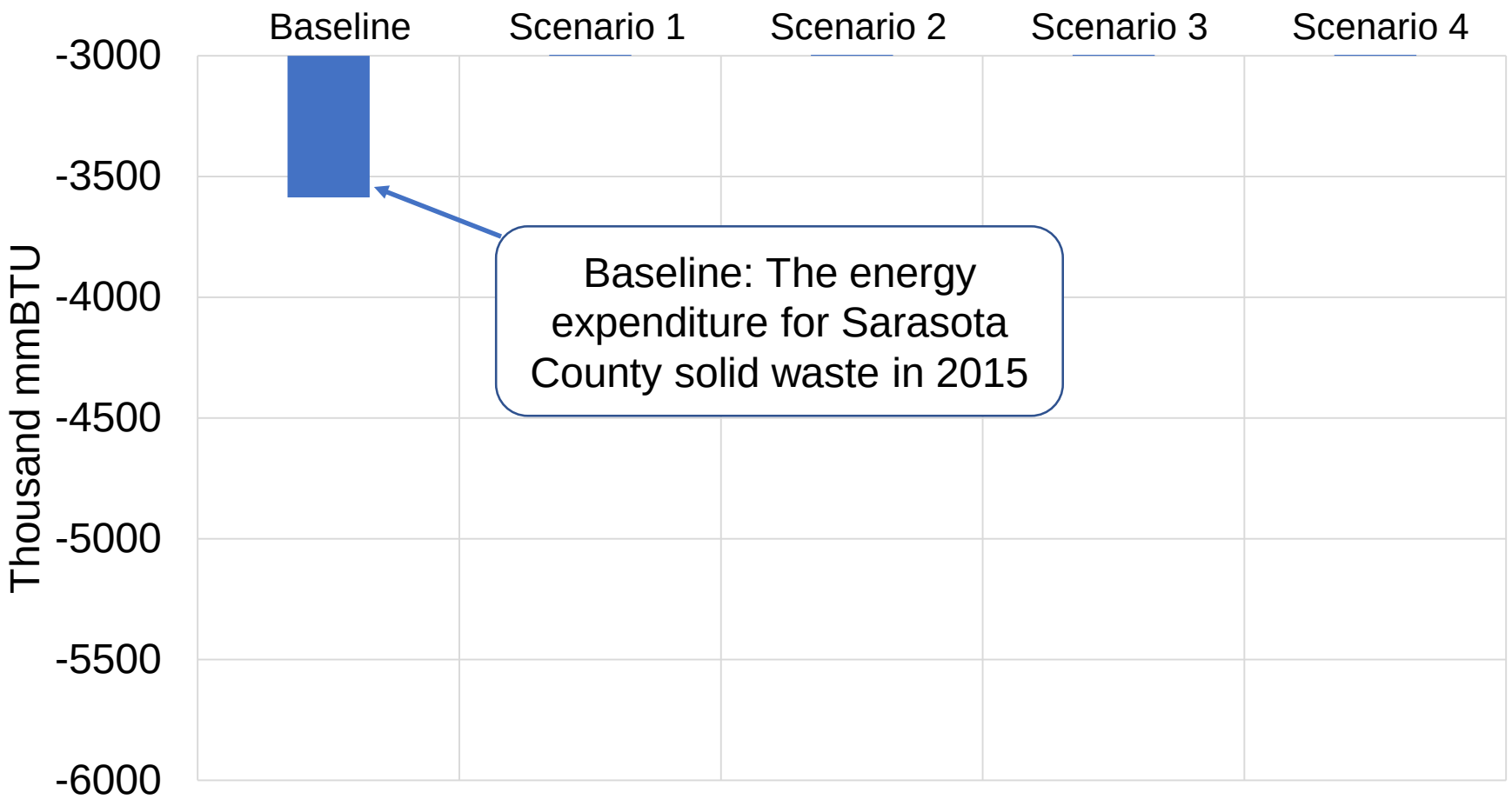
2015 WARM $MTCO_2E$ Scenarios



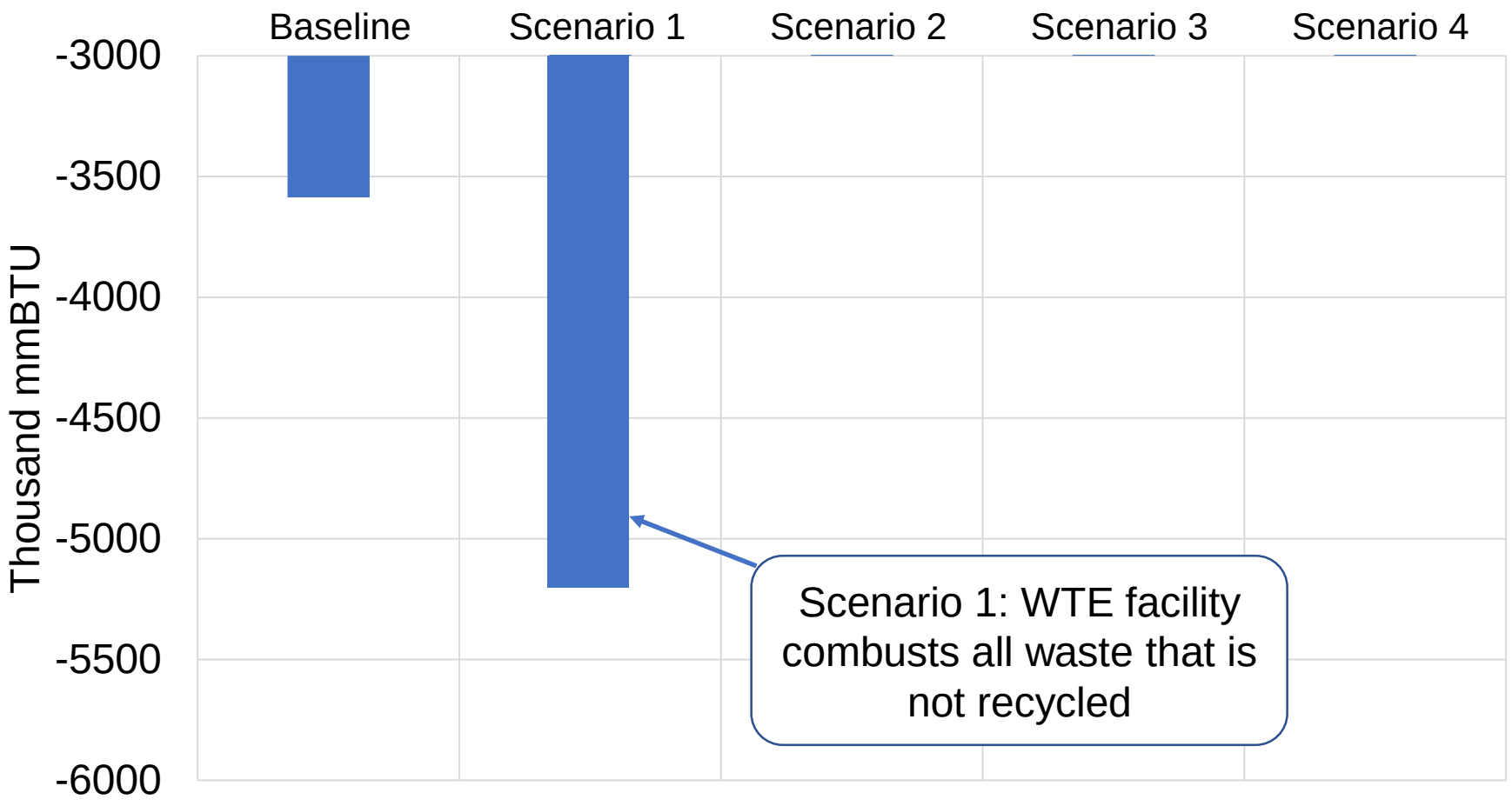
2015 WARM $MTCO_2E$ Scenarios



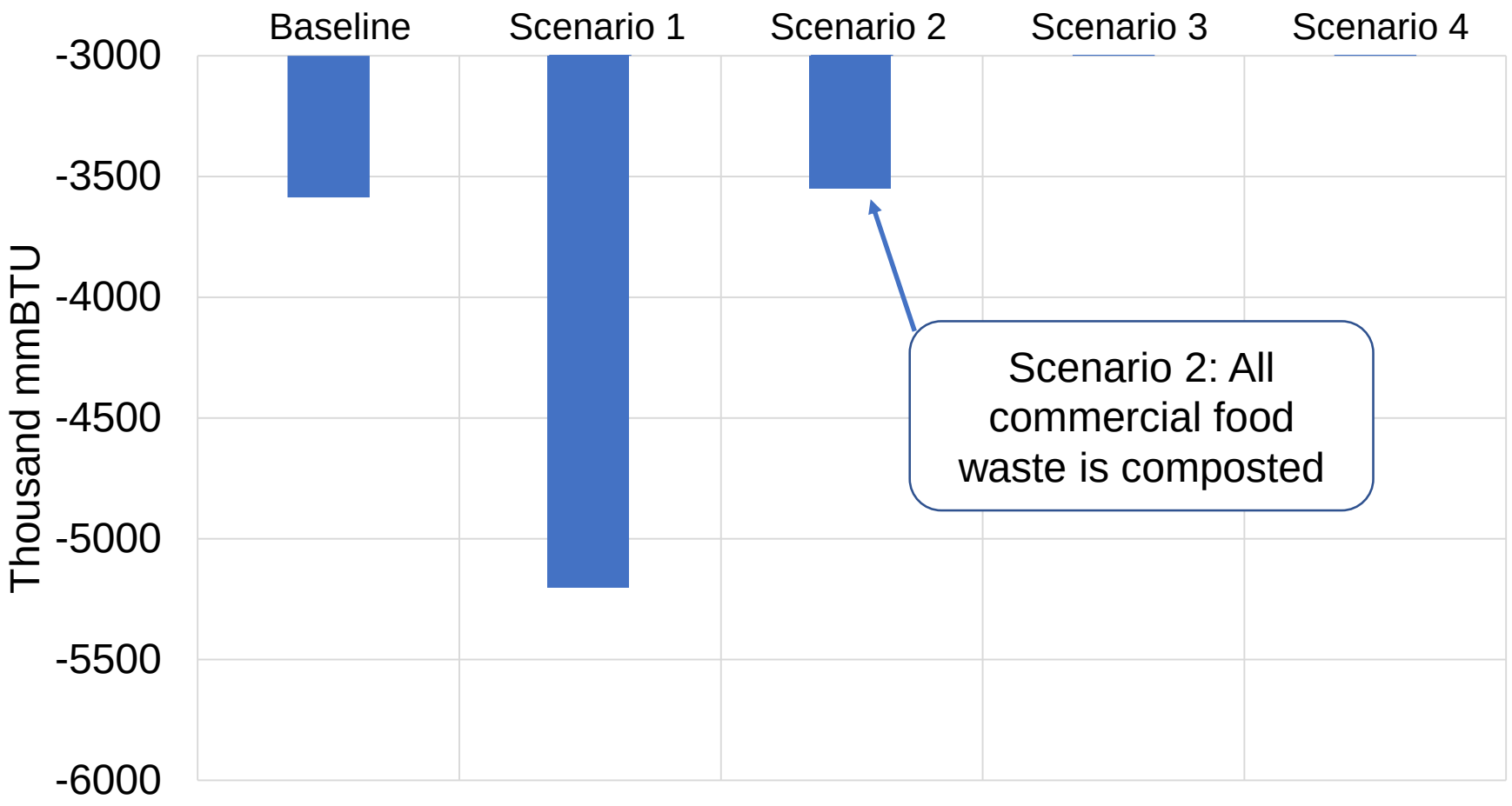
2015 WARM Energy Savings Scenarios



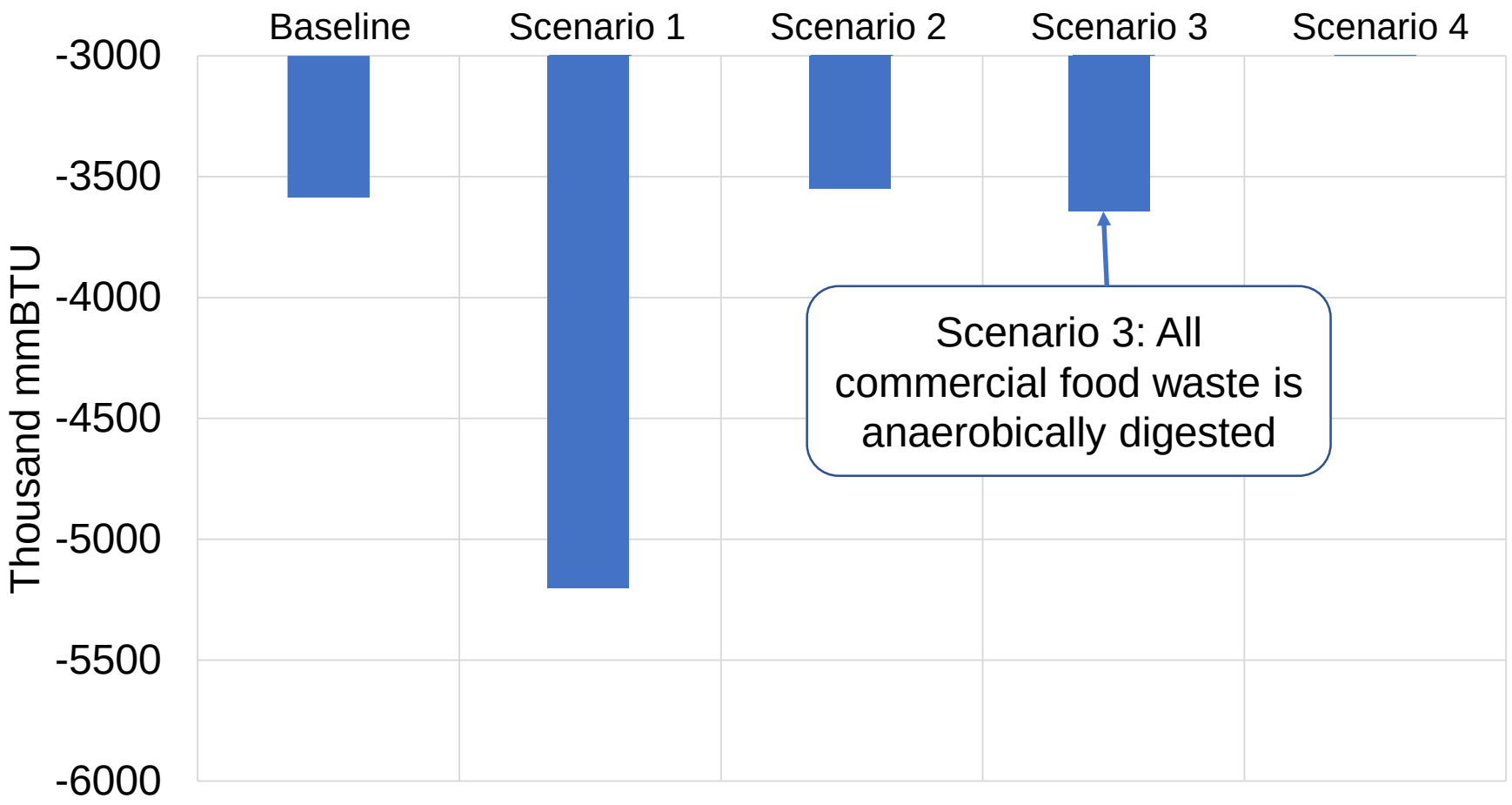
2015 WARM Energy Savings Scenarios



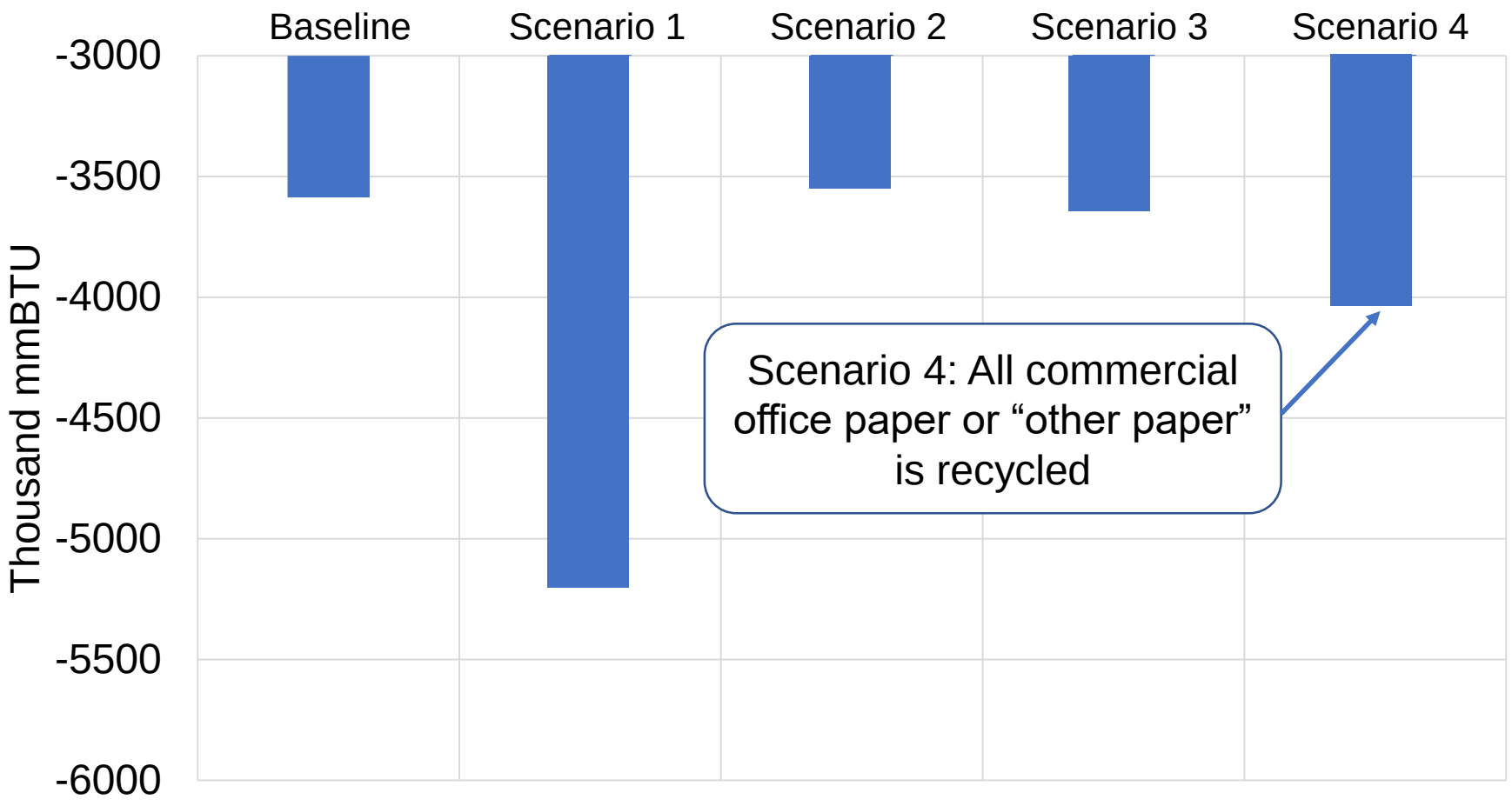
2015 WARM Energy Savings Scenarios



2015 WARM Energy Savings Scenarios



2015 WARM Energy Savings Scenarios



How can SMM be utilized in a similar manner as the 75% goal?

- With the SMM tools discussed, we can model the environmental burden (e.g., carbon footprint) associated for a solid waste management for the State or for an individual municipality.
- Or we can compare different solid waste management systems?
- But to track progress over time, what do you compare the environmental burden to?
- One possible approach, is to compare to a baseline environmental burden.

Developing a Baseline for Florida

- Let's consider the following:
  - The Statute with Florida 75% recycling goal was issued in 2008. Let's use 2008 as our baseline.
    - Traditional Recycling Rate = 28.4%
    - Adjusted Recycling Rate = 41.5%
    - MTCO2E Emissions = - 13.0 million MTCO2E
    - Energy usage = -147 million mmBTU

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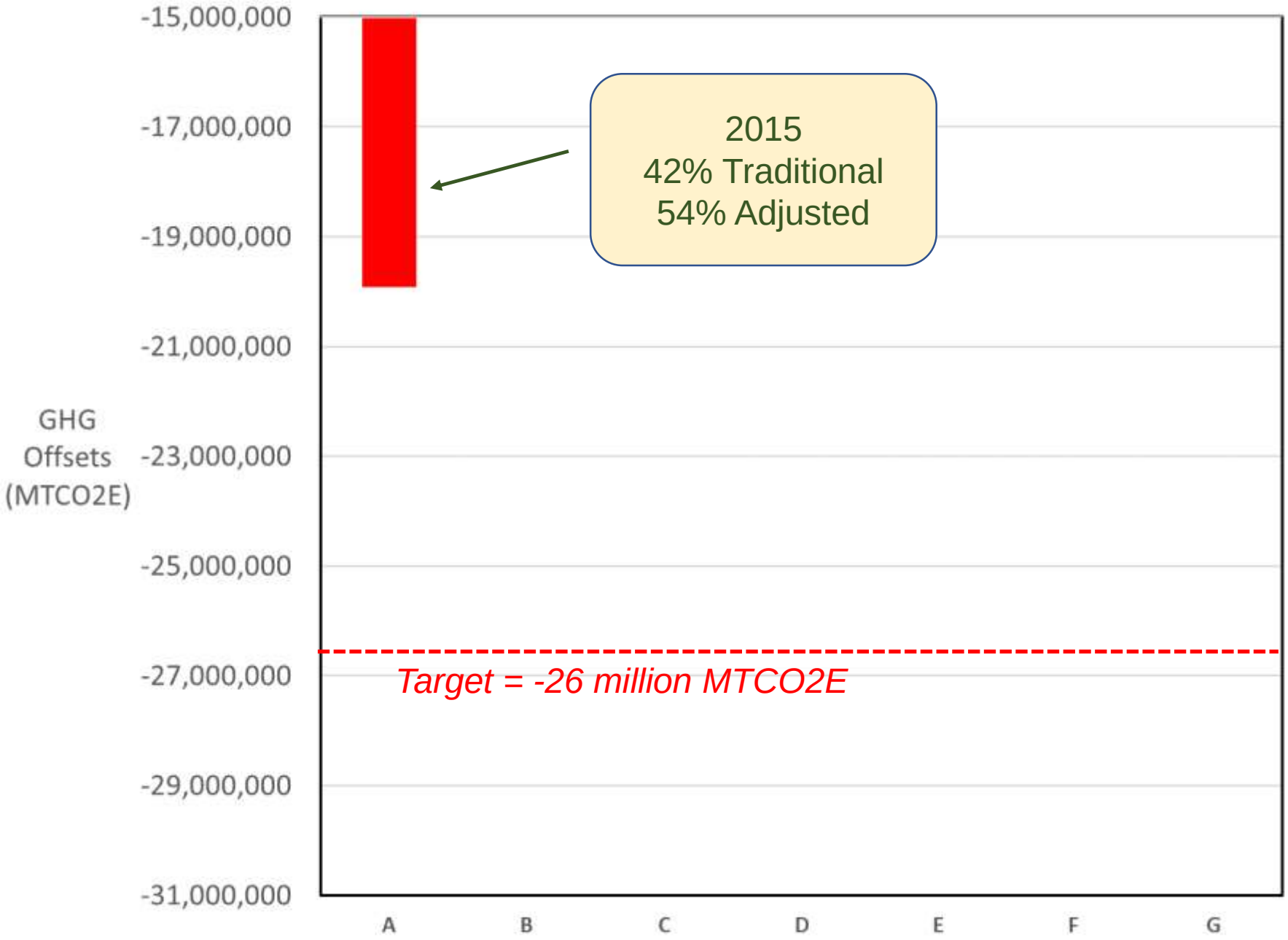
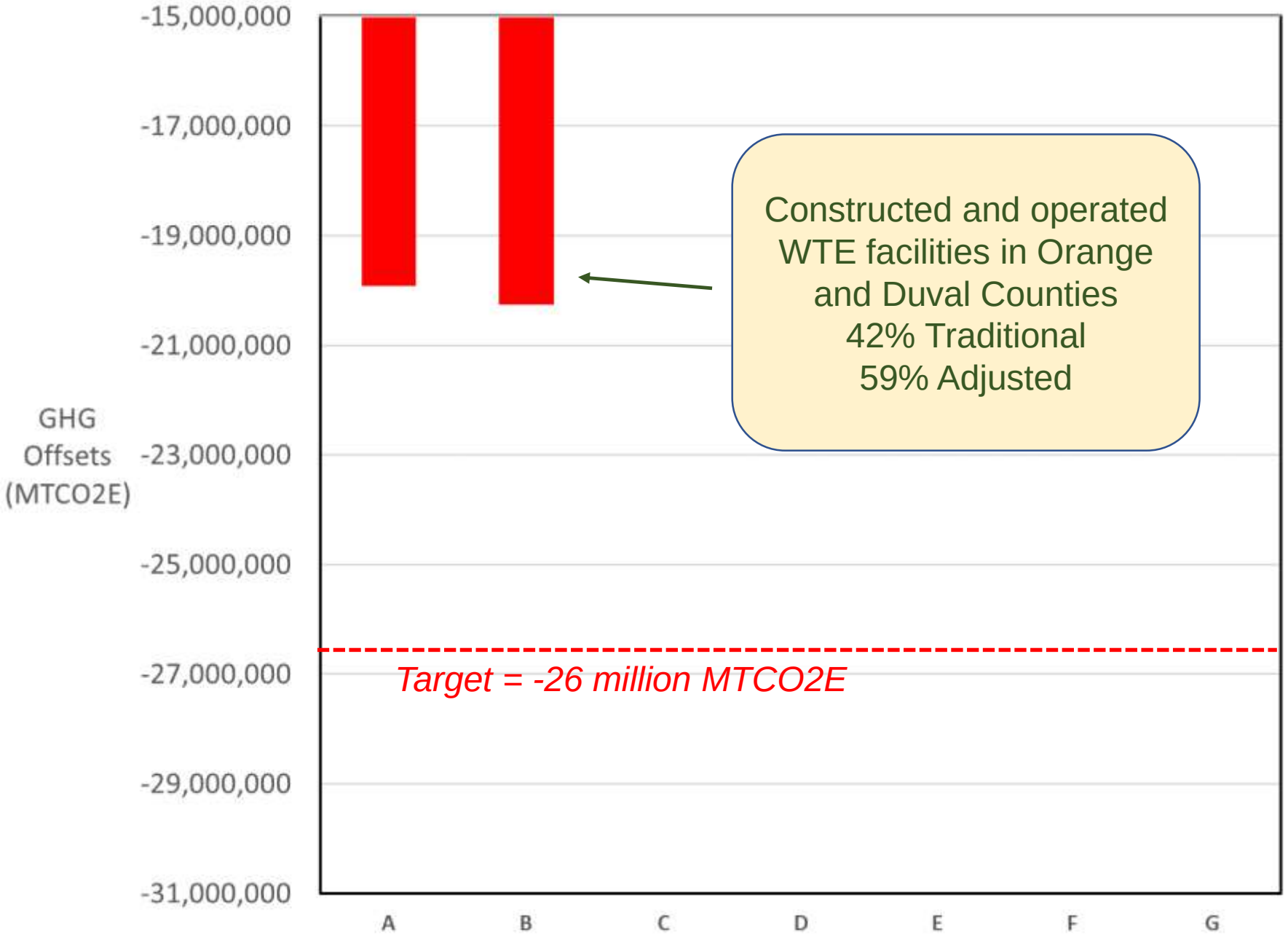
    - MTCO2E Emissions = - 13.0 million MTCO2E
    - Energy usage = -147 million mmBTU
- We developed a hypothetical waste management profile that would have corresponded to a 75% recycling in 2008 (included some additional WTE).
    - Traditional Recycling Rate = 59.6%
    - Adjusted Recycling Rate = 75.3%
    - MTCO2E Emissions = - 25.9 million MTCO2E
    - Energy usage = -275 million mmBTU

Our Target


-15,000,000
-17,000,000
-19,000,000
-21,000,000
GHG Offsets (MTCO2E)
-23,000,000
-25,000,000
-27,000,000
-29,000,000
-31,000,000
2015
42% Traditional
54% Adjusted
Target = -26 million MTCO2E
A
B
C
D
E
F
G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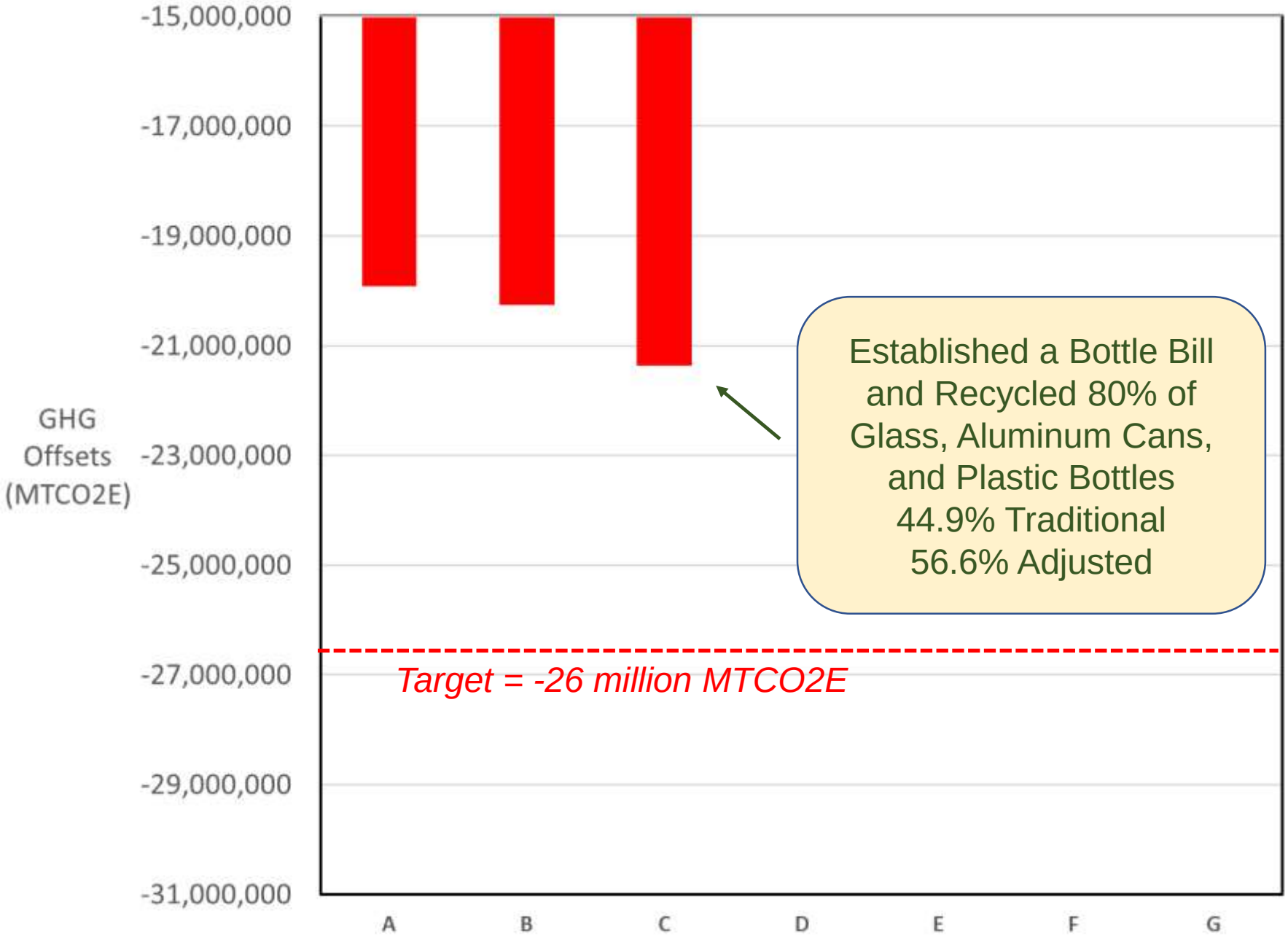
-21,000,000
GHG Offsets (MTCO2E)
-23,000,000
-25,000,000
-27,000,000
-29,000,000
-31,000,000
A
B
C
D
E
F
G
Constructed and operated WTE facilities in Orange and Duval Counties
42% Traditional
59% Adjusted
Target = -26 million MTCO2E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-25,000,000
-27,000,000
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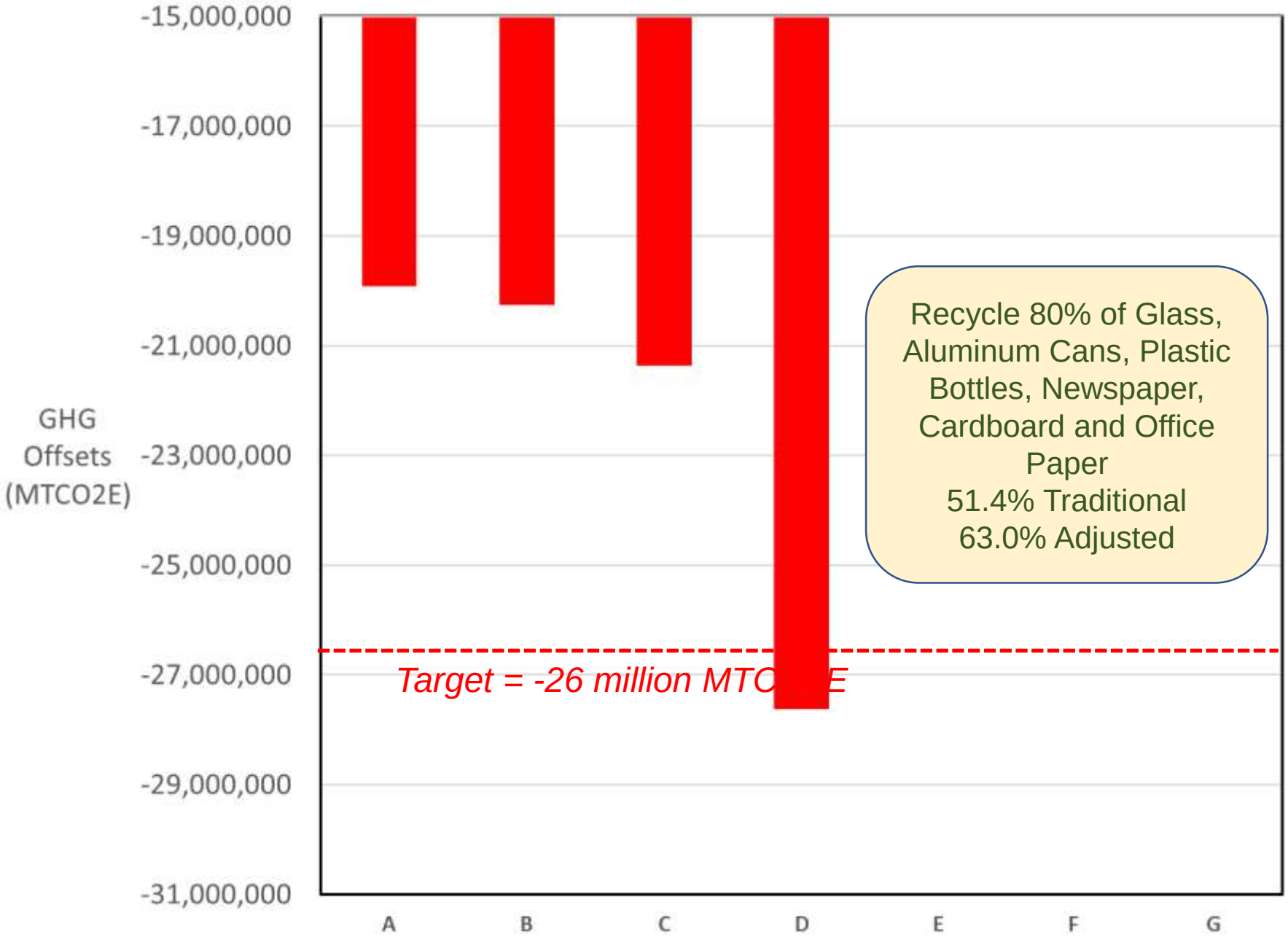
-31,000,000
GHG Offsets (MTCO2E)
A
B
C
D
E
F
G
Established a Bottle Bill and Recycled 80% of Glass, Aluminum Cans, and Plastic Bottles
44.9% Traditional
56.6% Adjusted
Target = -26 million MTCO2E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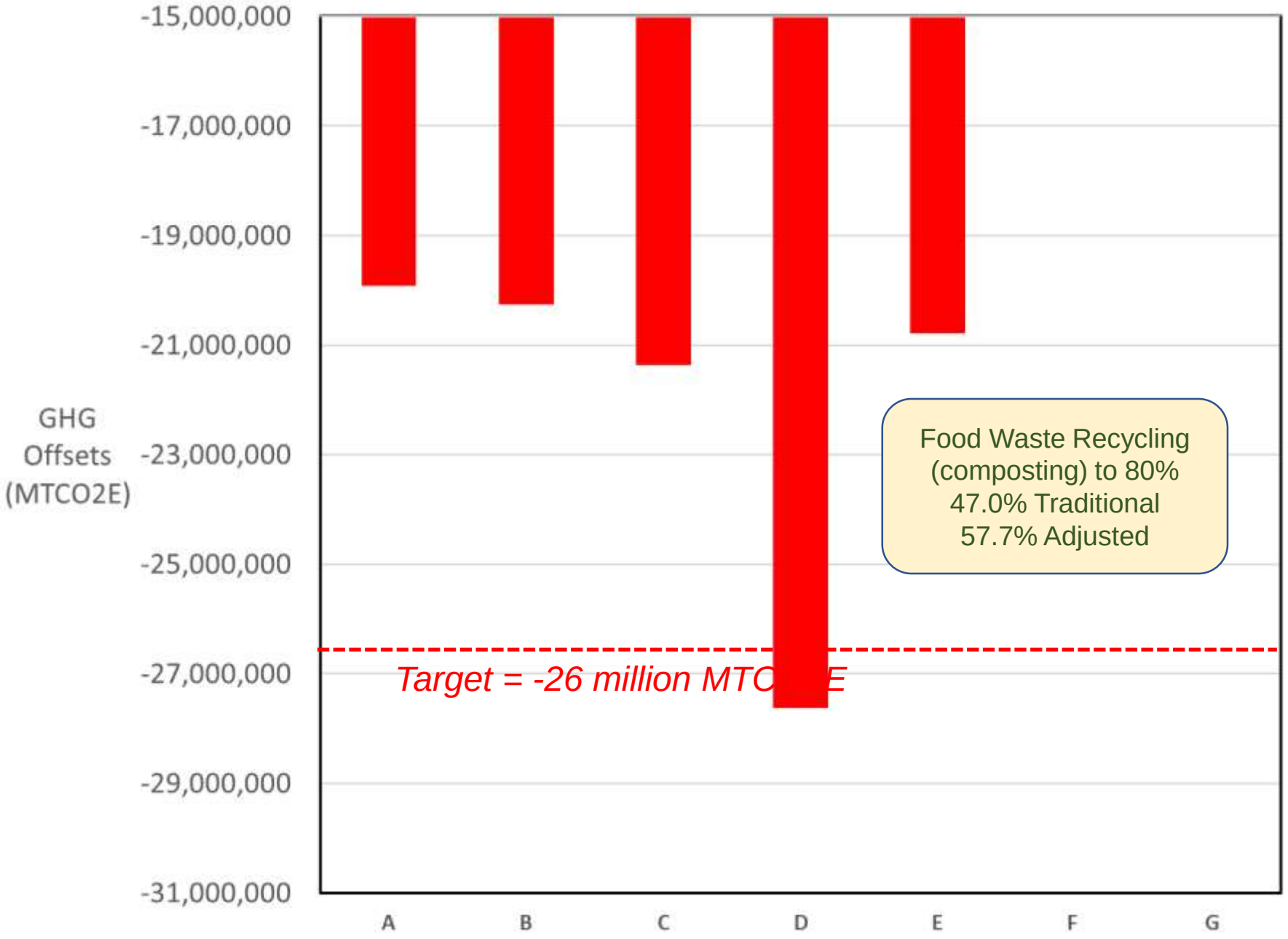
-31,000,000
GHG Offsets (MTCO2E)
A
B
C
D
E
F
G
Recycle 80% of Glass, Aluminum Cans, Plastic Bottles, Newspaper, Cardboard and Office Paper
51.4% Traditional
63.0% Adjusted
Target = -26 million MTC E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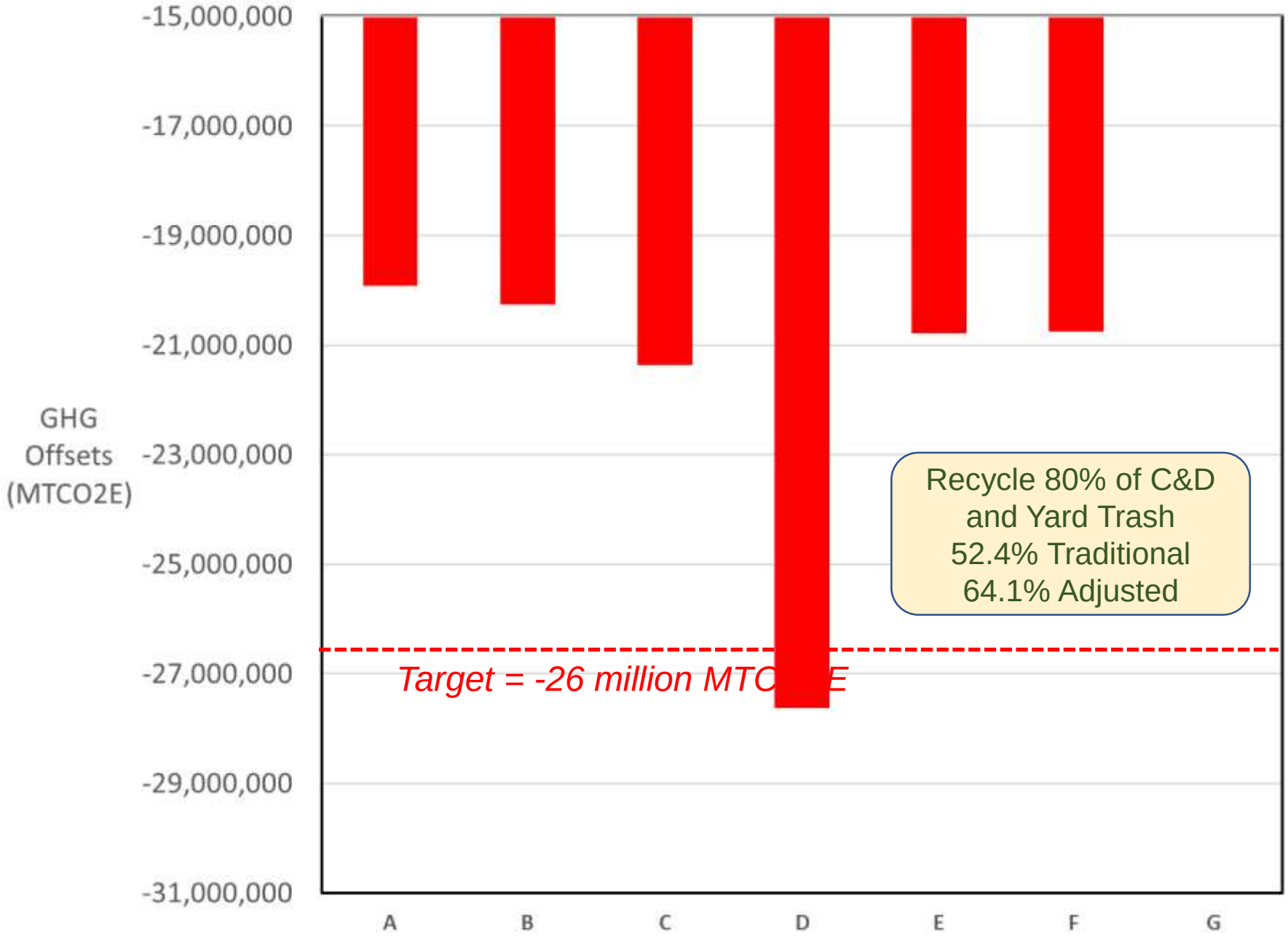
-31,000,000
GHG Offsets (MTCO2E)
A
B
C
D
E
F
G
Food Waste Recycling (composting) to 80%
47.0% Traditional
57.7% Adjusted
Target = -26 million MTCO2E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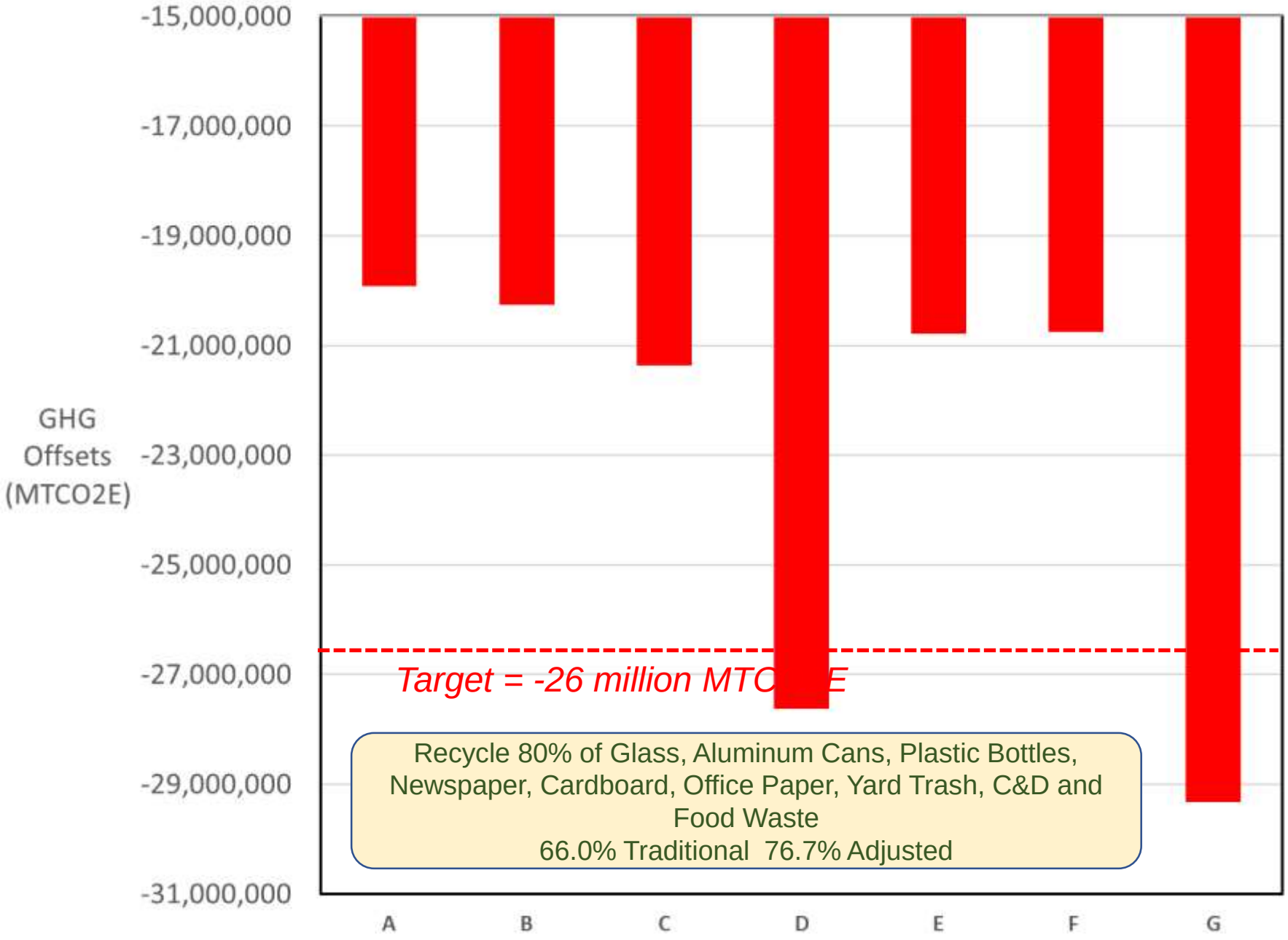
-29,000,000
-31,000,000
GHG Offsets (MTCO2E)
A
B
C
D
E
F
G
Recycle 80% of C&D and Yard Trash
52.4% Traditional
64.1% Adjusted
Target = -26 million MTCO2E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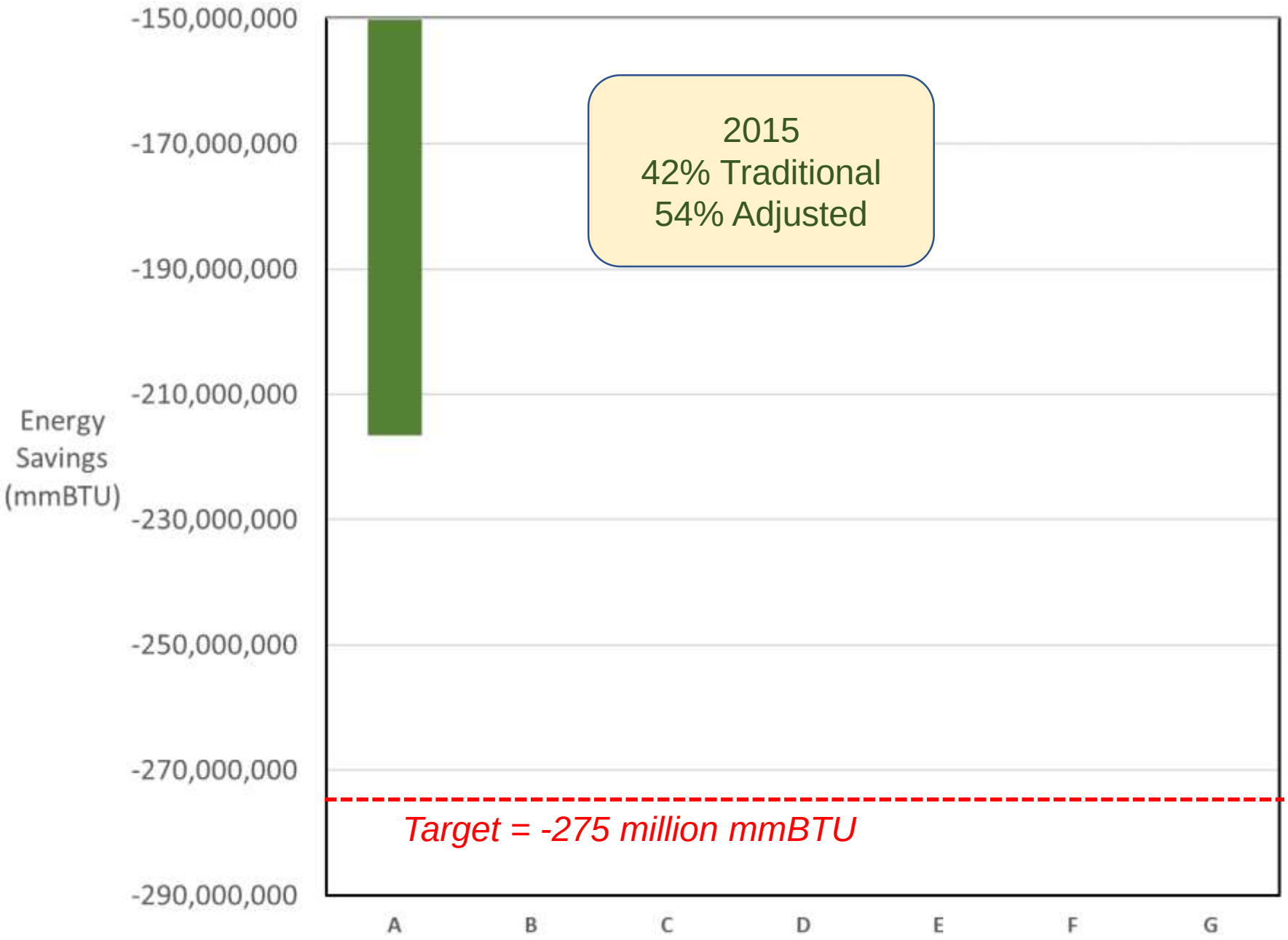
-19,000,000
-21,000,000
GHG Offsets (MTCO2E)
-23,000,000
-25,000,000
-27,000,000
-29,000,000
-31,000,000
A
B
C
D
E
F
G
Target = -26 million MTCO2E
Recycle 80% of Glass, Aluminum Cans, Plastic Bottles, Newspaper, Cardboard, Office Paper, Yard Trash, C&D and Food Waste
66.0% Traditional 76.7% Adjusted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-210,000,000
-230,000,000
-250,000,000
-270,000,000
-290,000,000
Energy Savings (mmBTU)
2015
42% Traditional
54% Adjusted
Target = -275 million mmBTU
A
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C
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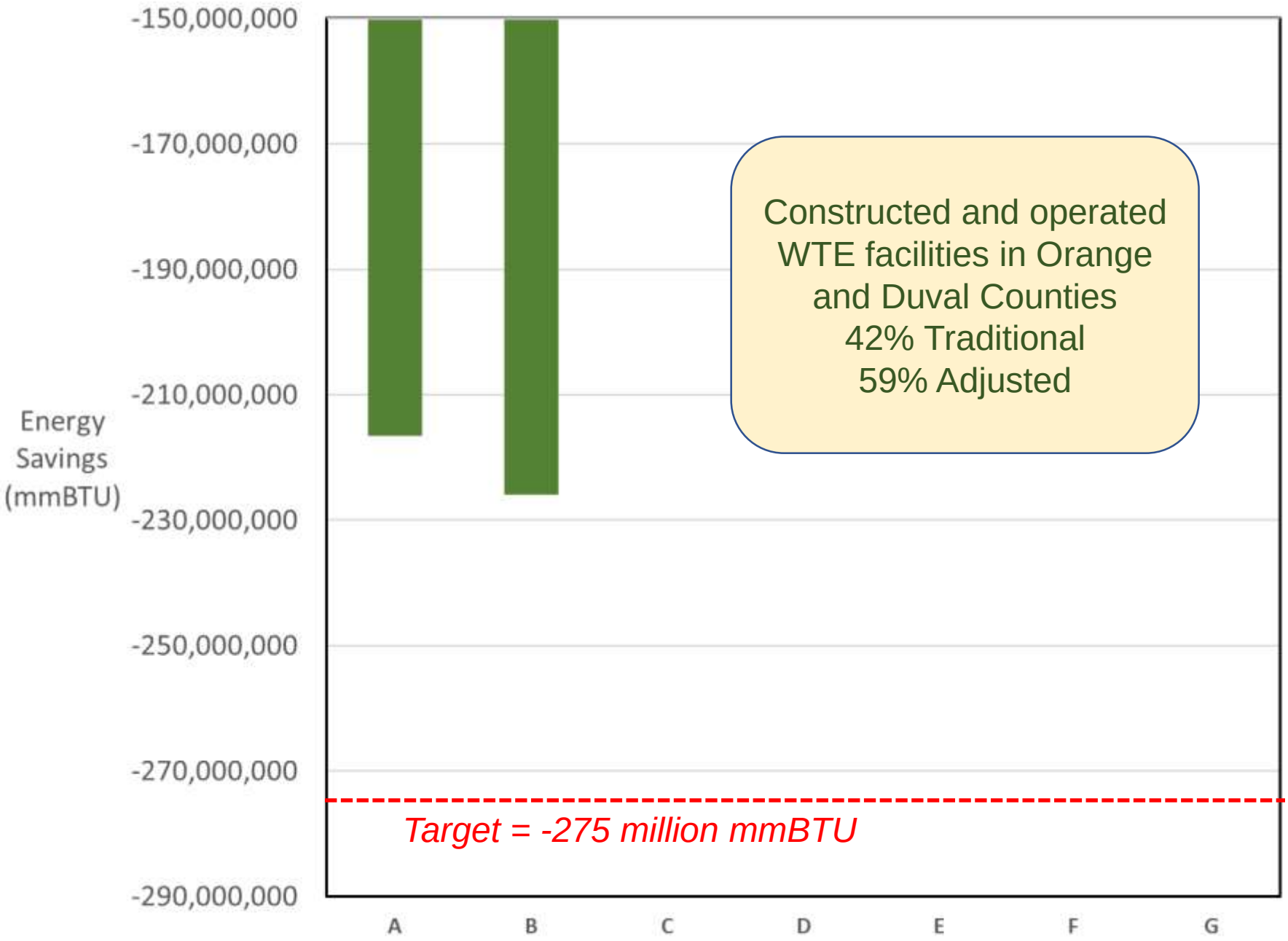
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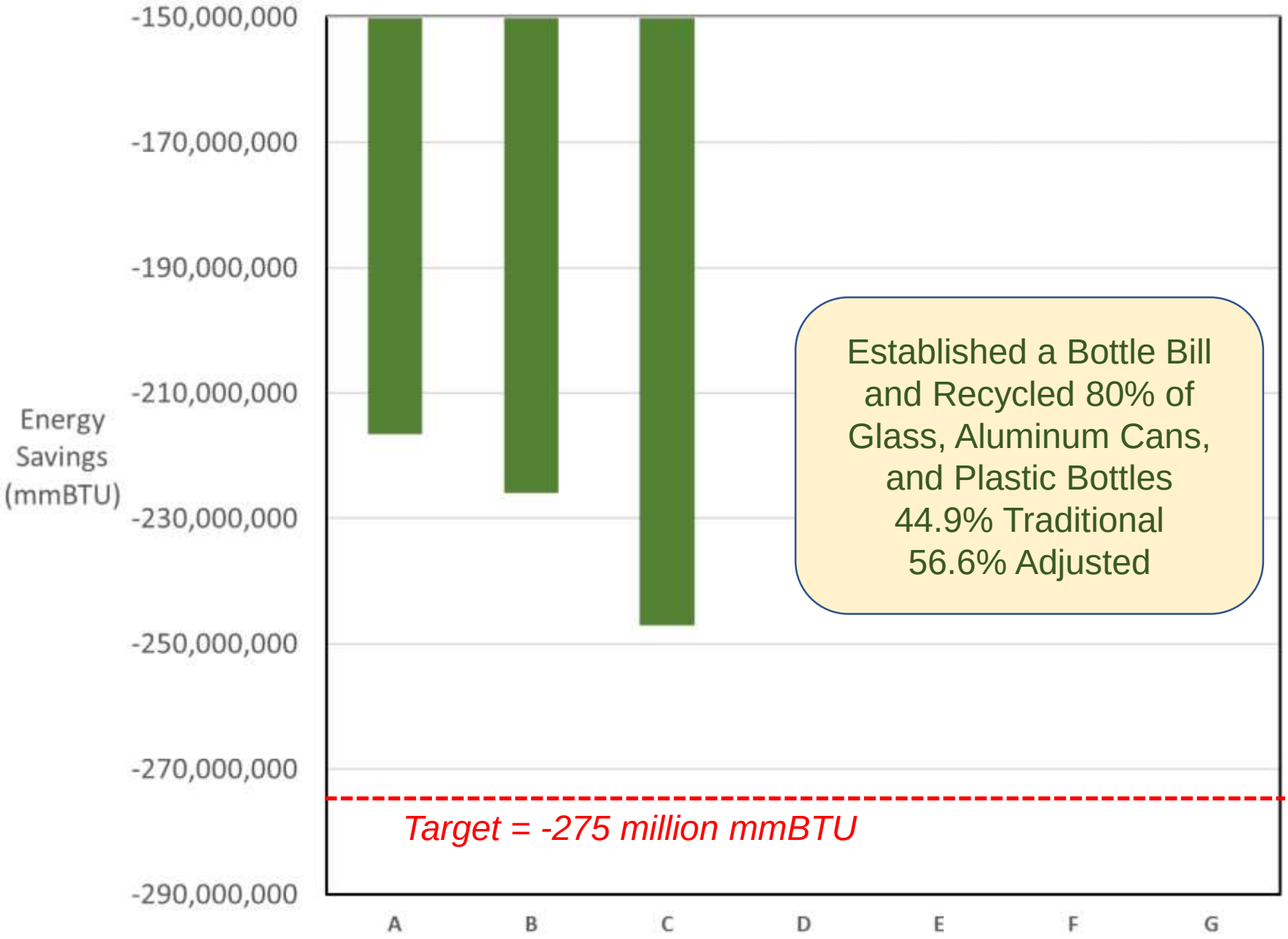
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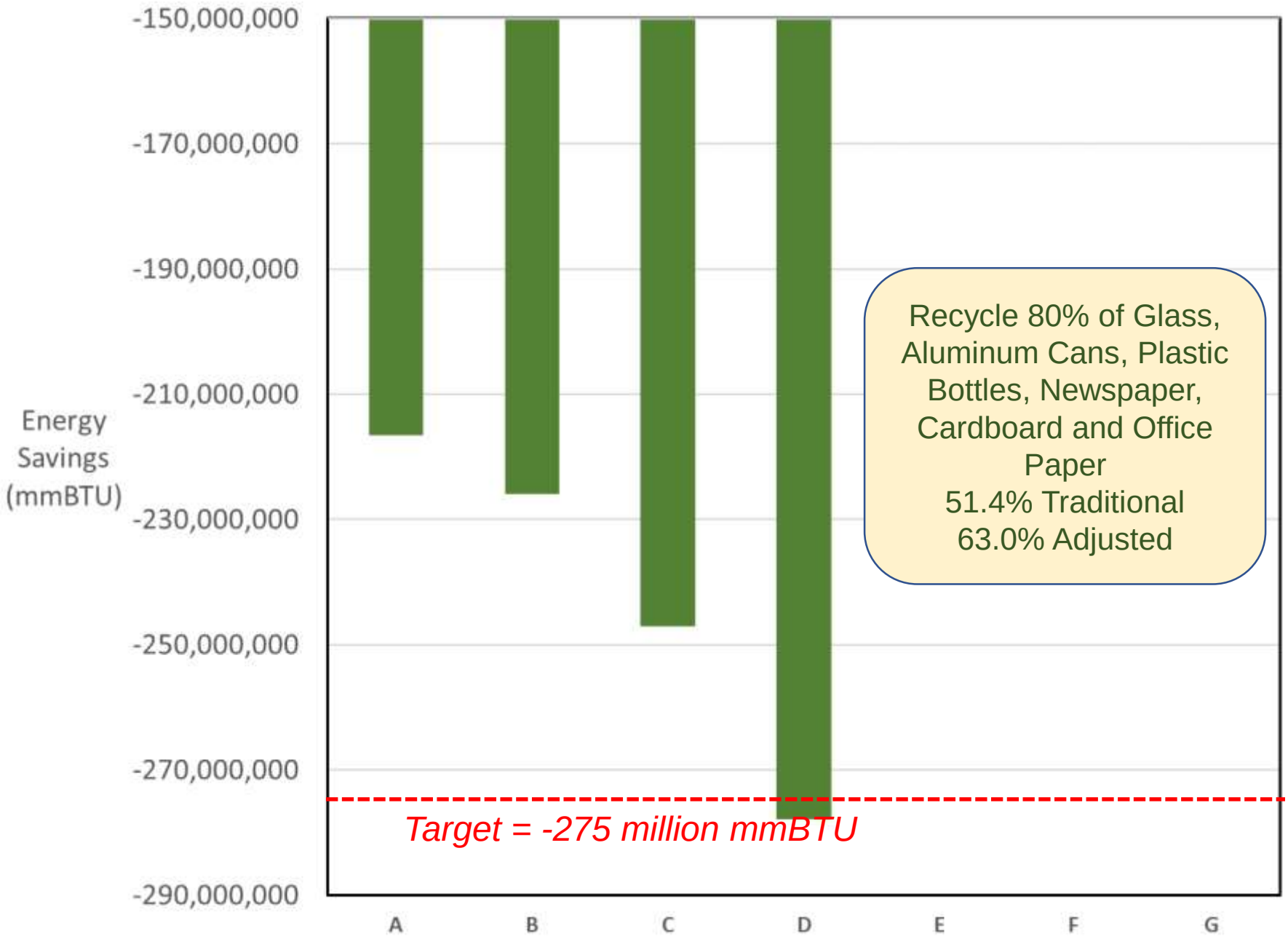
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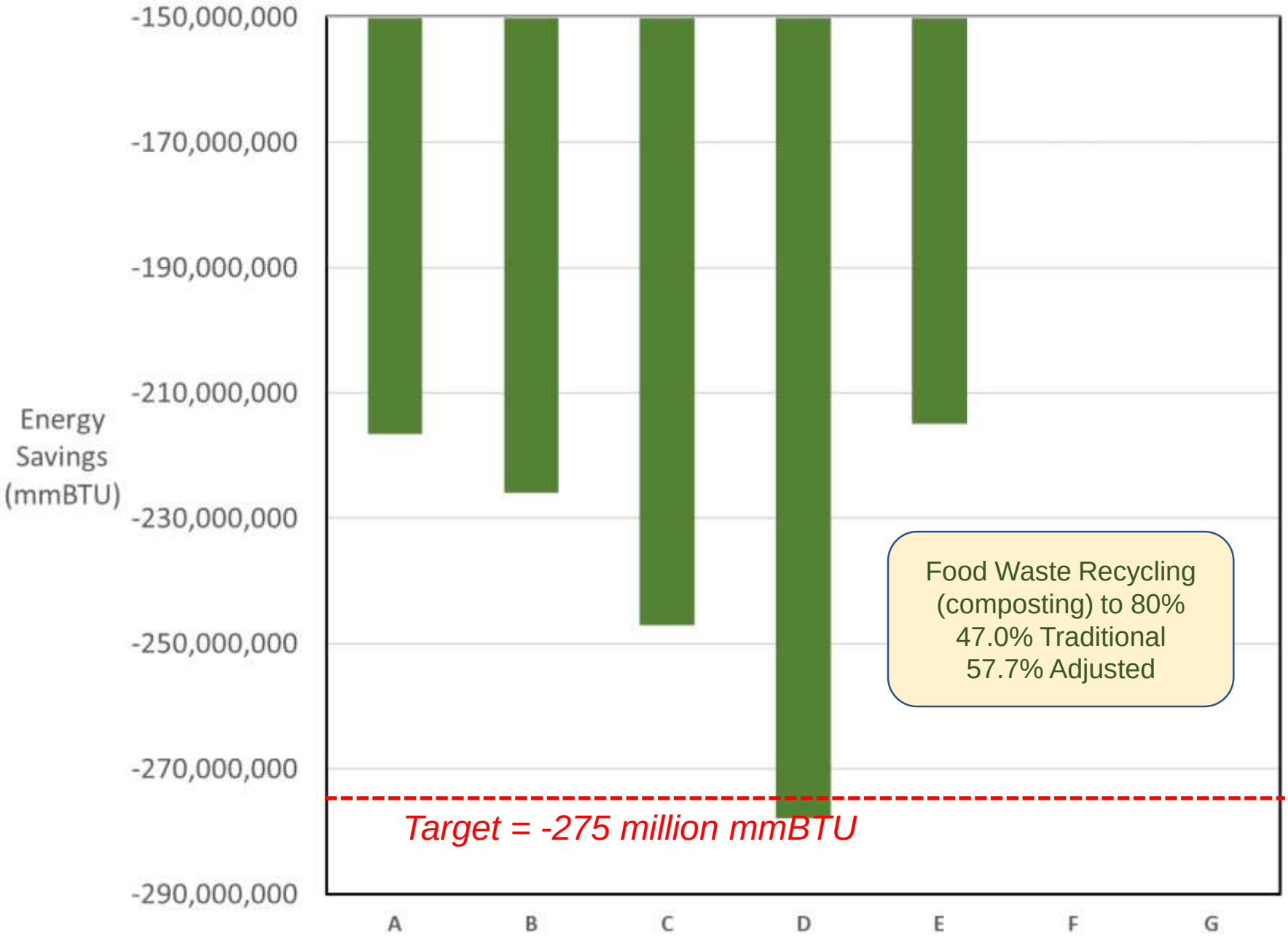
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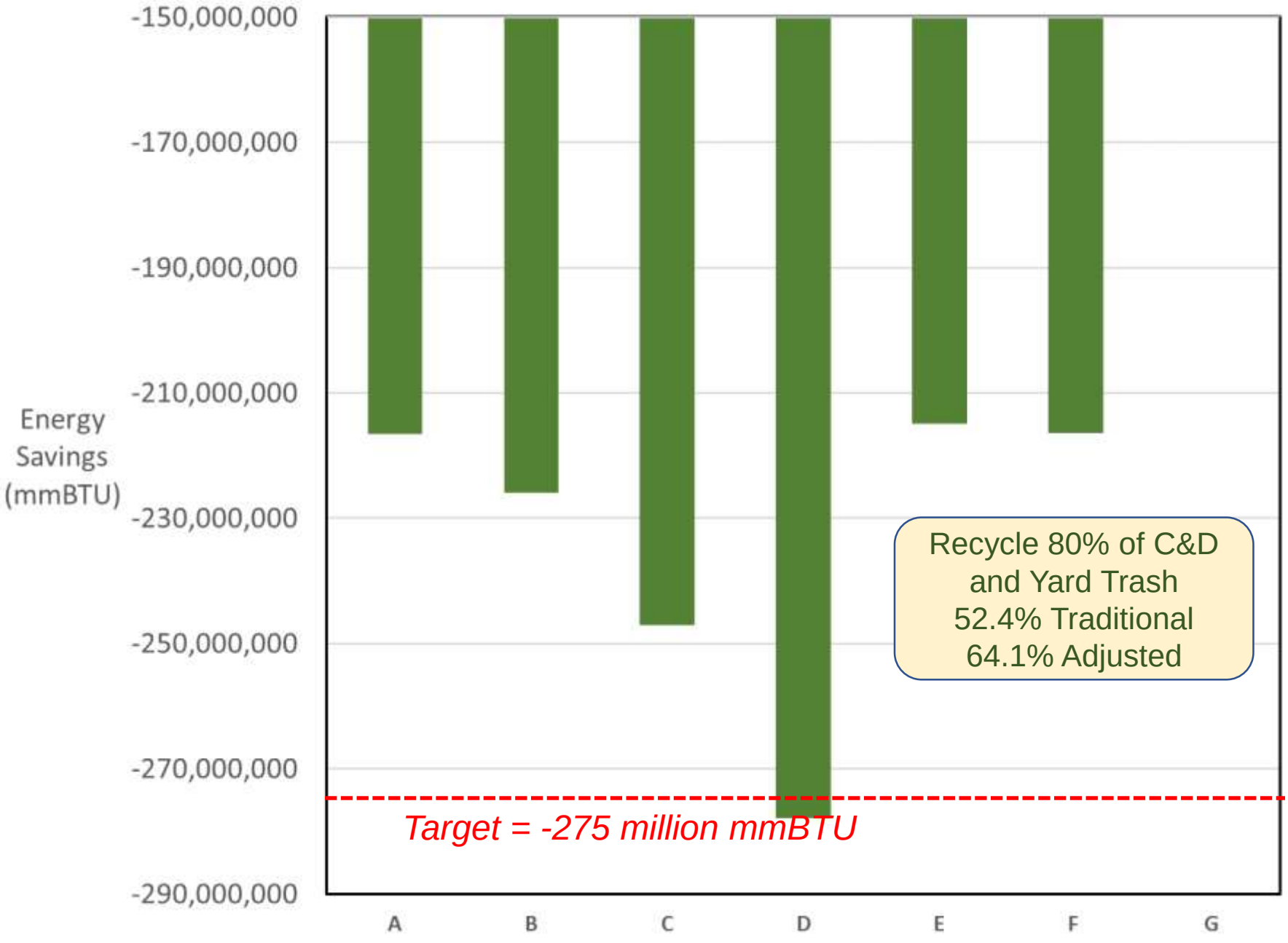
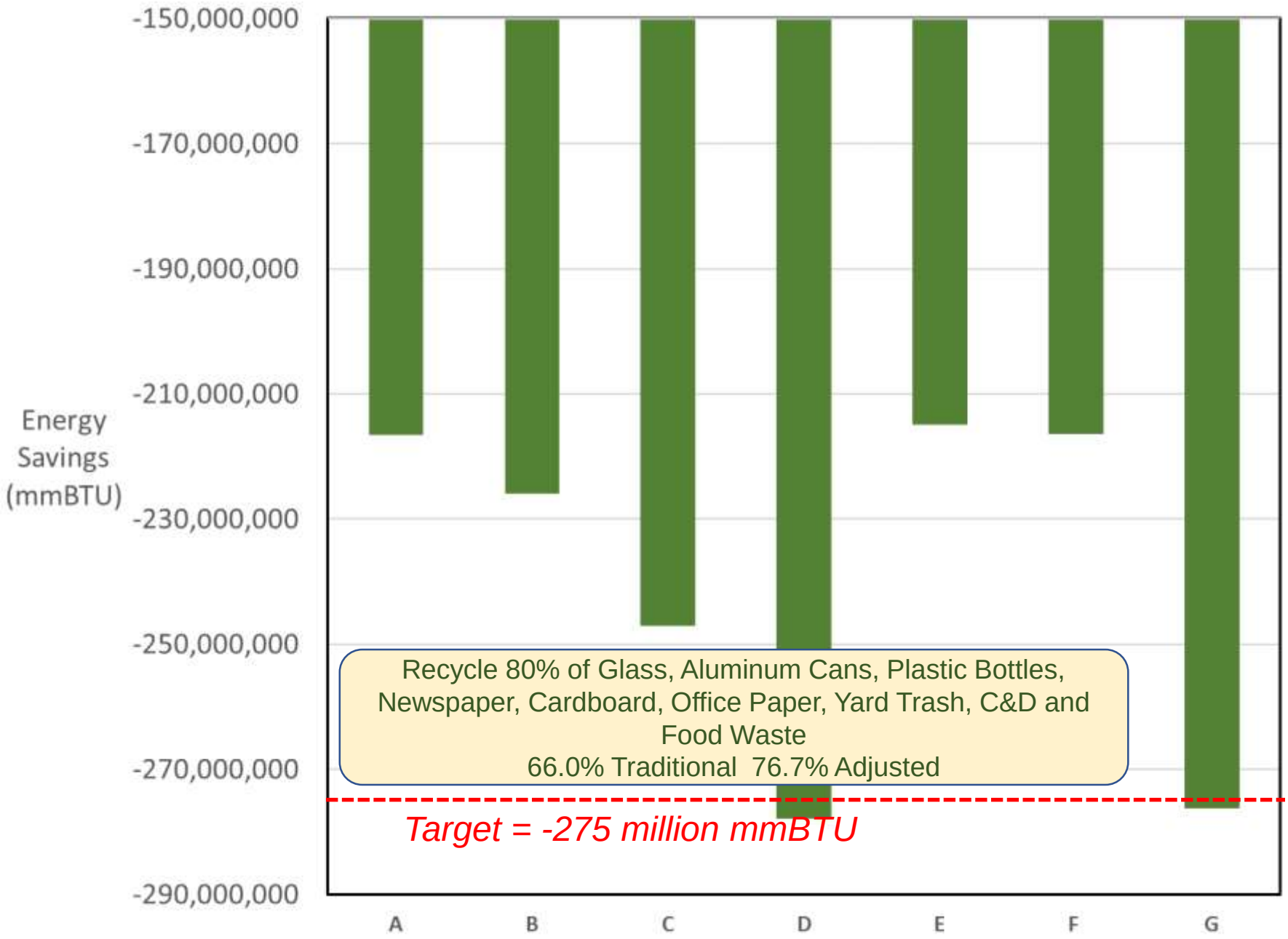
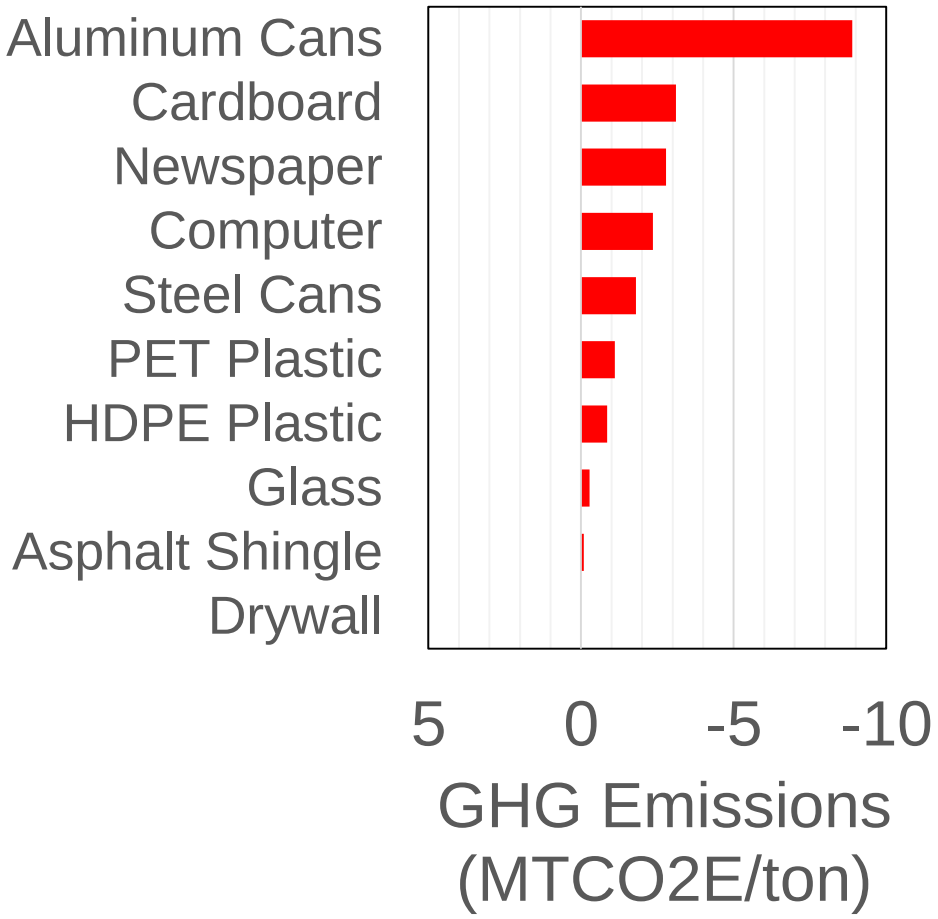
57.7% Adjusted
Target = -275 million mmBTU


-150,000,000
-170,000,000
-190,000,000
-210,000,000
-230,000,000
-250,000,000
-270,000,000
-290,000,000
Energy Savings (mmBTU)
A
B
C
D
E
F
G
Recycle 80% of C&D and Yard Trash
52.4% Traditional
64.1% Adjusted
Target = -275 million mmBTU


-150,000,000
-170,000,000
-190,000,000
-210,000,000
-230,000,000
-250,000,000
-270,000,000
-290,000,000
Energy Savings (mmBTU)
A
B
C
D
E
F
G
Recycle 80% of Glass, Aluminum Cans, Plastic Bottles, Newspaper, Cardboard, Office Paper, Yard Trash, C&D and Food Waste
66.0% Traditional 76.7% Adjusted
Target = -275 million mmBTU

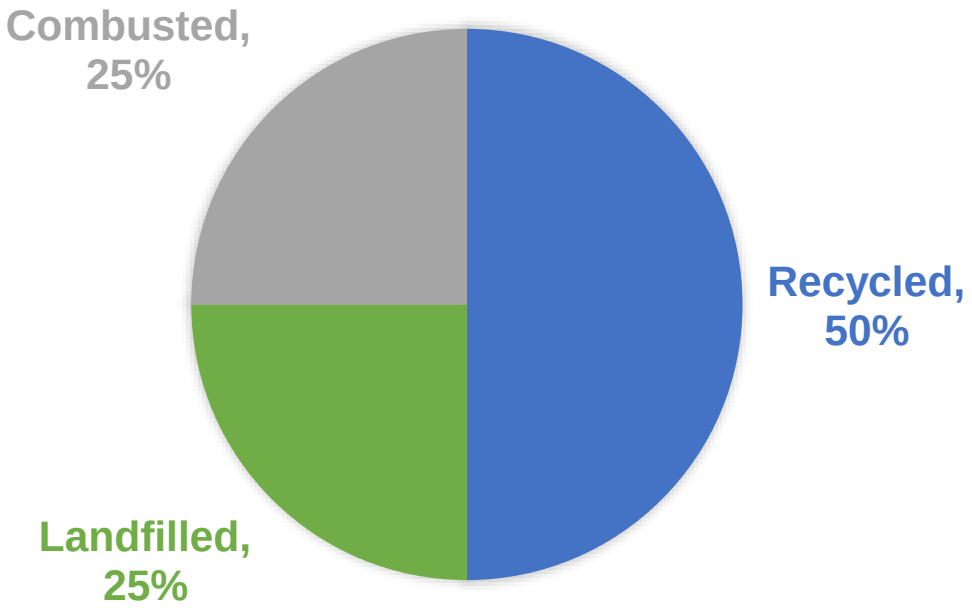
Lessons Learned

- With respect to two environmental burden categories (GHG emissions, energy), different recycling approaches result in different progress toward the goal.
- The materials targeted play a major role.
- The selection of a baseline is critical.



Refined Approach

- Lets assume a hypothetical waste management profile in 2008, Baseline 2, that follows:



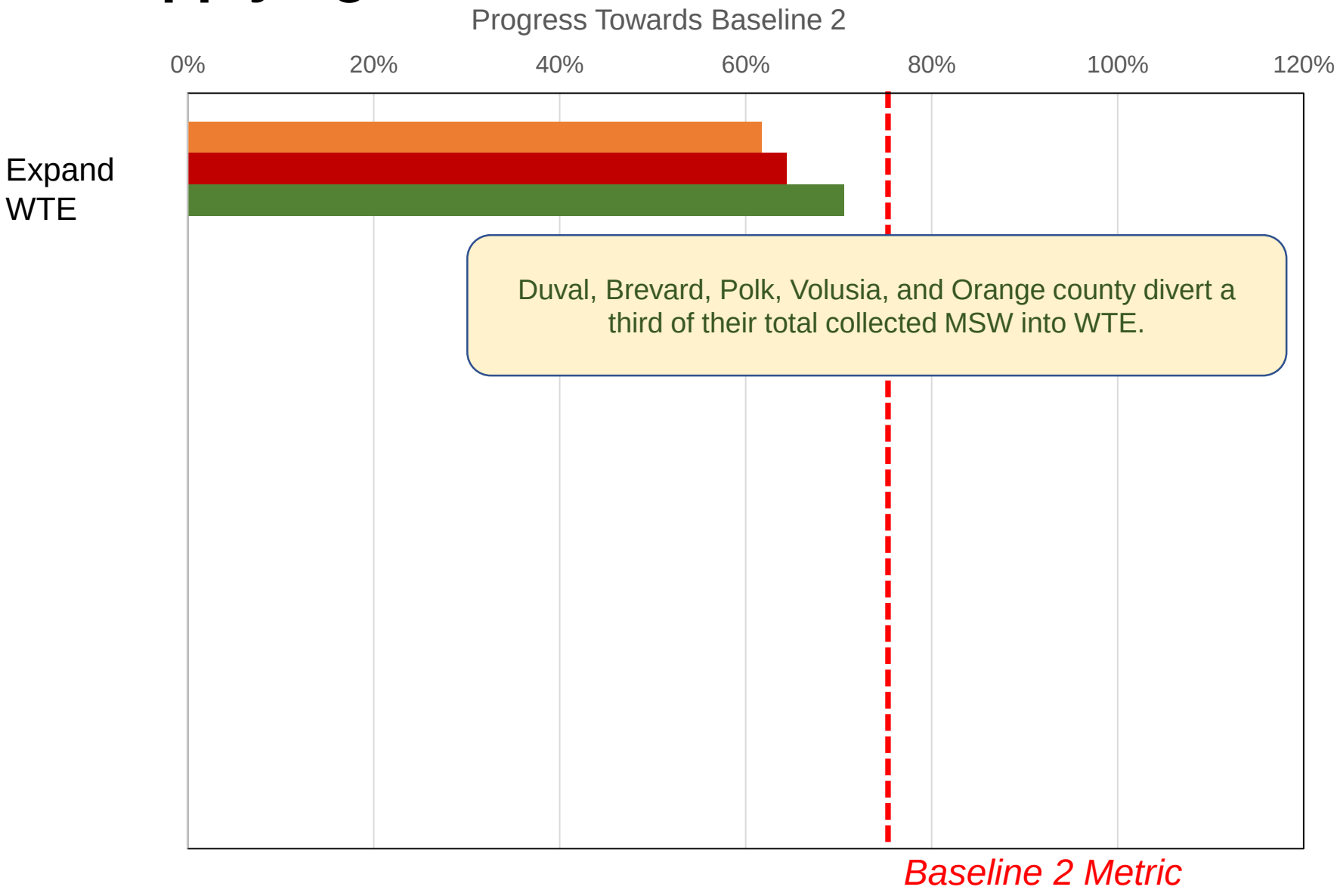
Refined Approach

- The Baseline 2 outputs:
  - Traditional Recycling Rate = 52%
  - Adjusted Recycling Rate = 77%
  - $MTCO_2E$ Emissions = - 25.8 million $MTCO_2E$
  - Energy usage = -272 million mmBTU

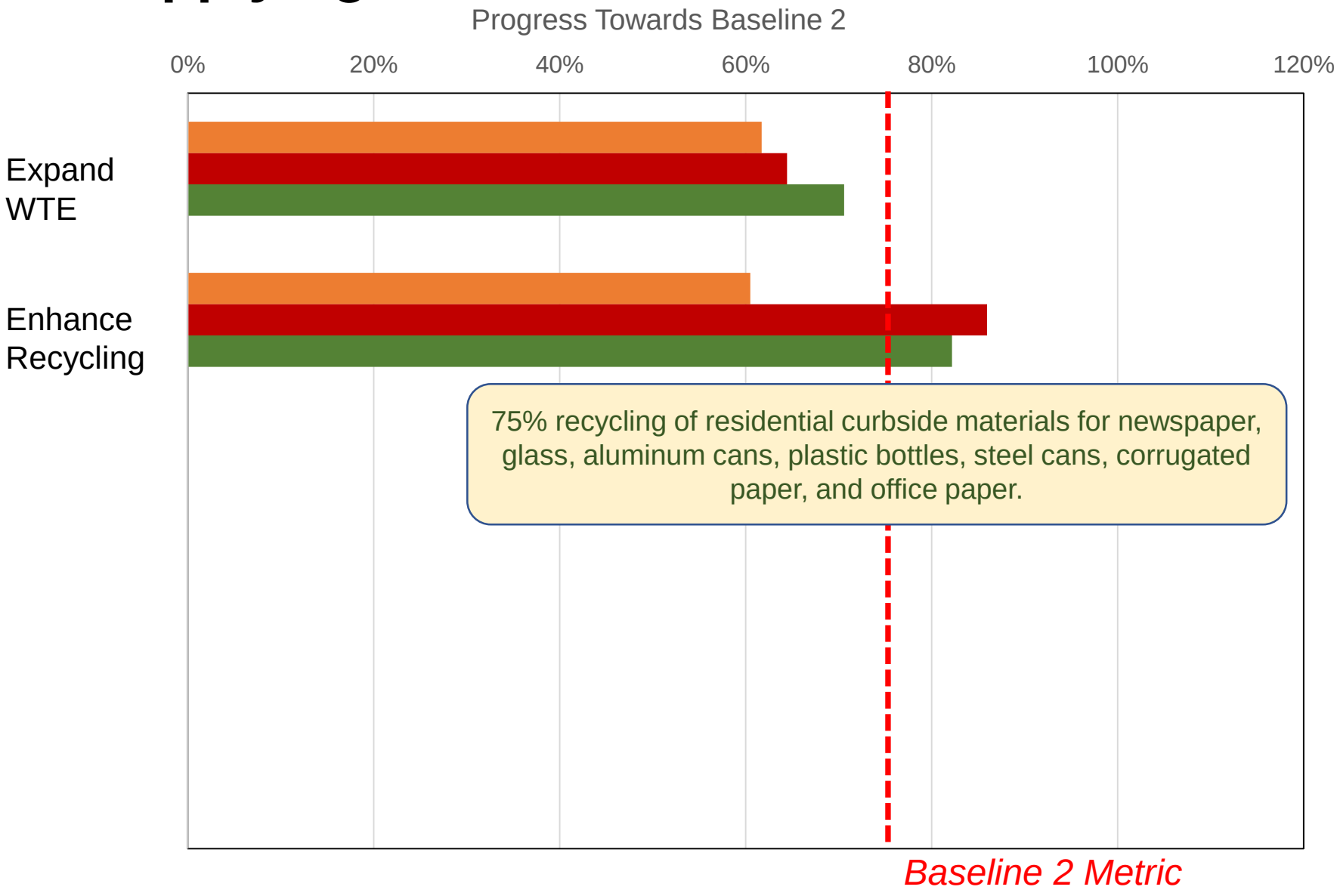
Our Target

To make it easier to compare, we will normalize the GHG and energy burdens to an equivalent progress toward a recycling goal.

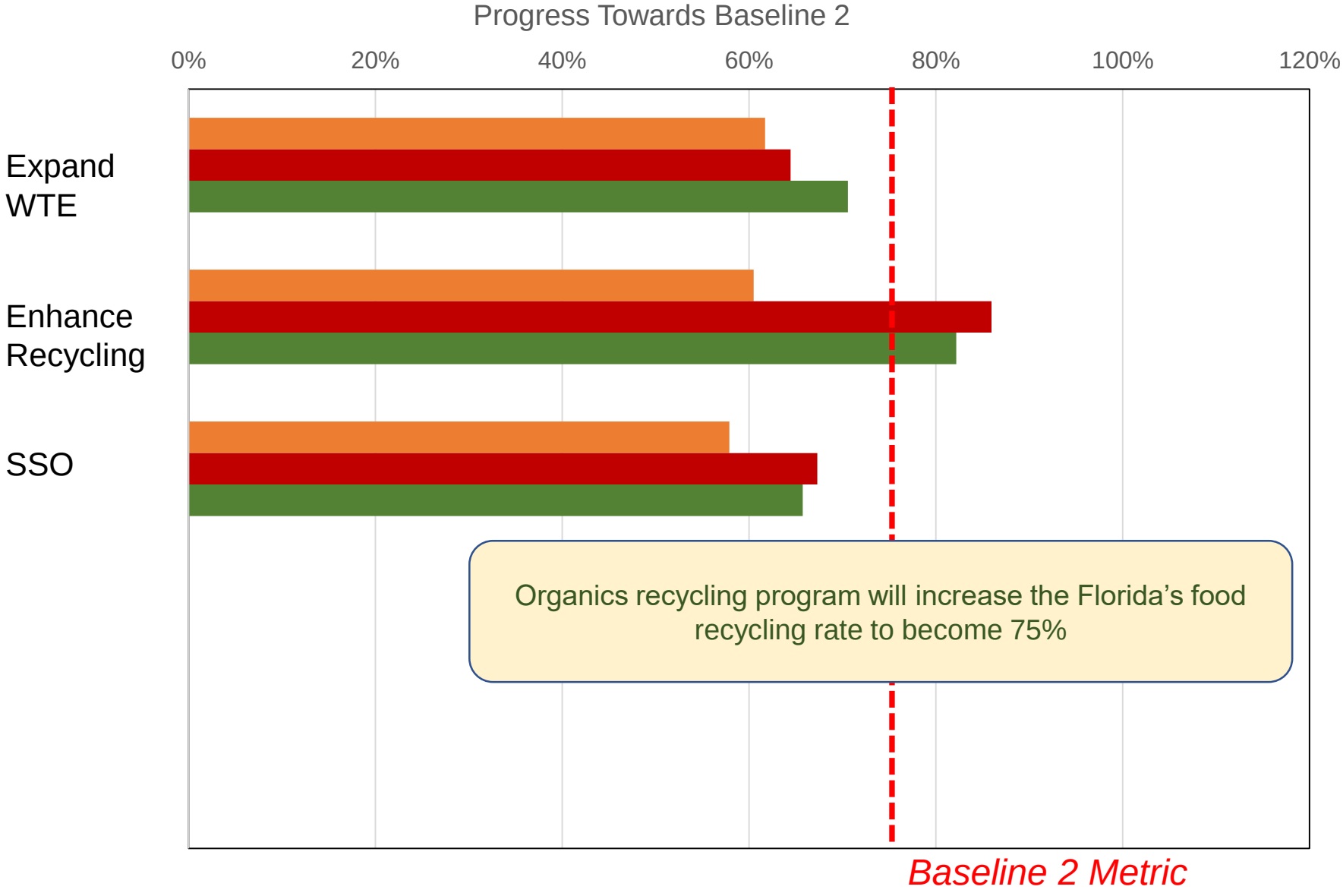
Applying SMM for Florida SWM in 2020



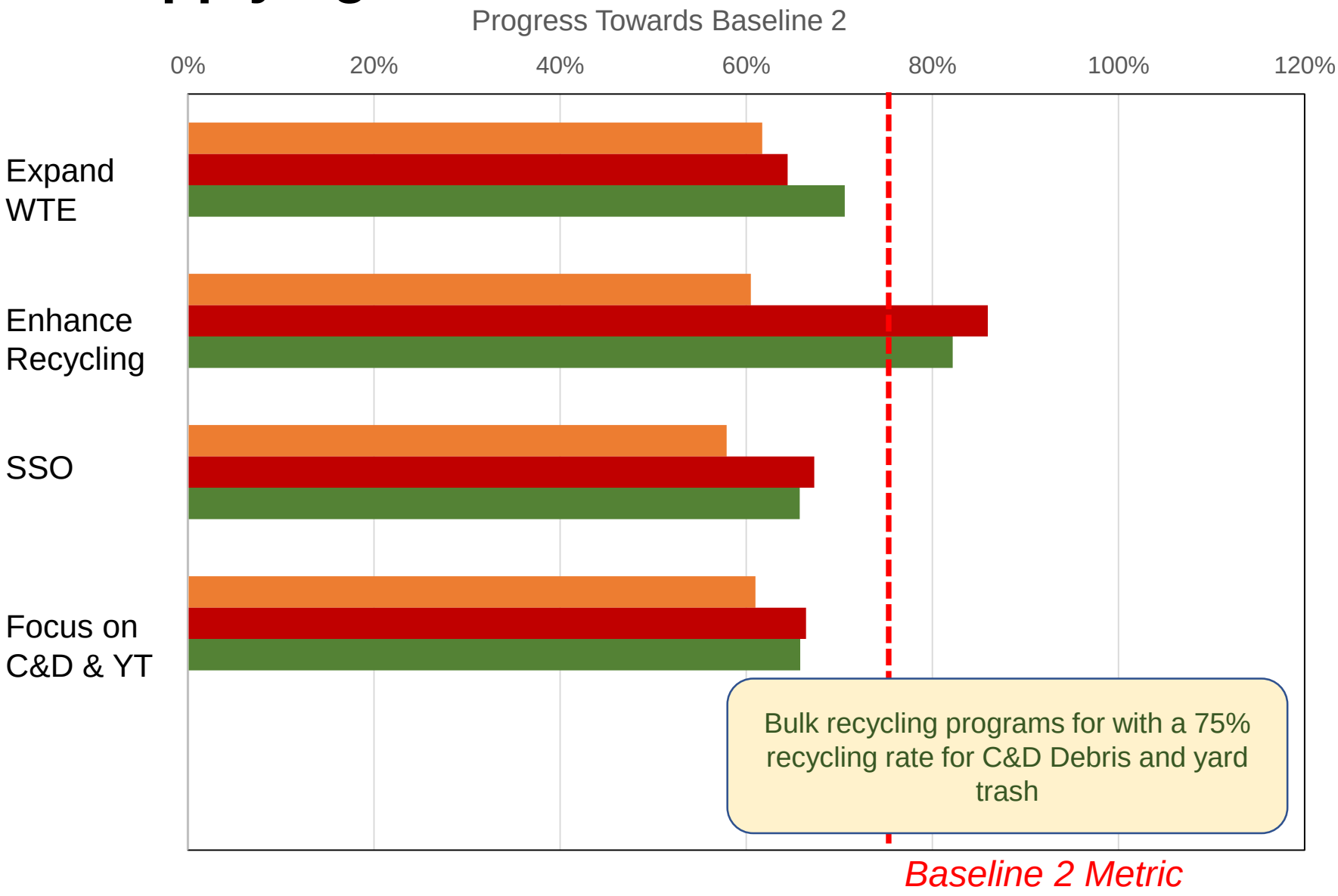
Applying SMM for Florida SWM in 2020



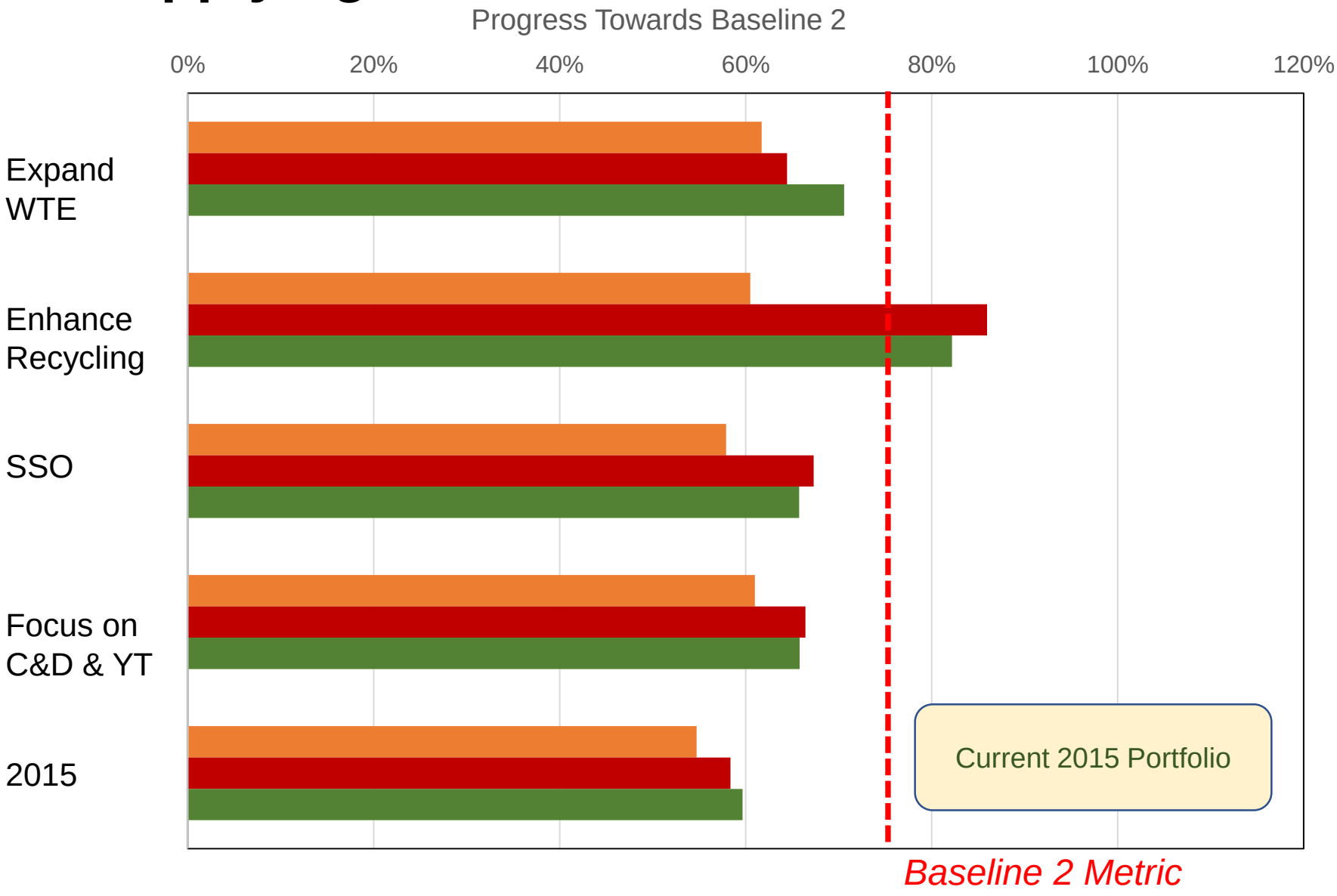
Applying SMM for Florida SWM in 2020



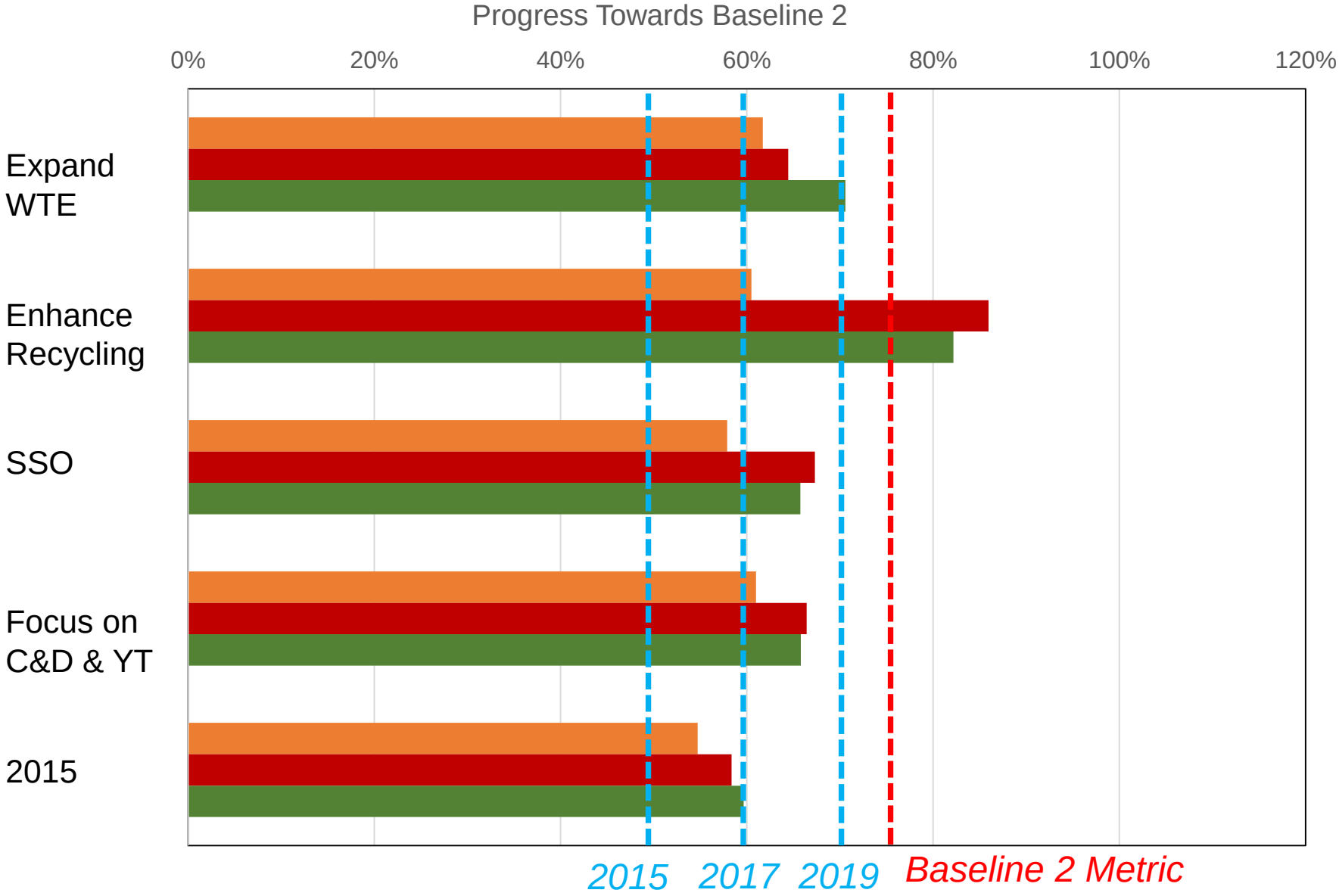
Applying SMM for Florida SWM in 2020



Applying SMM for Florida SWM in 2020



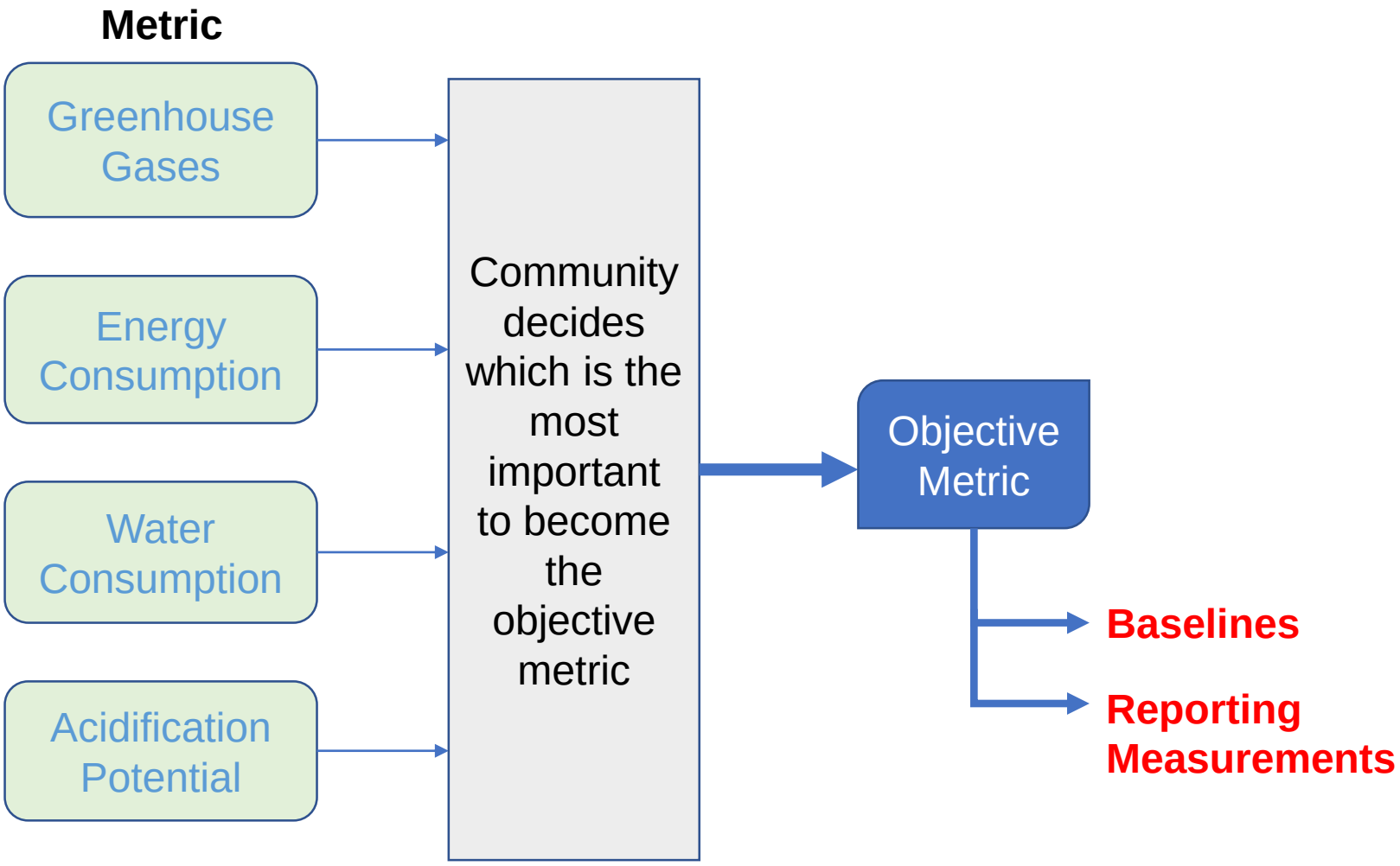
Applying SMM for Florida SWM in 2020



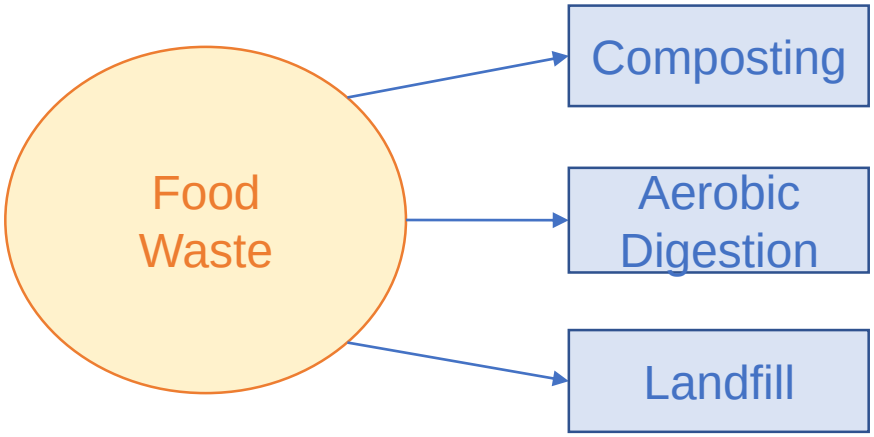
Discussion

- SMM could be used as a tool to set alternative “targets” with respect to solid waste management in Florida.
- This approach helps identify materials/system targets to reach SMM goals.
- What is an appropriate SMM metric? Could be community specific.
- Provides a scientific methodology to recognize WTE and more sustainable landfill practices, but still rewards recycling efforts.
- Reaching 75% is still a challenge.

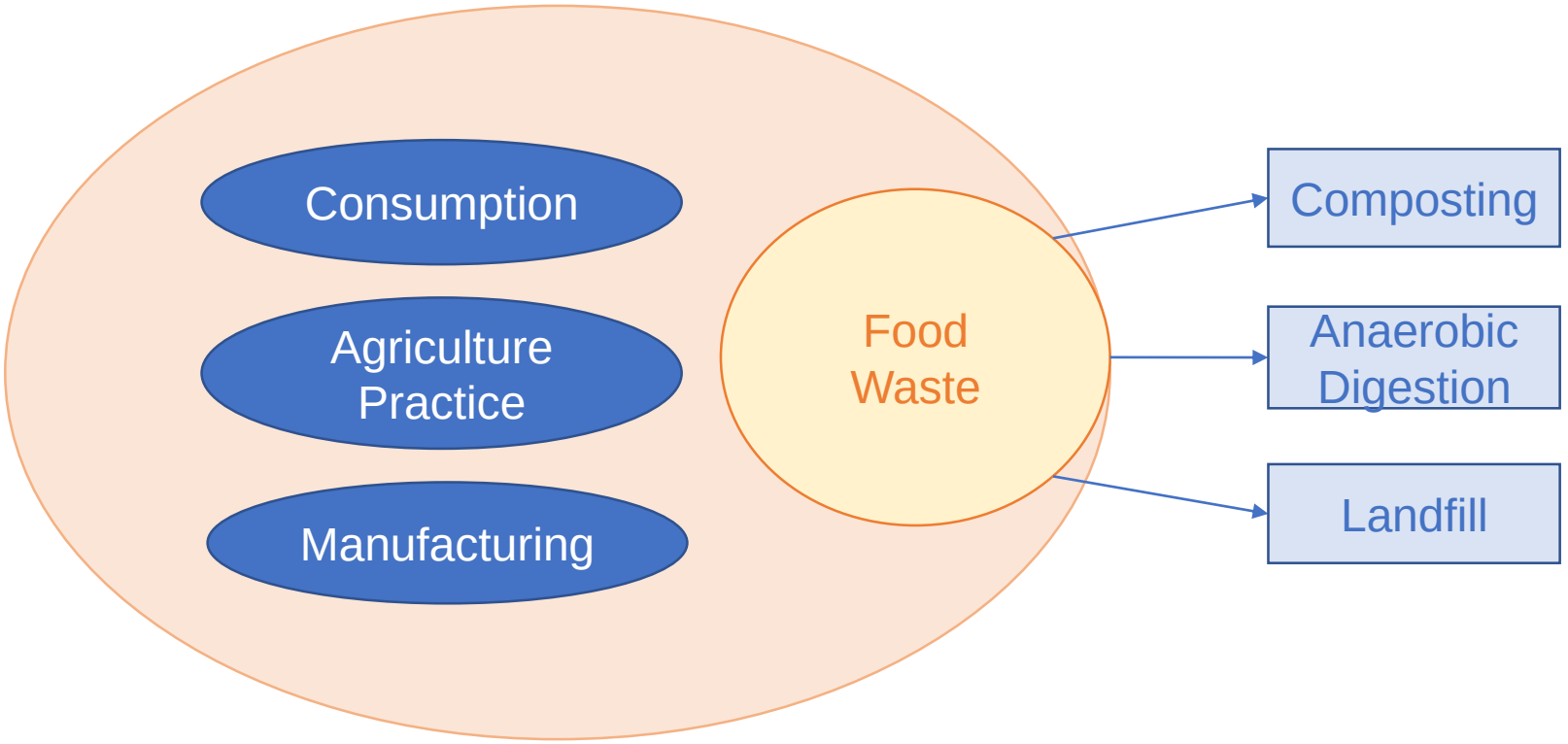
What is the Appropriate SMM Metric?



Expanded View of SMM as a Tool



Expanded View of SMM as a Tool



Next Steps

- Our team will keep working throughout the summer to:
  - Refine materials flow estimates
  - Synthesize cost data and refine environmental burden footprint
  - Evaluate feasibility and outcome of alternative waste management strategies
  - Continue to explore SMM metrics as a tool
- RFT webinar → June 28
- SWANA Summer Meeting → July 25

http://www.essie.ufl.edu/home/townsend/research/florida-solid-waste-issues/hc16/