Where Are We Now - 75% Goal and How It's Measured

Timothy Townsend, PhD, PE
Jones Edmunds Professor of Environmental Engineering
Malak Anshassi
PhD Candidate

Department of Environmental Engineering Sciences
Engineering School for Sustainable Infrastructure and Environment
University of Florida

FLC 7th Annual Fall Research Symposium:
Reassessing Recycling
Kissimmee, Florida
November 14, 2018

UNIVERSITY of FLORIDA

Hinkley Center for Solid and Hazardous Waste Management





Challenging Times for Solid Waste Management

Objective 1. Describe Florida's current solid waste management and the status of the 75% recycling goal

Objective 2. Introduce the concept of sustainable materials management (SMM)

Objective 3. Describe how SMM can be integrated into solid waste management policy and planning

Florida's 2017 Solid Waste Stream

- 45,128,981 Tons Collected
  - 12.1 pounds/person-day

US EPA
National Estimate
2014

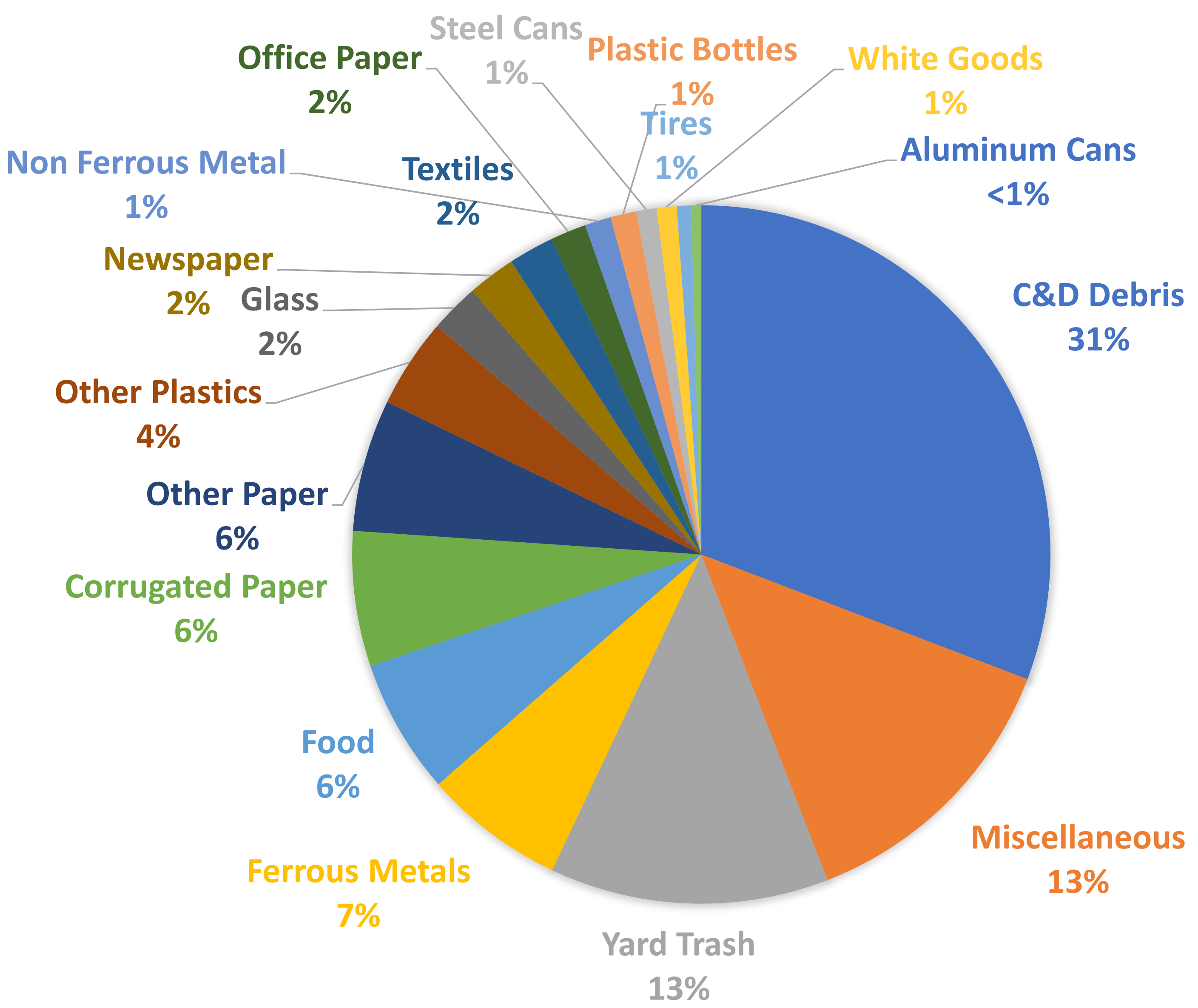
4.44 pounds/person-day

- Recycling Rate = 50.72%
  - Includes Renewable Energy Recycling Credits

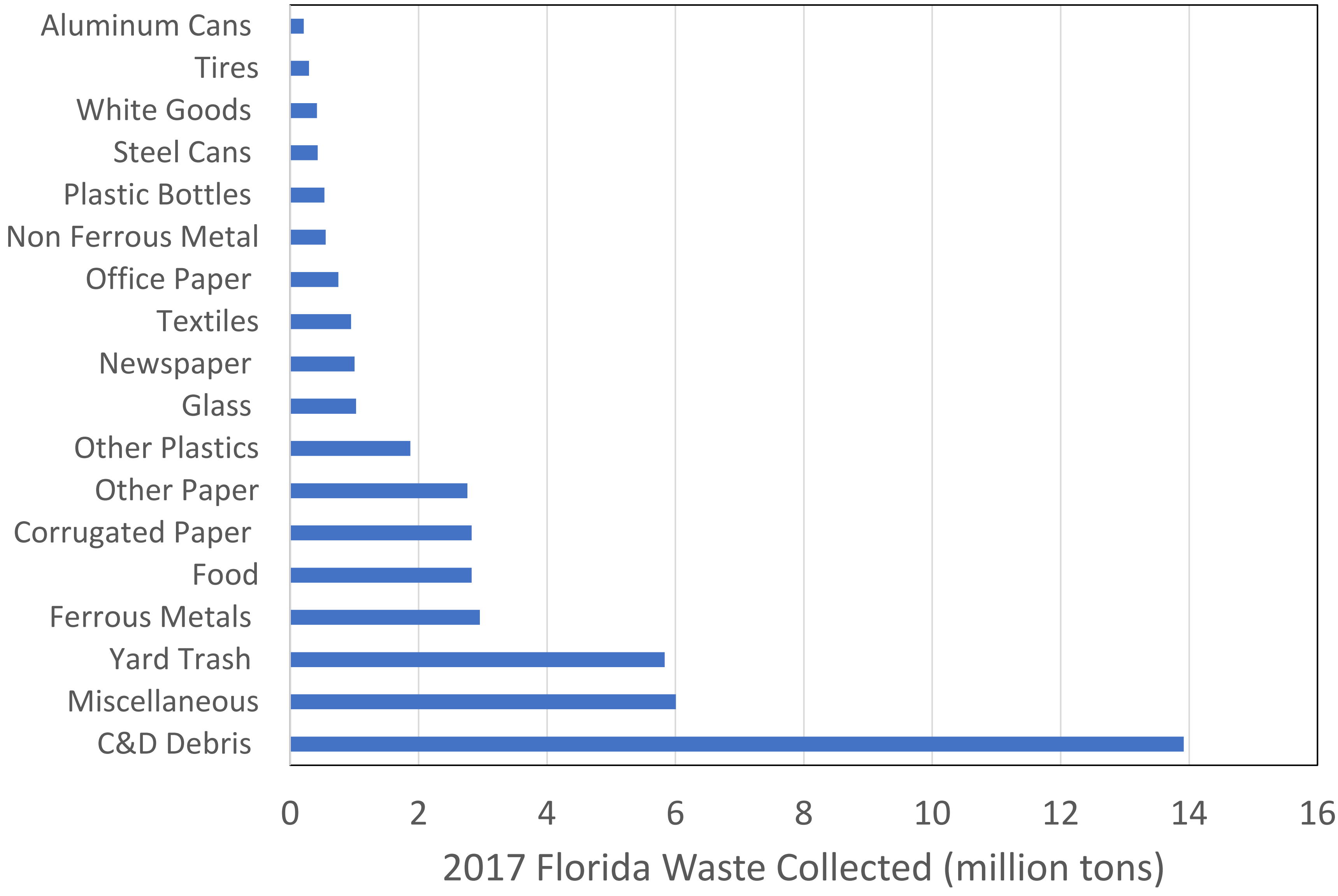
US EPA
National Estimate
2014

34.6%

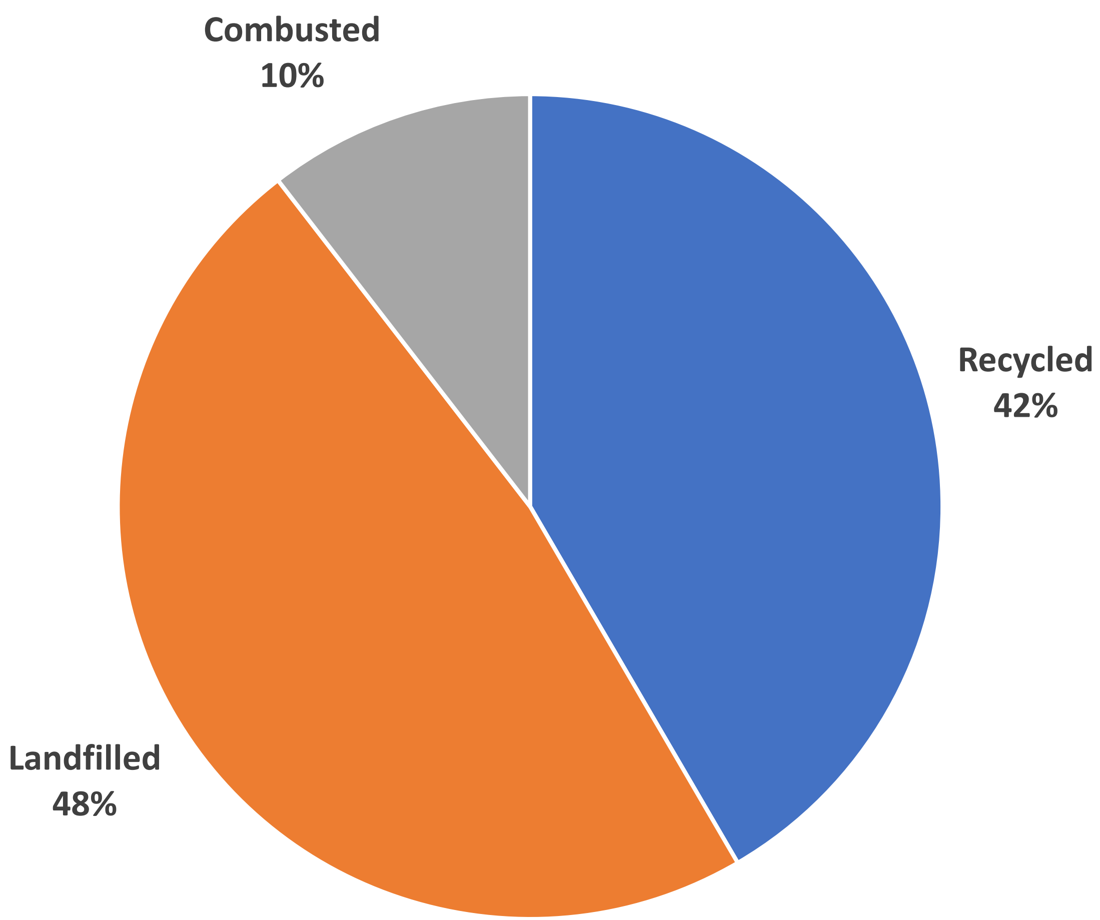
Florida’s 2017 Collected Composition



Florida's 2017 Collected Composition



2017 Florida Solid Waste Disposition

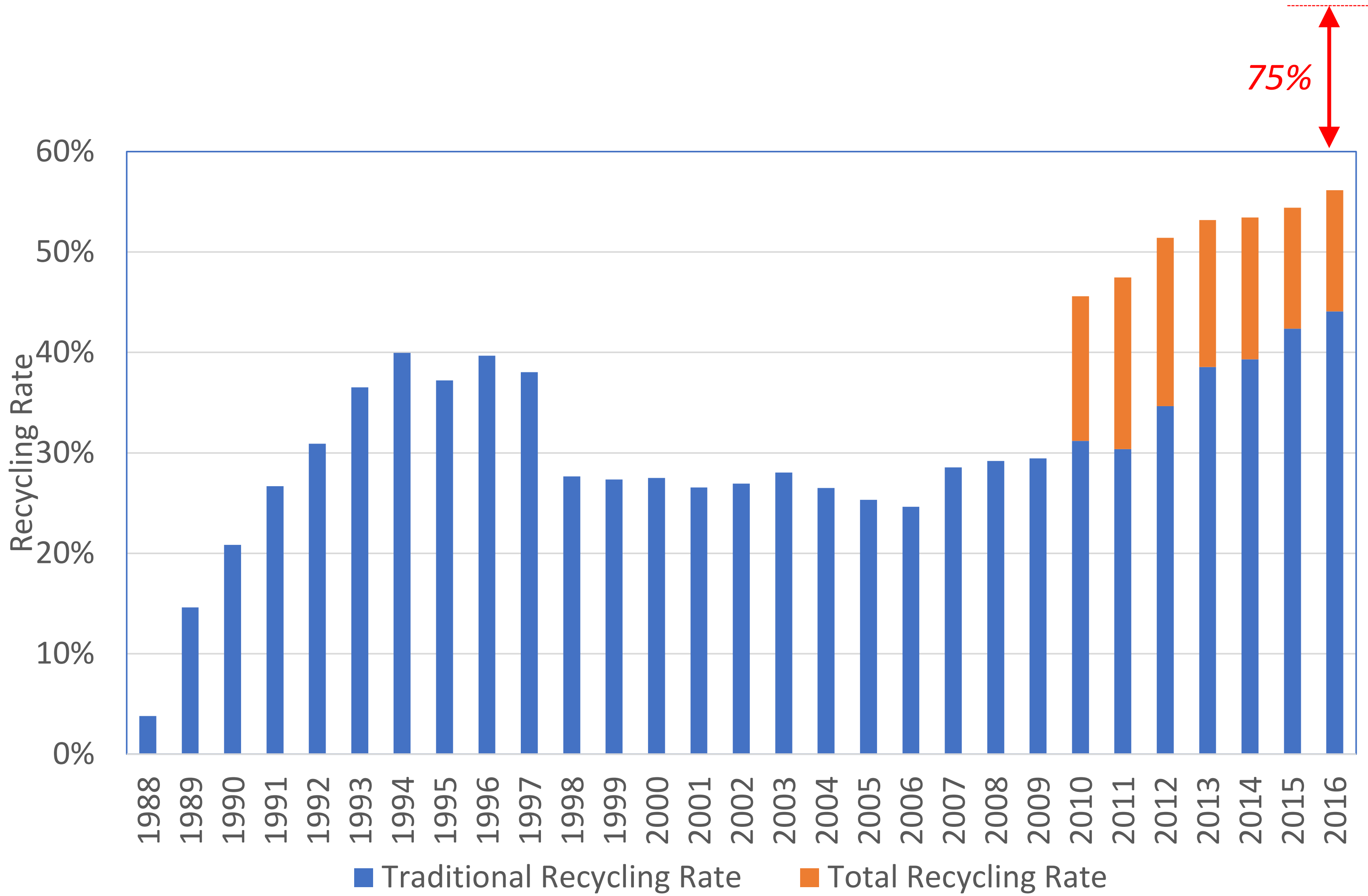


Traditional Recycling Rate: 42.1%
Total Recycling Rate: 50.7%

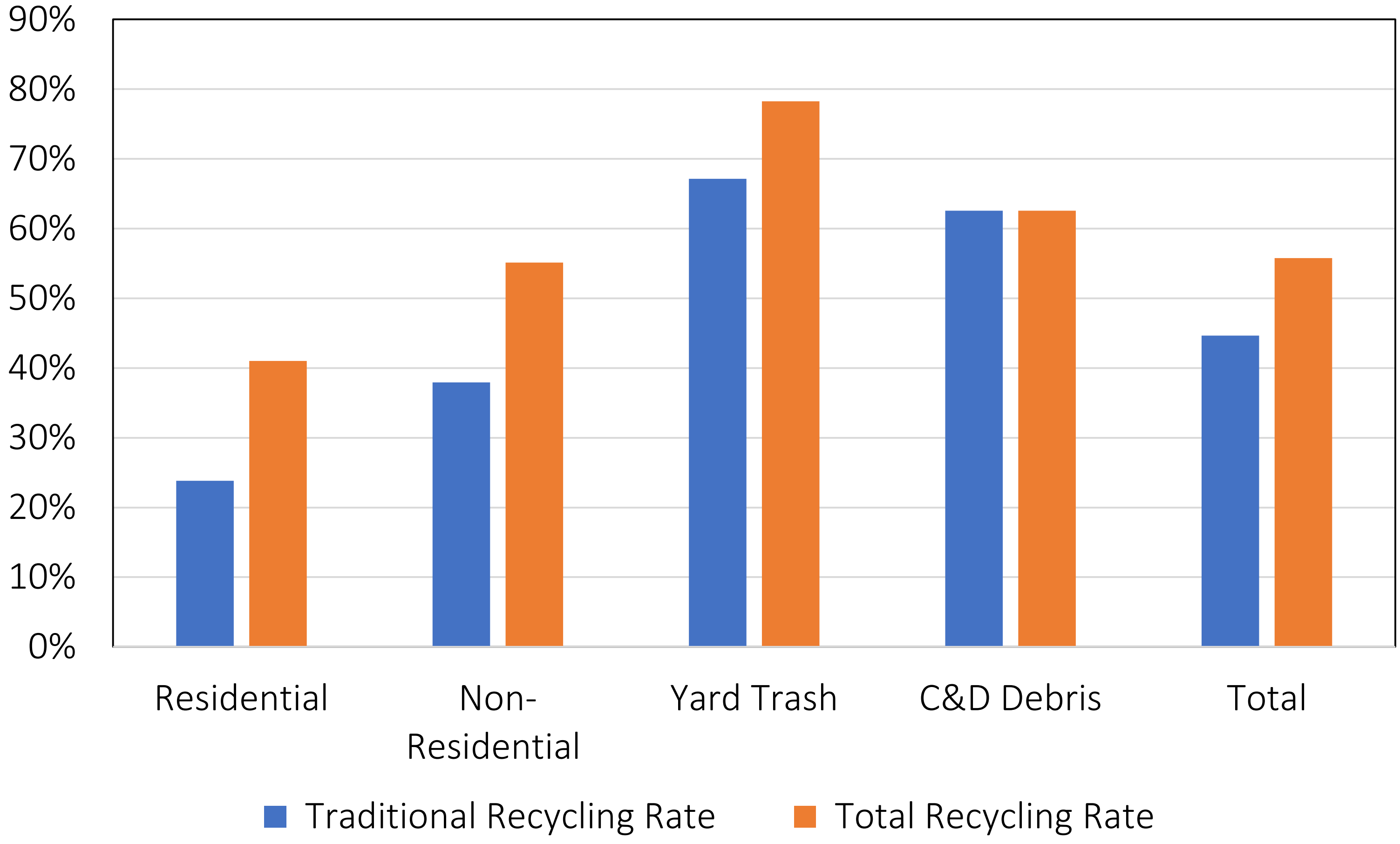
Florida's Recycling Rates

- Total → Includes energy from MSW combustion and energy from landfill gas
- Traditional → Measured from recycling programs as well as materials used as landfill cover

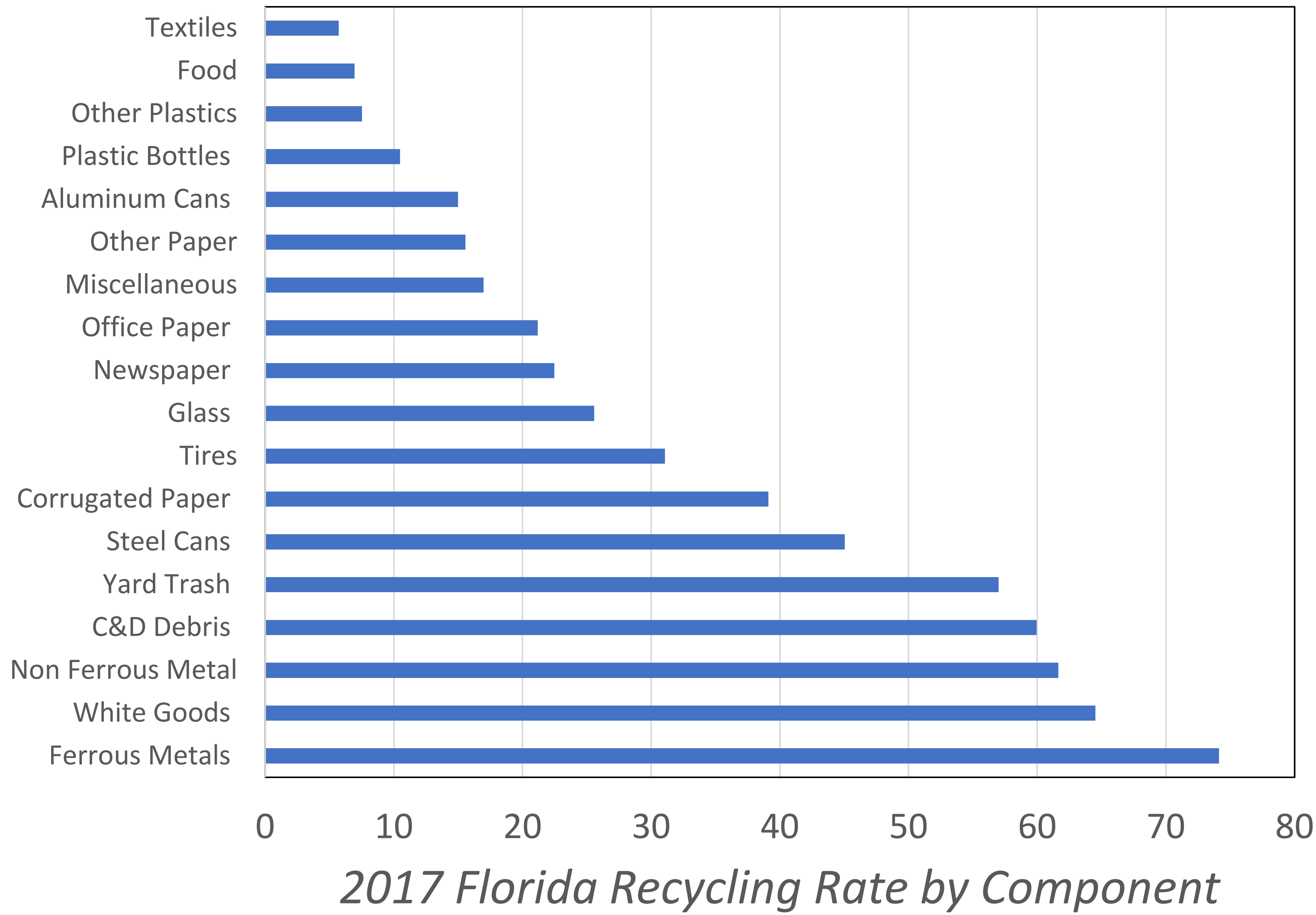
Florida Historic Recycling Rates



Florida Recycling Rates by Source
(Estimated for 2016)

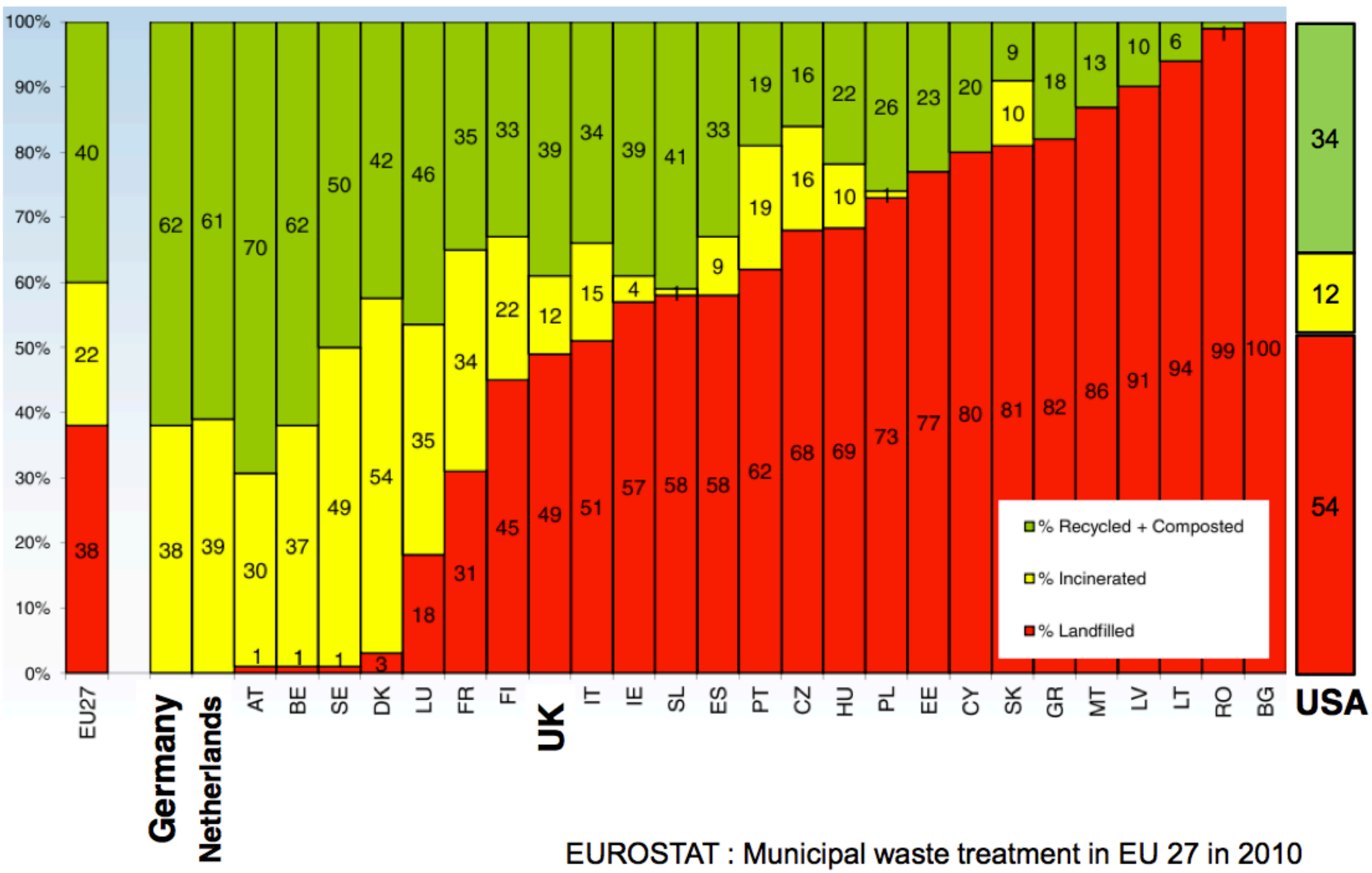


2017 Florida Recycling Rates by Component



Can 75% be Reached?

Global MSW Management



EUROSTAT : Municipal waste treatment in EU 27 in 2010

Reported 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

Challenges of Weight-Based Recycling Rates

- All materials are treated equally
- Material reduction is not counted

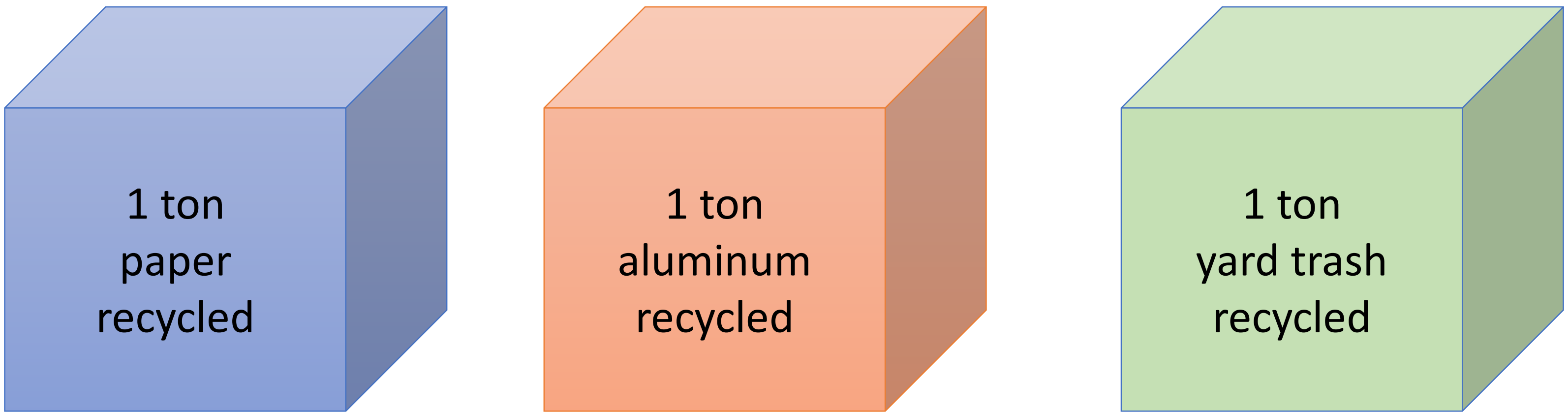
Sustainable Materials Management

- Systemic approach to using and reusing materials productively
- Represents a change in how our society thinks about the use of natural resources
- Looks at a product's entire lifecycle to reduce environmental impacts, conserve resources, and reduce costs

https://www.epa.gov/smm

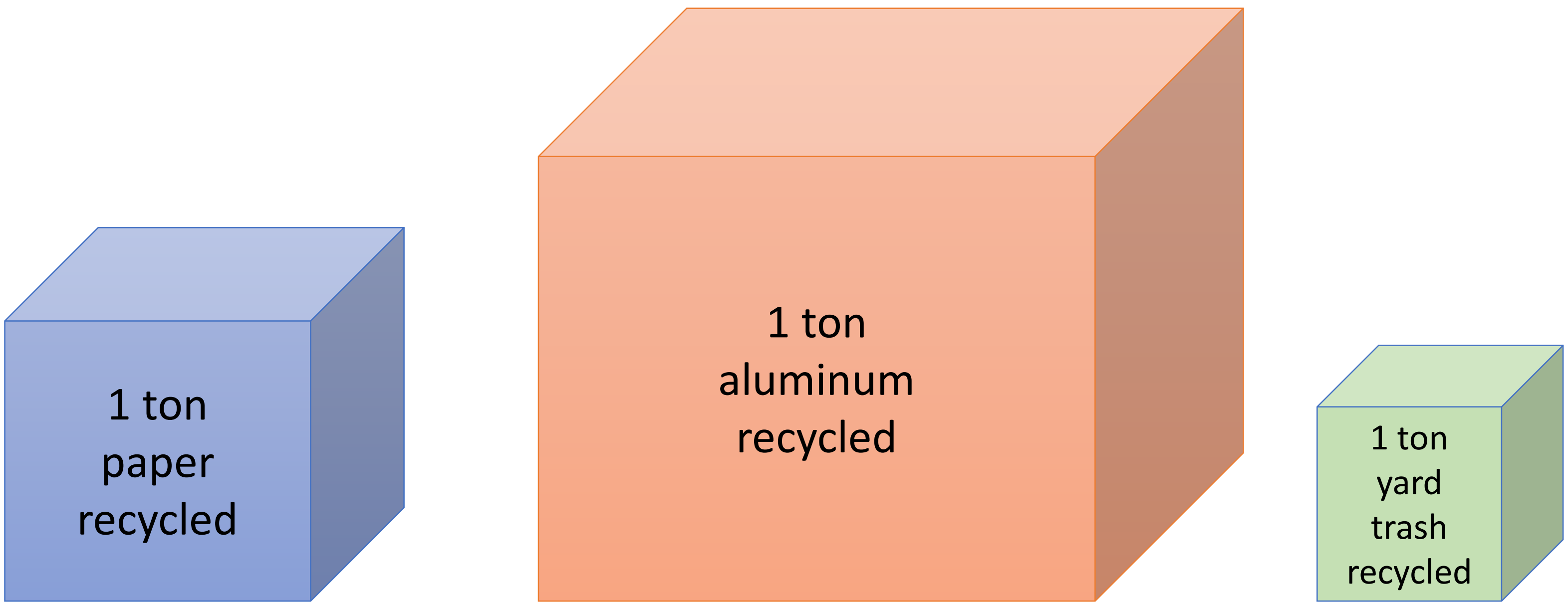
Current Approach

All materials are treated the same



The SMM Approach

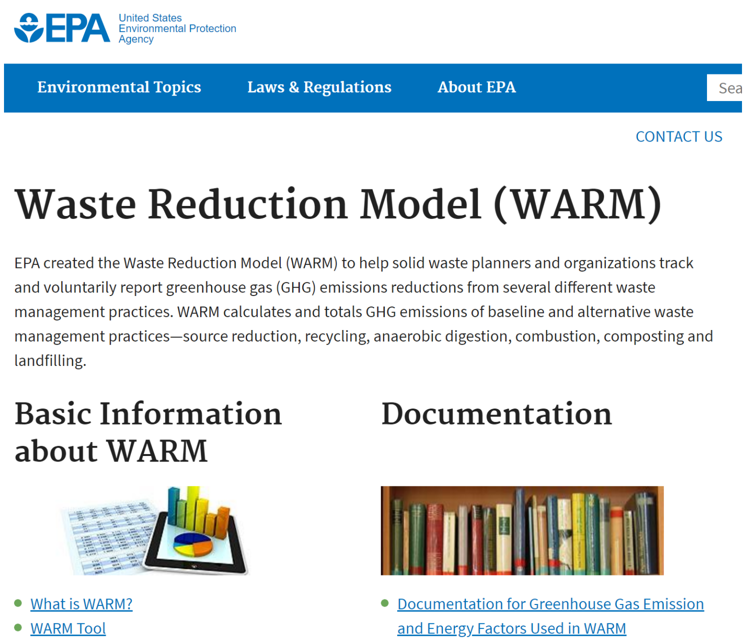
Different materials result in different outcomes



Metrics to Track Progress Besides Tons

- Greenhouse gas emissions
- Energy production/consumption
- Impact on air
- Impact on water
- Resource consumption
- Human toxicity
- Landfill capacity
- Jobs
- Costs

US EPA's WARM


EPA United States Environmental Protection Agency

Environmental Topics | Laws & Regulations | About EPA | Sea

CONTACT US

Waste Reduction Model (WARM)

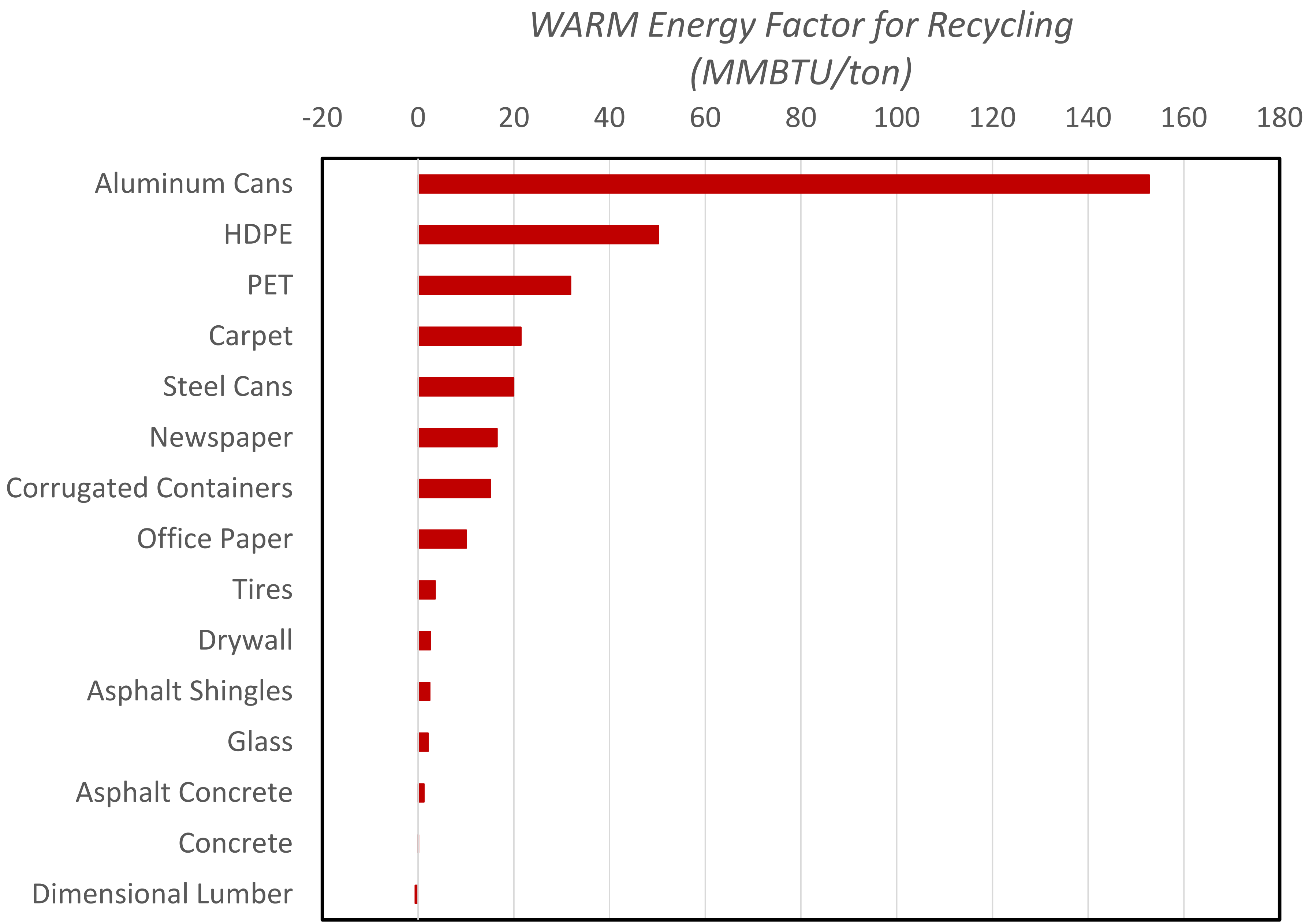
EPA created the Waste Reduction Model (WARM) to help solid waste planners and organizations track and voluntarily report greenhouse gas (GHG) emissions reductions from several different waste management practices. WARM calculates and totals GHG emissions of baseline and alternative waste management practices—source reduction, recycling, anaerobic digestion, combustion, composting and landfilling.

Basic Information about WARM

- What is WARM?
- WARM Tool

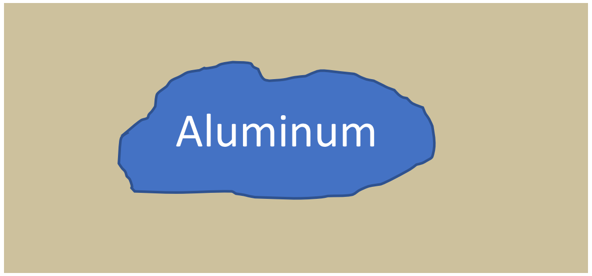
Documentation

- Documentation for Greenhouse Gas Emission and Energy Factors Used in WARM


WARM Energy Factor for Recycling
(MMBTU/ton)
-20
0
20
40
60
80
100
120
140
160
180
Aluminum Cans
HDPE
PET
Carpet
Steel Cans
Newspaper
Corrugated Containers
Office Paper
Tires
Drywall
Asphalt Shingles
Glass
Asphalt Concrete
Concrete
Dimensional Lumber

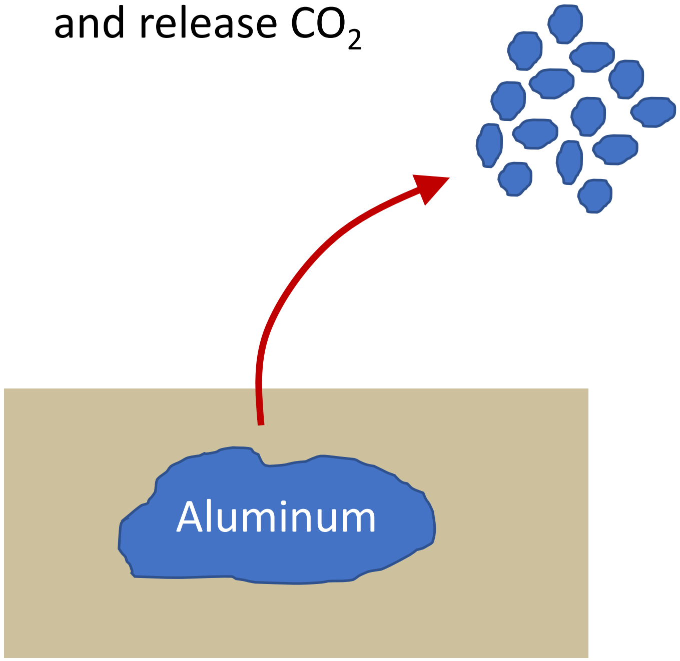
Let's consider the life-cycle of an aluminum can

Source of Aluminum in Earth

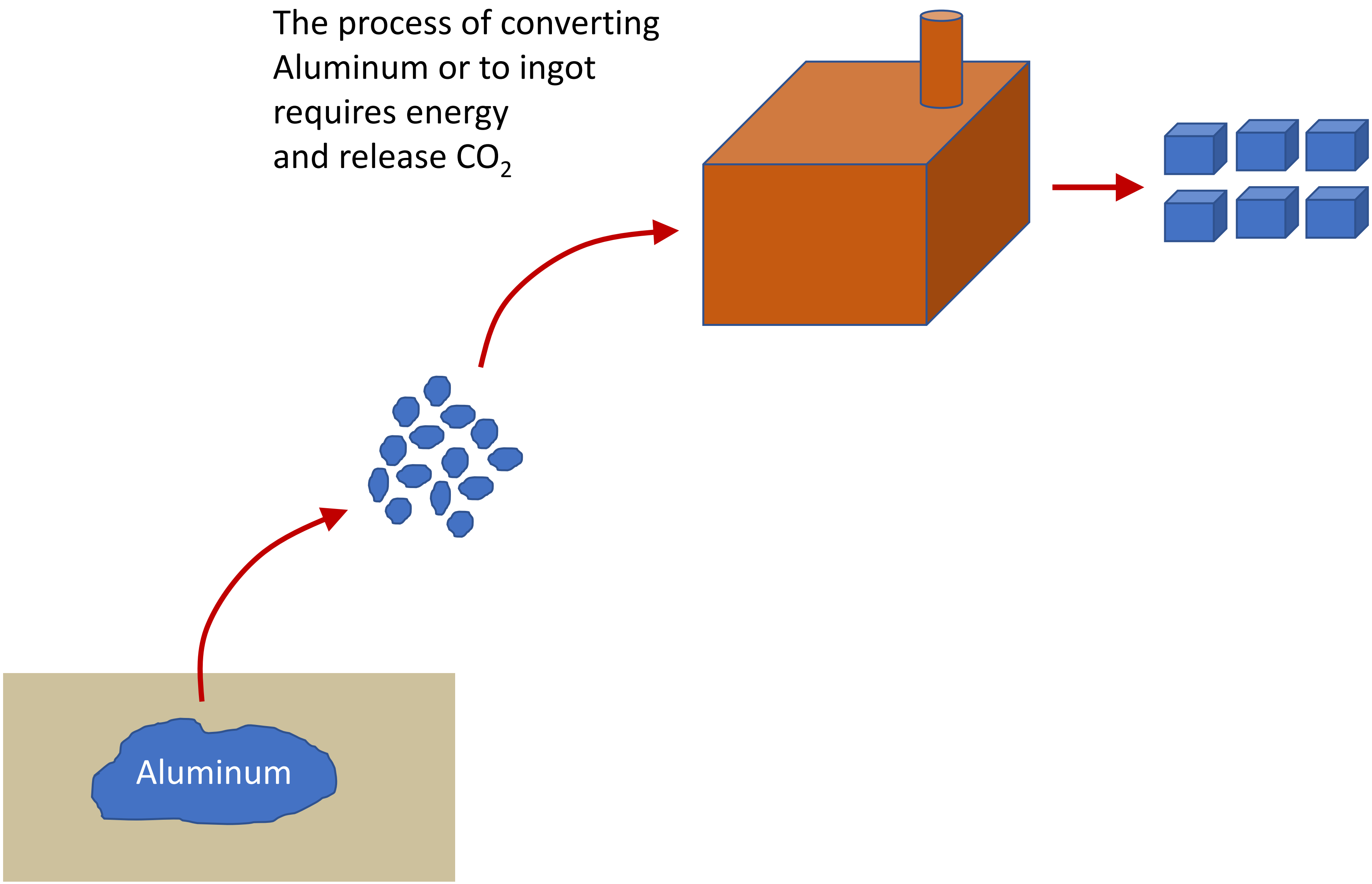


Let’s consider the life-cycle of an aluminum can

The process of mining the Aluminum from the earth requires energy and release CO_2

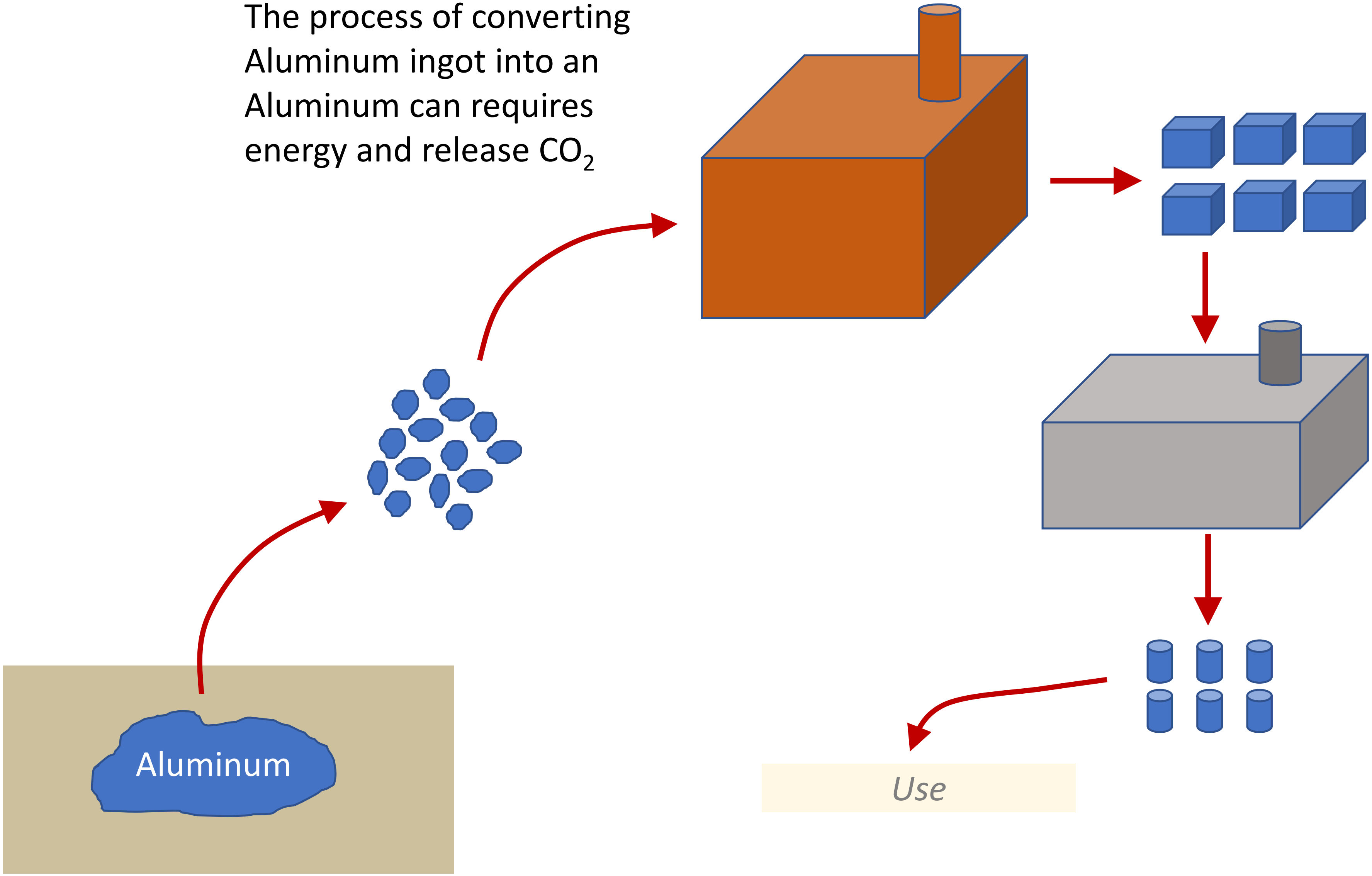


Let’s consider the life-cycle of an aluminum can

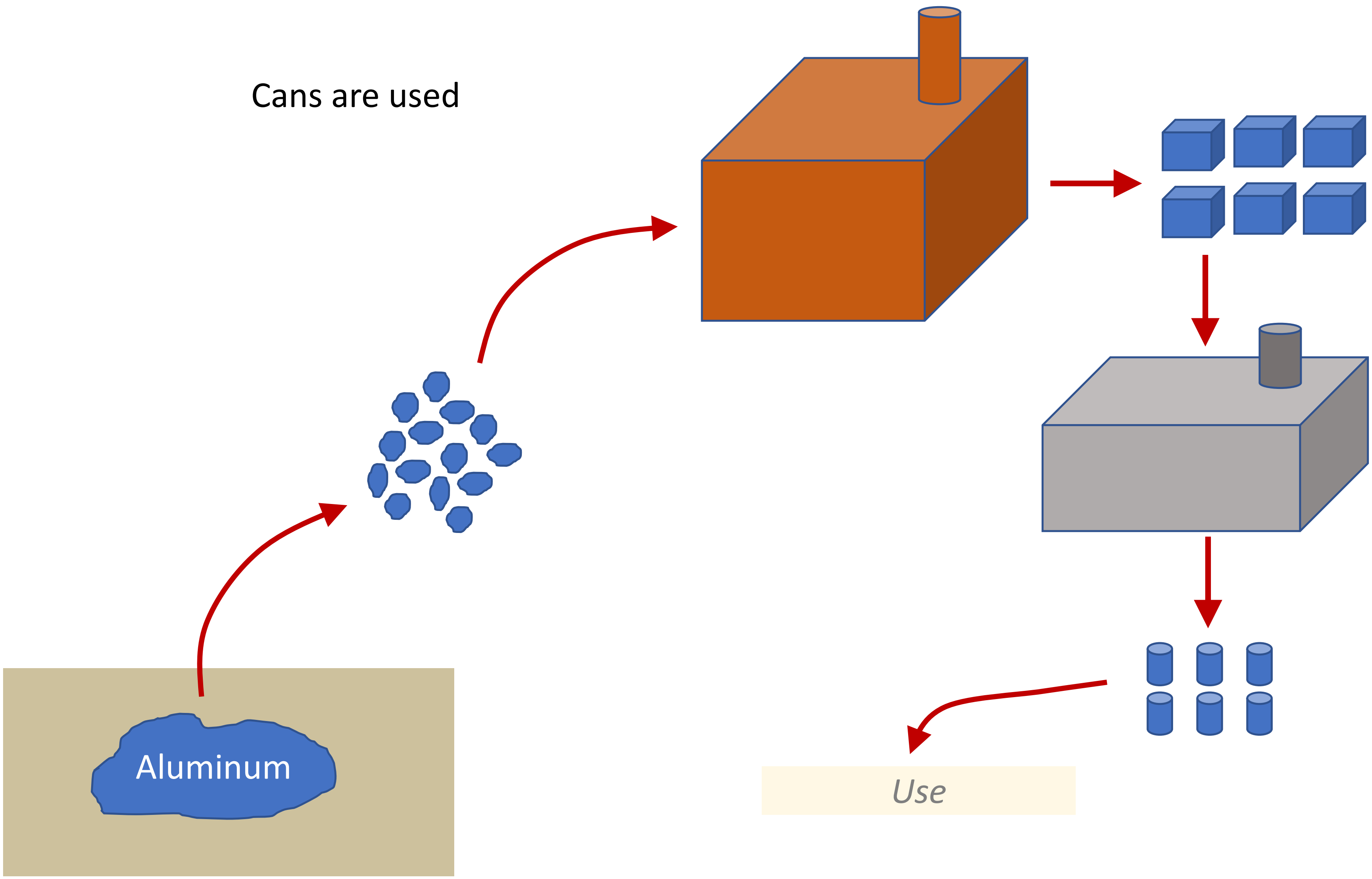


Let's consider the life-cycle of an aluminum can

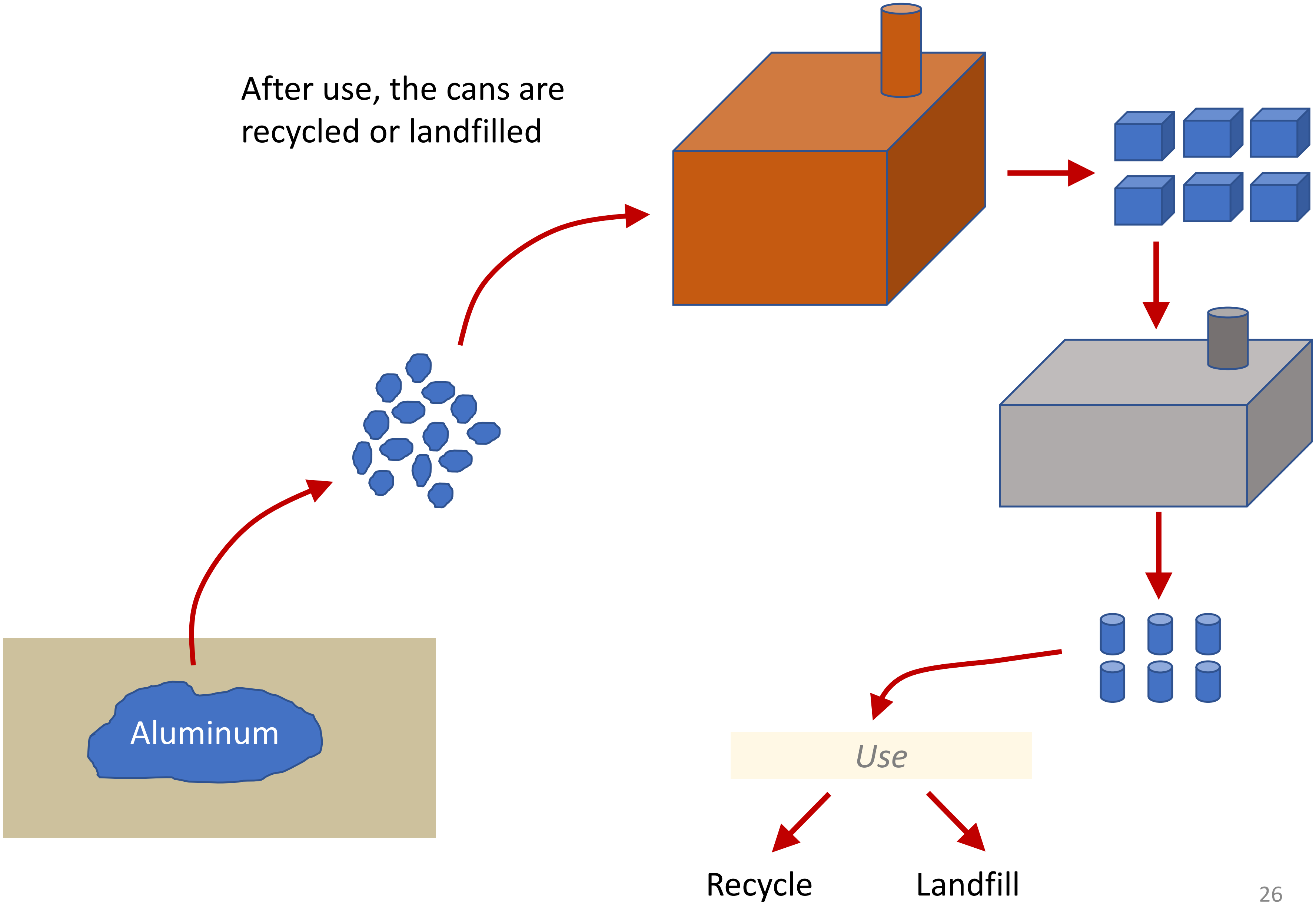
The process of converting Aluminum ingot into an Aluminum can requires energy and release CO_2



Let's consider the life-cycle of an aluminum can

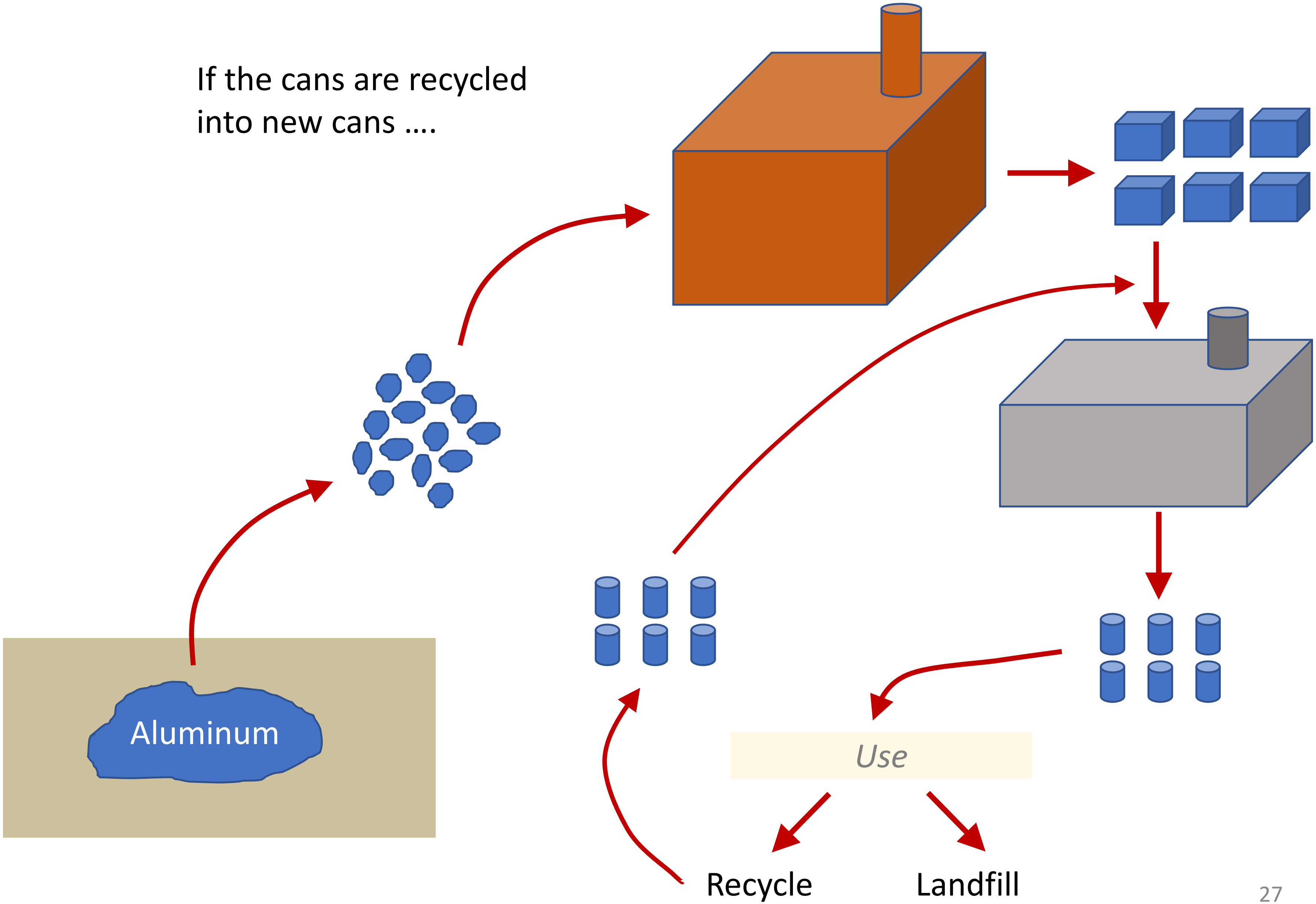


Let's consider the life-cycle of an aluminum can



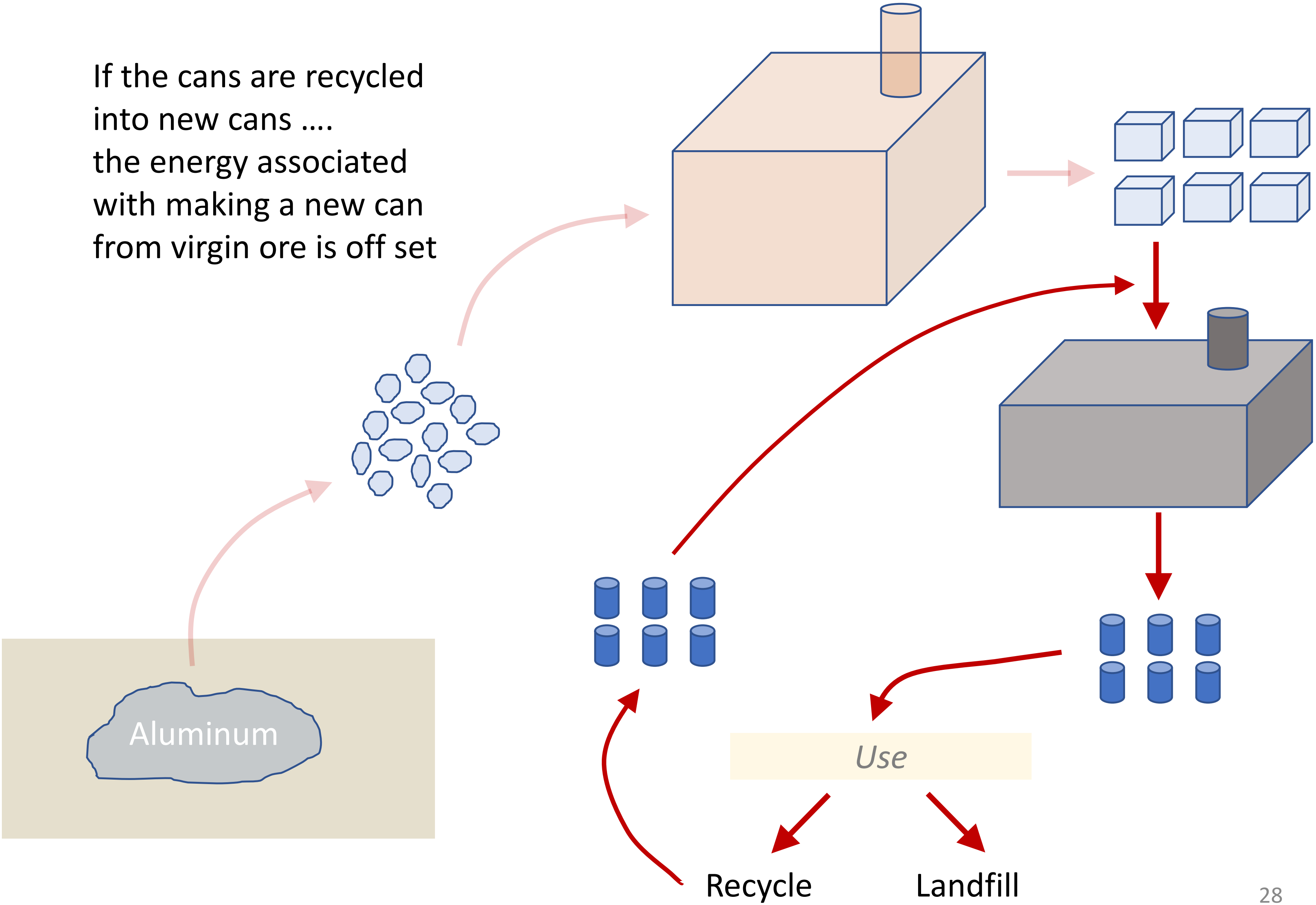
Let's consider the life-cycle of an aluminum can

If the cans are recycled into new cans ….

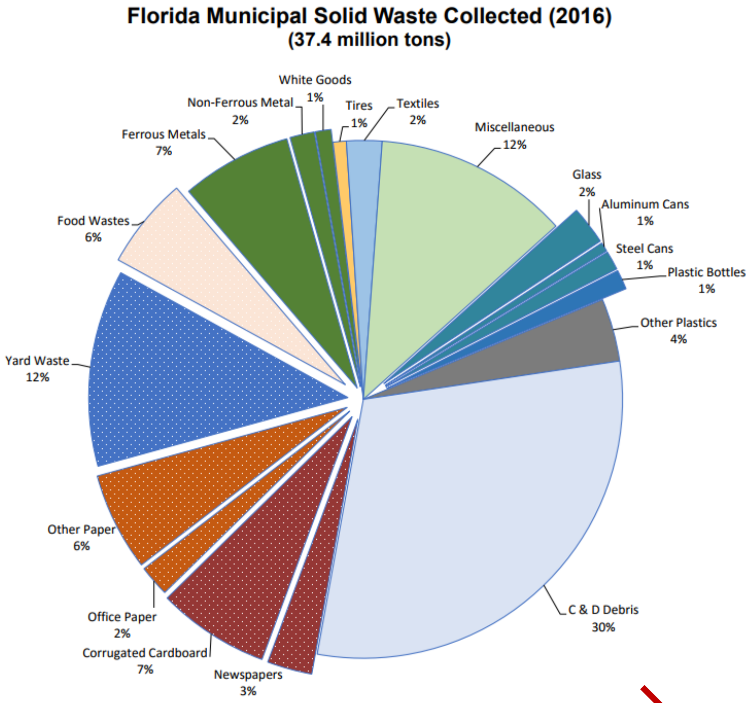


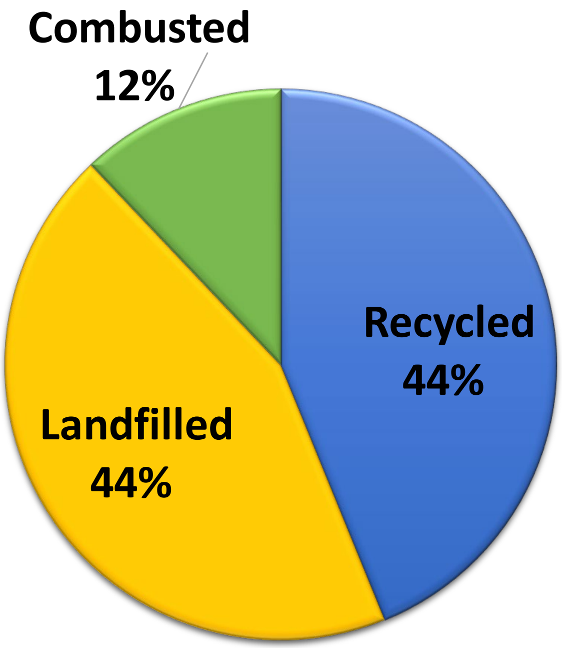
Let's consider the life-cycle of an aluminum can

If the cans are recycled into new cans ….
the energy associated with making a new can from virgin ore is off set



Florida's Energy and Greenhouse Gas Footprints Associated with 2016 Waste Management





WARM

Energy Footprint = -12,900 MJ/person

GHG Footprint = -1.08 $tCO_2eq.$/person

Integrating SMM

- We are not on track to reach 75%
- Strategies do exist to increase our recycling rate, but no single strategy is going to get us there. Multiple approaches would need to be employed. These come with a cost.
- Tools exist to relate waste management to outcomes such as energy savings and GHG avoidance.
- How can this be integrated into statewide policy making?

Incorporating Sustainable Materials Management

We can use the SMM model in solid waste policy to minimize our environmental footprint by following approaches that either:

Answer Questions Like…

1. Prioritize and Strategically Plan

- Which materials should we prioritize recycling?
- Which disposal method is best for our waste stream?
- Which policies or technologies should we prioritize?
- Which stakeholders should we prioritize?

AND/OR

2. Performance Metrics

- What should our targets metrics be based on?
- What are the units of measure our metrics should be?
- How can we measure our solid waste system performance?

Incorporating Sustainable Materials Management

Approach	Description
Priority and Strategic Planning Approaches	
Best Target Materials Recycling	Determines which materials to prioritize recycling by ranking their environmental impact
Best Disposal Management	Evaluates whether to strategically dispose of a material via combustion or landfilling
Prioritizing Policy and Technology Approach	Identifies which solid waste policy or technology generates the most environmental avoidances
Prioritizing Stakeholders	Identifies the stakeholders responsible for generating the most environmental avoidances
Performance Metrics Approaches	
Effective Recycling Rates	Uses a mass-based recycling rate to normalize LCA results so that the recycling rate and LCA results are the same unit
Arbitrary Performance Outcomes	Sets an arbitrary target environmental avoidance based on a desired environmental footprint
Technical Performance Outcomes	Sets a technical-based target environmental avoidance based on scientifically recommended thresholds

Best Target Material Recycling Approach

FL has a 75% Recycling Goal by 2020

If my waste stream is glass, plastics, and metals? Which one should we prioritize recycling of to meet the goal and minimize our footprint?

Looking at each material's current recycling rate and their environmental impact …

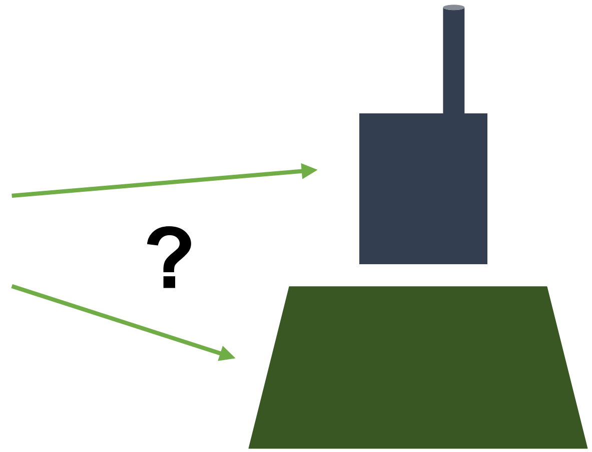
Prioritize: Materials with a low recycling rate and high environmental savings

Spotlight:

- Oregon and Maryland are now prioritizing materials by setting material specific recovery rates.
- Both Oregon & Maryland prioritize food waste, yard trash, and metals.

Best Disposal Management Approach

Should the yard trash in our waste stream be combusted or landfilled?



Depends on how much of the material's mass is sent to landfill or combustion and the environmental impact

Prioritize: If from a greenhouse gas (GHG) emissions perspective landfilling has a larger saving, but if from an energy use perspective combustion has a larger savings.

Prioritizing Policy and Technology Approach

Let's look at an example of how to use this:

If FL wanted to evaluate if they should focus on:

1. Investing in a composting facility =
2. Instituting a mandatory commercial recycling =
3. Investing in a renewable energy facility =

Applying LCA:

Total GHG Emission Footprint
And
Total Energy Use Footprint

Prioritize: The scenario with the most environmental savings

Spotlight:

Various US states/cities like Boston, California, and Ohio have used LCA environmental results to determine the best policies or technologies to invest in

Prioritizing Stakeholders Approach

Let's look at an example of how to use this:

If FL wanted to evaluate if they should focus on:

1. Restaurants composting =
2. Multi-Family residents recycling =
3. Commercial retailers recycling =

Applying LCA:

Total GHG Emission Footprint
And
Total Energy Use Footprint

Prioritize: The scenario with the most environmental savings

Spotlight:

Oregon directed industry and business owners to collaborate with the state environmental agencies to advance the use of the SMM model

Arbitrary Performance Outcomes

- **How can we use LCA results as a performance metric?**
- Use the results directly and set an environmental footprint reduction:

Spotlight:

- Agencies like the MDE have already established GHG emissions reduction goals, such as a statewide annual reduction of 25% by 2020 and 40% by 2030, relative to 2006 levels.
- MDE have further recommended that the state reduce their GHG emissions and energy use footprints by 1.2 million $tCO_2eq.$ and 4.3 million BTUs by 2035, compared to 2016

Technical Performance Outcomes

- **How can we use LCA results as a performance metric?**
- Use the results directly and set an environmental footprint reduction:

The percent reduction is based on a technically supported threshold:

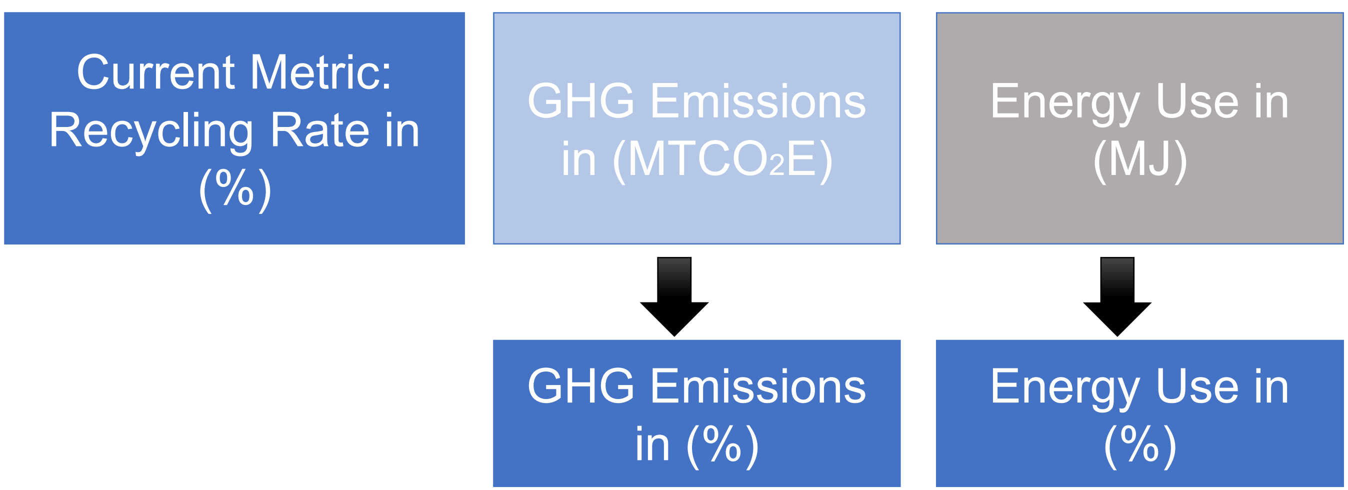
i.e., a X% reduction based on pre-industrial levels

Effective Recycling Rates

- **How can we use LCA results as a performance metric?**
- Issue: LCA results are abstract (e.g., emissions)

What if we normalize LCA results so that the recycling rate and LCA results are the same unit?

- Normalizing means: adjusting values measured on different scales to a common scale.



Environmental Science & Technology

Article

Cite This: *Environ. Sci. Technol.* XXXX, XXX, XXX−XXX

pubs.acs.org/est

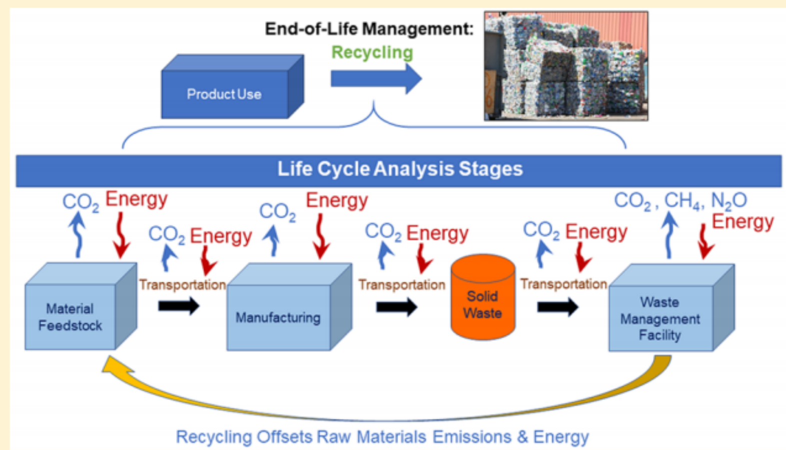
Replacing Recycling Rates with Life-Cycle Metrics as Government Materials Management Targets

Malak Anshassi, Steven Laux, and Timothy G. Townsend*

Department of Environmental Engineering Sciences, Engineering School of Sustainable Infrastructure and Environment, University of Florida, 333 New Engineering Building, P.O. Box 116450, Gainesville, Florida 32611-6450, United States

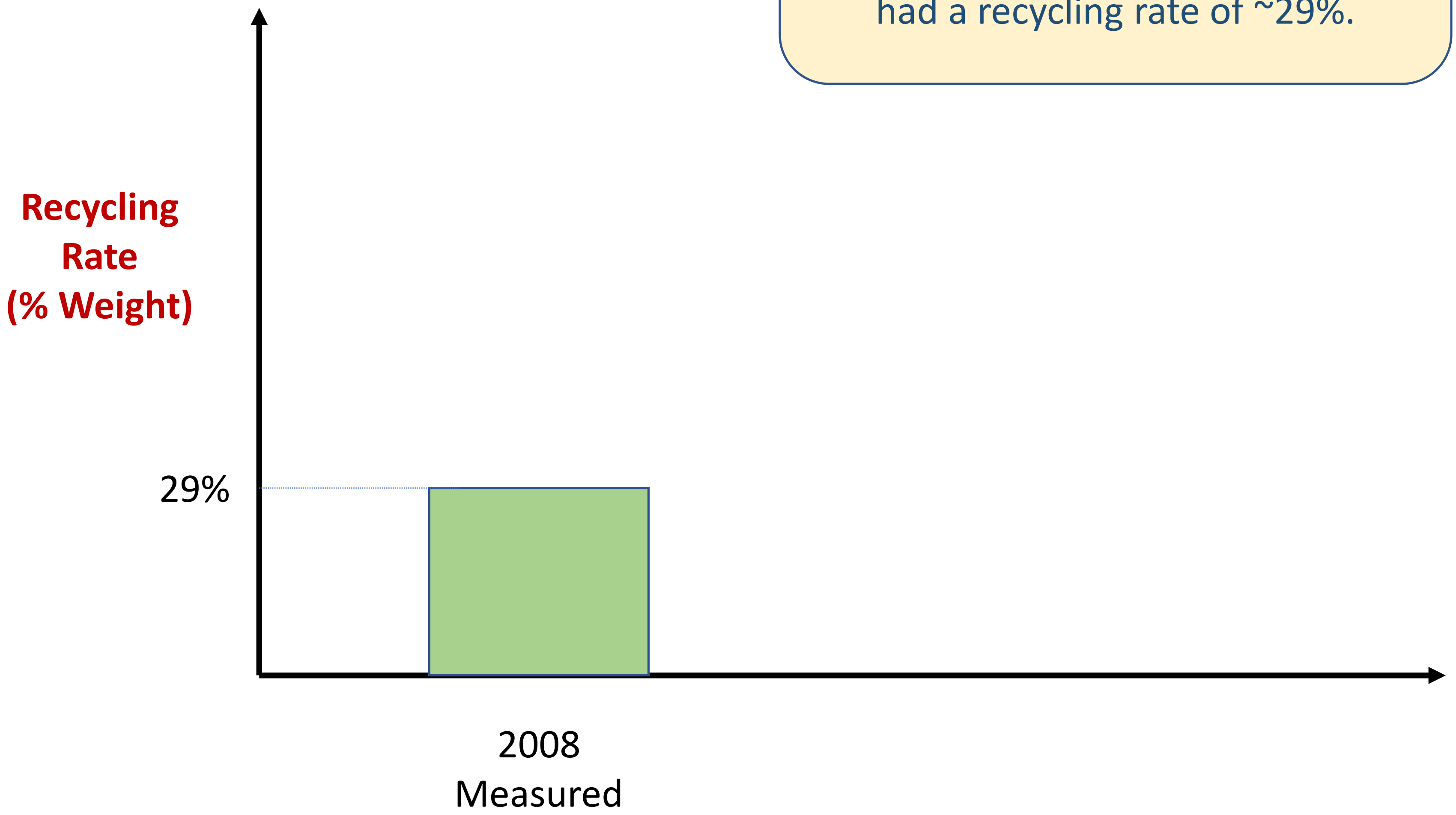
Supporting Information

ABSTRACT: In Florida, the passing of the Energy, Climate Change, and Economic Security Act of 2008 established a statewide mass-based municipal solid waste recycling rate goal of 75% by 2020. In this study, we describe an alternative approach to tracking performance of materials management systems that incorporates life-cycle thinking. Using both greenhouse gas (GHG) emissions and energy use as life-cycle indicators, we create two different materials management baselines based on a hypothetical 75% recycling rate in Florida in 2008. GHG emission and energy use footprints resulting from various 2020 materials management strategies are compared to these baselines, with the results normalized to the same mass-based 75% recycling rate. For most scenarios, LCI-normalized recycling rates are greater than mass-based recycling rates. Materials management strategies that include recycling of curbside-collected materials such as metal, paper, and plastic result in the largest GHG- and energy-normalized recycling rates. Waste prevention or increase, determined as the net difference in per-person mass discard rate for individual materials, is a major contributor to the life-cycle-normalized recycling rates. The methodology outlined here provides policy makers with one means of transitioning to life-cycle thinking in state and local waste management goal setting and planning.



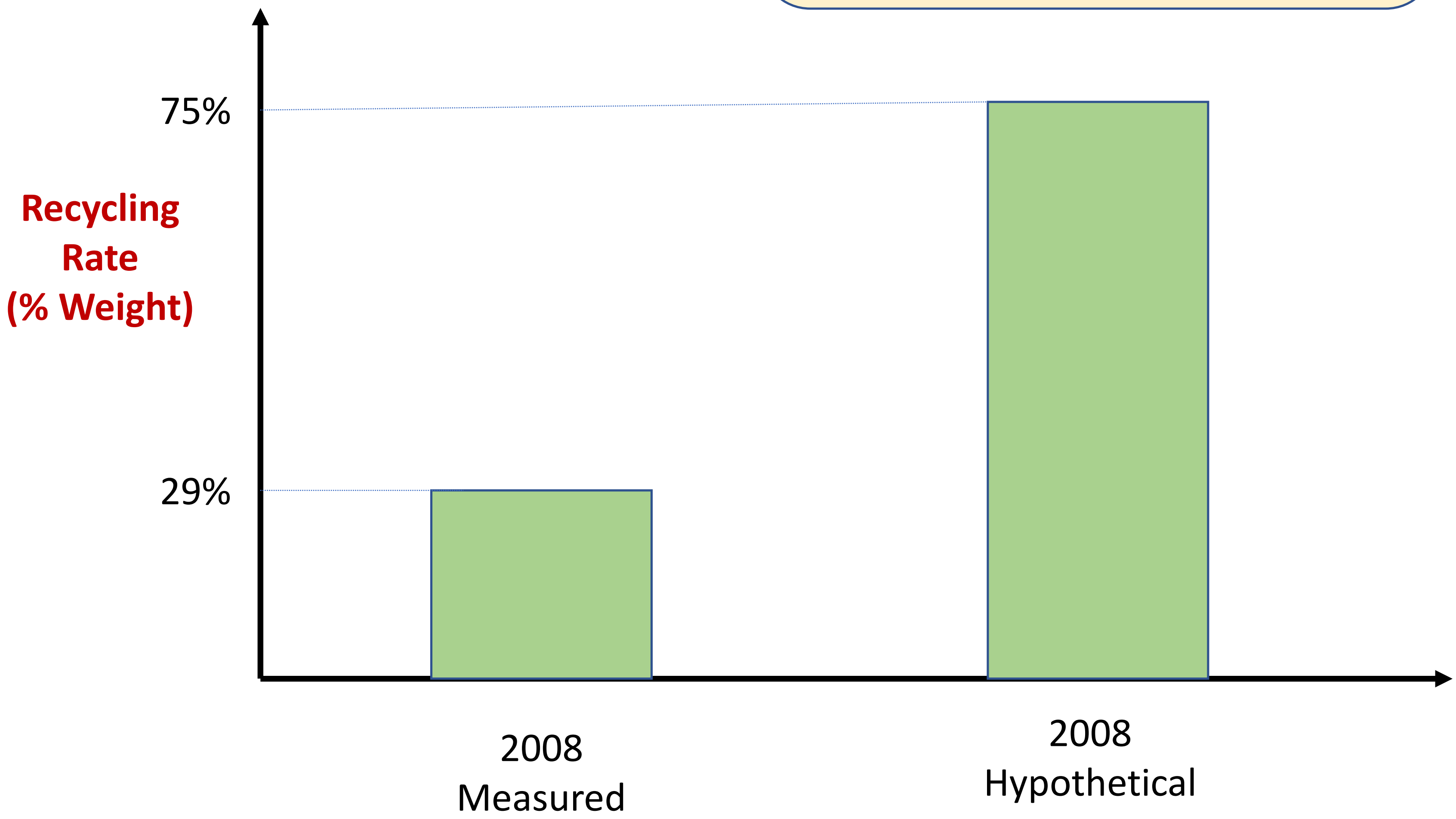
Approach

Since the statute was passed in 2008, let's set this as our baseline year. Originally in that year Florida had a recycling rate of ~29%.



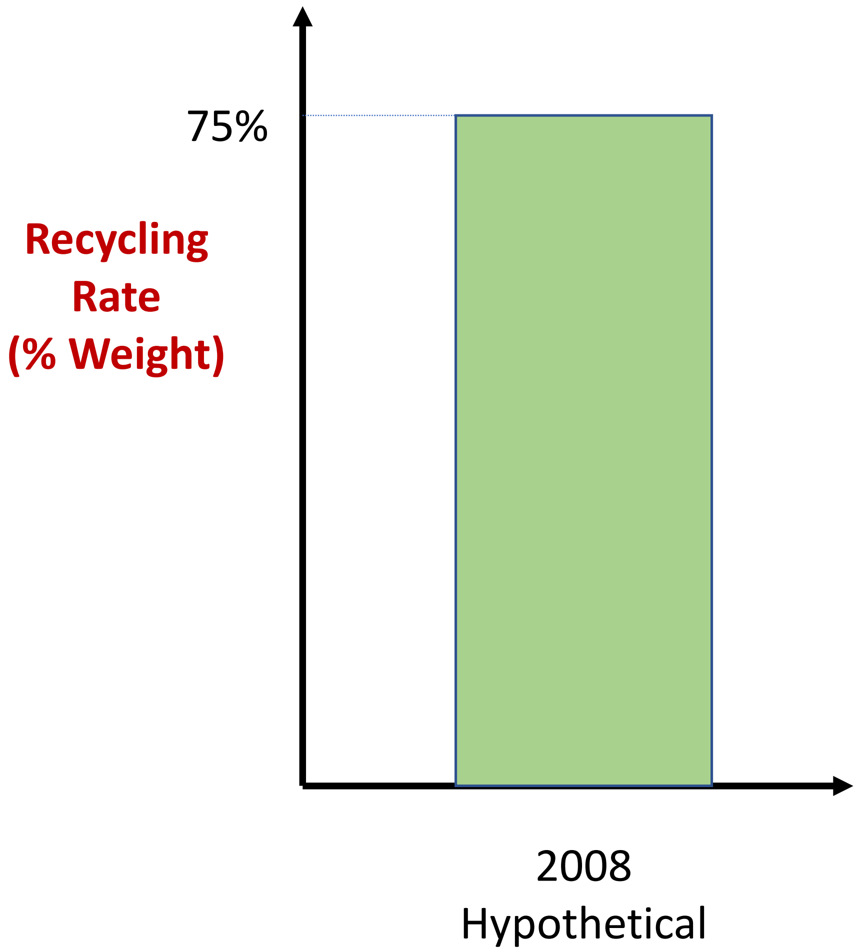
Approach

Then we come up with a hypothetical waste management scenario that reached 75% in 2008. We will use this to set the threshold the state will aspire to.



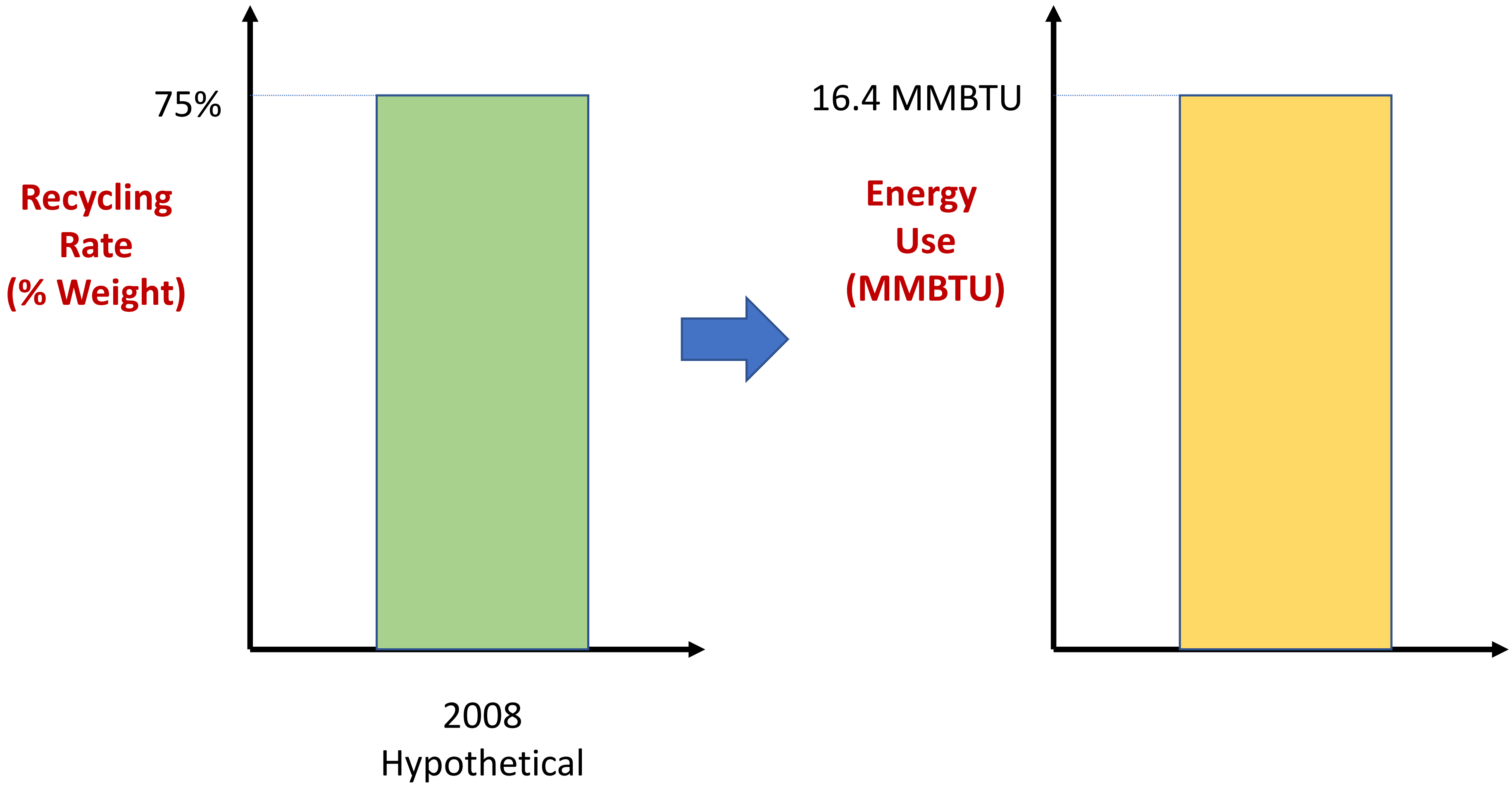
Approach

Use this hypothetical 75% recycling scenario, calculate a corresponding energy footprints (with WARM factors)

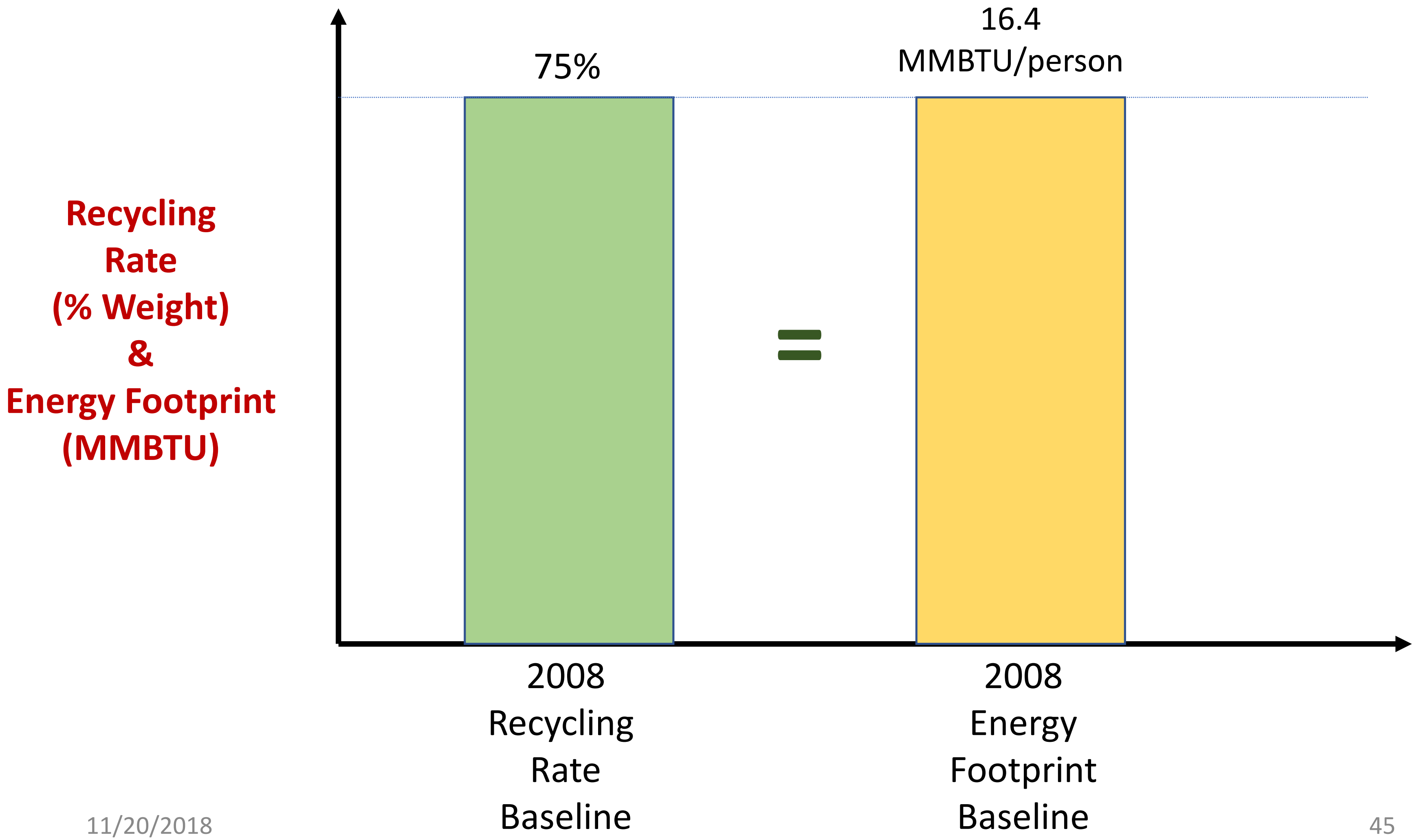


Approach

Calculate a “baseline” energy footprint

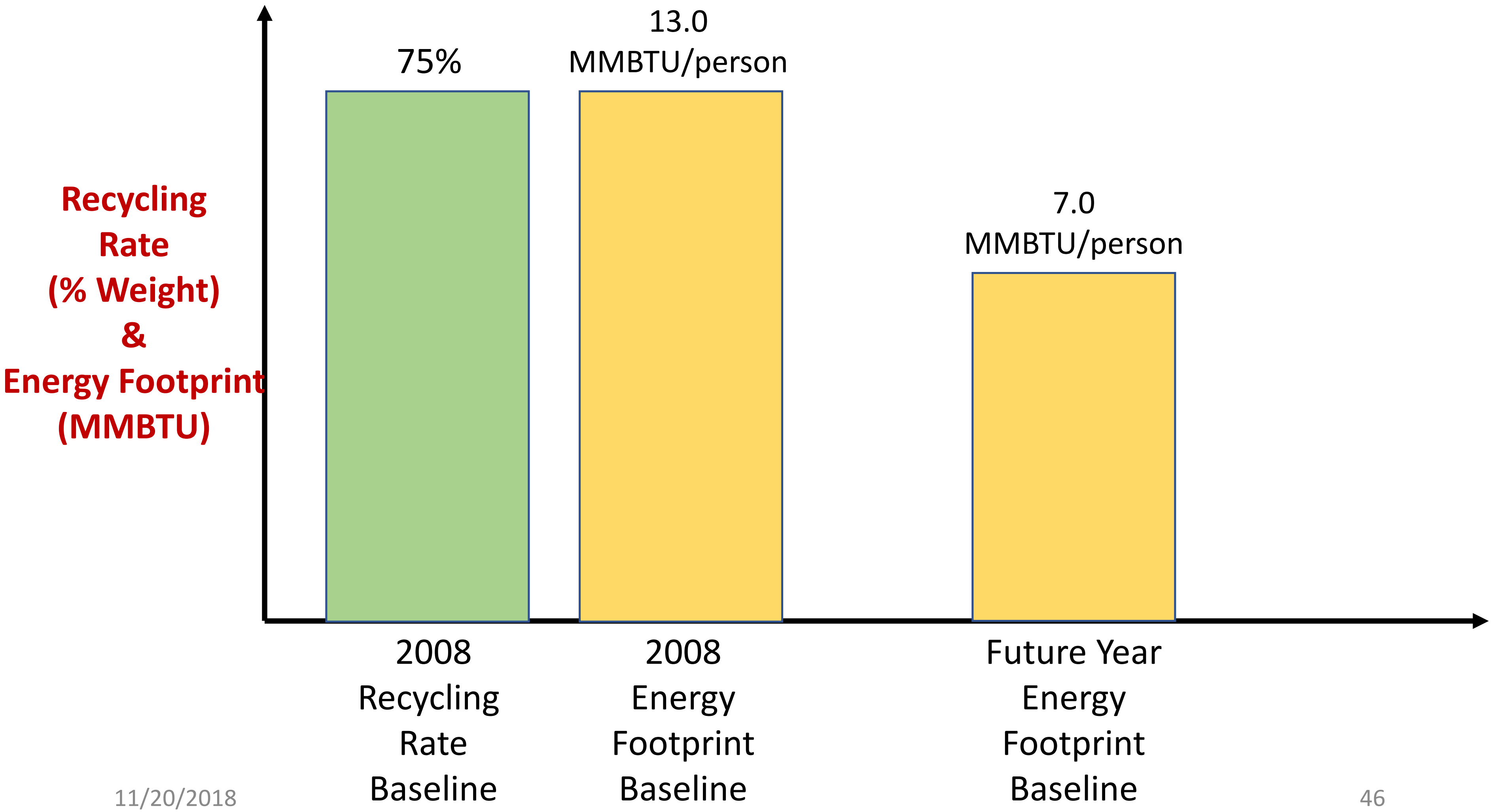


Approach



Recycling Rate (% Weight) & Energy Footprint (MMBTU)
75%
16.4 MMBTU/person
=
2008 Recycling Rate Baseline
2008 Energy Footprint Baseline

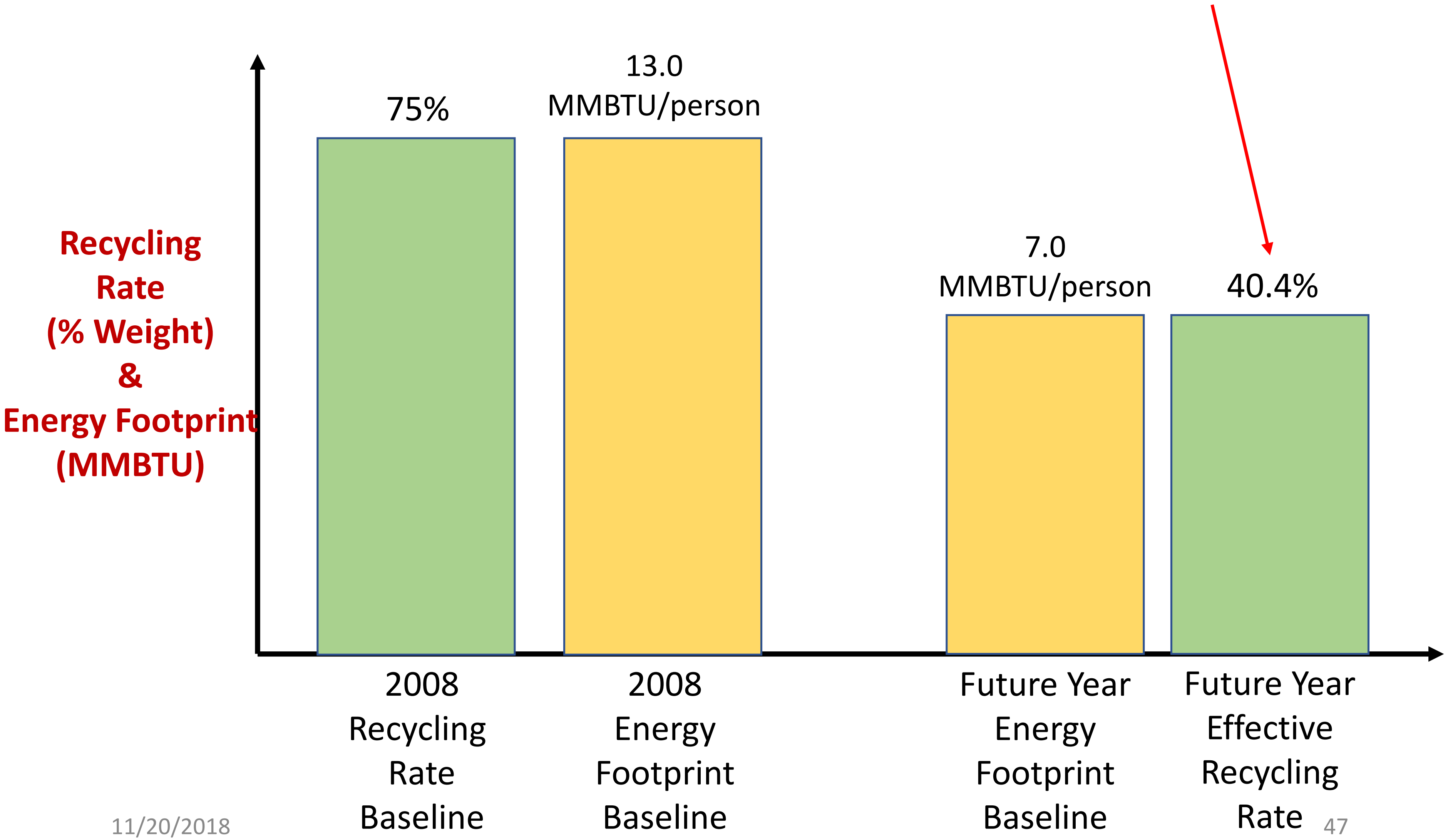
Approach



Recycling
Rate
(% Weight)
&
Energy Footprint
(MMBTU)
75%
13.0
MMBTU/person
7.0
MMBTU/person
2008
Recycling
Rate
Baseline
2008
Energy
Footprint
Baseline
Future Year
Energy
Footprint
Baseline

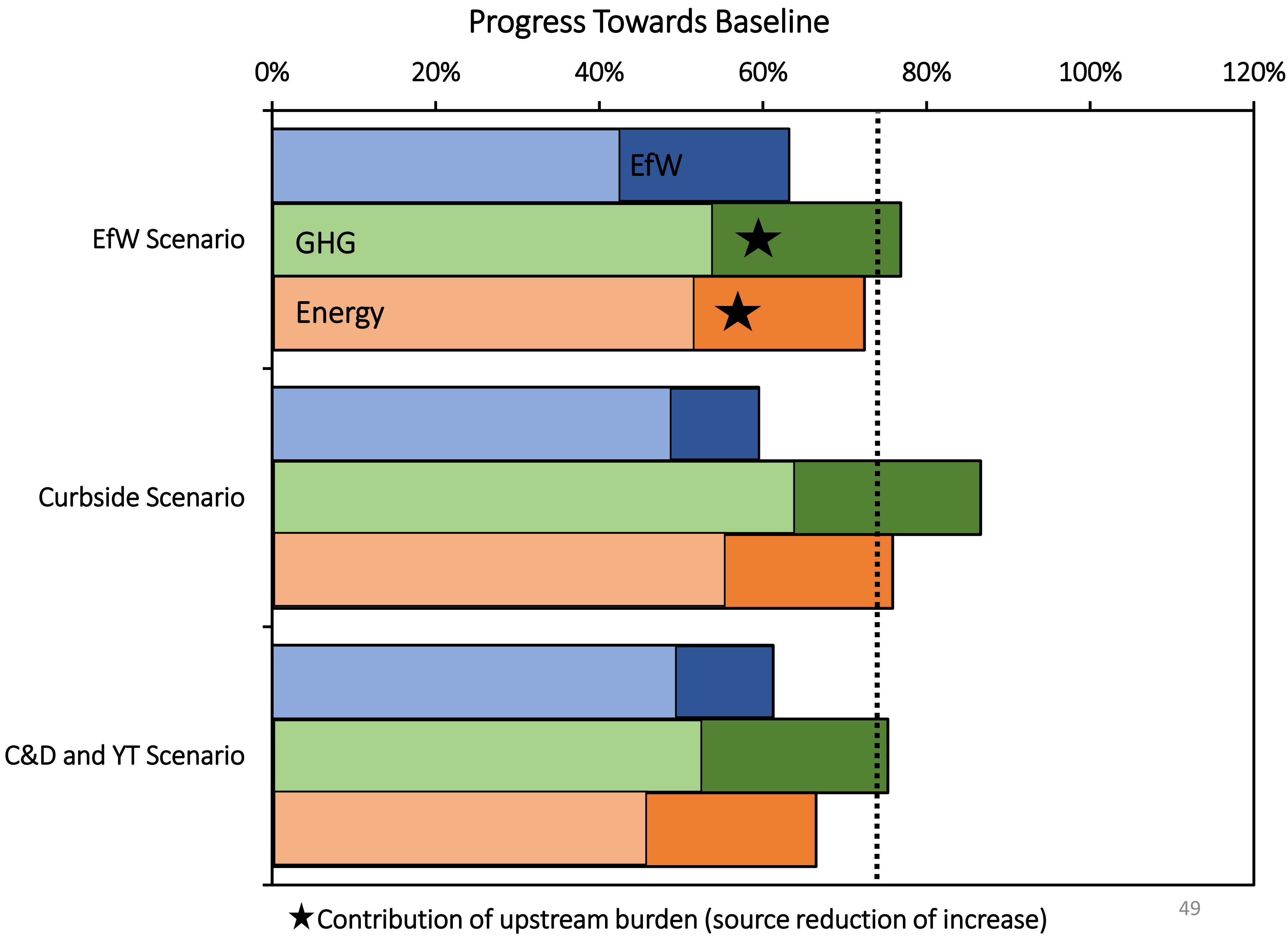
Approach

$$\frac{7.0}{13.0} \times 75\% = 40.4\%$$

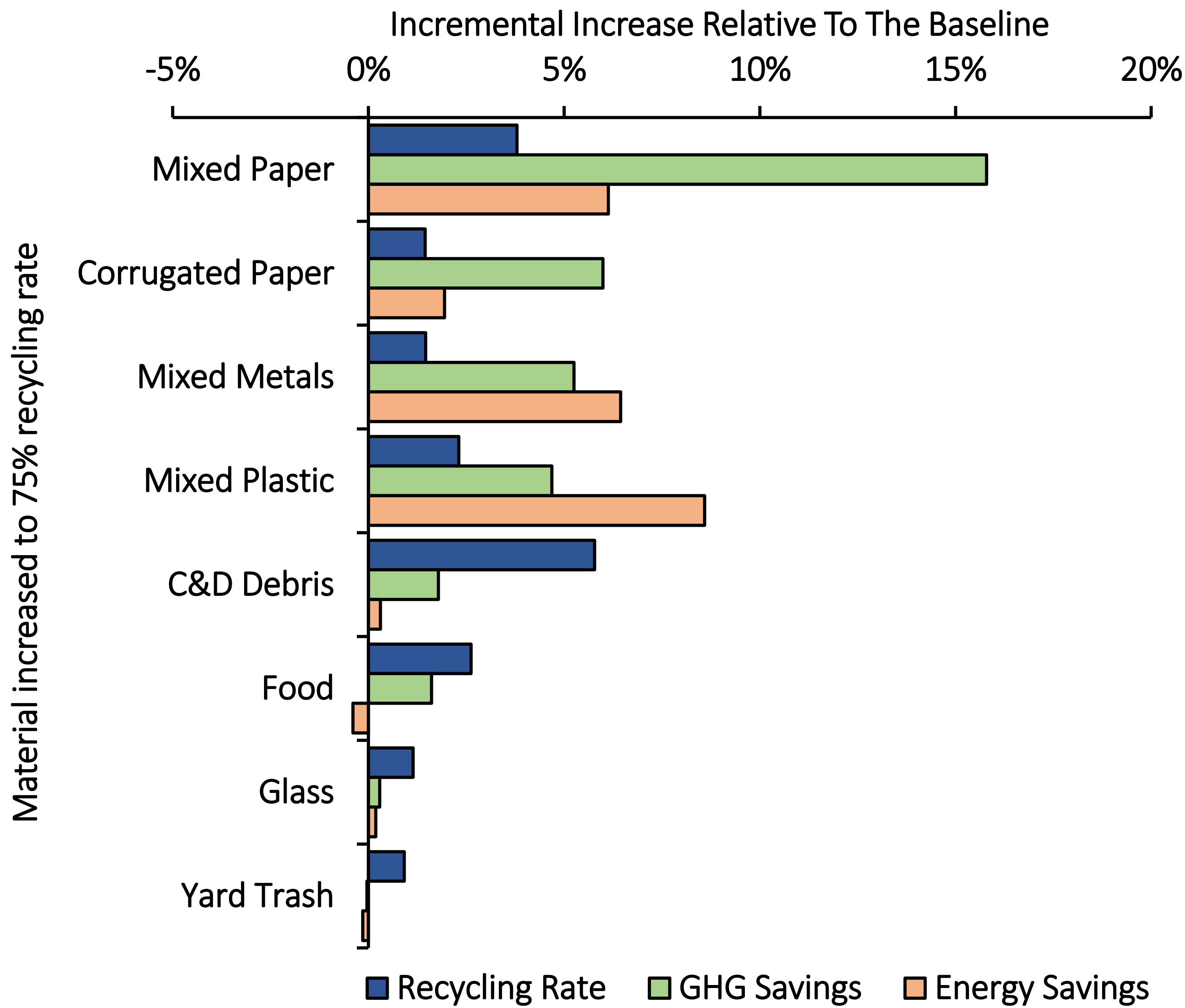


Integrating Source Reduction

- By comparing the net energy footprint from recycling, landfilling, and WTE in any year to a target year, we can calculate an "energy equivalent recycling rate."
- This approach treats materials differently, but it still does not incorporate source reduction.



Progress Towards Baseline
0%
20%
40%
60%
80%
100%
120%
EfW Scenario
Curbside Scenario
C&D and YT Scenario
EfW
GHG
Energy
★Contribution of upstream burden (source reduction of increase)



Incremental Increase Relative To The Baseline
-5%
0%
5%
10%
15%
20%
Material increased to 75% recycling rate
Mixed Paper
Corrugated Paper
Mixed Metals
Mixed Plastic
C&D Debris
Food
Glass
Yard Trash
Recycling Rate
GHG Savings
Energy Savings

Lessons to Date

- We can develop metrics that incorporate SMM.
- Source reduction is very important.
- Depending on which outcome you evaluated, results among materials differ.
- But we have to be careful about how we interpret results. Remember the goal of SMM is look at the whole materials life cycle.

Example: Bottled vs Canned Beer

- Aluminum Can
  - Weight of can: 15g
  - Recycling rate: 33%
  - WARM GHG Emission Factor:
    -9.11 MTCO2E.ton
- Glass Bottle
  - Weight of can: 170g
  - Recycling rate: 10%
  - WARM GHG Emission Factor:
    -0.28 MTCO2E.ton

Example: Bottled vs Canned Beer

- Aluminum Can
  - Weight of can: 15g
  - Recycling rate: 33%
  - WARM GHG Emission Factor:
    -9.11 MTCO2E.ton
- End-of-life footprint for 1,000,000 beers
  - -49.3 MTCO2E

- Glass Bottle
  - Weight of can: 170g
  - Recycling rate: 10%
  - WARM GHG Emission Factor:
    -0.28 MTCO2E.ton
- End-of-life footprint for 1,000,000 beers
  - -1.53 MTCO2E

Example: Bottled vs Canned Beer

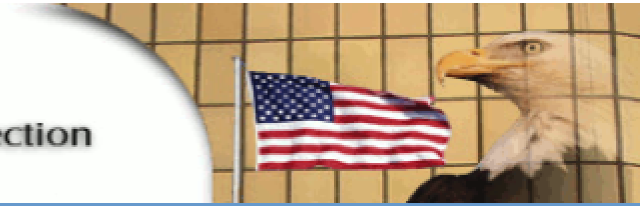
- Aluminum Can
  - Weight of can: 15g
  - Recycling rate: 33%
  - WARM GHG Emission Factor: -9.11 MTCO2E.ton
- End-of-life footprint for 1,000,000 beers
  - -49.3 MTCO2E
- Including manufacture:
  - 101.0 MTCO2E

- Glass Bottle
  - Weight of can: 170g
  - Recycling rate: 10%
  - WARM GHG Emission Factor: -0.28 MTCO2E.ton
- End-of-life footprint for 1,000,000 beers
  - -1.53 MTCO2E
- Including manufacture:
  - 97.6 MTCO2E

Next Steps

- Refine the methodology for potential future implementation in Florida
  - Impact factors for more outcome categories
  - Integrate approach into WasteCalc
- Continue to explore other approaches to integrate SMM
- Examine policies and approaches for better promoting and capturing the benefits of reuse/reduction
- Work with local governments on how best to implement SMM approaches

Florida
Department of Environmental Protection



WasteCalc
The Florida Waste Composition Model

Estimate your county's waste composition data online

Welcome to the Florida **Waste** Composition **Calc**ulation Model **(WasteCalc)**, a user-friendly tool to estimate the composition of municipal solid waste generated in Florida counties. The composition data generated by **WasteCalc** should prove useful for annual reporting purposes, as well as solid waste and recycling program planning.

WasteCalc was developed through a Florida Department of Environmental Protection (DEP) Innovative Recycling Grant to Pinellas County. Project partners also included Highlands, Indian River, and Levy Counties. Waste composition studies and model development were conducted by Kessler Consulting, Inc., of Tampa, Florida, and Franklin Associates, Ltd., of Prairie Village, Kansas.

WasteCalc was developed using demographic and socio-economic factors (for example, population and employment in select SIC codes) that are specific to each county. It integrates the latest national municipal solid waste (MSW) research done for the U.S. Environmental Protection Agency, along with the most recent MSW and construction and demolition debris data for Florida.

WasteCalc also relies on waste composition sampling studies conducted in the four counties that participated in the project. In addition, recent sampling studies conducted in ten other Florida counties were consulted.

Should you have questions or comments about **WasteCalc**, please contact: Shannan Reynolds, Recycling Program, at Shannan.Reynolds@dep.state.fl.us.

Click below to begin using **WasteCalc**.

WasteCalc

WasteCalc
The Florida Waste Composition Model

To use **WasteCalc**, you need to input basic information about the total amount of municipal solid waste generated in your county, and the amount landfilled, combusted, and recycled. For the purposes of **WasteCalc**:

Landfill tonnage + Combustion tonnage + Recycled tonnage =
Total MSW generated/collected in your county

To estimate the percent composition by material type of municipal solid waste generated in your county, simply follow the instructions below. All data entered should be actual and accurate data for the year selected. All weights should be in tons and should be entered as whole numbers only (no commas or decimal points).

1) Select the Data Year in line 1.
2) Select your County in line 2.
3) Enter your County's population for that year in line 3.
4) Enter your County's MSW landfilled (including landfilled combustor ash) in line 4.
5) Enter your County's MSW combusted (NOT including landfilled combustor ash, recyclables recovered from combustor ash, or process fuel) in line 5.
6) Enter your County's recycling tonnages in lines 6-23. Use countywide data, including public and private recycling, and recyclables recovered from combustor ash. Yard waste does not include backyard composting or "grasscycling."
7) For a printout of the figures you are submitting simply click the Print button below.
8) Click the Submit button when finished.

1	Select the Data Year	2016 ▾
2	Select Your County	Alachua ▾
3	Enter County Population	0
4	Enter MSW Landfilled (in tons)	0
5	Enter MSW Combusted (if any) (in tons)	0
	Enter your most recent recycling data (in tons)	
6	Newspapers	0
7	Glass	0
8	Aluminum Cans	0
9	Plastic Bottles	0
10	Steel Cans	0
11	C&D Debris	0
12	Yard Trash	0
13	White Goods	0
14	Tires	0
15	Other Plastics	0
16	Ferrous Metals	0
17	Nonferrous Metals	0
18	Corrugated Boxes	0
19	Office Paper	0
20	Other Paper	0
21	Food Waste	0
22	Textiles	0
23	Miscellaneous	0

Print Submit


POWERflow

https://www.essie.ufl.edu/home/townsend/