Sustainable Materials Management:

Using Lifecycle Thinking for Strategic Goal Setting

WDOE
October 4, 2017

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The State of Recycling Goals

- States, cities and corporations have developed aspirational diversion goals: 50%, 75%, 100%
- Weight-based recycling has been our measure of material management performance
- Cities added more materials and convenient programs to help achieve their goals.

Do we have the right goals?

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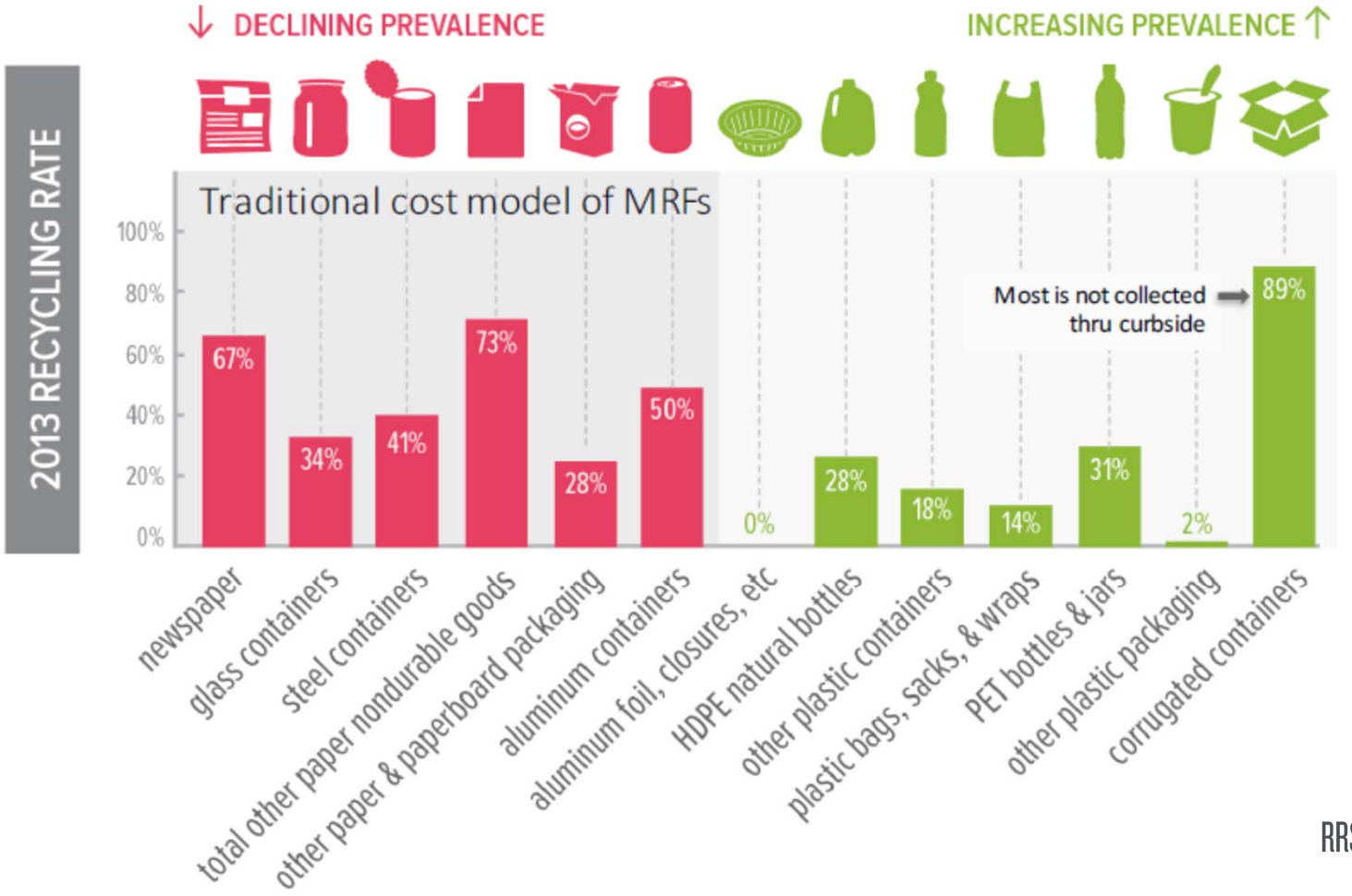
The Evolution of an Industry

- Many of the materials that have been added to recycling programs have increased recycling processing costs, or are hard (impossible) to market
- As the waste stream has changed, it has become more complex and contamination has increased
- Achieving weight based goals will become even more difficult and expensive with China's new policies on material bans.
- We have more data in 2017 to help define environmental outcomes.

What we recycle now



RRS

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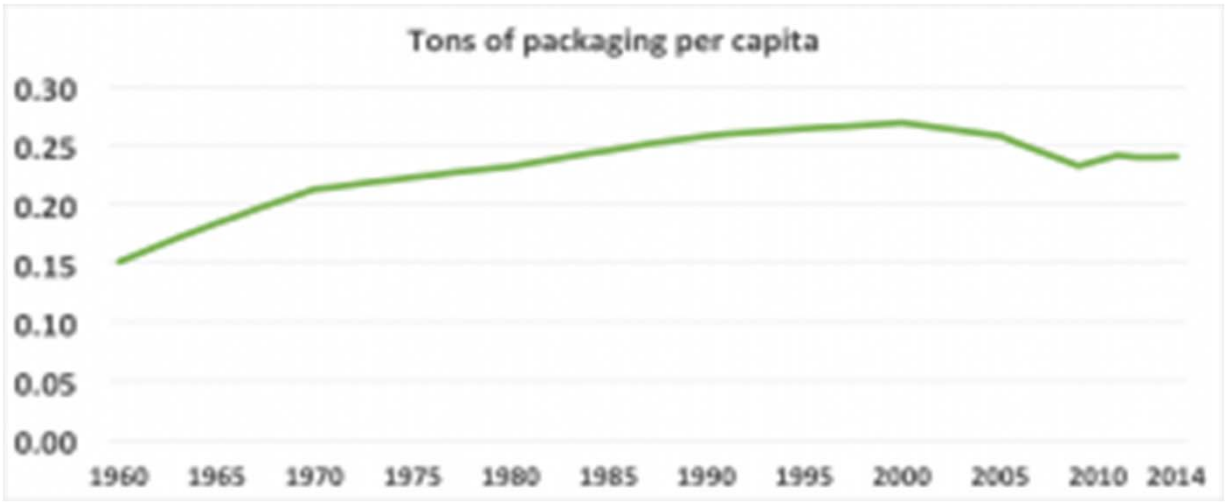
Packaging Peaked in 2000



Courtesy: SPC

- Per capita packaging generation has fallen from 0.27 tons per person annually in 2000 to less than 0.24 tons in 2013
- Per capita packaging is roughly equivalent to 1983 levels.

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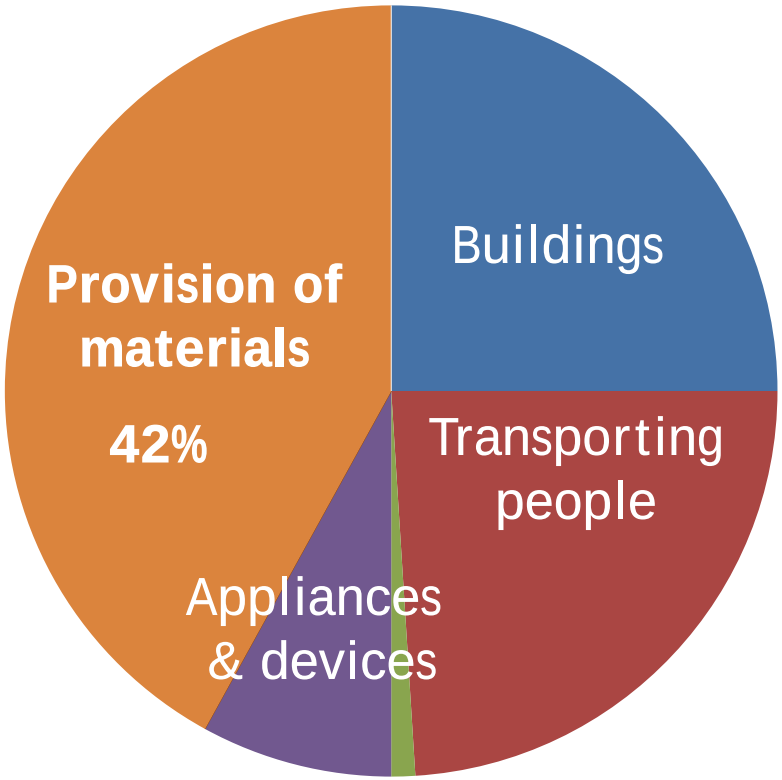
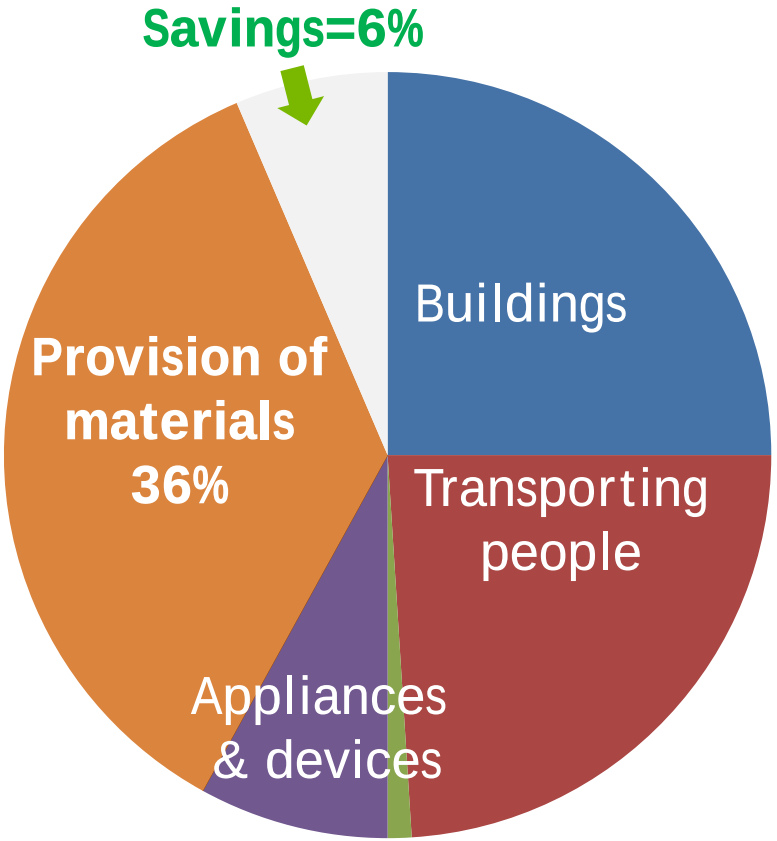
Paradigm Shift: From Weight to Environmental Burden

The goal is to reduce environmental impacts.
Recycling is one way to achieve the goal.
Reduction is a better way to achieve the goal.

Limitations of Optimizing "Solid Waste"



2006 U.S. GHG inventory with 32% recovery (MSW)



2006 U.S. GHG inventory with very high recovery rate (~95% MSW + >70% C&D)

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A Tale of Two States: Oregon and Florida

Oregon: ODEQ is in the process of implementing new reduction goals based on Sustainable Materials Management

Florida: University of Florida is driving a review of the State's 75% recycling goal and reframing in terms of Sustainable Materials Management

Oregon Material Flow Approach

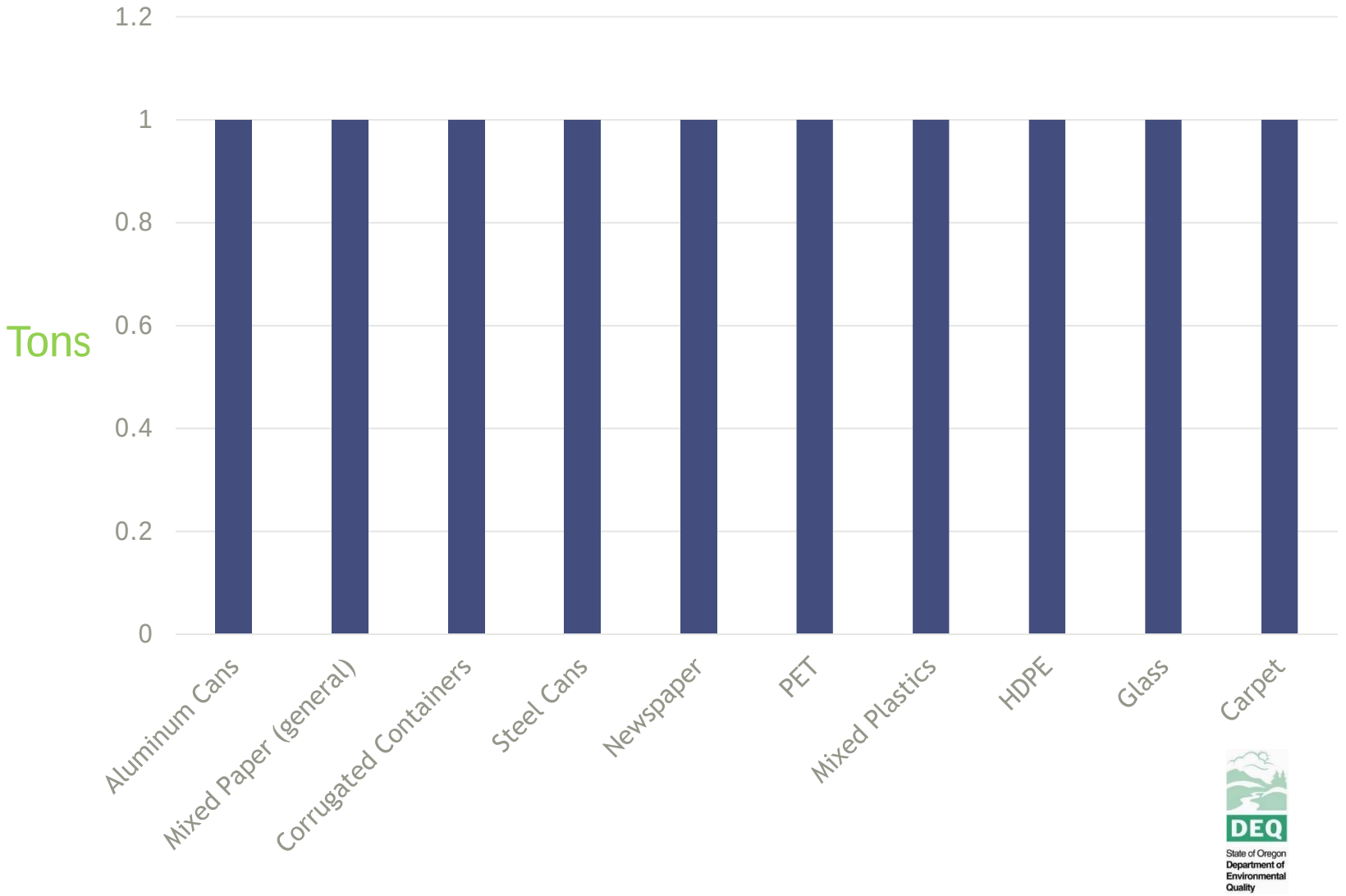
- **Focuses on the environmental outcomes of waste management**
- **Uses life cycle analysis of the materials in Oregon's waste stream**
  - ✓ Full life cycle, not only end-of-life
  - ✓ Ultimately will incorporate demand, not just waste
- **Supports more and better recycling and waste prevention**

Limits to Weight Based Recovery Goals

1. All recovery is the same (recycling = composting = energy recovery*)
2. All materials are the same (aluminum = yard debris)
3. All end-markets are the same (glass to bottles = glass to roadbed)
4. Encourages “recovery for the sake of recovery”
5. Some energy recovery is excluded
6. Does nothing to move up the hierarchy, no value to reduction or broader lifecycle thinking.

* *For illustrative purposes. States count energy recovery differently.*

Weight based recovery measurement



DEQ
State of Oregon
Department of
Environmental
Quality

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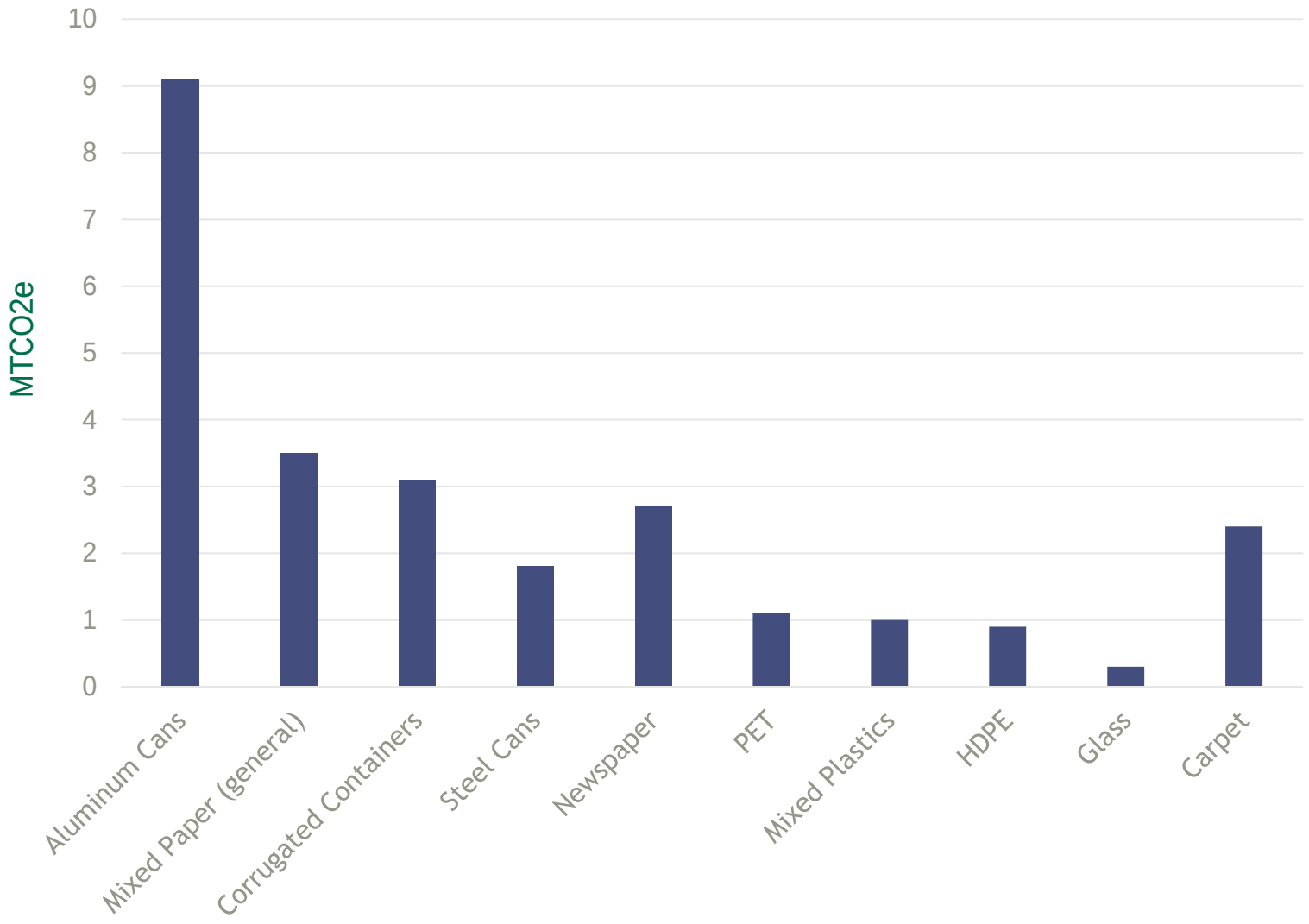
GHG Impact of One Ton of Recycled Material



Material Specific Recovery Goals

25% recovery by 2025

25% reduction by 2020

25% recovery by 2020

DEQ
State of Oregon Department of Environmental Quality

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Implementing Oregon's 25% Food Reduction Goal

In 2017, Oregon released their plan to achieve their 25% food reduction goal.

- **Preventing one ton of food** from being wasted results in 6X larger lifecycle GHG benefits than composting, and 7X the GHG emission benefits of anaerobic digestion
- **Their plan focuses solely on upstream prevention** and recovery – rather than EOL recycling.

The plan identifies key priorities focusing on upstream prevention and recovery, instead of end-of-life:

1. Wasted Food Measurement Study	6. Edible Food Rescue
2. Messaging	7. Labelling
3. Consumer Outreach	8. Coalition of Interested Regional Parties
4. Schools	9. Research Not included elsewhere
5. Commercial Sector	10. Guiding Principles for Project implementation

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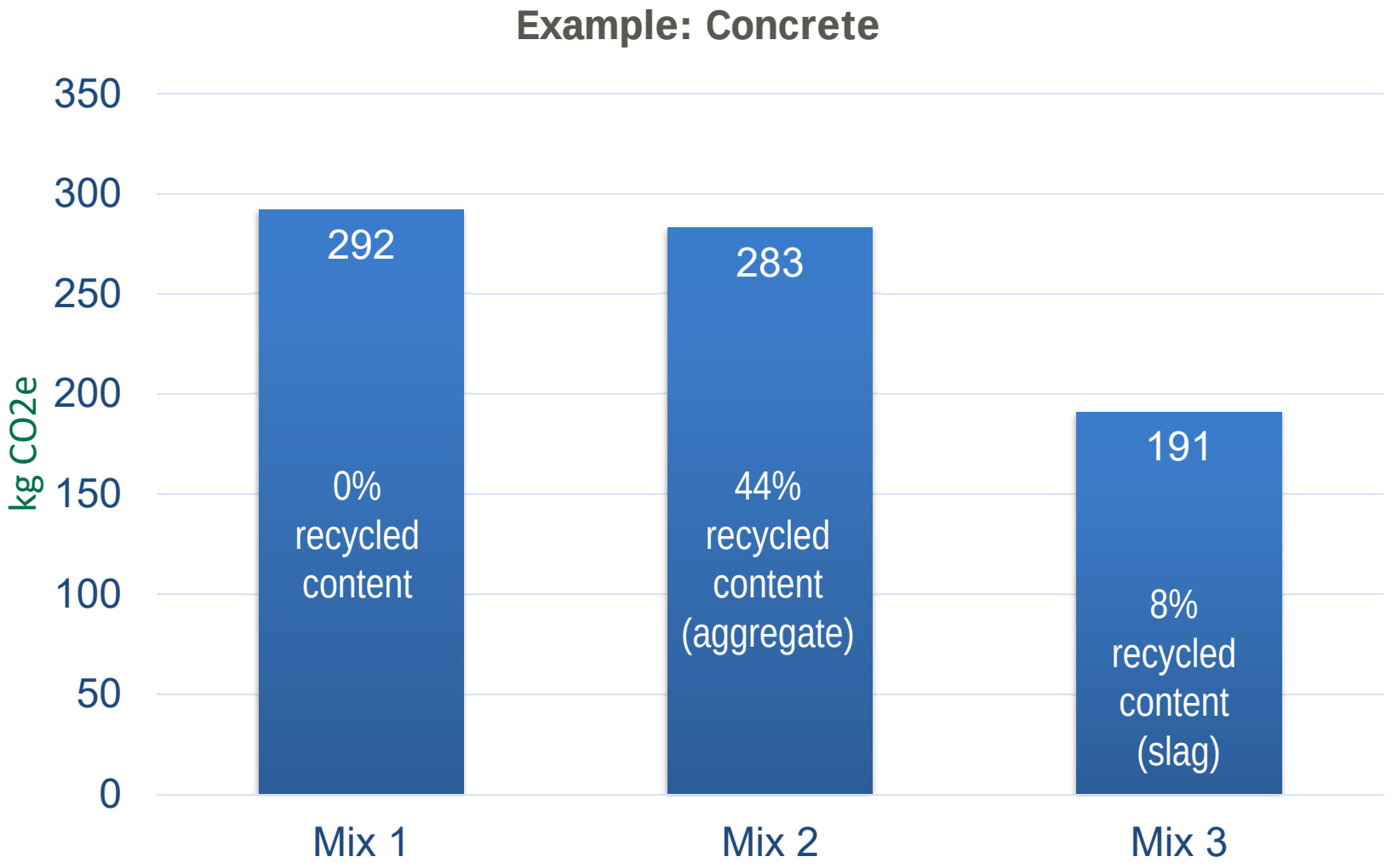
Recycled Content Doesn't Consistently Predict Environmental "Goodness"



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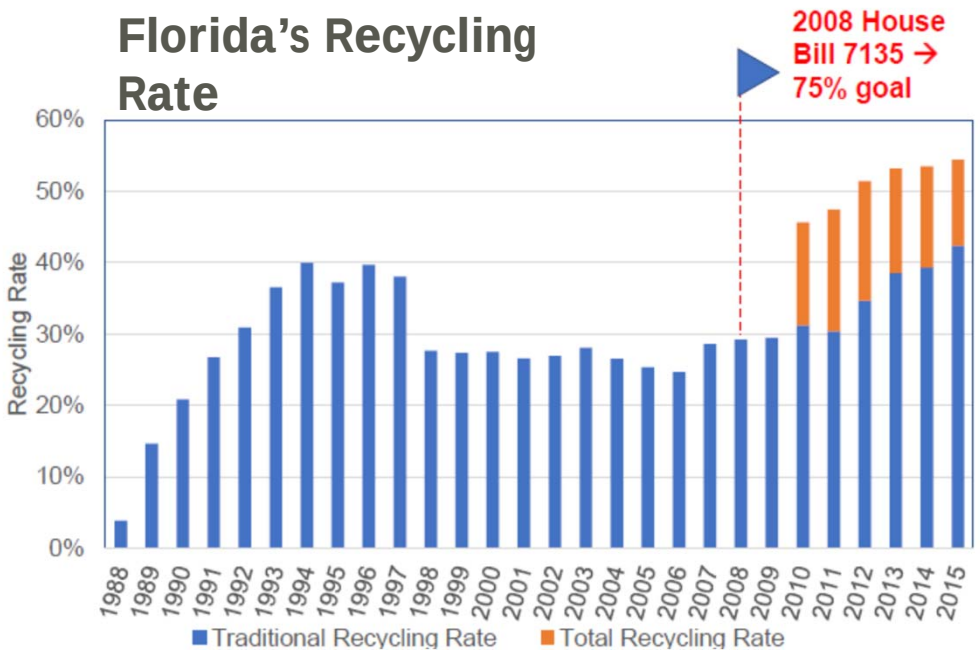
State of Oregon Department of Environmental Quality

The Florida Story: Academics at Work



- The University of Florida project was driven by an interest in material measurement and impact. Materials counted have changed over the past two decades
- Recognition of the role of SMM and Lifecycle Assessment
- State-wide workshops now contemplating how to apply this information to the State's 75% goal.

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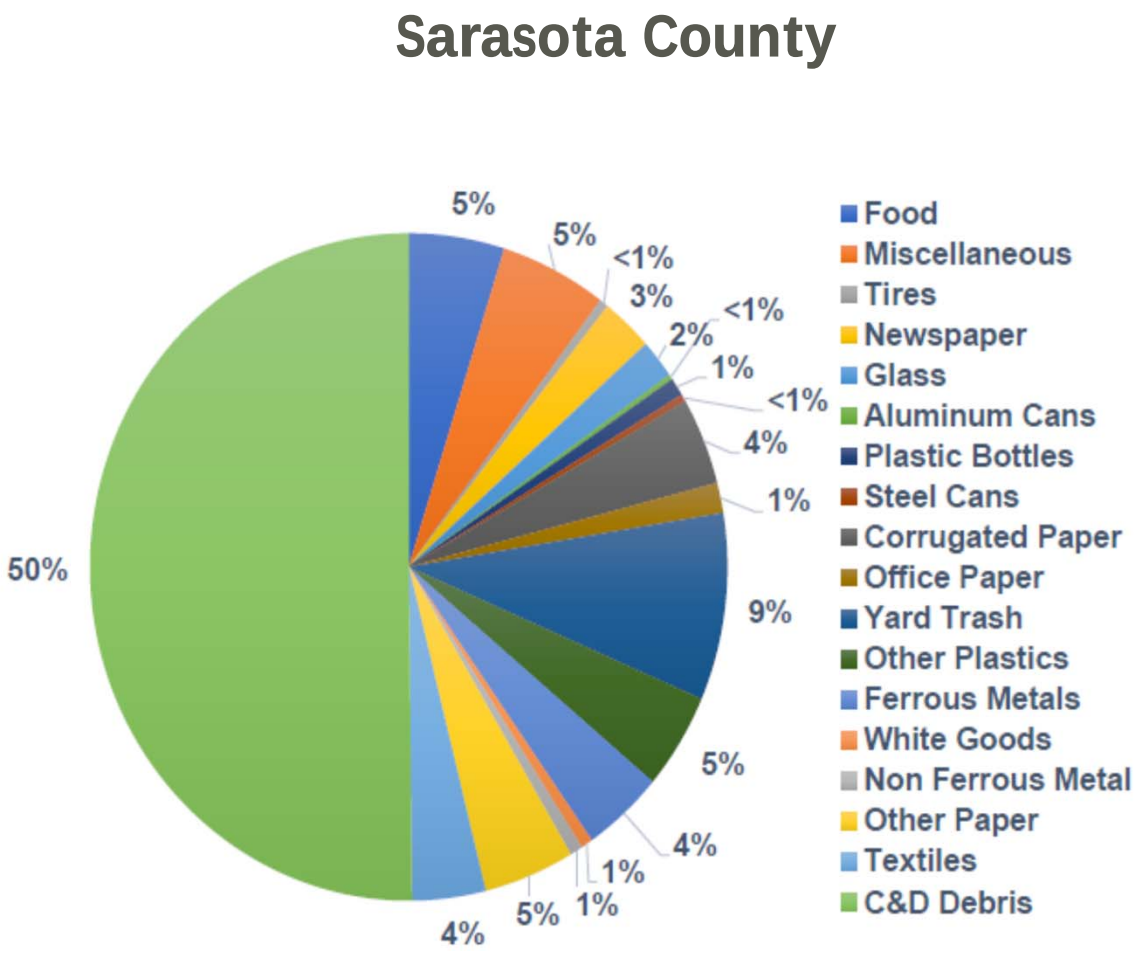
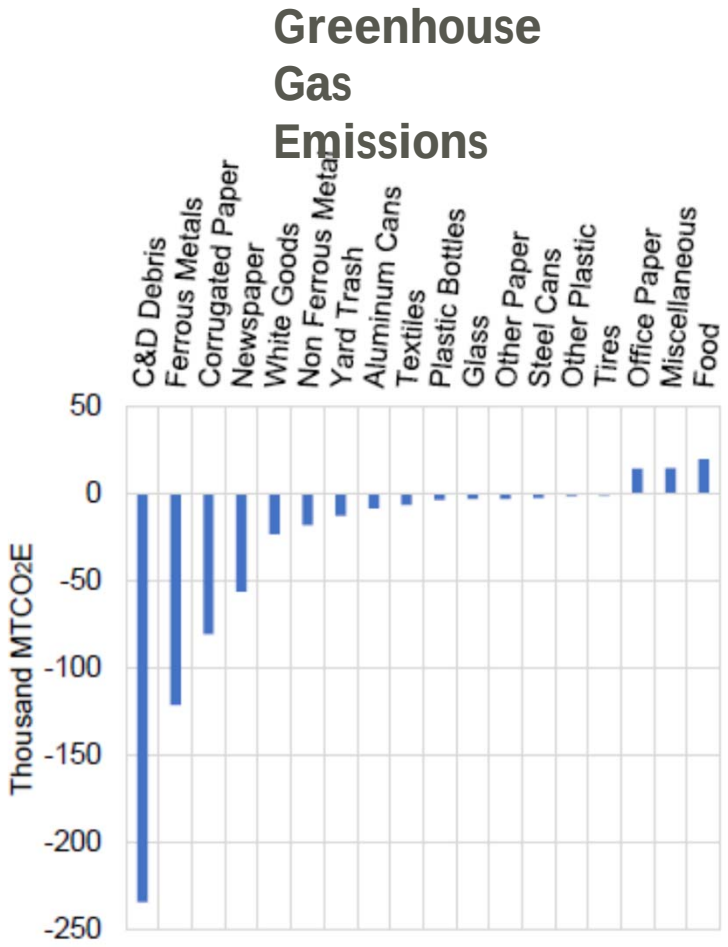
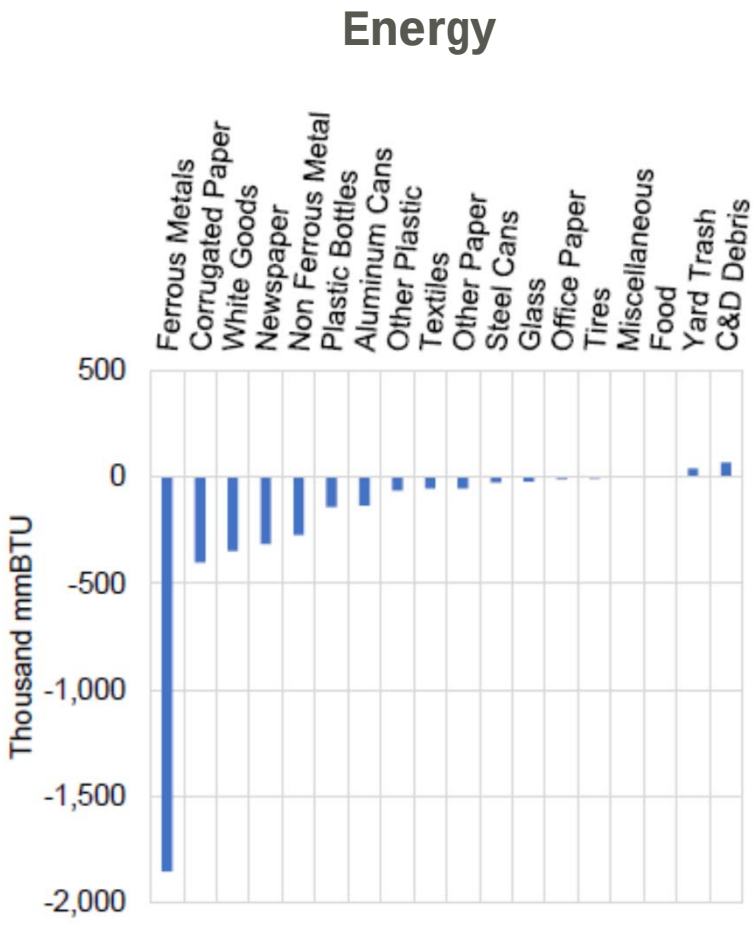
1: Waste Characterization



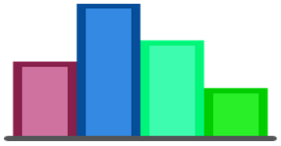
2. Evaluate Environmental Impacts





INPUTS: Materials by disposition (tons)

Impact factors (by material & disposition & life cycle stage)



OUTPUT: Impact of each material type

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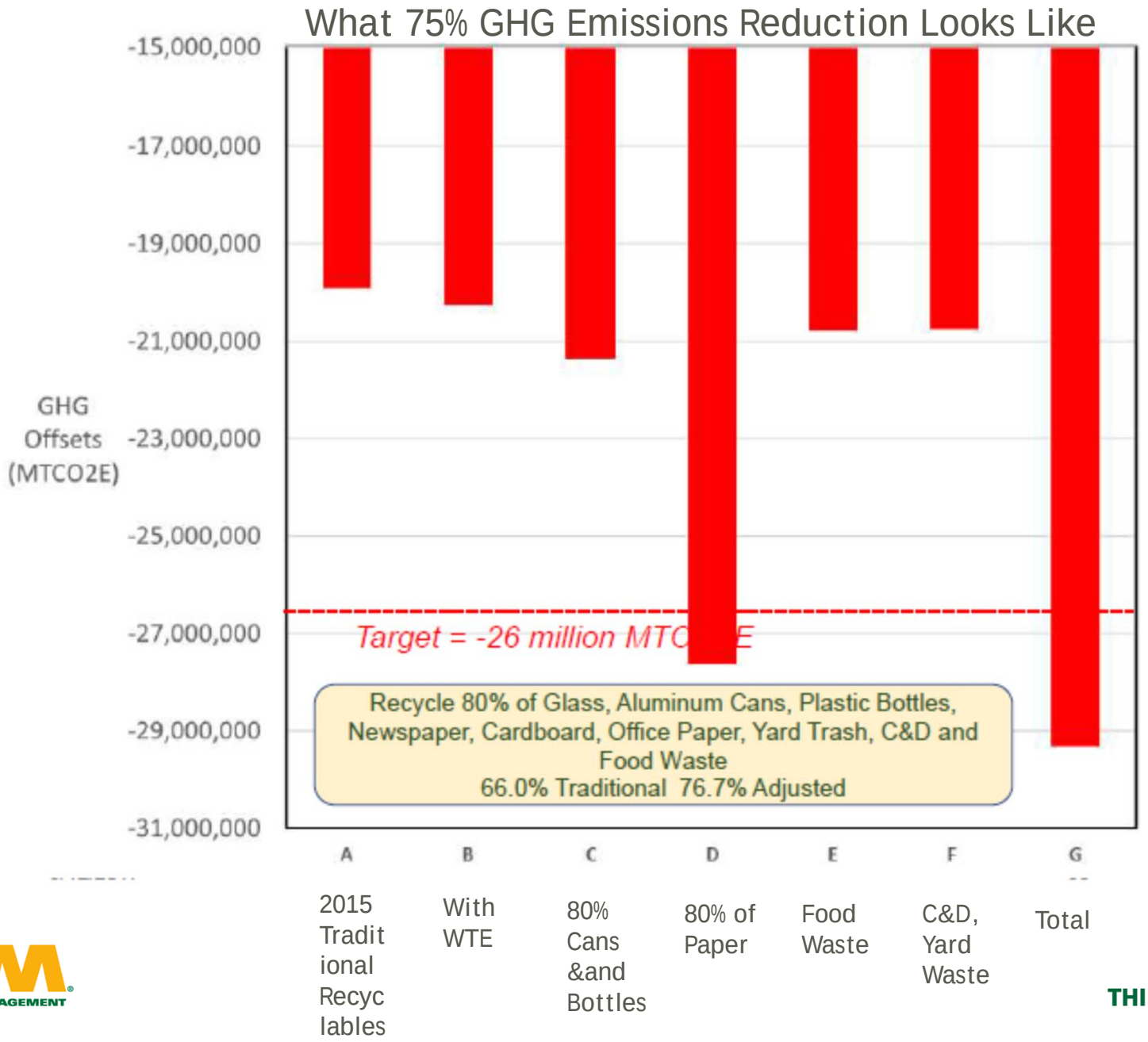
3. Setting New Goals

1. University of Florida recommends using a Base Year to create an “Environmental Burden Baseline”
2. Create a target reduction goal from this number
3. The University of Florida introduced the idea of replacing their 75% recycling goal with a 75% GHG emissions reduction goal.

4. Develop Programs to Achieve the Goal



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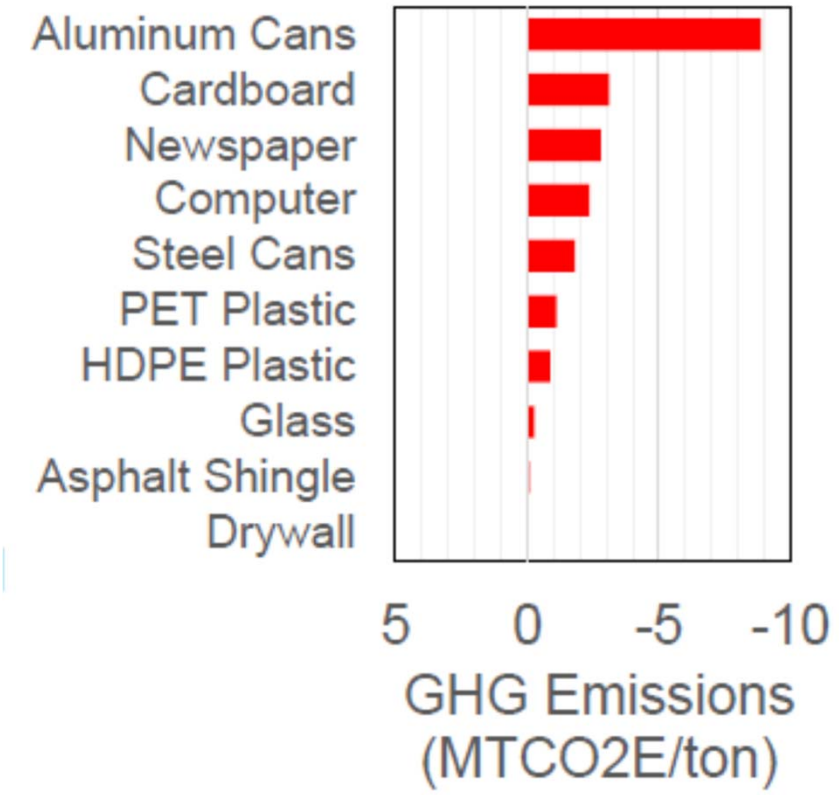
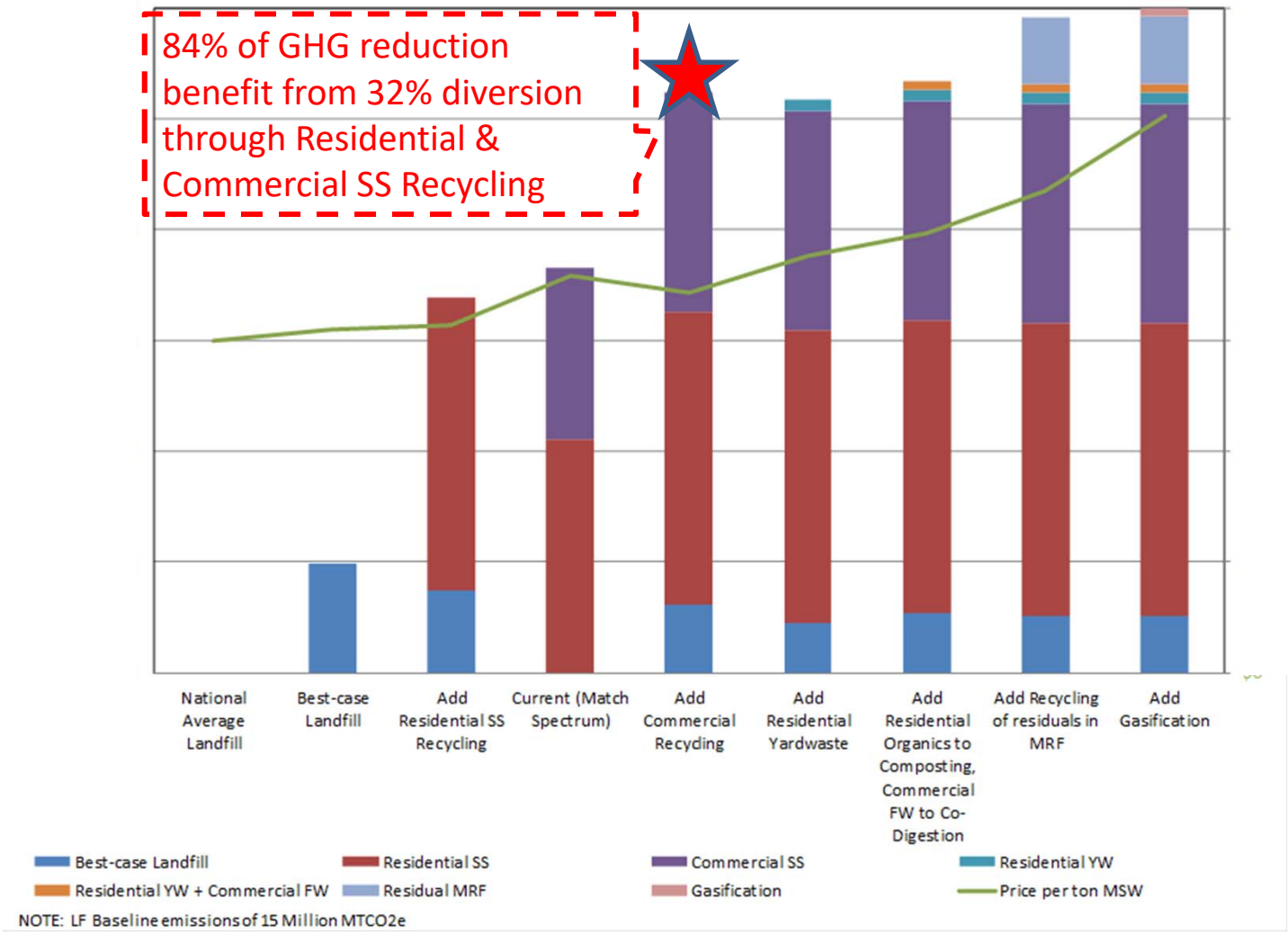
Florida Lessons Learned

- Different recycling approaches result in different progress towards the goal
- The type of materials targeted makes a difference
- The selection of a baseline is critical

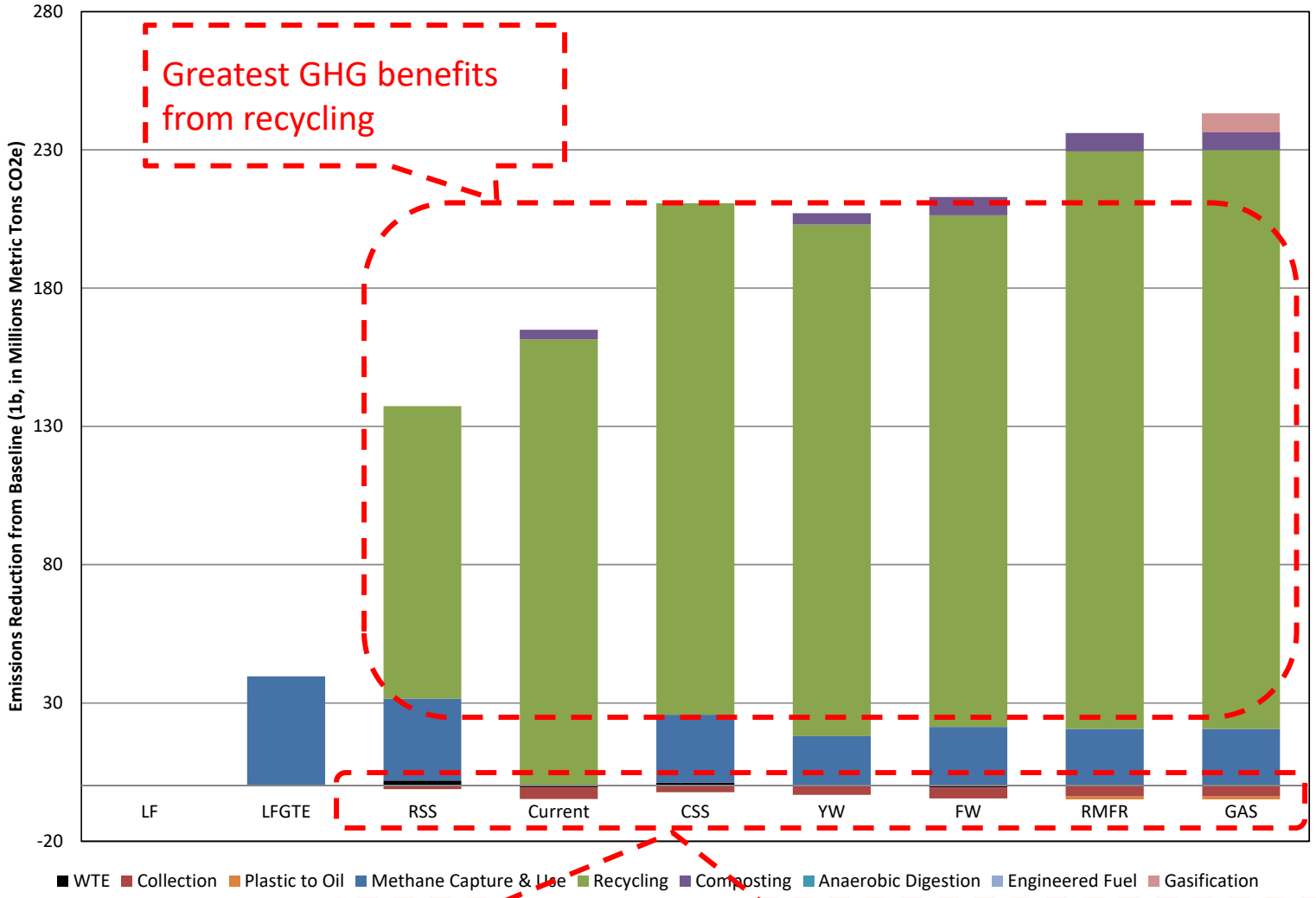


WM Spectrum: What we found



- **Scenarios build upon each other**
- **84% GHG benefit from aggressive LFG capture & use + recycling 32% of MSW**
- **More processing = high incremental cost for low incremental GHG reduction**

Recycling drives significant reduction of GHG



- **Above x-axis = emissions reductions**
- **Recycling is bulk of the potential GHG emissions reductions**

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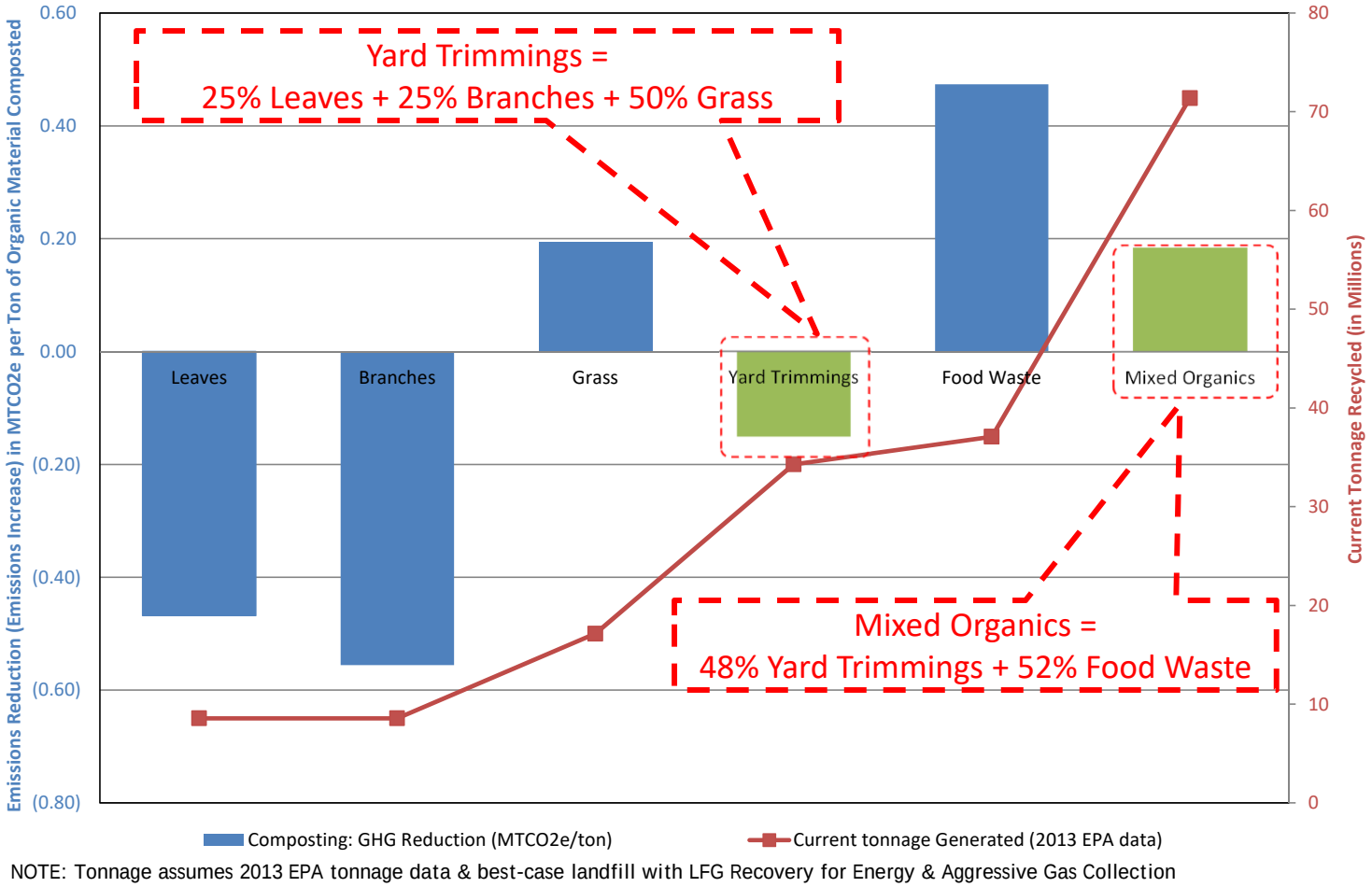
GHG impact from composting organics depends on specific material;
Total impact driven by tonnages times GHG reduction per ton



NOTE: Tonnage assumes 2013 EPA tonnage data & best-case landfill with LFG Recovery for Energy & Aggressive Gas Collection

- **Not all organics are created equal:**
  - ✓ Foodwaste has greatest emission reduction potential, grass is next.
  - ✓ Leaves and branches have least emissions in Best Practices landfill (EPA)
- **Mixed Organics in EPA's Warm Model averages all blends of organics**:
  YW *= grass, leaves & branches.* ***FW*** *= all FW, including produce, diary, meats*

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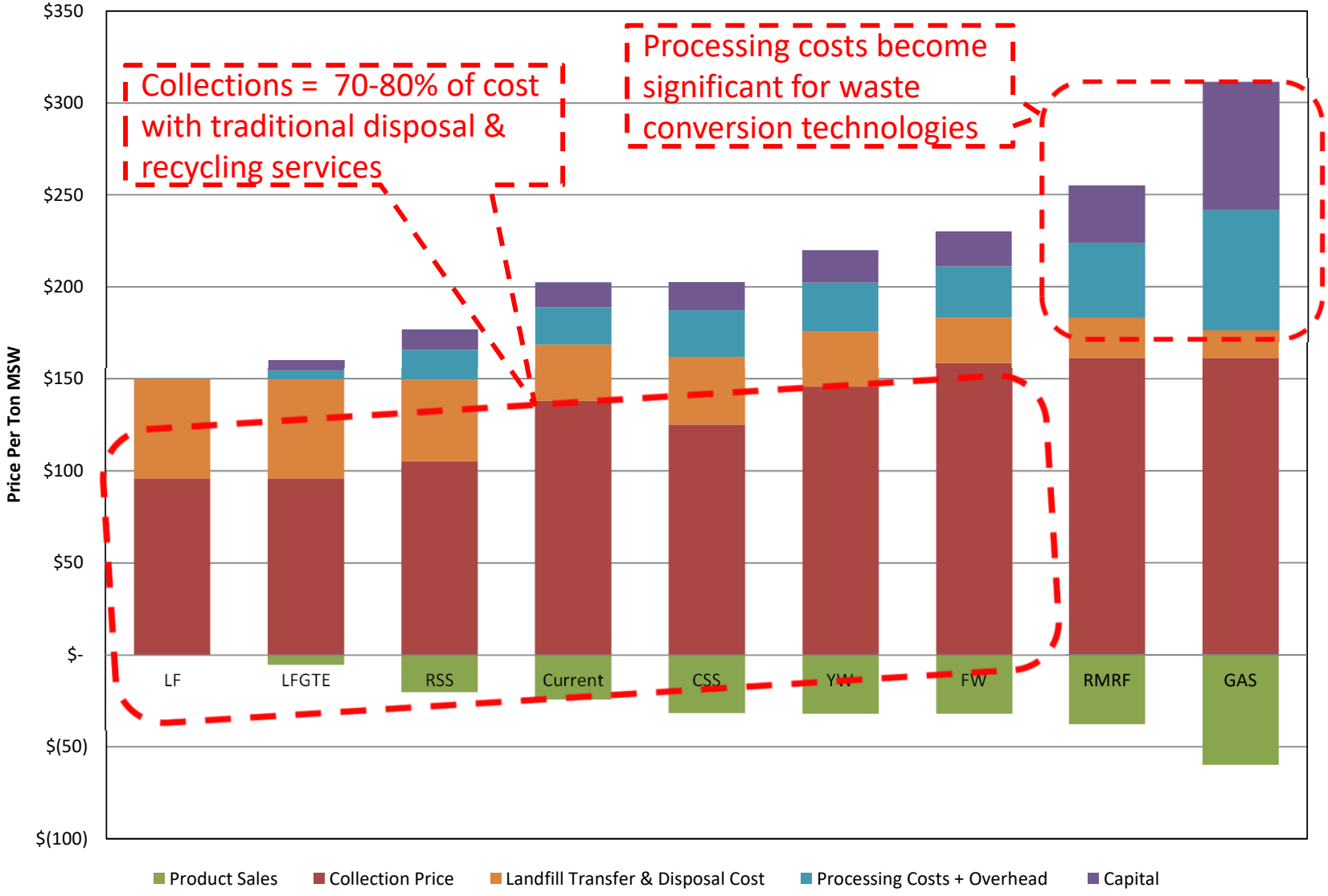
Price breakdown - by Category



- **Collections is 70-80% of integrated costs until post processing options**
- **Infrastructure cost of new technologies is very high**
- **Commodity revenue is based on 10-year average blended value**

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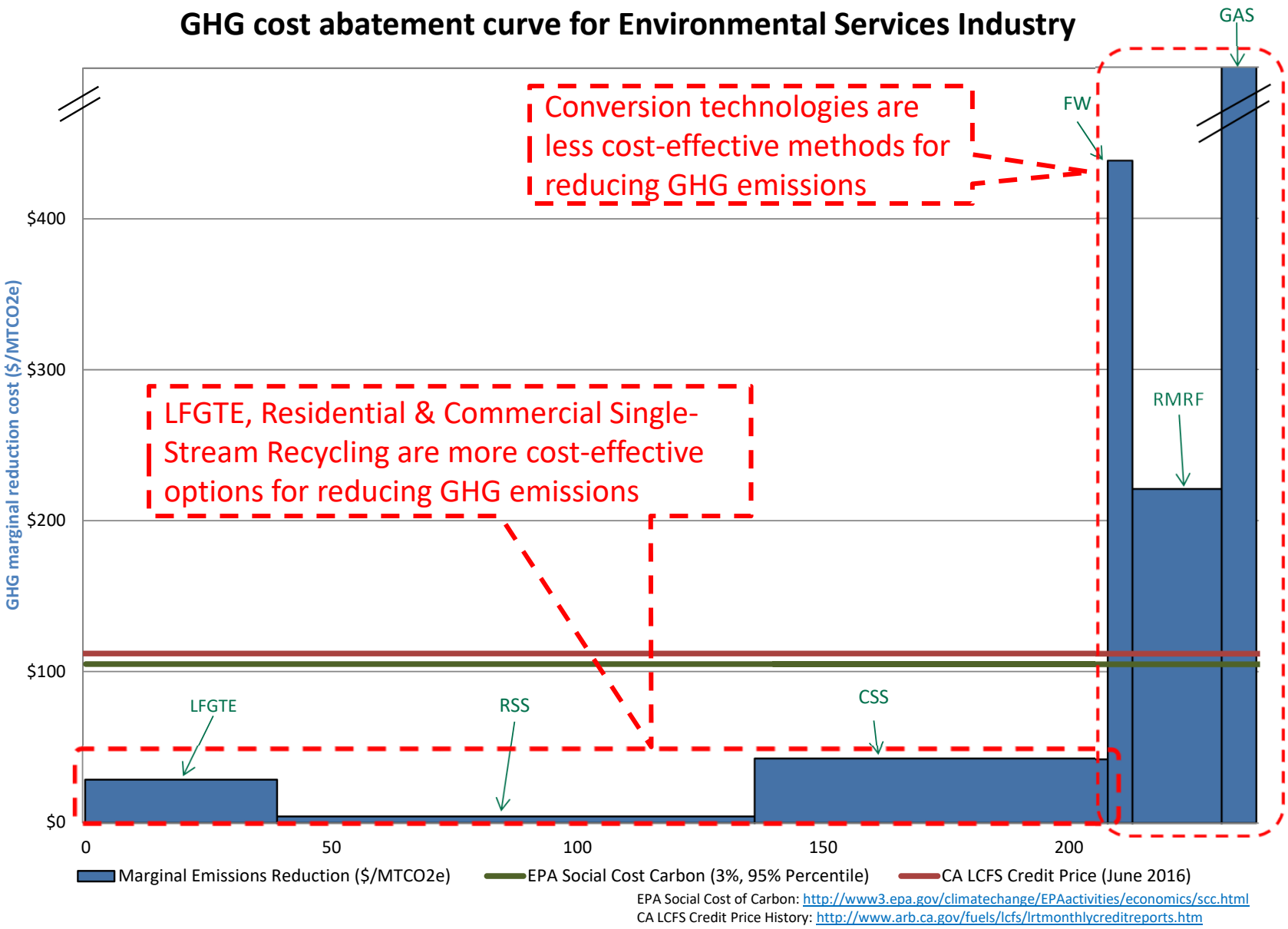
GHG cost abatement curve for Environmental Services Industry



EPA Social Cost of Carbon: http://www3.epa.gov/climatechange/EPAactivities/economics/scc.html
CA LCFS Credit Price History: http://www.arb.ca.gov/fuels/lcfs/lrtmonthlycreditreports.htm

- **Costs plus environmental benefits create a single metric = $/ton of GHG**
- **Width of bars is GHG reduction, height is cost of GHG reduction**
- **Also includes LCFS & EPA social cost of carbon as proxies**

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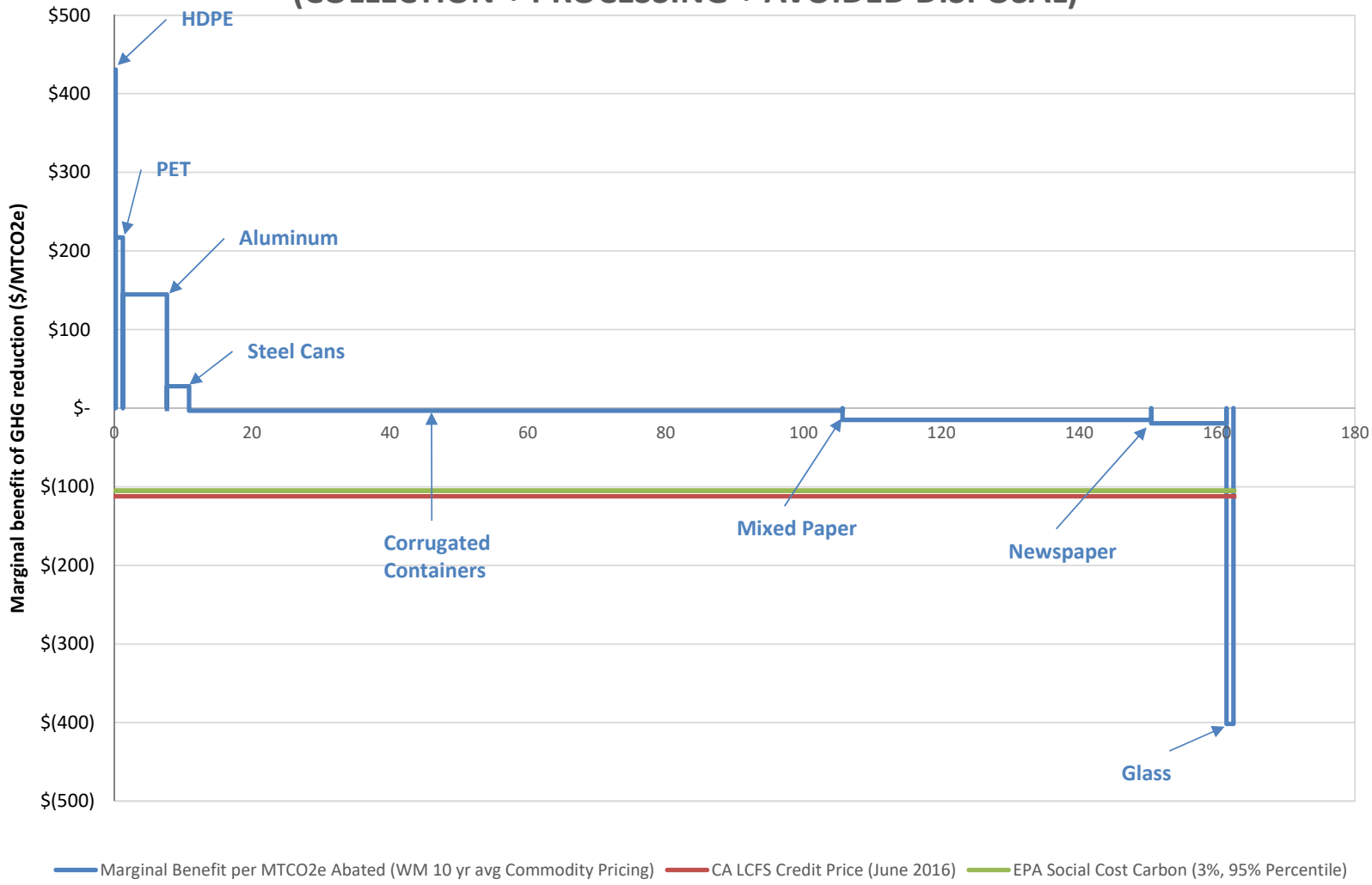
Marginal GHG reduction benefit by material type (COLLECTION + PROCESSING + AVOIDED DISPOSAL)



Assumes: WMRS variable processing cost by material type, 10 yr avg WM commodity pricing, 2013 EPA recovered tons & LF Baseline for GHG calculations

- **Environmental benefits & cost per ton of carbon reduction for recycling only**
- **Includes collection, processing and commodity values**
- **Results show the benefits of recycling paper, metal and plastic bottles**

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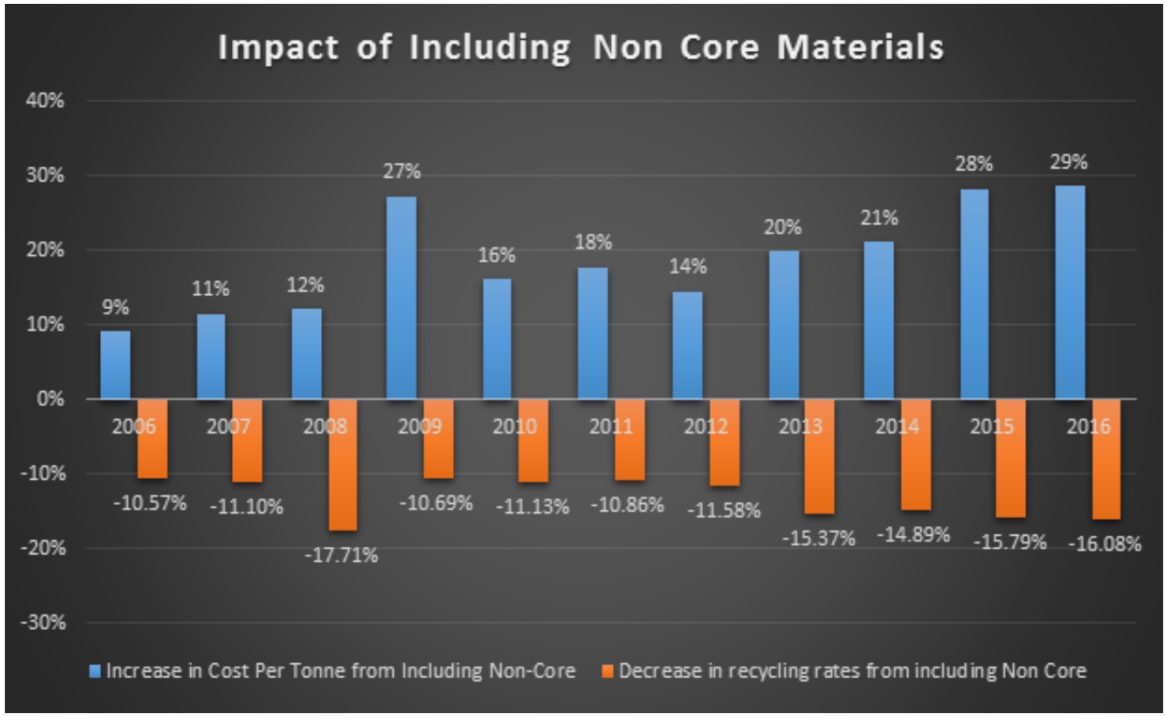
Ontario Materials Study



- MRF feedstock increased by 15% over the past decade
- Cost increased by 63% (adjusted for inflation)
- Analysis indicates that 7 materials caused the increased cost with negligible contribution to recycling: Gable Top Cartons, Aseptic Containers, Paper Laminates, Plastic Film, Plastic Laminates, Polystyrene and Other Plastics.

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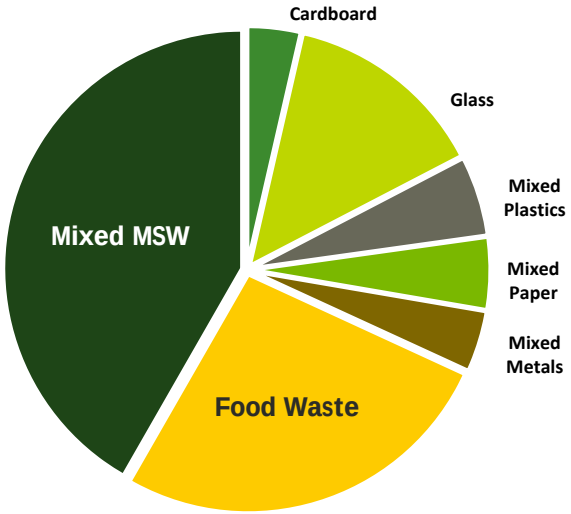
Commercial Generator

Weight



GHG Emissions

Scenario	Baseline	Source Separated	Mixed Recyclables	Foodwaste added
Mixed waste				
Foodwaste				
Glass				
Mixed Recyclables				
Cardboard				
Cost/ton	$42/ton	$35/ton	$40/ton	$55/ton

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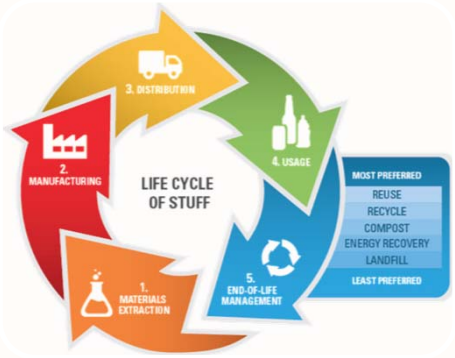
Developing goals and measuring success



Step 1:

Waste Characterization

Complete **state-wide waste characterization** study of disposed materials

Step 2:

Evaluate Environmental Impact

Use waste characterization and LCA to **prioritize goals based on environmental benefits**

Step 3:

Set Goals

Develop **material specific** waste reduction & recovery goals to maximize environmental benefit

Step 4:

Develop Programs and Measure in tons

Convert goals to tons to measure reduction and recovery.

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Summary

- **It's time to think differently about how we set goals for materials management**
- **Focus on individual materials.** Using data lets us be strategic in maximizing broader environmental benefits.
- **Lifecycle thinking** lets us prioritize programs for the best overall environmental results
- **Emphasize material specific goals.** After developing material specific goals, per capita reduction (measured in tons) allows us to measure from a base year.

Policies should focus on the primary goal:
Reducing overall environmental impact

Thank you!

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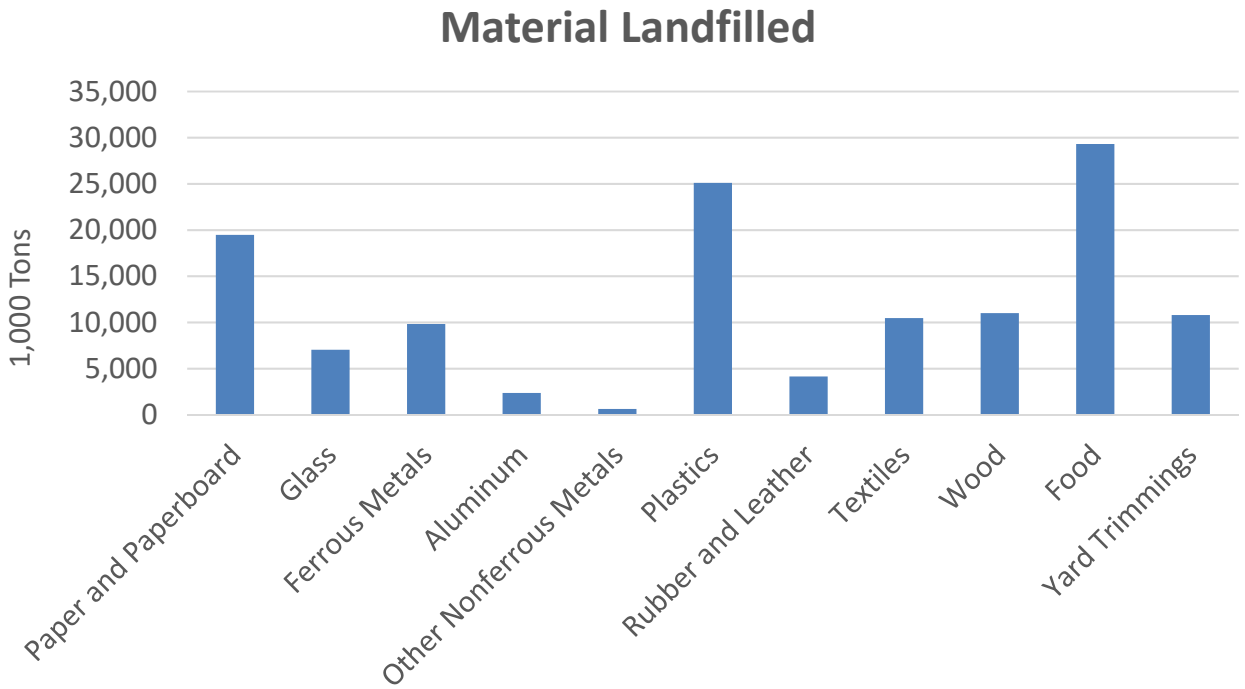
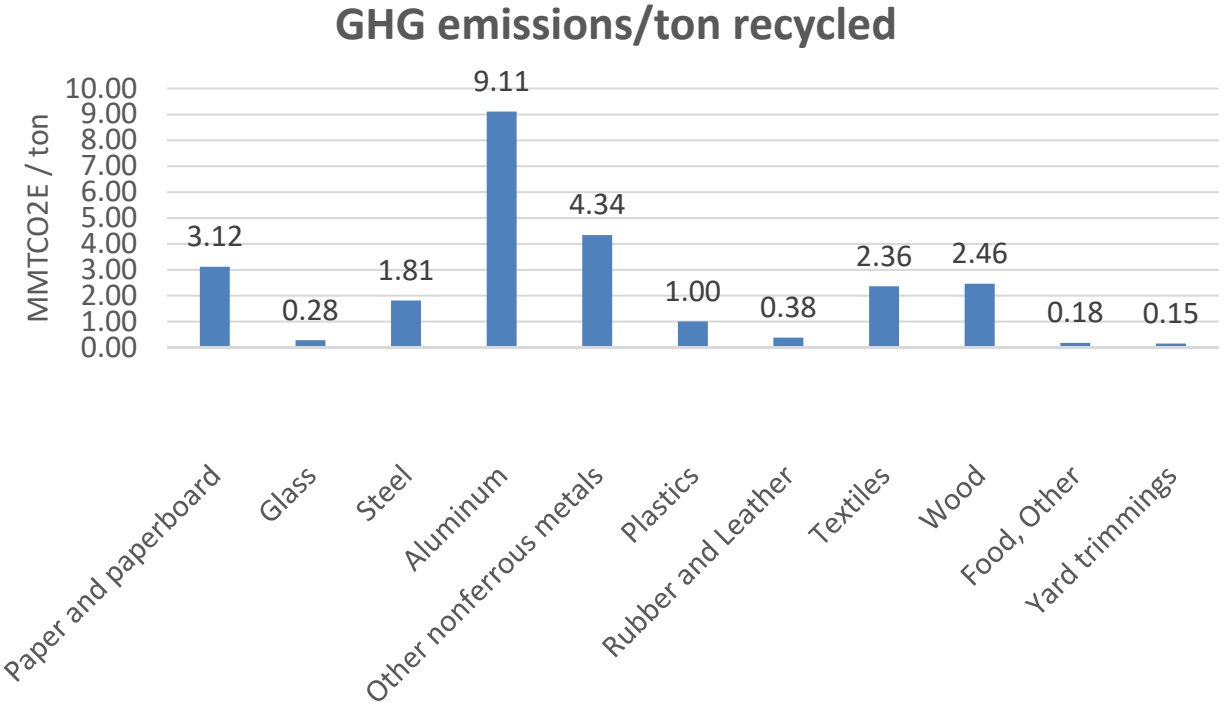
Measuring Success: US EPA





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