



Materials Management:

THE NEXT GENERATION

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The Effects of Organic Waste Diversion on Landfill Gas Generation from U.S. Landfills

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Introduction

- Organic waste diversion
- Changes in organic MSW disposal
- Lower landfill gas generation
 - Lower GHG (methane) emissions
 - Reduced methane fuel supply for landfill gas to energy projects

Purpose of Study

- Document historic changes in organic MSW disposal
- Develop & model alternative future organic MSW disposal scenarios
- Evaluate effects of organics diversion on landfill gas generation

GHG Emissions from Waste Disposal

- Methane emissions from landfills = largest GHG source in waste sector
- Large GHG emissions reduction from:
 - Diverting organic waste from disposal
 - Collecting landfill gas and generating electricity

Types of Models (1)

- Lifecycle Analysis – e.g. WARM
 - Accounts for all emissions by material
 - Full life-cycle benefits from diversion
 - Time independent – e.g. 100 years
 - Good for long-range planning
 - Not good for monitoring progress from baseline for specific sources (landfills)

Types of Models (2)

- Emissions Inventory – e.g. LandGEM
 - Emissions from a specific source over time
 - No accounting outside of source

Estimating Landfill Methane Emissions

- Emissions and emissions avoidance estimates not precise
- Variations in landfill methane emissions
 - Methane generation
 - Methane recovery
 - Methane oxidation

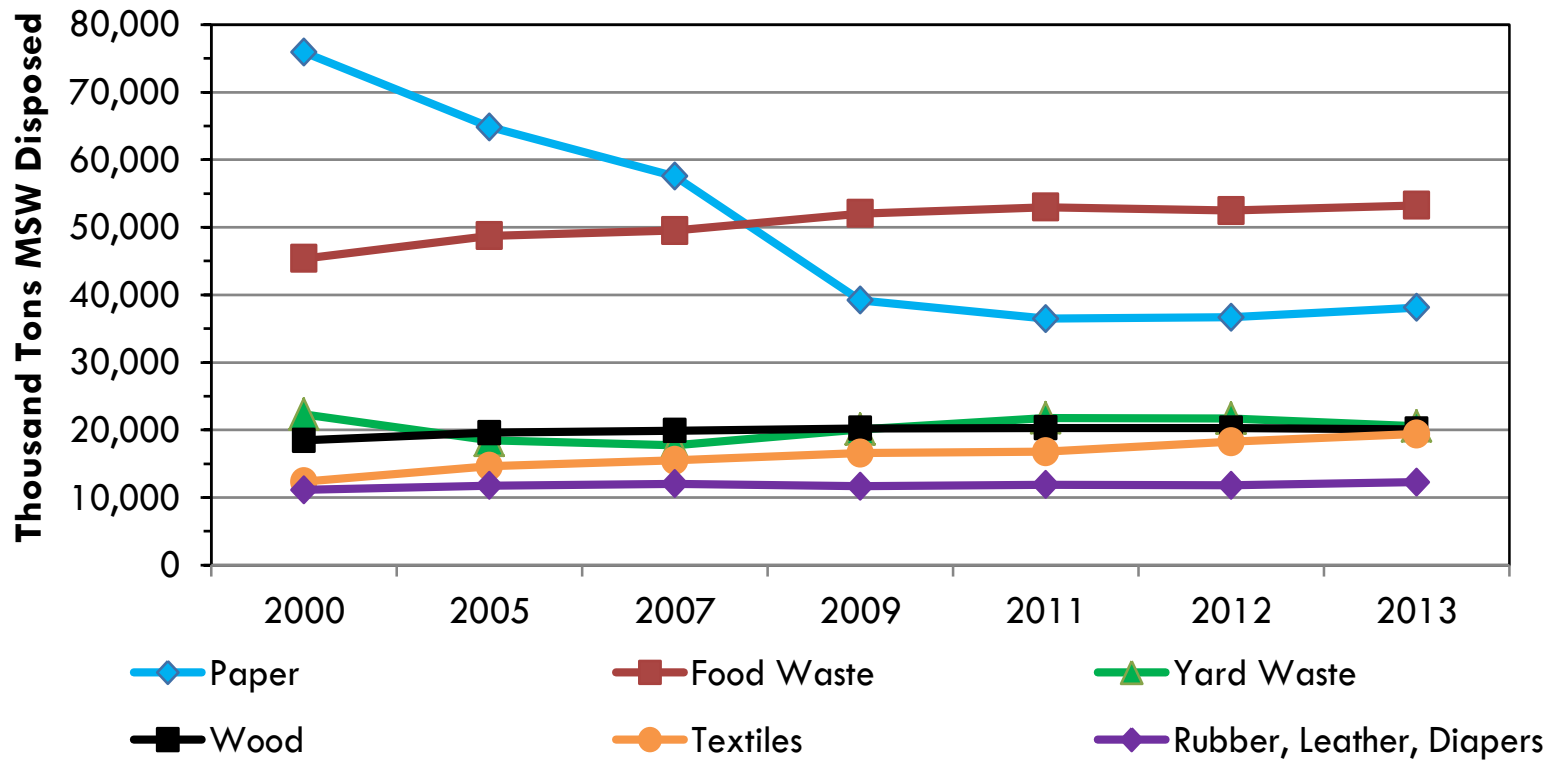
Landfill Gas Generation Models

- LandGEM
 - LandGEM well known
 - Adjusting key assumptions for site conditions poorly known
 - Regulatory vs. non-regulatory models
- IPCC
 - Offers calculations by material category
 - Option for GHG emissions reporting
 - Similar climate adjustment limitations as LandGEM

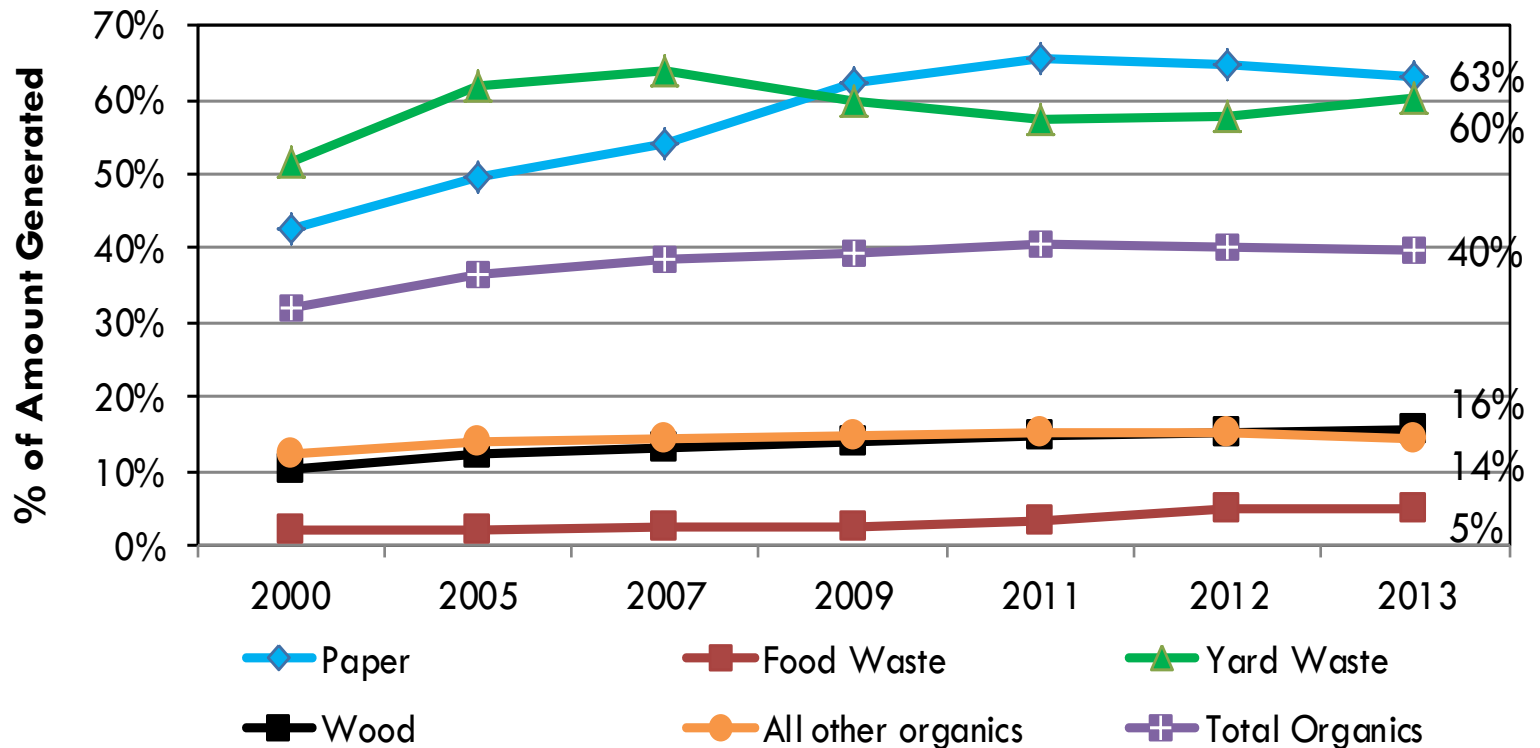
MSW Disposal/Diversion Data

- U.S. EPA (2015 for 1990-2013)
 - Composition of U.S. MSW generated, diverted, and disposed
- EREF (2015)
 - 2013 U.S. MSW disposal was 50% higher than reported by EPA

2000-2013 U.S. Organic MSW Disposal (EPA data adjusted to EREF totals)



2000-2013 U.S. Organic MSW Diversion %s (EPA data)



Declines in U.S. Organic Waste Disposal

Year	Million Mg MSW Disposed	% Organics in MSW	Million Mg Organic MSW Disposed
1990	240	74.9%	180
2000	239	70.5%	168
2005	239	67.7%	162
2007	236	66.3%	156
2009	222	65.5%	145
2011	224	64.8%	145
2013	229	64.9%	149

Declining Methane Productivity of U.S. Waste

Year	Million Mg MSW Disposed	Average MSW L_0 (m^3/Mg)	L_0 x Mg MSW Disposed (% decline since 1990)
1990	240	102.7	--
2000	239	97.2	5.9%
2005	239	91.0	11.9%
2007	236	87.7	16.3%
2009	222	81.3	26.8%
2011	224	79.5	27.7%
2013	229	79.7	25.8%

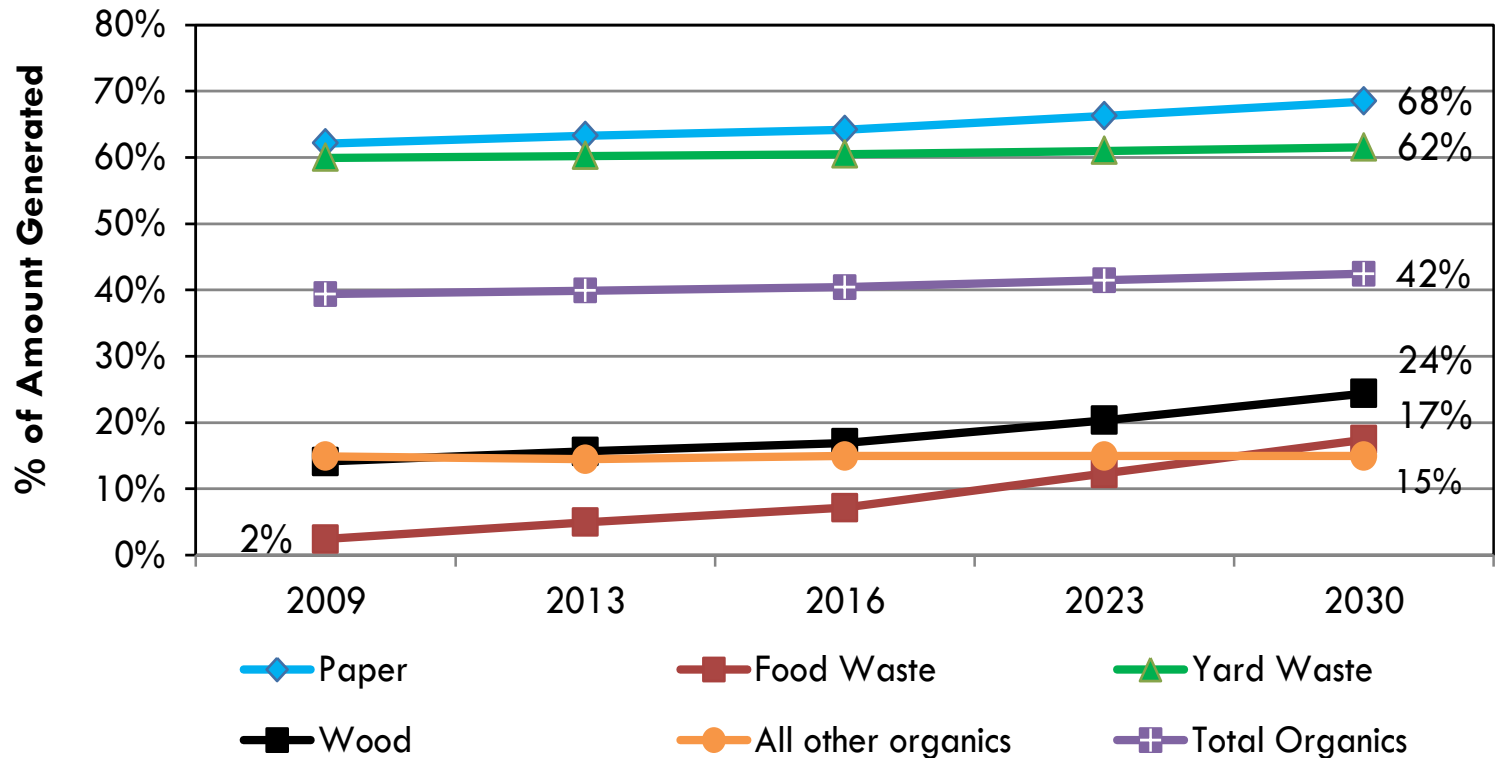
Effects of 1990-2013 Declines in U.S. MSW Organics

- 17% decrease in organic MSW disposed
- 26% decrease in methane productivity of MSW disposed
 - Does not = 26% decline in LFG generation
 - Delayed effect depends on decay rates and timing of disposal

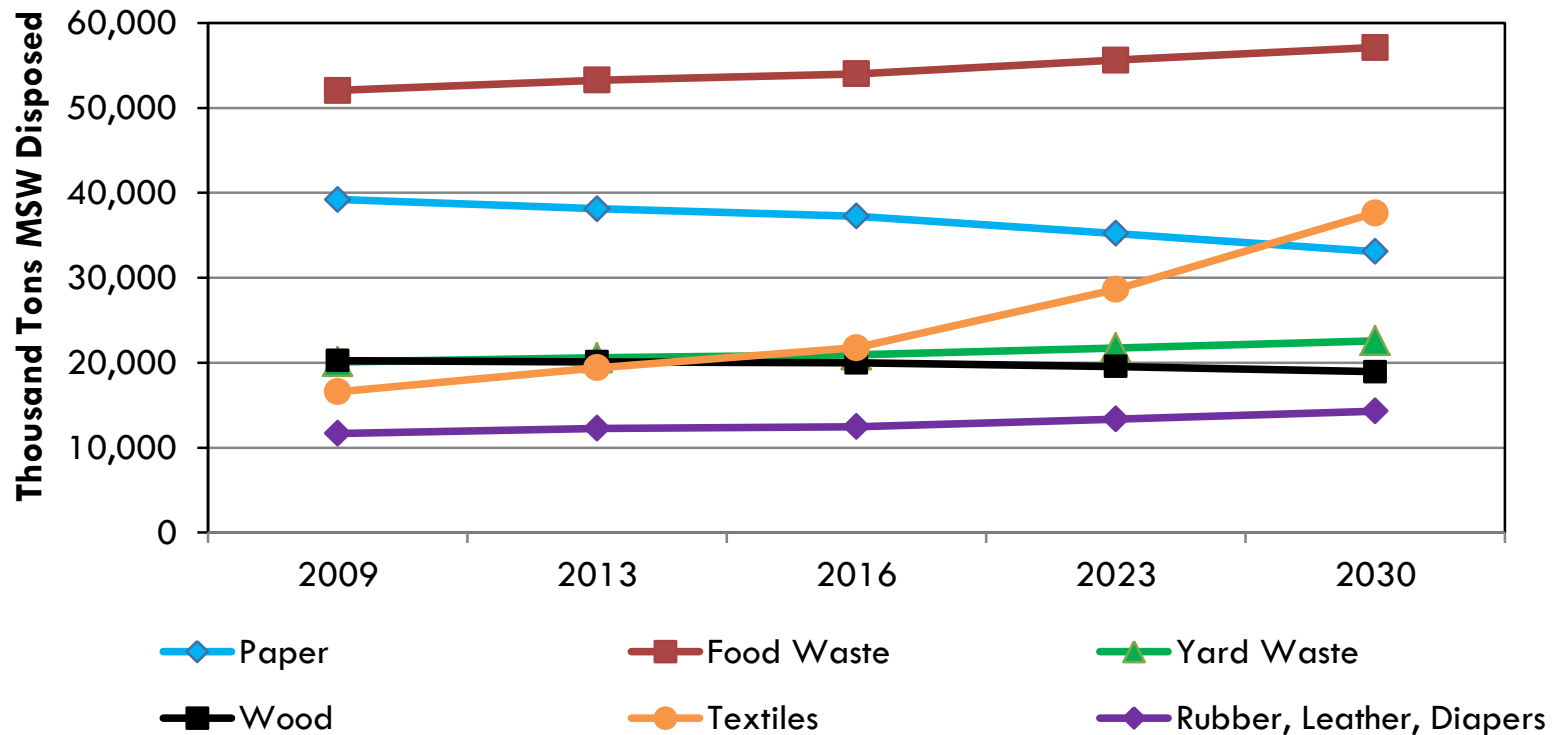
Future MSW Disposal Scenarios

- Define for organic MSW categories
 - Disposal = Generation x (1-% Diversion)
- Generation defined by 2009-13 trends
 - Discounted future MSW generation in medium and high diversion scenarios
- Diversion scenarios
 1. Baseline – continue 2009-13 trends
 2. Mid-range – 2 x Baseline diversion % increases
 3. High – 4 x Baseline diversion % increases

Baseline U.S. Organic MSW Diversion Forecasts

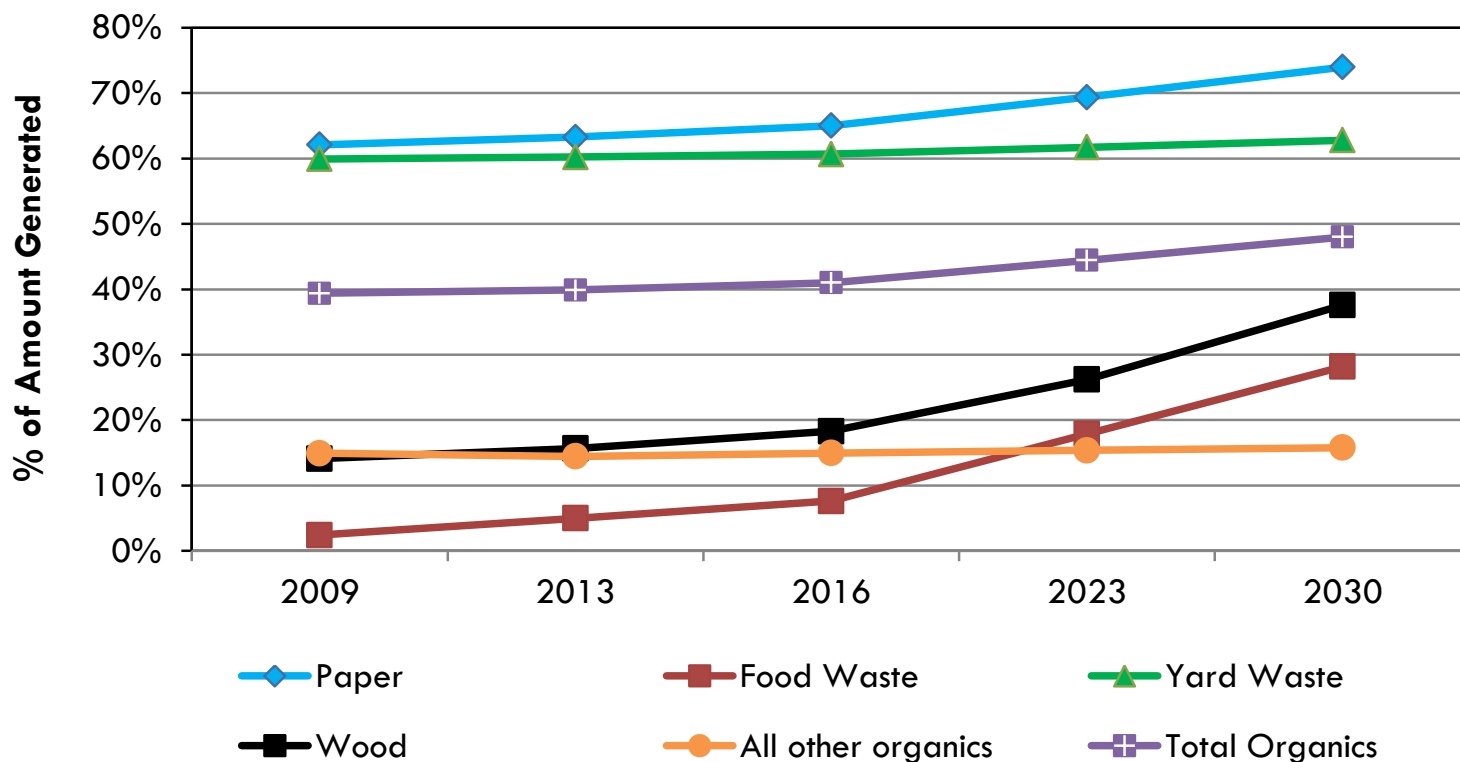


Baseline U.S. Organic MSW Disposal Forecasts

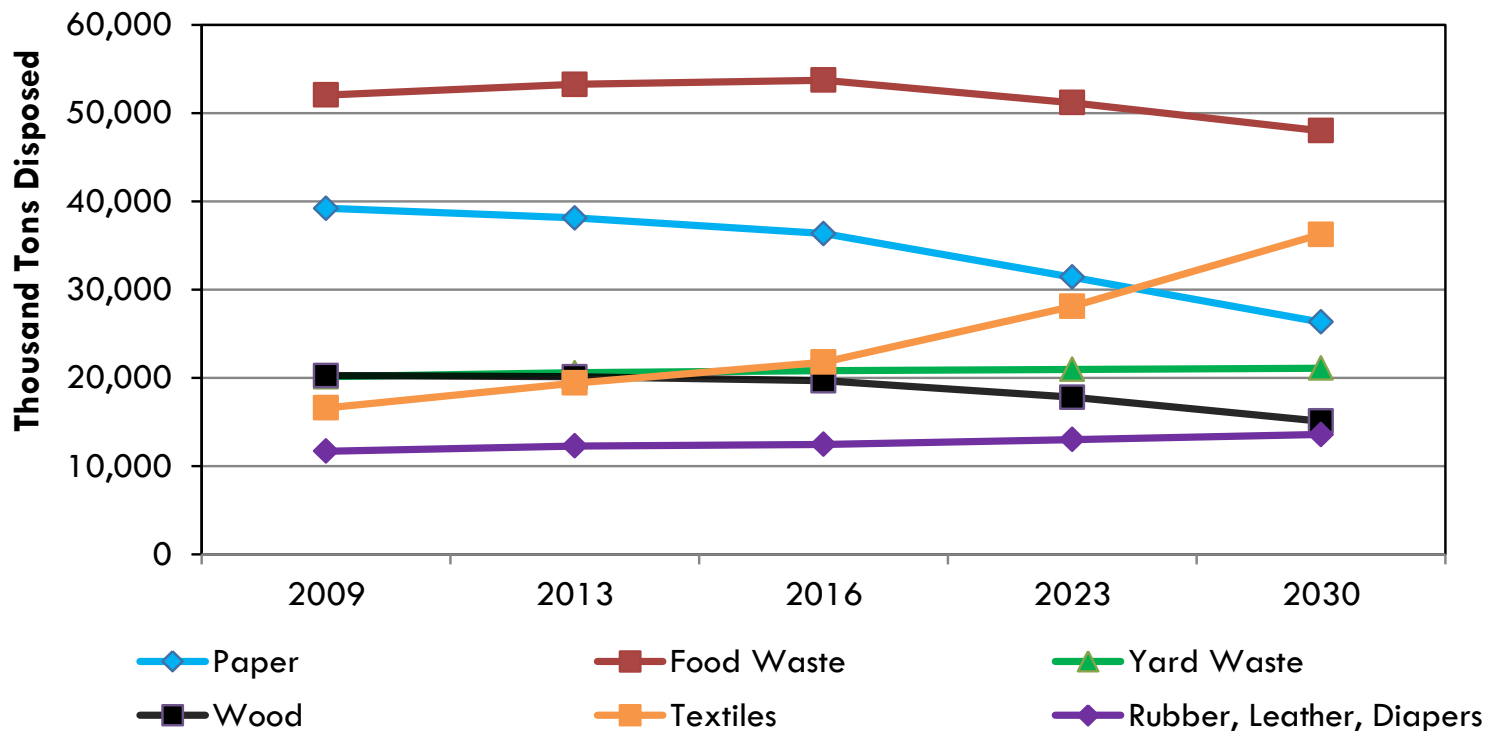


12% increase in organic MSW disposal: 2013-2030

U.S. Organic MSW Diversion: Mid-Range Scenario

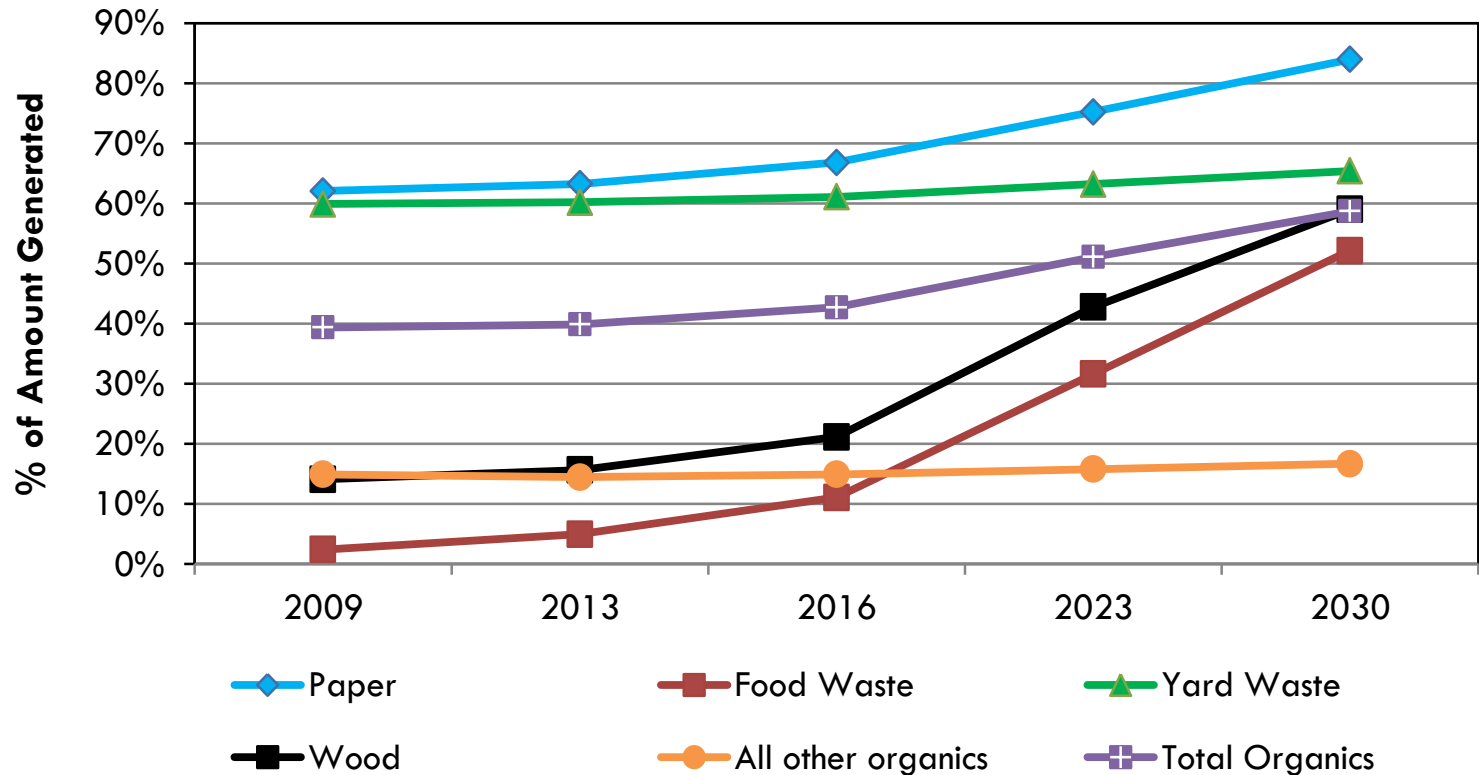


U.S. Organic MSW Disposal: Mid-Range Diversion Scenario



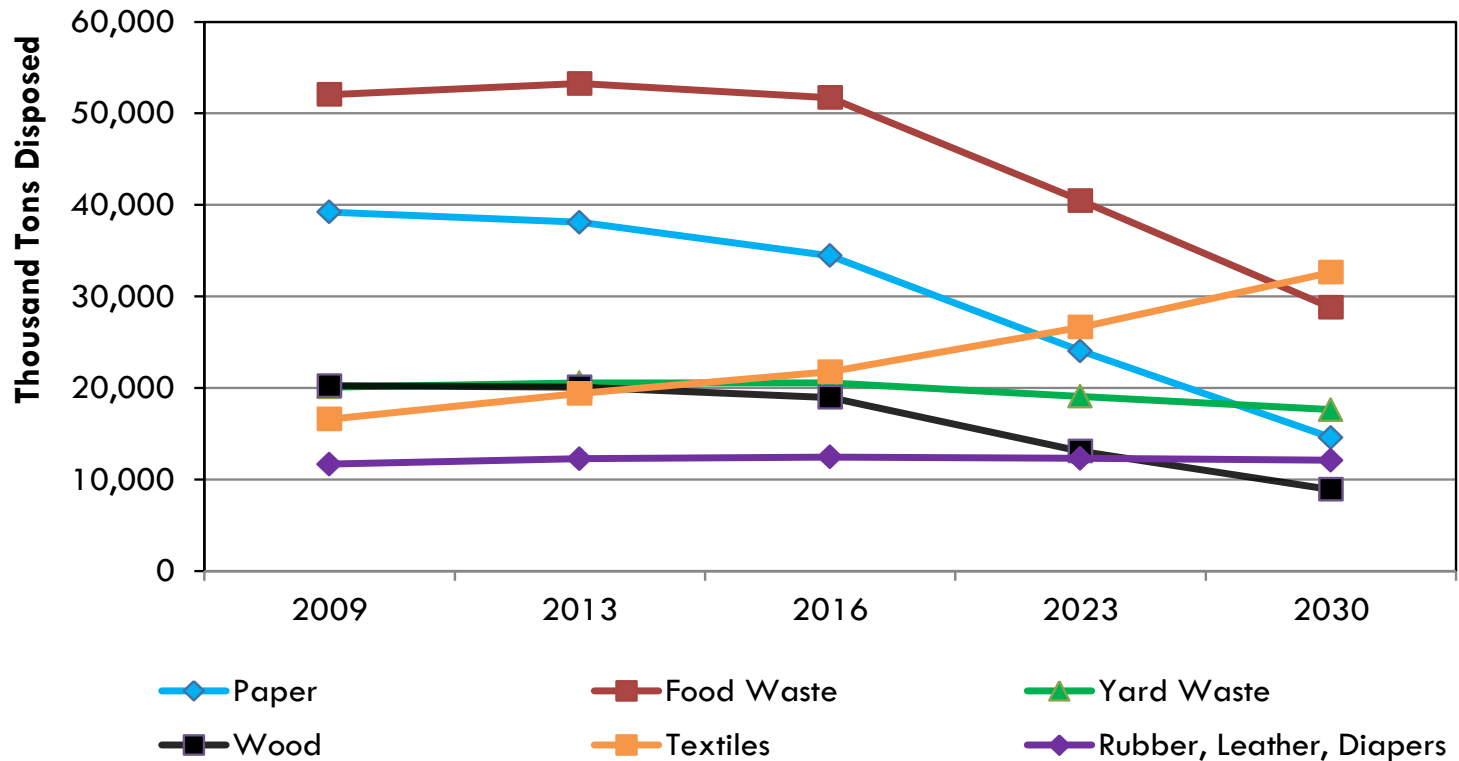
2% decrease in organic MSW disposal: 2013-2030

U.S. Organic MSW Diversion: High Scenario



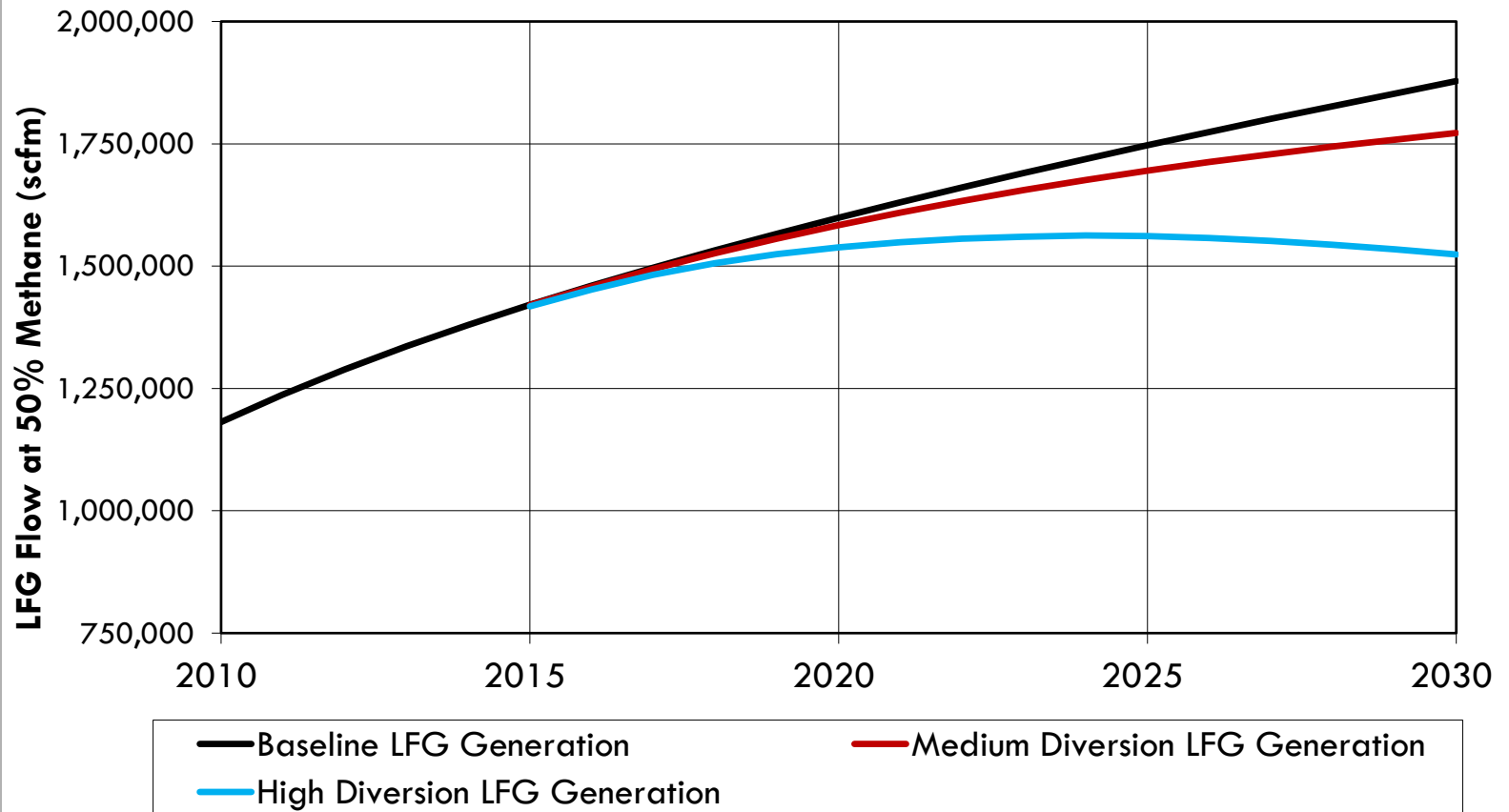
*Meets US EPA food waste diversion goal of 50% by 2030

U.S. Organic MSW Disposal: High Diversion Scenario

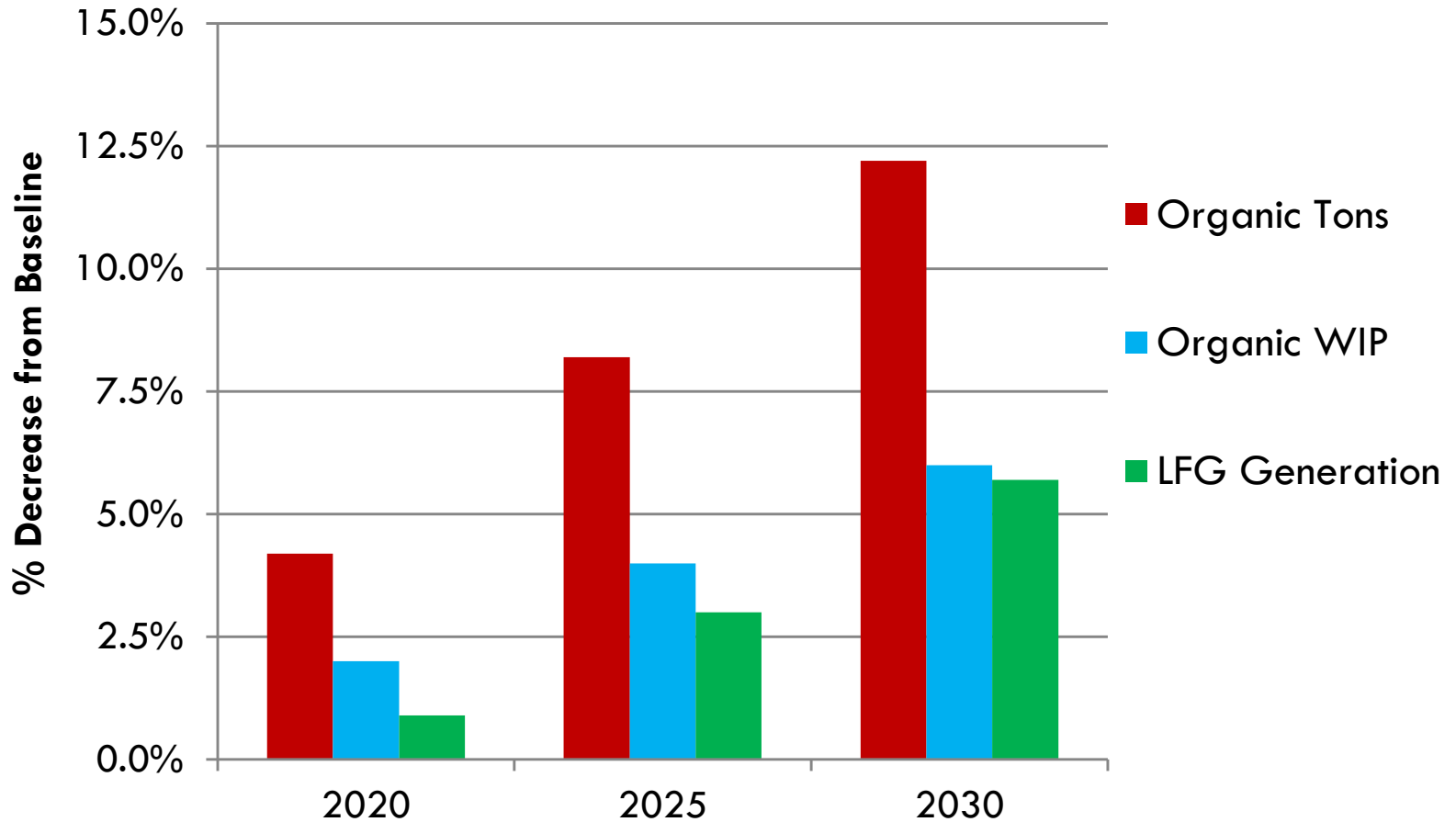


30% decrease in organic MSW disposal: 2013-2030

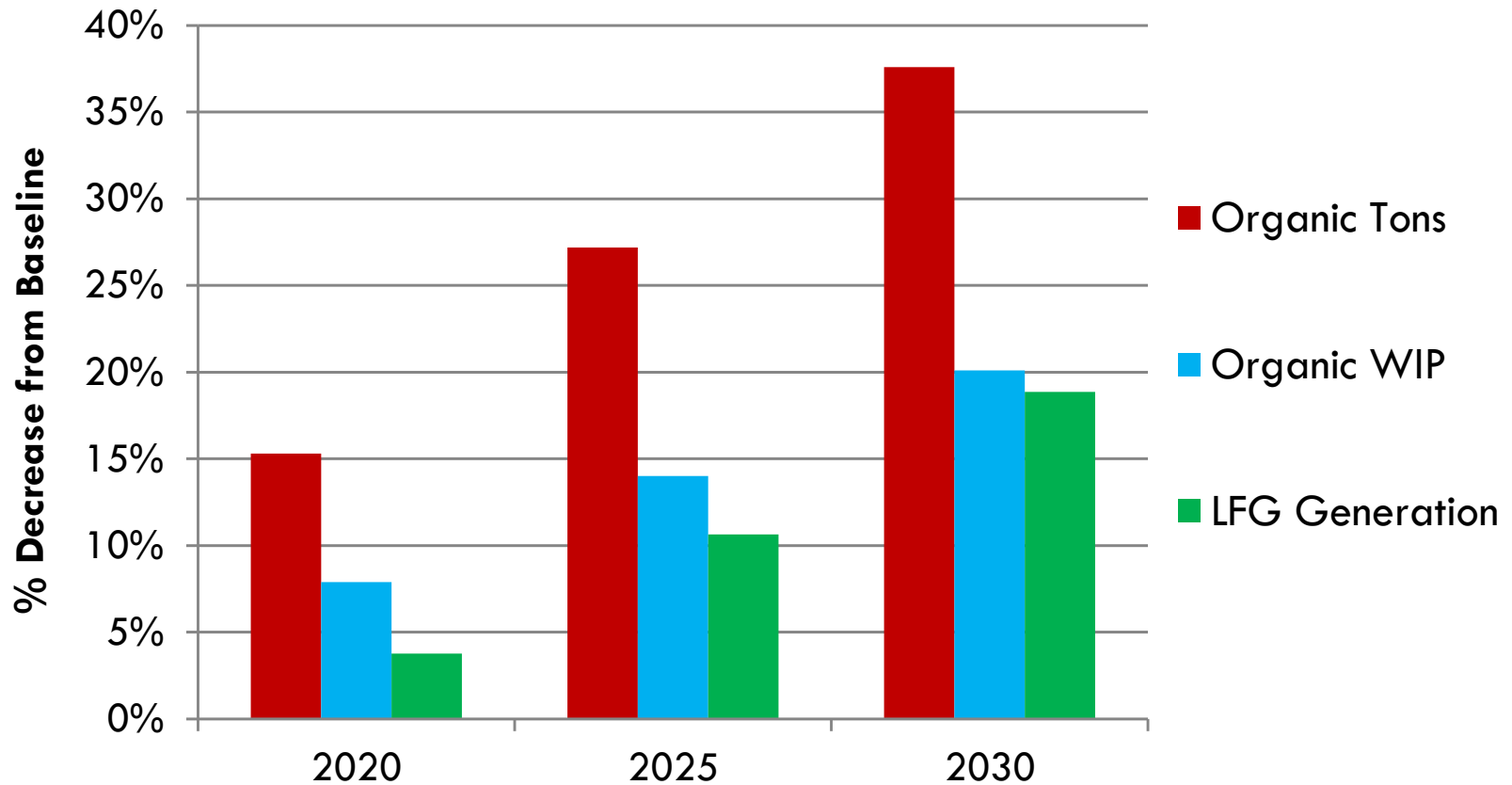
LFG from U.S. MSW Disposed 2000-2030



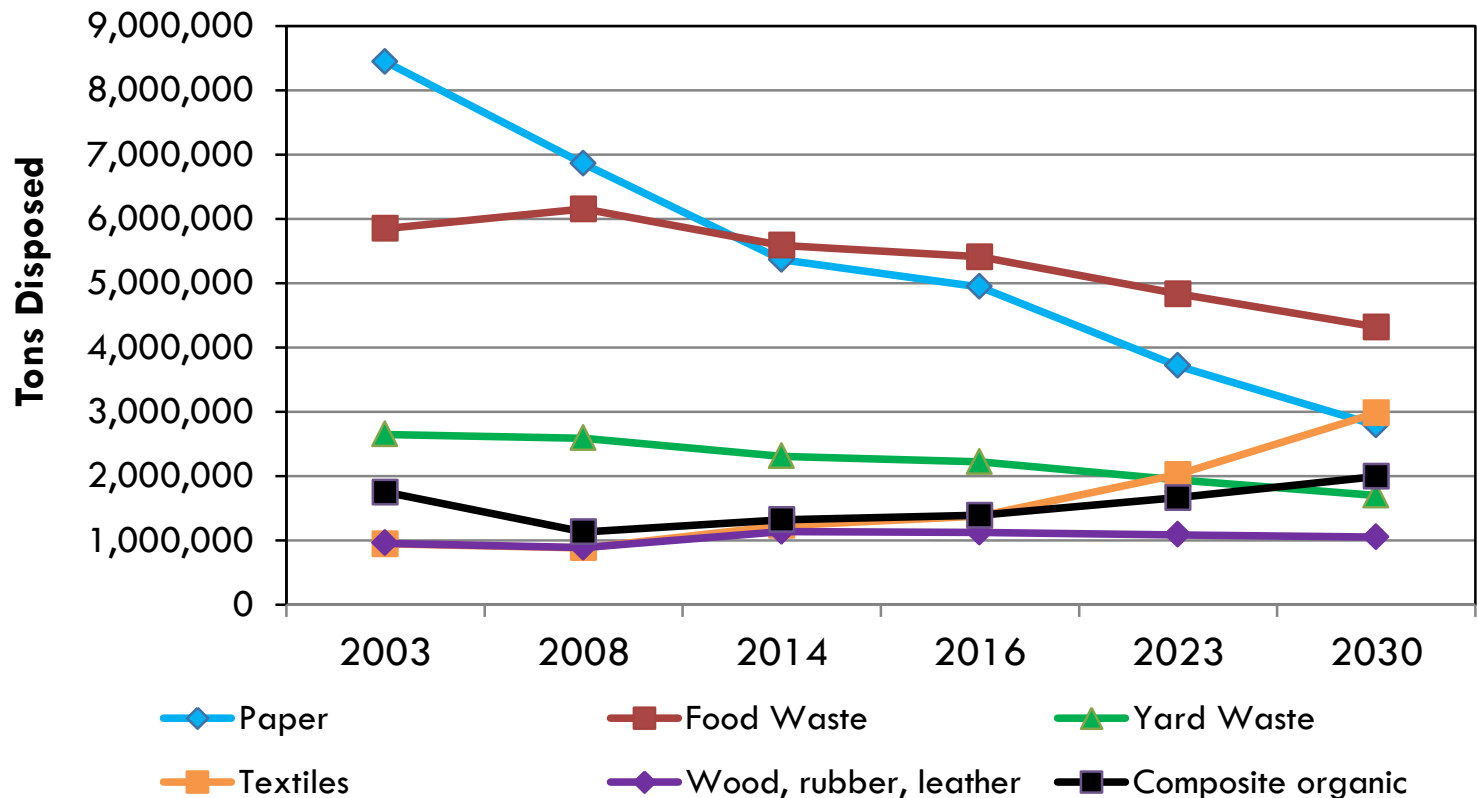
U.S. % Decreases from Baseline – Mid-Range Diversion



U.S. % Decreases from Baseline – High Diversion

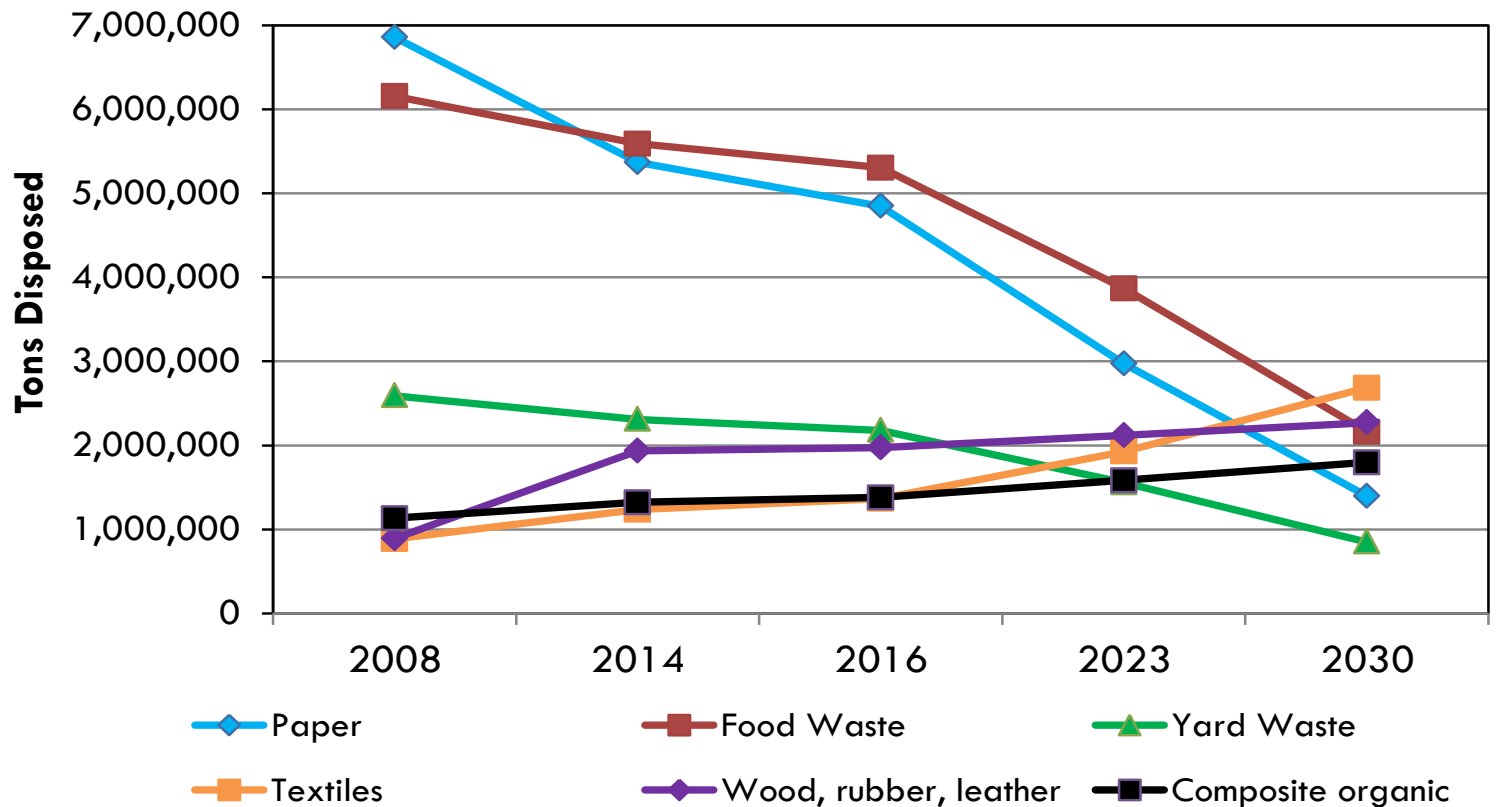


CA Organic MSW Disposal: Baseline



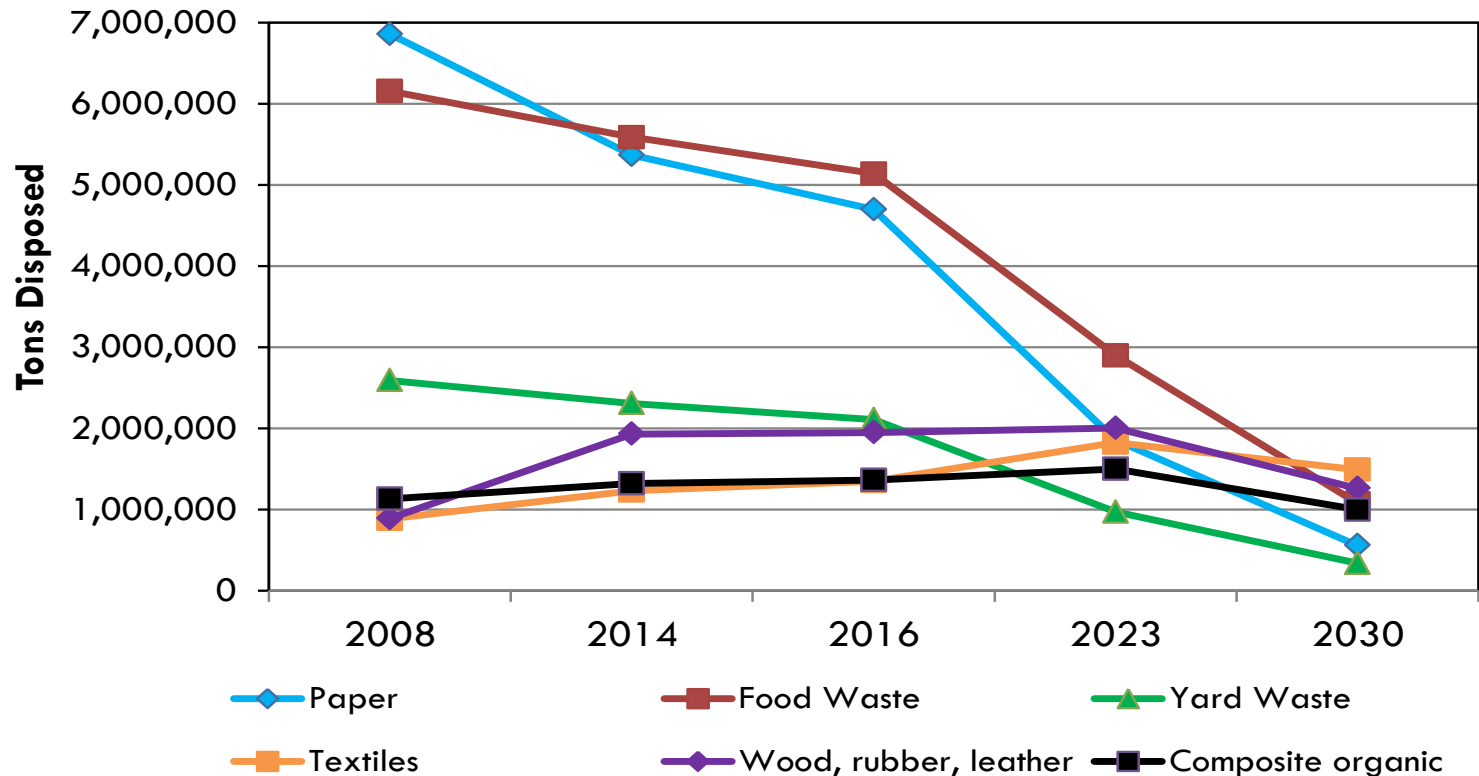
12% decrease in organic MSW disposal: 2014-2030

CA Organic MSW Disposal: Mid-Range Diversion Scenario



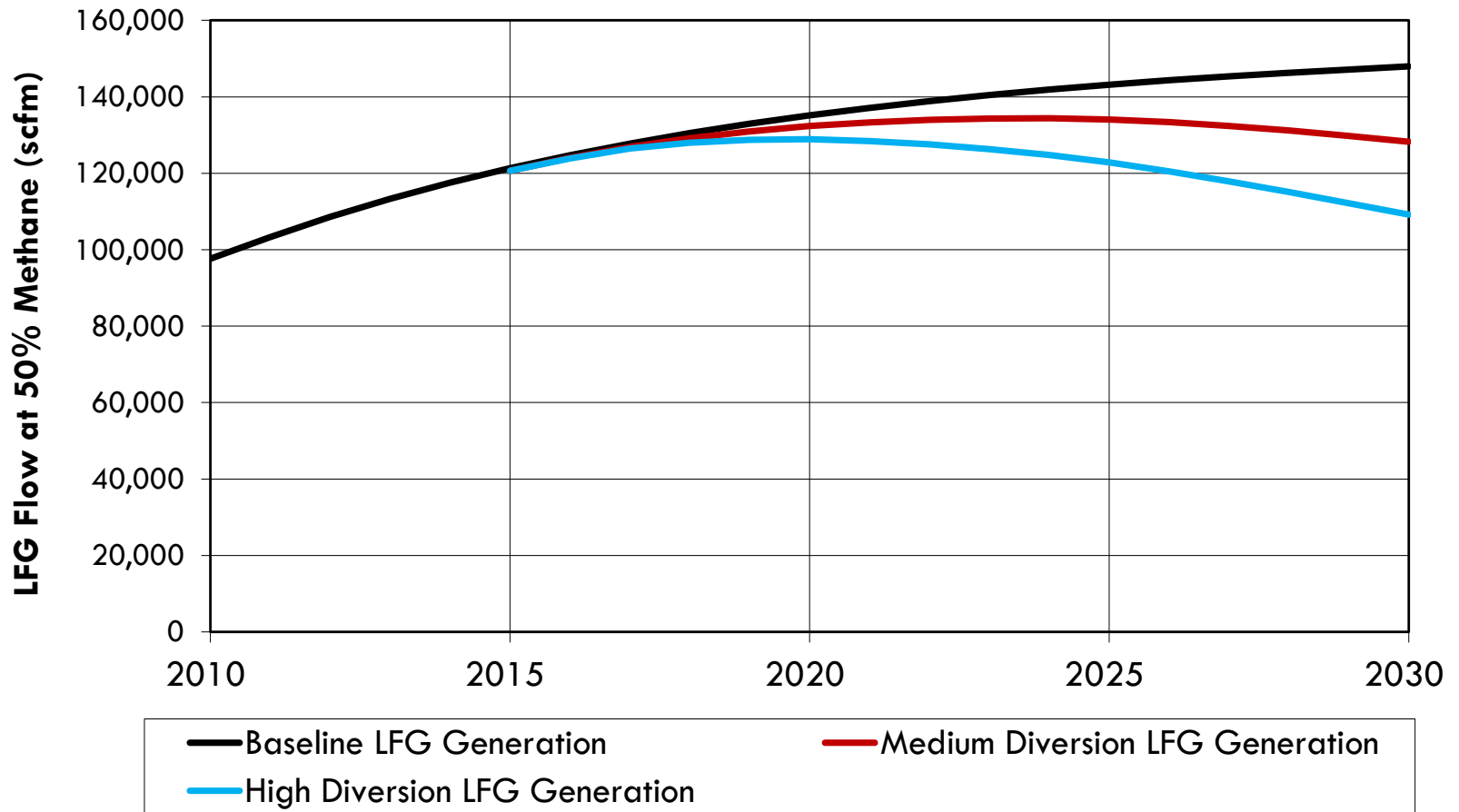
43% decrease in organic MSW disposal: 2014-2030

CA Organic MSW Disposal: High Diversion Scenario

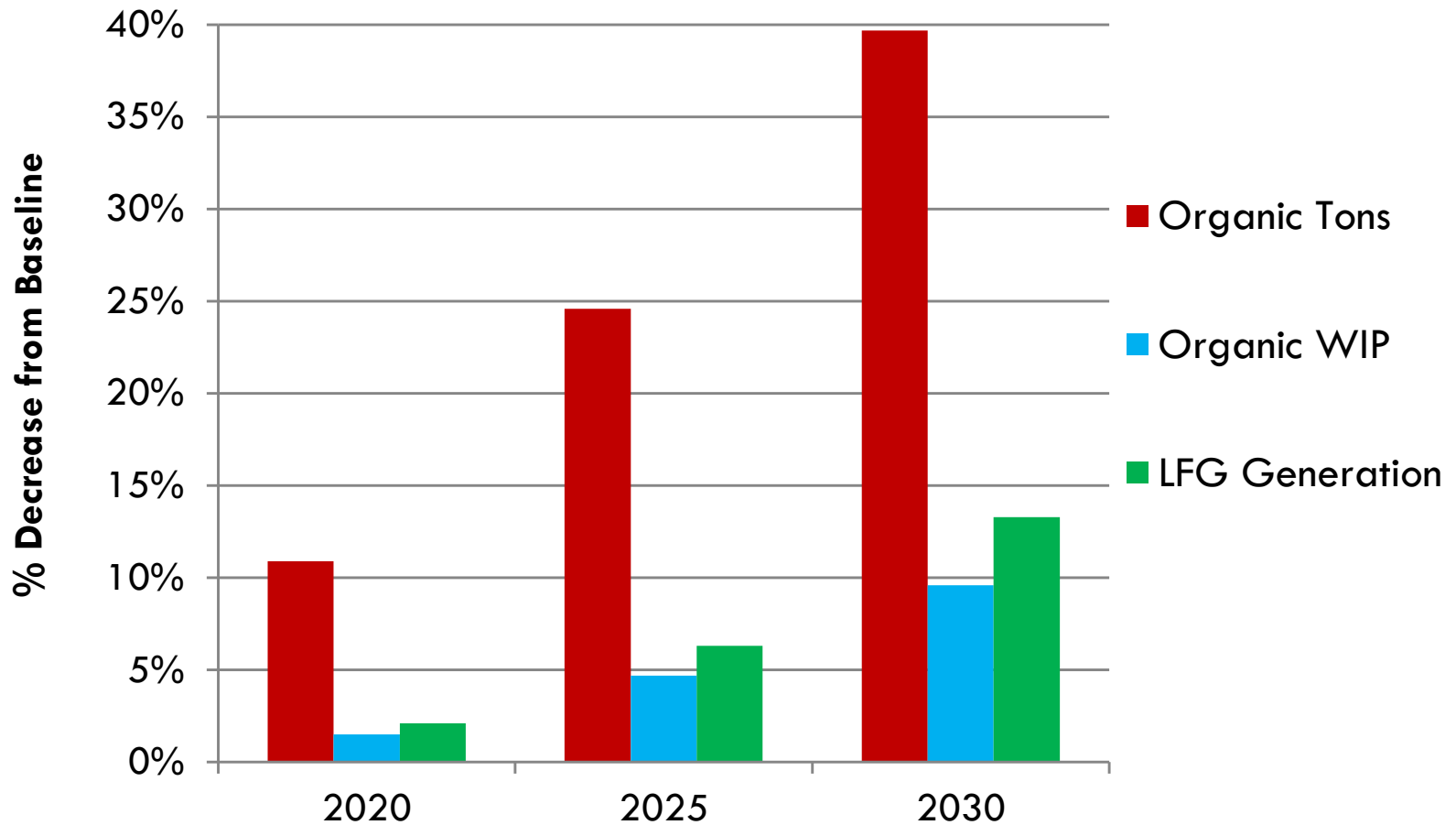


71% decrease in organic MSW disposal: 2014-2030

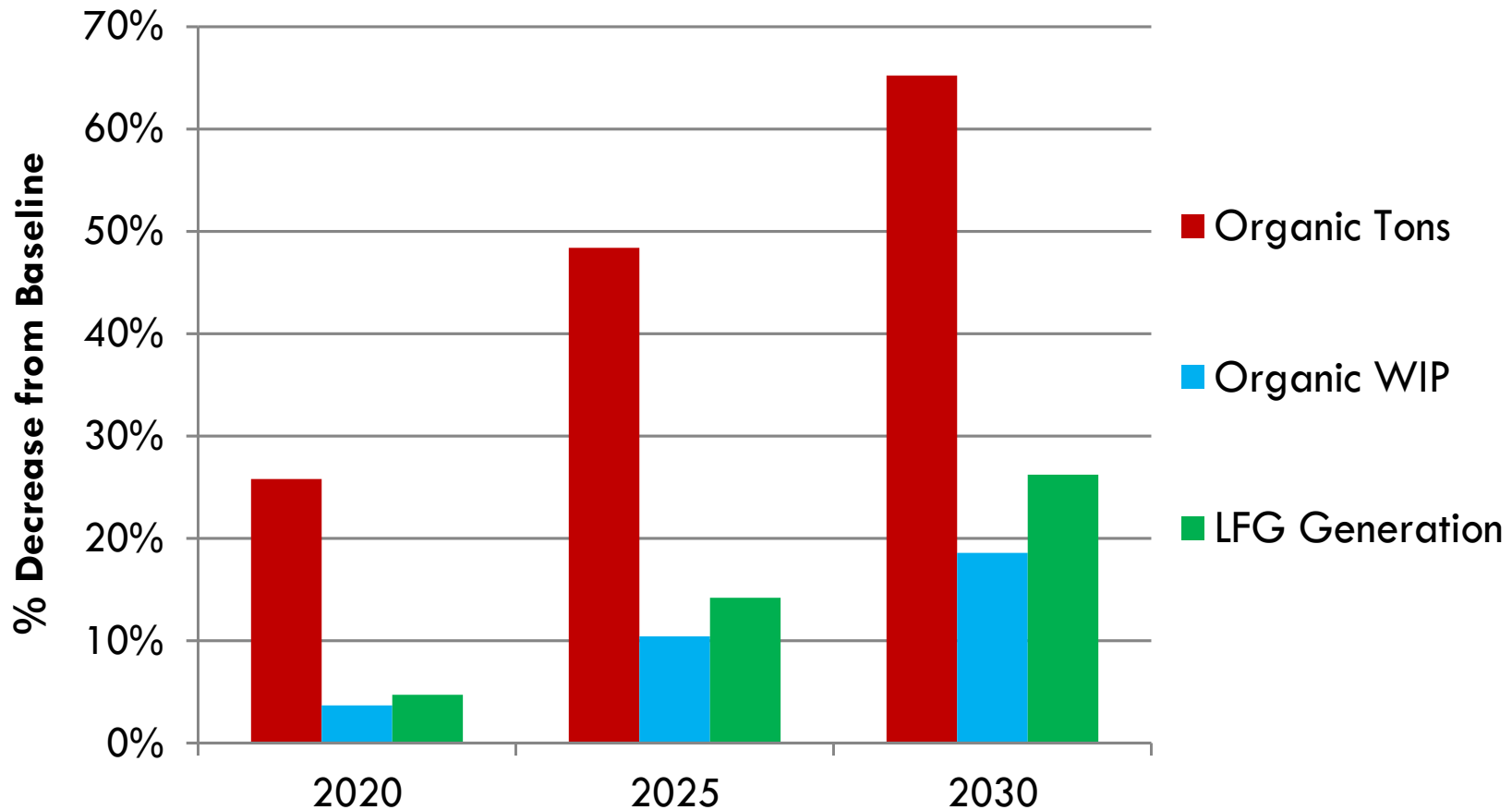
LFG from CA MSW Disposed 2000-2030



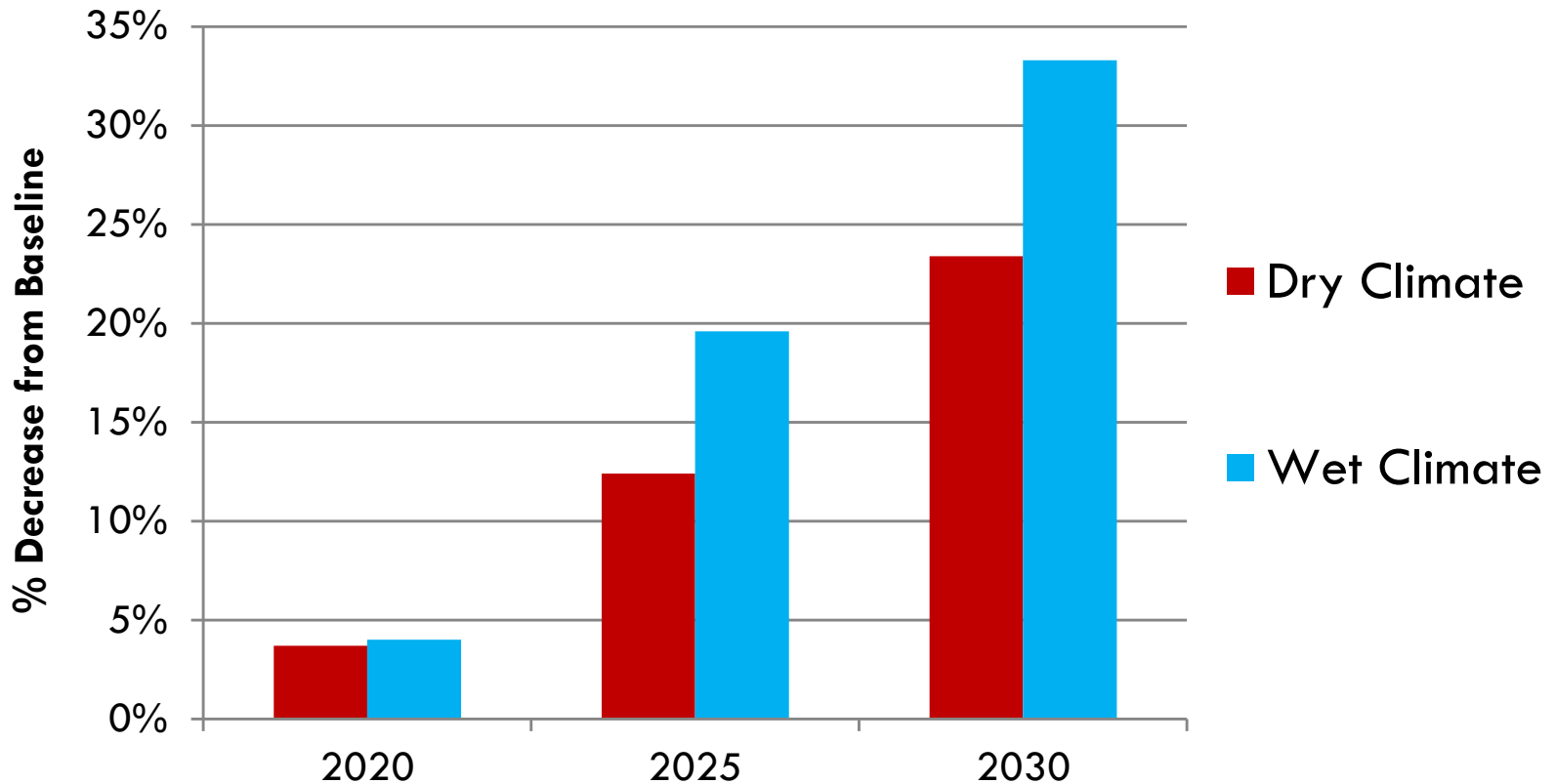
CA % Decreases from Baseline – Mid-Range Diversion



CA % Decreases from Baseline – High Diversion



CA High Diversion: Dry vs. Wet Climate



Summary

- From 2009-2013, organics diversion increased by 1% and generation increased by 3%, causing a 2% disposal increase
- Continuing disposal trends → LFG increases
- Aggressive increases in recycling would be required to cause LFG generation declines

For More Information

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