Improving Oregon Recycling Systems Infrastructure

Initial Scenario Analysis Results

6/10/2020

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Bell & Associates

Scenarios

0	Baseline (S0)
A	Single-stream with current list and modern MRFs (S1)
A+	Single-stream with longer list and modern MRFs (advanced container sorting at one MRF) (S2)
B	Single-stream with longer list and transfer to out-of-state CRF (S3)
C	Dual-stream with even longer list and one container MRF (S4)

Evaluation Criteria

Quantitative Criteria

- Access to recycling
- In-bound (collection) quantity and quality of materials
- Outbound quantity and quality of materials to reach markets
- Transactional costs
- Employment (FTEs)

Qualitative Criteria

- Equity
- Worker safety/working conditions
- Potential for stranded assets
- Resiliency/adaptability

When reviewing results please remember:

Figures in this report represent the consultant team's reasonable modeling estimates but should be considered to have meaningful yet unknown error ranges.

Where data were limited, the consultant team used professional judgement and prior experience to develop inputs.

Data were especially limited regarding current (baseline) processing costs, revenues, bales produced, and bale quality.

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Access to Recycling

Materials accepted:

- Increased (A+, B, C)

Recycling participation:

- No change

Collection frequency:

- Scenario C (dual-stream) expands weekly collection from 52% to 100% of current single-family customers

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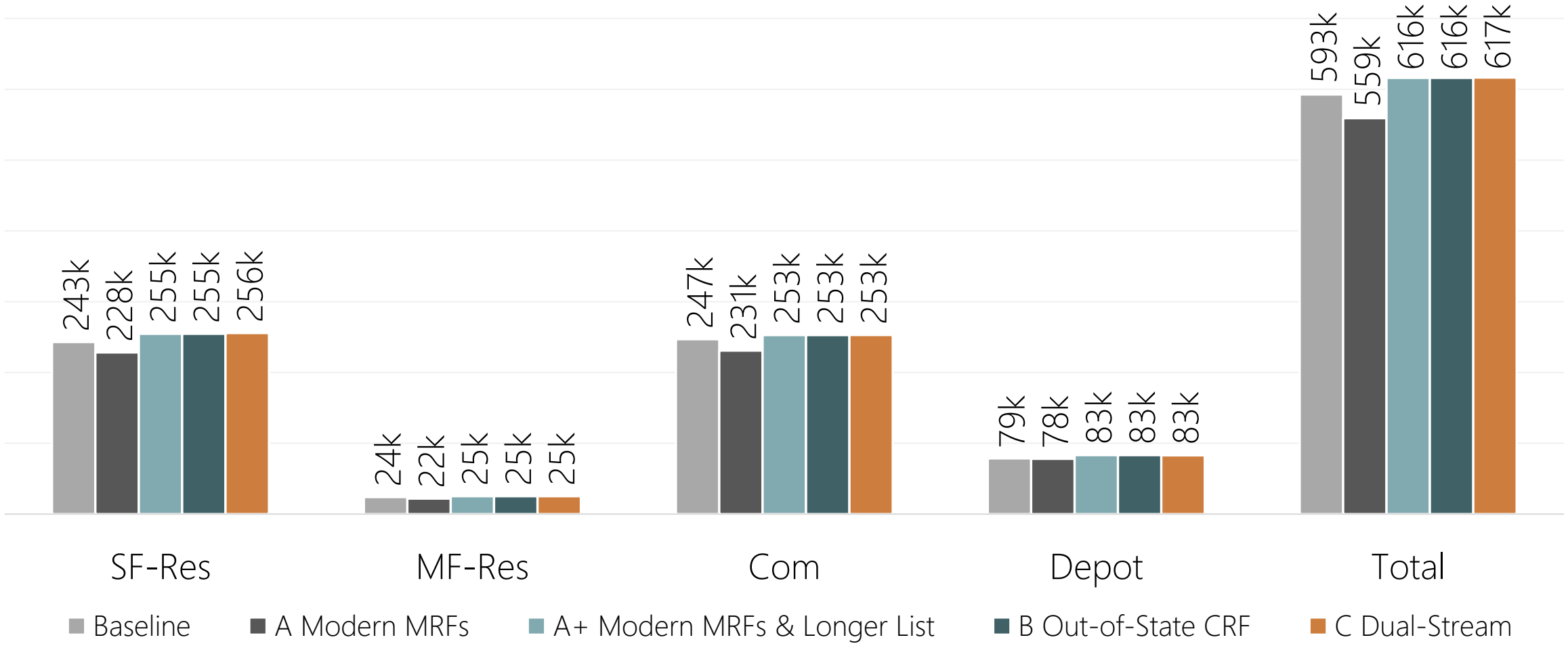
In-Bound Collection Quantities (thousand tons)



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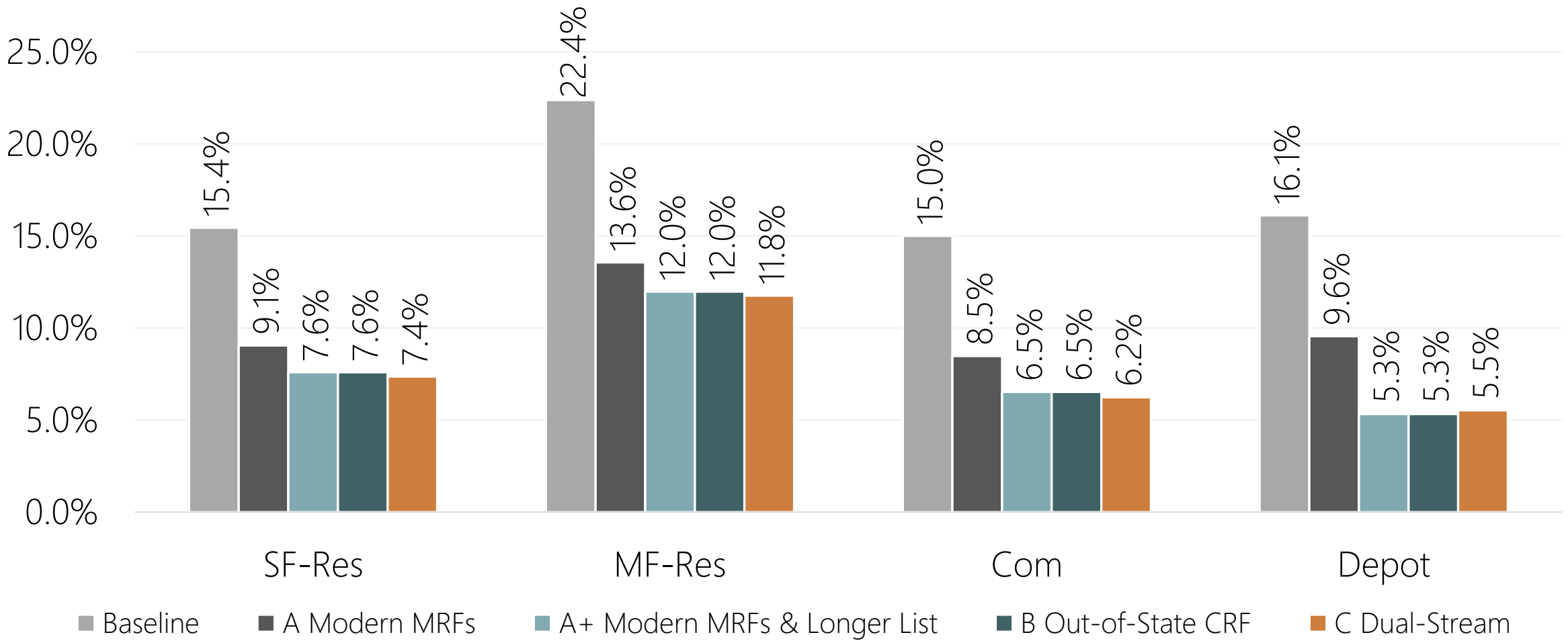
In-Bound Contamination Rate



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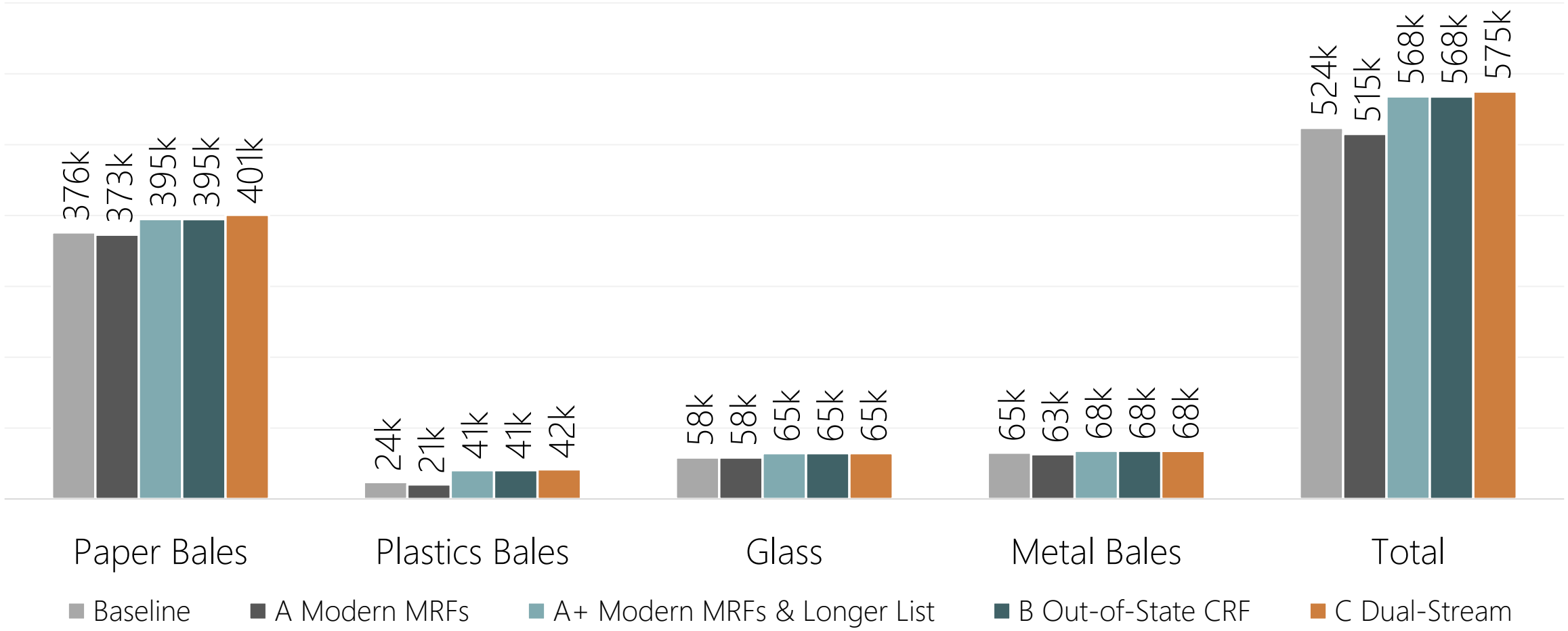
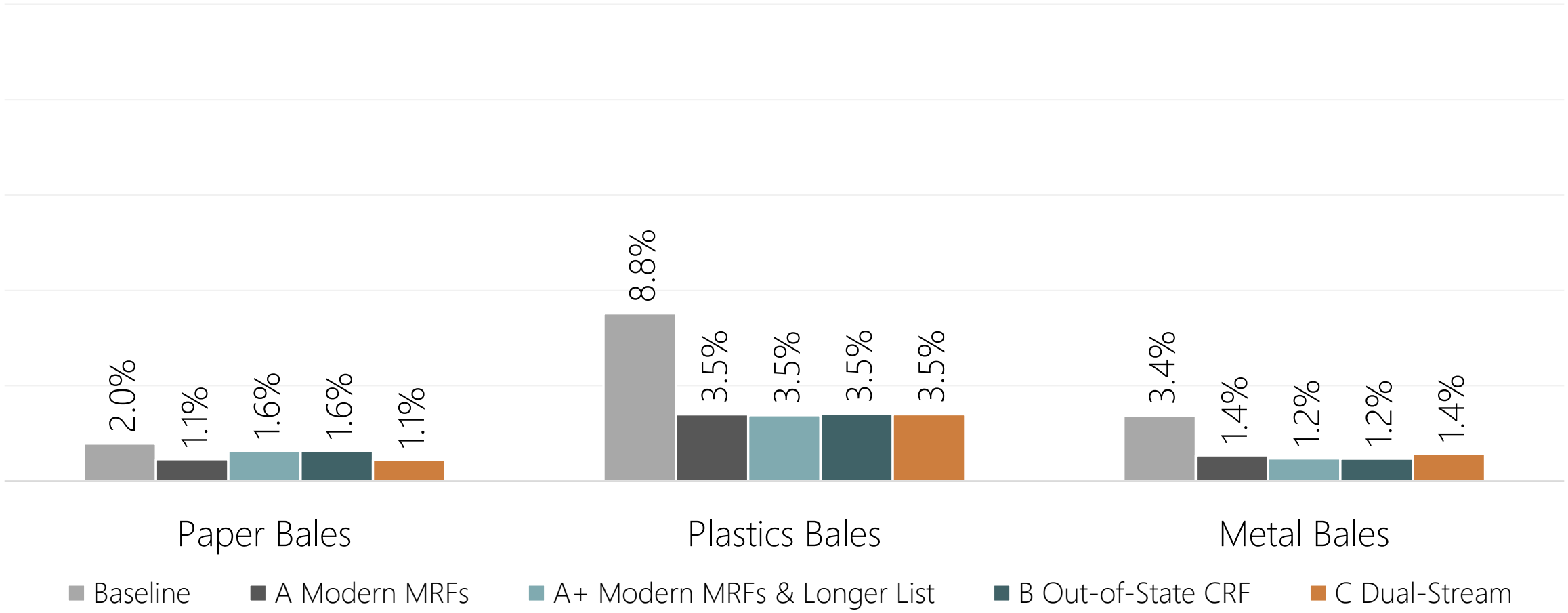
Bales Tonnages Including Contamination (thousand tons)



Outbound Bale Contamination Rates



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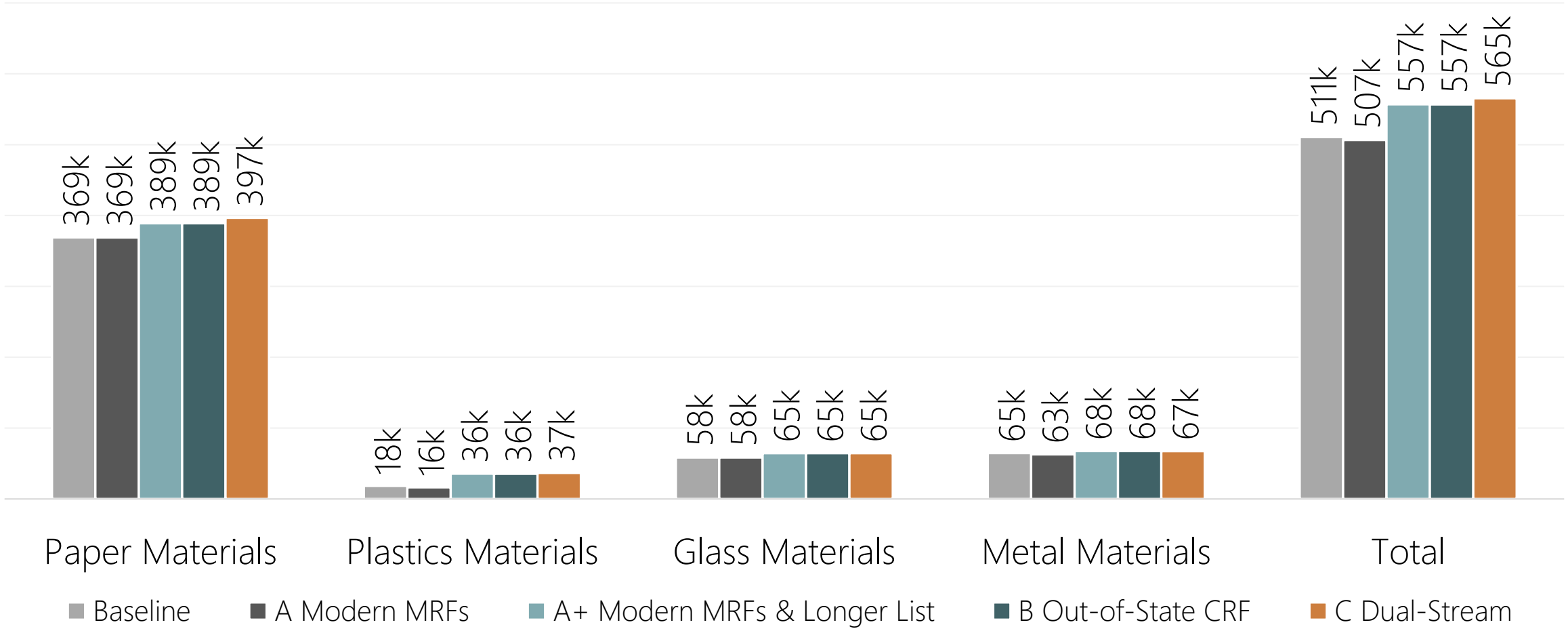
Target Materials Received by Intended Market (thousand tons)



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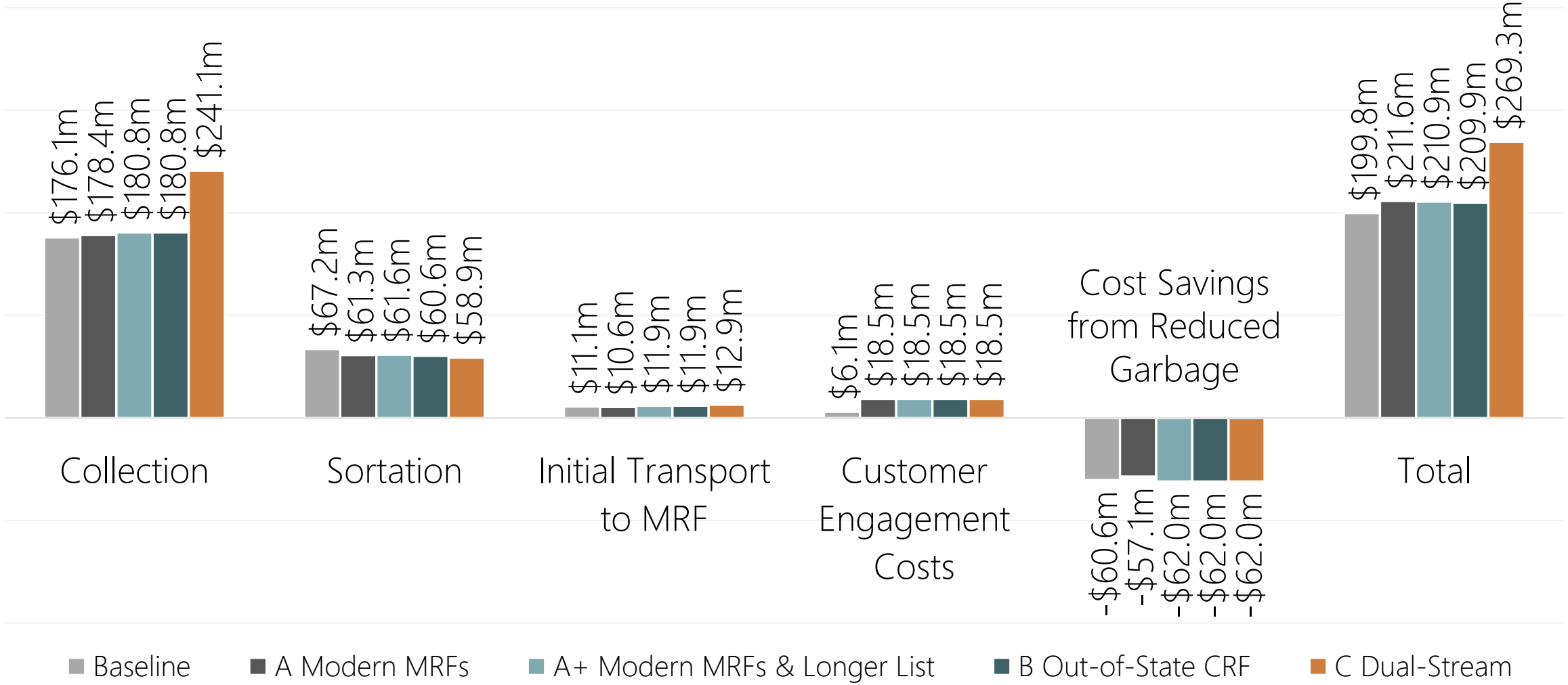
Tonnage Q&A

Overall Annualized System Costs (million 2025$)



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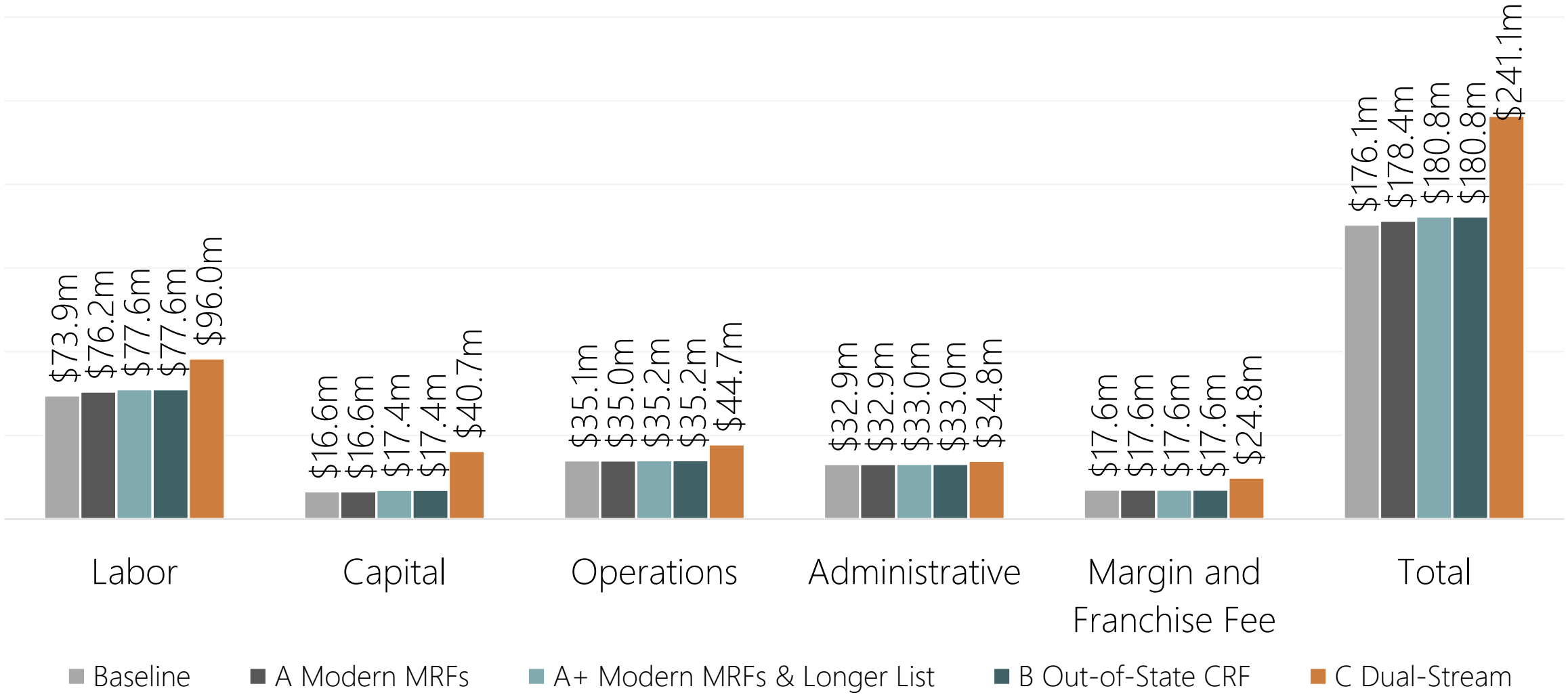
Annualized Collection Costs (million 2025$)



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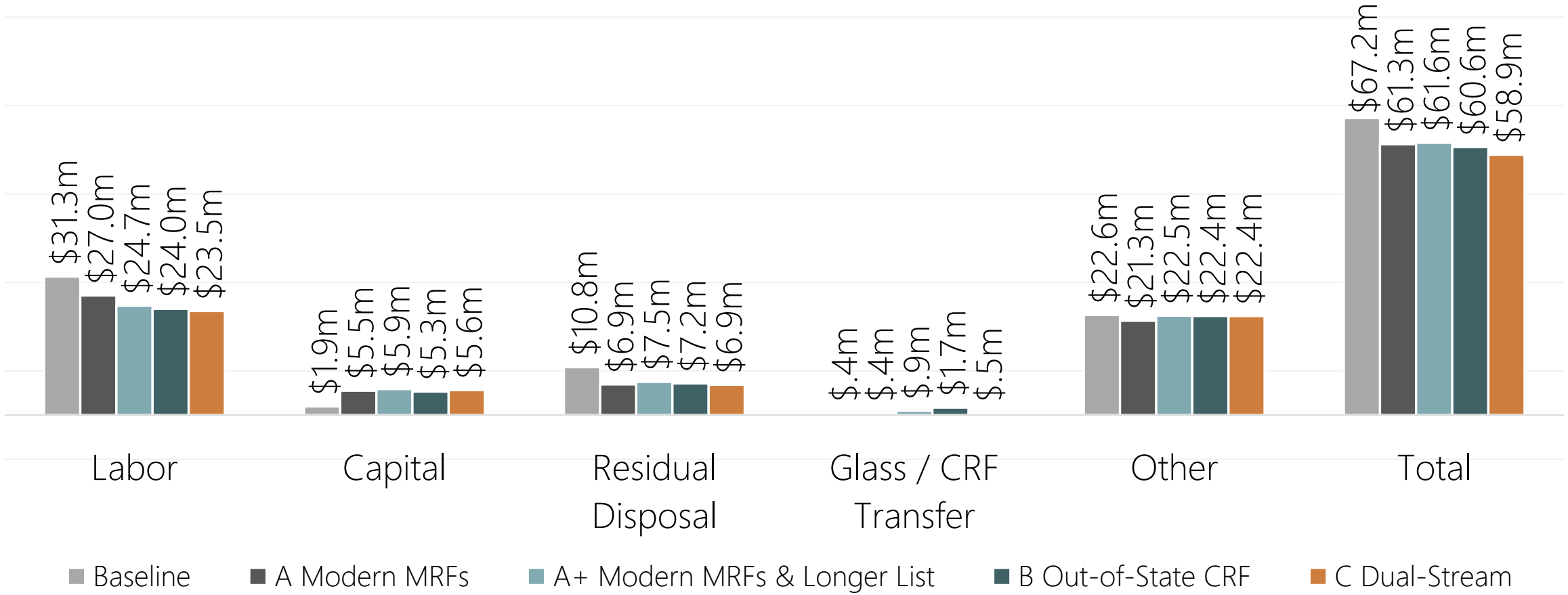
Annualized Sortation Costs (million 2025$)



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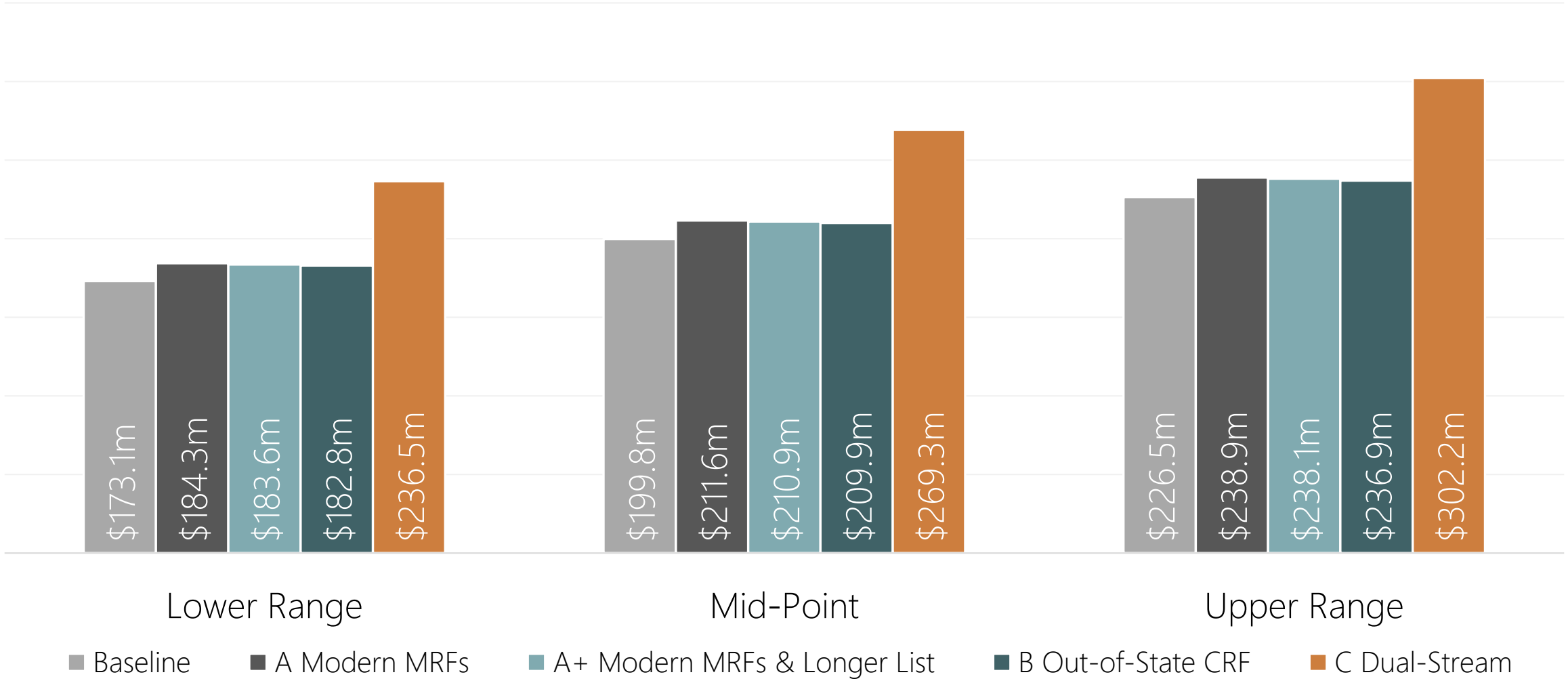
System Costs Sensitivity Analysis (million 2025$)



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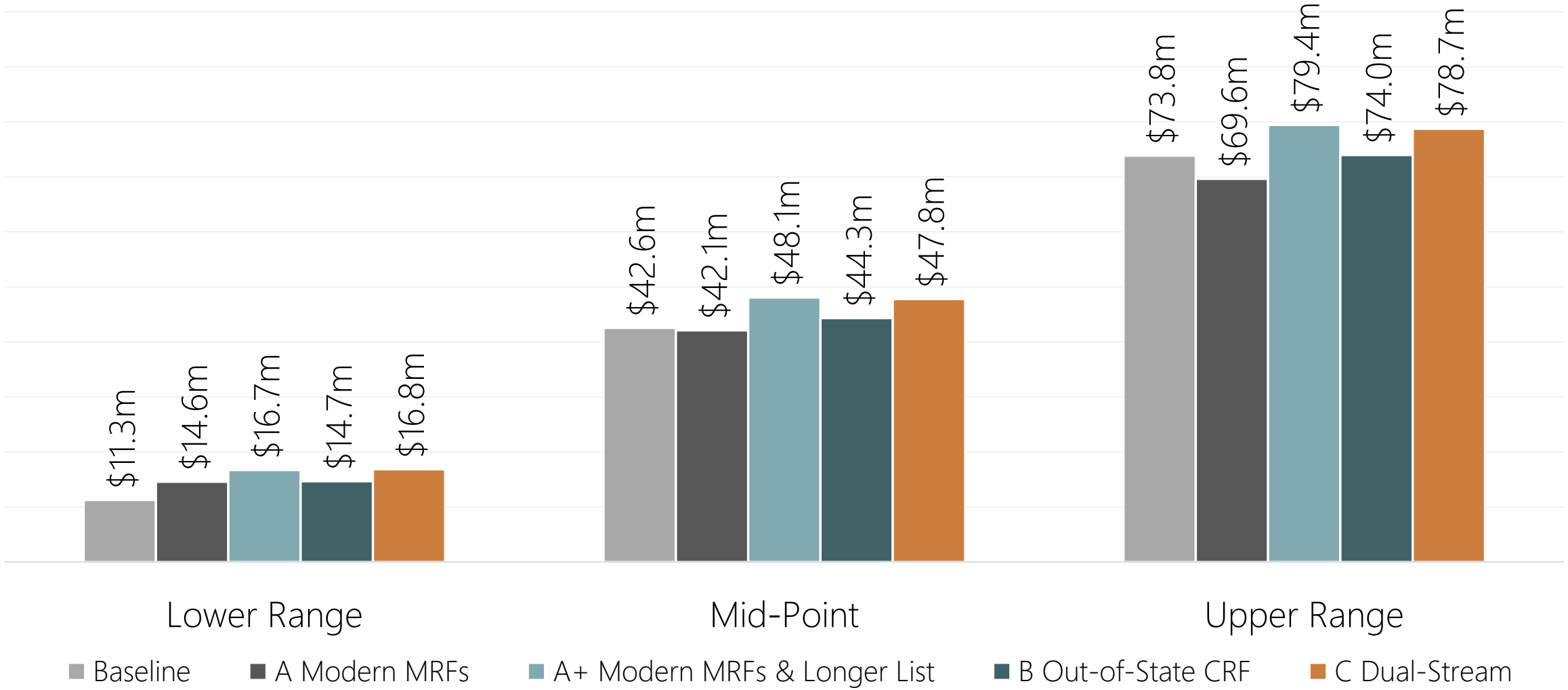
Annualized Commodity Revenues (million 2025$)



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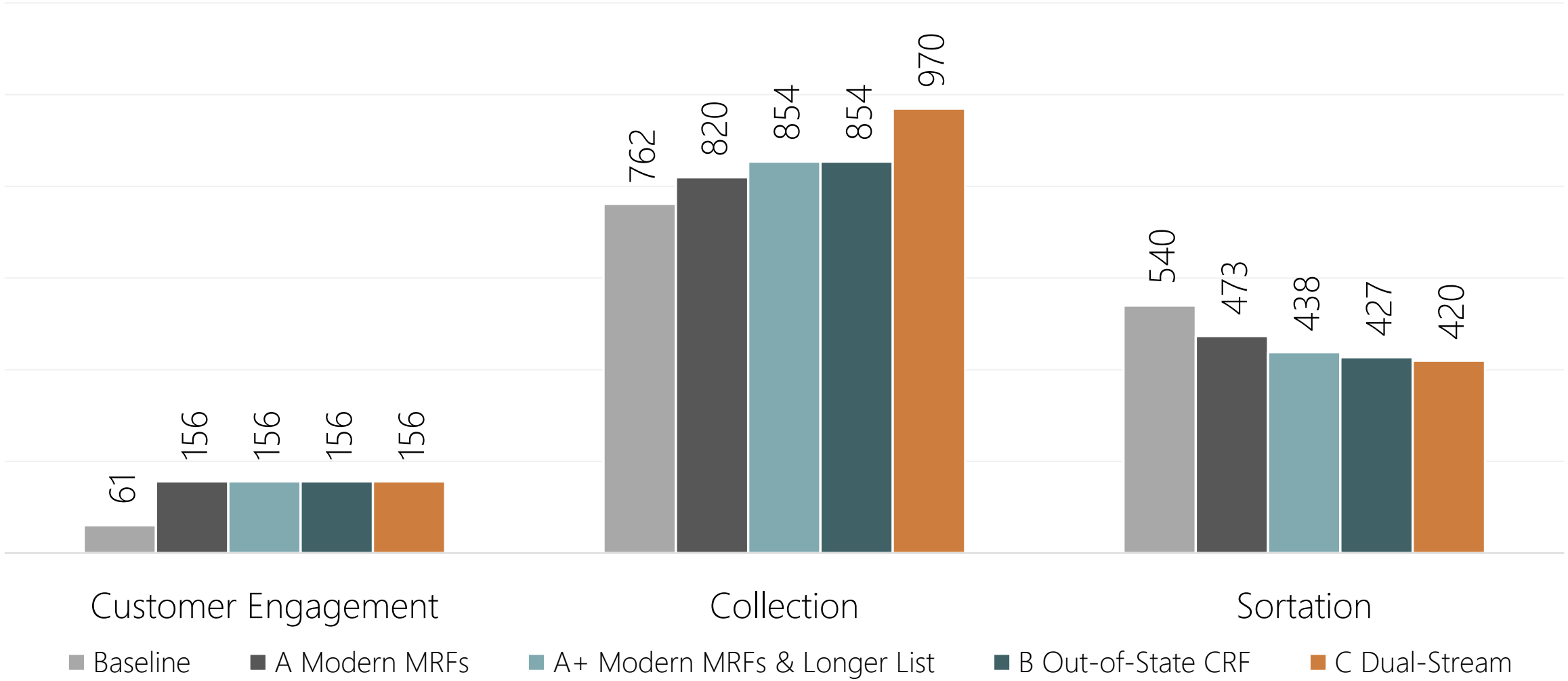
Employment (FTEs)



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Cost and Employment Q&A

Worker Safety / Working Conditions

- Wrap-resistant screens and reduced contamination reduces the dangerous task of removing tanglers
- Reduced manual sorting reduces the potential for repetitive motion injuries, needle sticks, and spread of infectious diseases

Equity

- Increased safety for remaining sort-line workers
- Materials lists expanded and standardized within geographic groupings
- Substantial increases in collection costs for customers who previously had every-other-week or less frequent collection may reduce affordability

Resiliency / Adaptability

- Increased marketability of bales:
  - Increased types and quality of fiber bales (all scenarios)
  - Reduced mixed plastics bales (Scenarios A+, B, and C)
- Risk of disruptions from concentrating container sorting into one MRF (Scenarios A+, B, and C)
  - Temporarily store containers, send to other markets (California or BC), or manually sort them

Stranded Assets

- Capital investment inputs assume that capital equipment with remaining lifespans will continue to be used

Qualitative Q&A

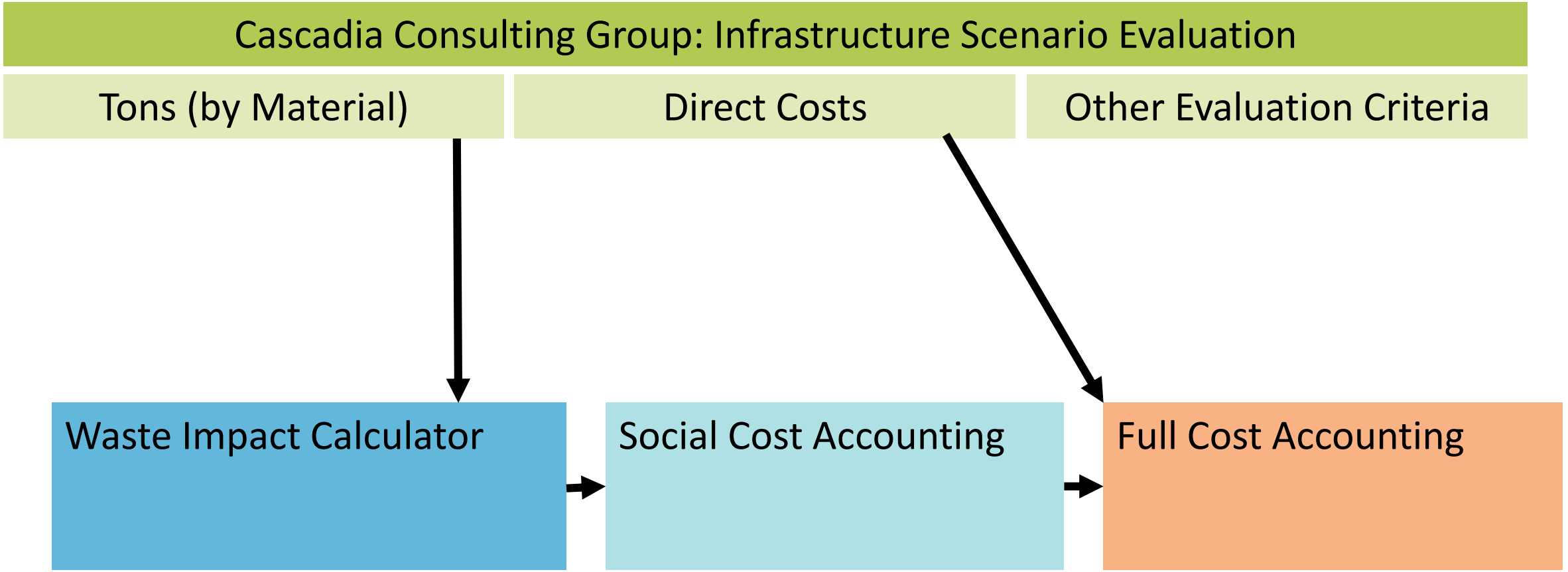
Environmental Impacts and Social Costs of Recycling

Recycling Steering Committee

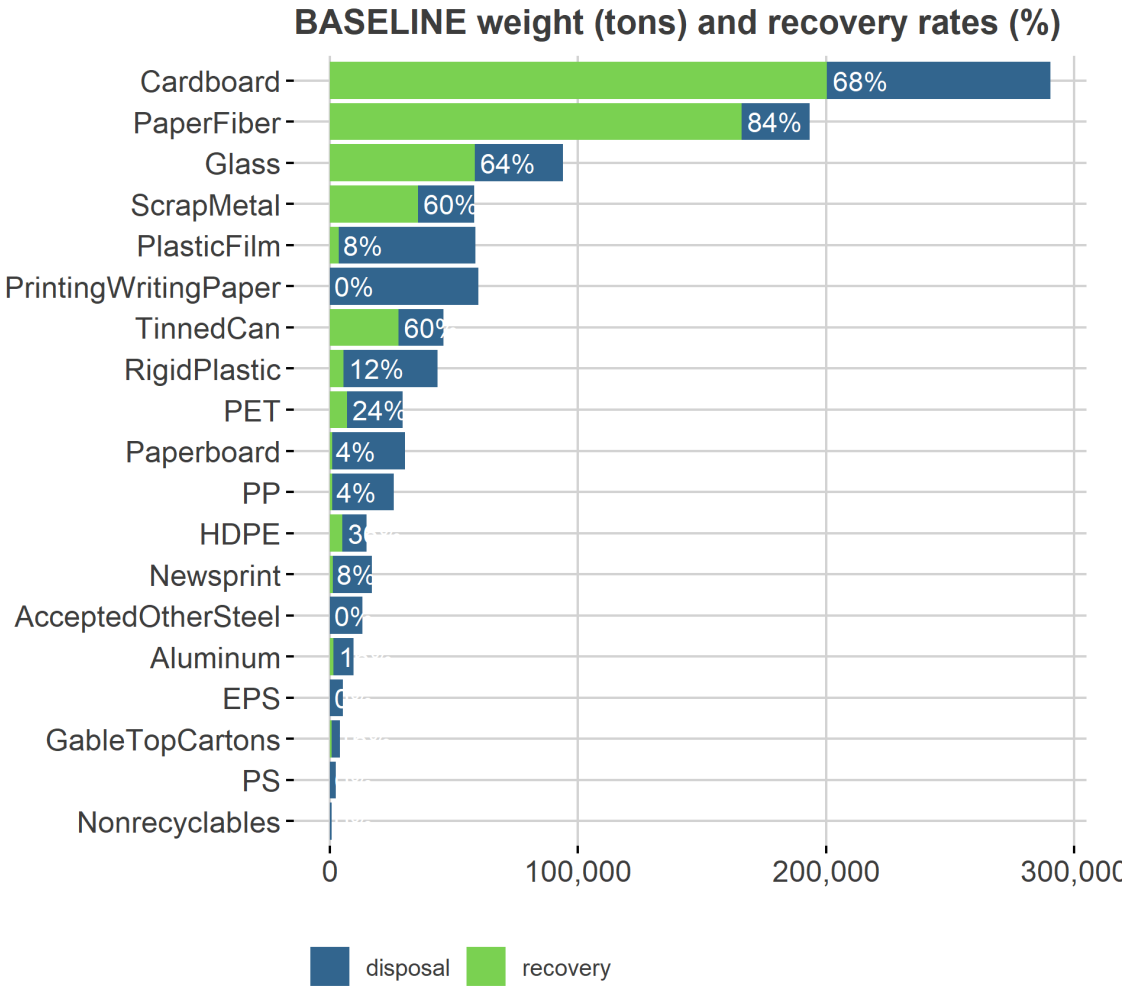
June 10, 2020

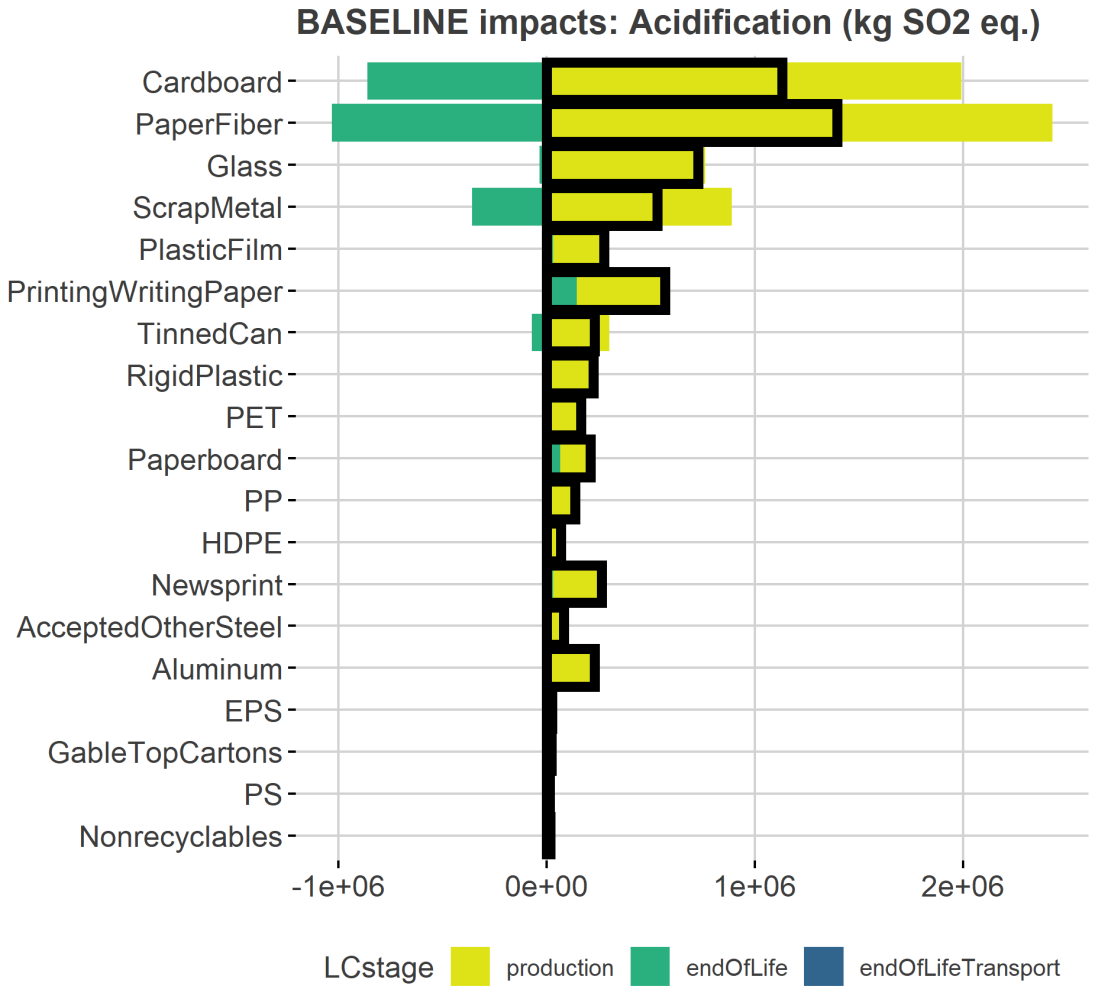
Note: All results in this presentation should be viewed as preliminary/draft.

Waste impact calculator, social cost accounting

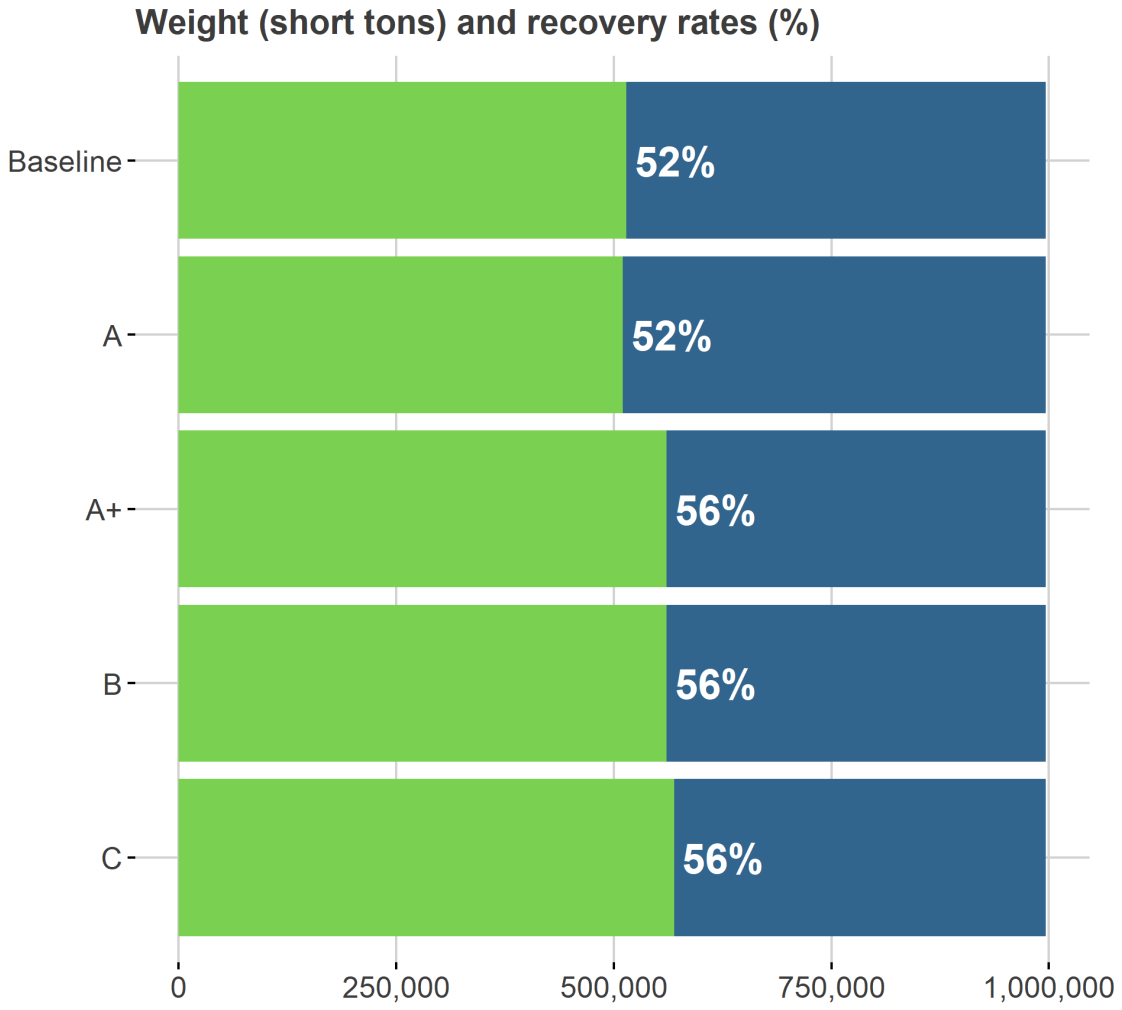


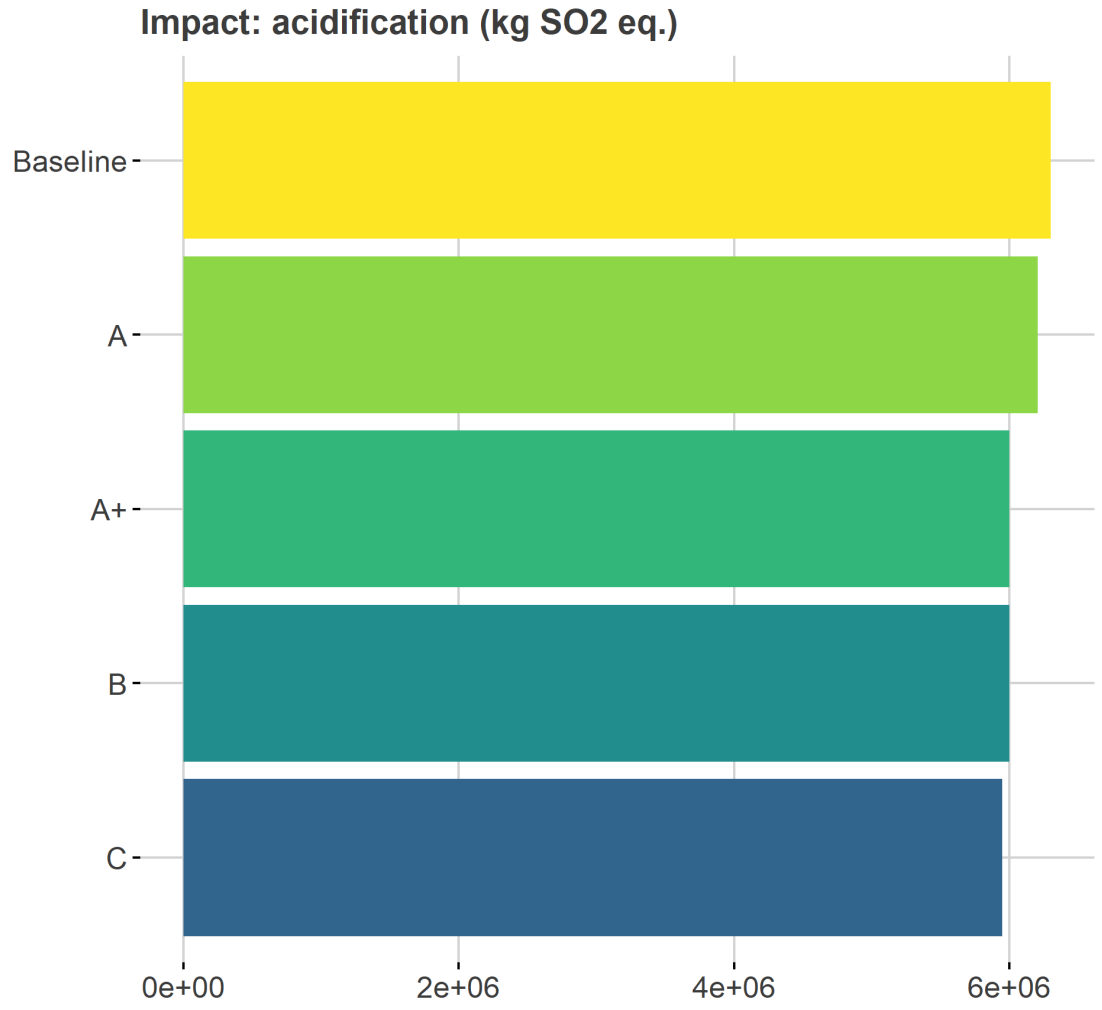
Waste Impact Calculator: from weights to impacts





Total weights and impacts for the 5 scenarios

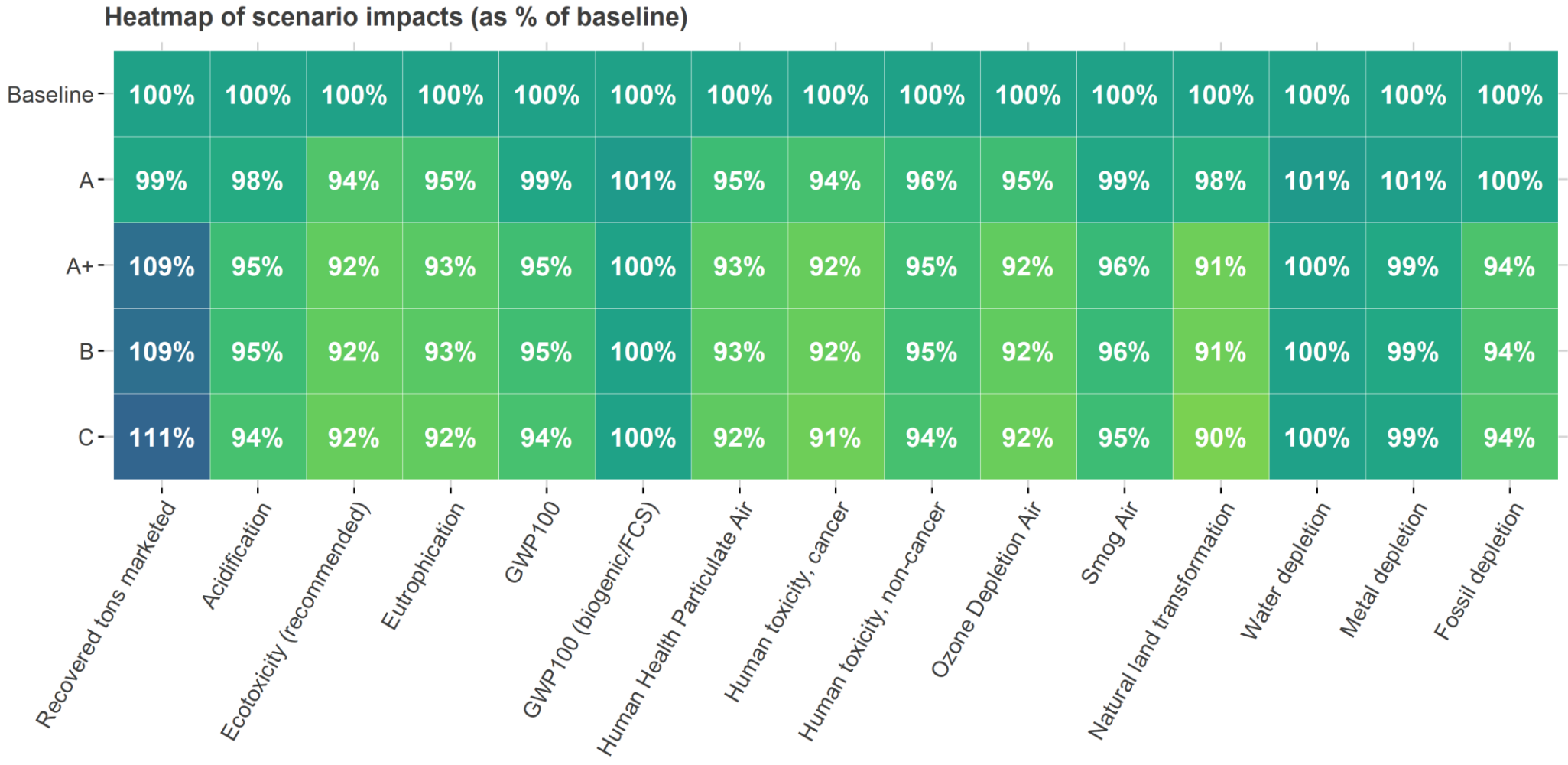




Draft impact results

Impact	Units	Baseline	Scen. A	Scen. A+	Scen. B	Scen. C
Acidification	kMT SO2 eq.	6.30	6.20	6.00	6.00	5.94
Ecotoxicity	MM CTUe	2678	2505	2470	2470	2460
Eutrophication	kMT N eq.	2.17	2.05	2.018	2.018	2.00
Global Warming (100-yr), excl. biogenic carbon (*GWP 100*)	MMT CO_2 eq.	1.57	1.56	1.49	1.49	1.48
Global Warming (100-yr), incl. biogenic (*GWP 100 (biogenic/FCS)*)	MMT CO_2 eq.	4.75	4.81	4.73	4.74	4.74
Human Health Particulate Air	kMT $PM_{2.5}$ eq.	1.00	0.95	0.93	0.93	0.93
Human toxicity, cancer	CTUh	21.5	20.3	19.7	19.7	19.6
Human toxicity, non-canc.	CTUh	373.0	358.5	354.0	354.0	352.3
Ozone Depletion	kg CFC 11 eq.	39.0	37.1	36.0	36.0	35.7
Smog	kMT O_3 eq.	81.5	80.7	78.1	78.1	77.6
Natural land transformation	k m^2-a	126.9	124.1	115.9	115.9	114.8
Water depletion	MM m^3 water	617	626	618	618	618
Metal depletion	kMT Fe eq.	305	308	302	302	304
Fossil depletion	kMT oil eq.	615	614	578	579	576

Draft impact results as a heatmap



Total cost formula

Three adjustments to compare transactional and social costs:

1. Compare marginal costs (from base case), not totals
2. Convert to constant units (2019 dollars)
3. Express results as ranges, not points

Ranges of costs (transactional)

Recycling "Worst Case"

Highest Increase in Gross Costs

Lowest Increase in Revenue

Recycling "Best Case"

Lowest Increase in Gross Costs

Highest Increase in Revenue

Year 2025 Change from Base Case, Million 2019$

	Scenario A		Scenario A+		Scenario B		Scenario C	
	Worst	Best	Worst	Best	Worst	Best	Worst	Best
Gross Transactional Cost	4.3	4.1	8.1	7.5	7.0	6.8	66.8	56.1
(Revenue)	3.9	(3.0)	(5.0)	(5.1)	0.1	(3.1)	(4.5)	(5.1)
Net Transactional Costs	8.2	1.1	3.1	2.4	7.0	3.7	62.4	51.0

Direct Environmental Costs as % of Total

	Baseline		Scenario A		Scenario A+		Scenario B		Scenario C	
	Low	High	Low	High	Low	High	Low	High	Worst	Best
Acidification	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Ecotoxicity	0.3%	0.5%	0.3%	0.5%	0.3%	0.5%	0.3%	0.5%	0.3%	0.5%
Eutrophication	2.3%	1.5%	2.3%	1.4%	2.3%	1.4%	2.3%	1.4%	2.3%	1.4%
Global Warming (100-yr), excl. biogenic carbon	9.6%		9.9%		9.7%		9.7%		9.7%	
Global Warming 100-yr), incl. biogenic carbon + forest carbon storage		34.0%		35.2%		35.3%		35.3%		35.4%
Human Health Particulate Air	29.5%	15.3%	29.1%	14.9%	29.1%	14.8%	29.1%	14.8%	29.1%	14.8%
Human toxicity, cancer	4.4%	3.2%	4.3%	3.1%	4.3%	3.1%	4.3%	3.1%	4.3%	3.1%
Human toxicity, non-canc.	46.5%	41.3%	46.4%	40.6%	46.8%	40.7%	46.8%	40.7%	46.8%	40.7%
Ozone Depletion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Smog	0.0%	0.9%	0.0%	0.9%	0.0%	0.9%	0.0%	0.9%	0.0%	0.9%
Natural land transformation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Water depletion	2.3%	1.0%	2.4%	1.0%	2.4%	1.0%	2.4%	1.0%	2.5%	1.0%
Metal depletion	0.3%	0.1%	0.4%	0.1%	0.4%	0.1%	0.4%	0.1%	0.4%	0.1%
Fossil depletion	4.7%	2.0%	4.9%	2.1%	4.7%	2.0%	4.7%	2.0%	4.7%	2.0%

Year 2025 Direct Social Costs, Change from Base Case, Million 2019$

	Scenario A		Scenario A+		Scenario B		Scenario C	
	Low	High	Low	High	Low	High	Low	High
Acidification	(0.02)	(0.05)	(0.05)	(0.15)	(0.05)	(0.15)	(0.06)	(0.17)
Ecotoxicity	(0.32)	(1.37)	(0.38)	(1.64)	(0.38)	(1.64)	(0.40)	(1.72)
Eutrophication	(2.38)	(3.53)	(3.11)	(4.62)	(3.11)	(4.62)	(3.40)	(5.06)
Global Warming (100-yr)	7.00	(3.73)	(0.96)	(24.75)	(0.94)	(24.72)	(0.52)	(27.66)
Human Health Particulate Air	(26.33)	(31.78)	(39.51)	(47.70)	(39.50)	(47.68)	(42.14)	(50.87)
Human toxicity, cancer	(4.58)	(7.81)	(6.74)	(11.51)	(6.74)	(11.51)	(7.20)	(12.30)
Human toxicity, non-canc.	(33.69)	(69.49)	(44.34)	(91.45)	(44.30)	(91.37)	(48.12)	(99.25)
Ozone Depletion	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Smog	(0.00)	(0.39)	(0.02)	(1.65)	(0.02)	(1.65)	(0.02)	(1.87)
Natural land transformation	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Water depletion	0.65	0.65	0.06	0.06	0.06	0.06	0.07	0.07
Metal depletion	0.04	0.04	(0.07)	(0.07)	(0.07)	(0.07)	(0.04)	(0.04)
Fossil depletion	(0.26)	(0.26)	(5.31)	(5.31)	(5.29)	(5.29)	(5.71)	(5.71)
Total	**(59.89)**	**(117.73)**	**(100.43)**	**(188.79)**	**(100.34)**	**(188.64)**	**(107.54)**	**(204.57)**

Ranges of costs (total)

Recycling "Worst Case"

Highest Increase in Gross Costs

−

Lowest Increase in Revenue

+

Lowest Increase in Social Benefit

Recycling "Best Case"

Lowest Increase in Gross Costs

−

Highest Increase in Revenue

+

Highest Increase in Social Benefit

Year 2025 Change from Base Case, Million 2019$

	Scenario A		Scenario A+		Scenario B		Scenario C	
	Worst	Best	Worst	Best	Worst	Best	Worst	Best
Net Transactional Costs	8.2	1.1	3.1	2.4	7.0	3.7	62.4	51.0
Direct Social Costs/(Benefits)	(59.9)	(117.7)	(100.4)	(188.8)	(100.3)	(188.6)	(107.6)	(204.6)
Net Transactional Costs + Direct Social Costs	(51.7)	(116.7)	(97.4)	(186.4)	(93.3)	(185.0)	(45.2)	(153.6)

Indirect environmental costs

David Allaway and Martin Brown | Oregon Department of Environmental Quality

Year 2025 Change from Base Case, Million 2019$

	Scenario A		Scenario A+		Scenario B		Scenario C	
	Worst	Best	Worst	Best	Worst	Best	Worst	Best
Net Transactional Costs	8.2	1.1	3.1	2.4	7.0	3.7	62.4	51.0
Direct Social Costs/(Benefits)	(59.9)	(117.7)	(100.4)	(188.8)	(100.3)	(188.6)	(107.6)	(204.6)
Indirect Social Costs/(Benefits)	(3.4)	(1.0)	(1.3)	(2.4)	(3.0)	(3.7)	(26.6)	(51.7)
Total Costs	(55.1)	(117.7)	(98.7)	(188.8)	(96.3)	(188.7)	(71.8)	(205.3)

The benefits – and limitations – of recycling

1. More recycling would be beneficial
2. Recycling alone is not sufficient to achieve Oregon's *2050 Vision*
3. Recycling isn't the most important action we can take

These three statements are not inconsistent with each other!

The charter of Oregon's Recycling Steering Committee is to modernize Oregon's recycling system.

Thank you

Questions?