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RECYCLING SYSTEM COST TRENDS

NATIONAL ACADEMIES OF SCIENCE, ENGINEERING, AND MEDICINE
COMMITTEE ON MSW RECYCLING
APRIL 16, 2024

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AGENDA

1. DISCLAIMER- PRESENTATION TO SET UP CONVERSATION
2. THE U.S. RECYCLING SYSTEM-WHAT WE ARE DEALING WITH- COMPLEXITIES
3. COST CONSIDERATIONS
4. PRICE TRENDS
6. DISCUSSION

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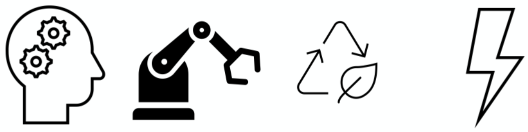
MACRO TRENDS AFFECTING RECYCLING SYSTEM
OPPORTUNITIES AND THREATS



AI

Automation

Environmental Issues

Electrification

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THE THREE SINS OF POST-CONSUMER RECYCLING
OVER 90% OF PROGRAMS

- Non-mandatory in over 80% of programs
- Low Enforcement, Education, Feedback
- Passive Management of performance metrics in the Public Sector

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SINGLE STREAM SERVICE OF RECYCLING —ROCKY GOALS

COLLECTION	SORTING	MARKET

COLLECTION — Evolved to Compete with Solid Waste Convenience
- Simple and convenient
- Permissive (Too Much)
- More items recycled
- More Participation/Diversion
- More Tons = more GHG's
- More Tons = More residue
- Lower Quality

SORTING — Cleans river of mixed materials into commodities
- More material types
- More complicated layouts
- More capital and scale
- More downtime/downtime
- Greater technology sophistication
- Higher technology velocity

MARKET — System Recovers ~75-80% of inbound material/ No inventory control
- Higher price than virgin
- Competition with clean virgin materials
- Food contact conflicts (mechanical recycling)
- Uncertain market demand at reasonable pricing

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LIMITS TO POST CONSUMER RECYCLING WITHIN COMMUNITIES
MODES OF COLLECTION VARY BY HOUSING TYPE AND ACTIVITY

Single-Family Homes:
68% of US households

2-4 Unit Buildings
8% of US households

Typically included in municipal curbside collection systems

5+ Unit Buildings
18% of US households

Mobile Homes or Other Housing Types
6% of US households

AFH, gatherings

Frequently excluded from municipal recycling system

Source: U.S. Census Bureau, 2019 American Community Survey 1-Year Estimates

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LIMITS TO MATERIAL INPUTS FOR MRF
EACH NEW OR MARGINAL MATERIAL

- Compatibility with Flow
  - -2d vs. 3d
  - -Discovery
- Efficient Means of sorting
- Baling time and other shared time activities
- Storage
- Target material yield and market (FOLI)

- **Smalls**
- **Flexible packaging and film**
- **Pods**
- **Clamshells**
- **Hybrids/polymaterial**

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MRF CONFUSION WITH SCRAP BUSINESS MODEL

Scrap Business	MRF Cleaning Service
Materials Market	Convenience for residential customers
Buys source separated. Only sorts (upgrades) for price advantage; often receives premiums on the spot market in an arbitrage position	Accepts mixed materials & sorts to clean materials to minimum standards • Define standards • Acceptable Materials • Non-recyclables • Measurements and formulas
Little residue	Expected residue (now 18%) increases with permissiveness • Responsibility and enforcement
Uses spot market purchases to regulate risk from contracts	Takes material regardless of ability to sell or price • Lessen material risk by insuring services is paid for first

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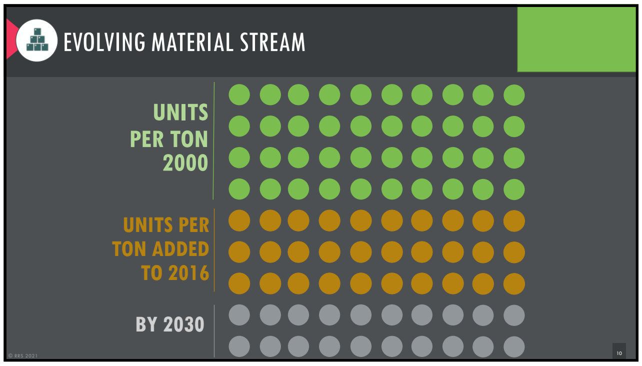
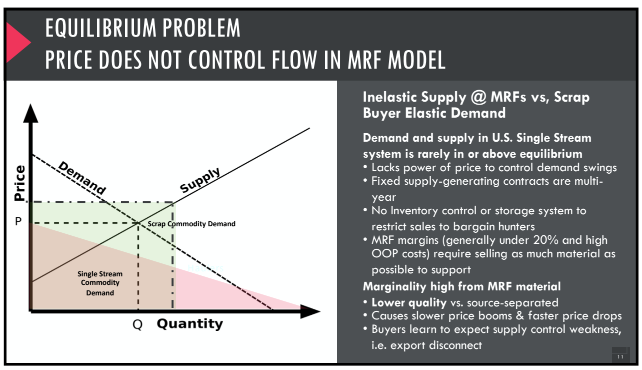

EVOLVING MATERIAL STREAM
UNITS PER TON 2000
UNITS PER TON ADDED TO 2016
BY 2030
10

10


EQUILIBRIUM PROBLEM
PRICE DOES NOT CONTROL FLOW IN MRF MODEL
Price
P
Demand
Supply
Scrap Commodity Demand
Single Stream Commodity Demand
Q
Quantity
Inelastic Supply @ MRFs vs, Scrap Buyer Elastic Demand
Demand and supply in U.S. Single Stream system is rarely in or above equilibrium
• Lacks power of price to control demand swings
• Fixed supply-generating contracts are multi-year
• No Inventory control or storage system to restrict sales to bargain hunters
• MRF margins (generally under 20% and high OOP costs) require selling as much material as possible to support
Marginality high from MRF material
• Lower quality vs. source-separated
• Causes slower price booms & faster price drops
• Buyers learn to expect supply control weakness, i.e. export disconnect
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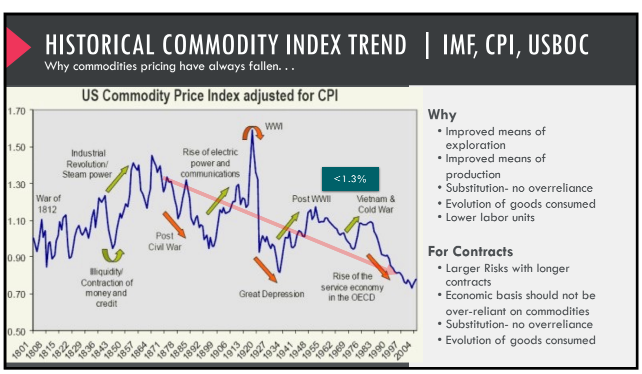
HISTORICAL COMMODITY INDEX TREND | IMF, CPI, USBOC
Why commodities pricing have always fallen. . .
US Commodity Price Index adjusted for CPI
1.70
1.50
1.30
1.10
0.90
0.70
0.50
War of 1812
Industrial Revolution/ Steam power
Illiquidity/ Contraction of money and credit
Post Civil War
Rise of electric power and communications
WWI
Great Depression
Post WWII
<1.3%
Vietnam & Cold War
Rise of the service economy in the OECD
1801 1808 1815 1822 1829 1836 1843 1850 1857 1864 1871 1878 1885 1892 1899 1906 1913 1920 1927 1934 1941 1948 1955 1962 1969 1976 1983 1990 1997 2004
Why
• Improved means of exploration
• Improved means of production
• Substitution- no overreliance
• Evolution of goods consumed
• Lower labor units
For Contracts
• Larger Risks with longer contracts
• Economic basis should not be over-reliant on commodities
• Substitution- no overreliance
• Evolution of goods consumed

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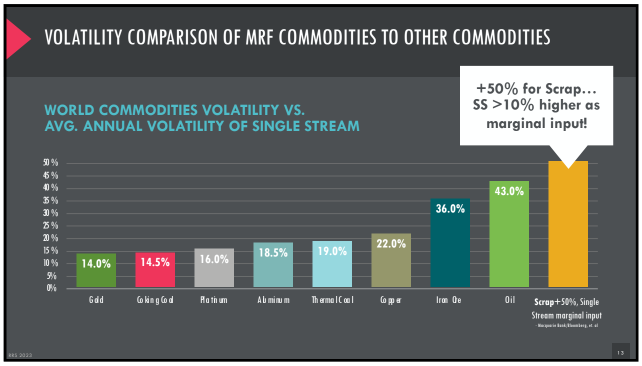
VOLATILITY COMPARISON OF MRF COMMODITIES TO OTHER COMMODITIES
WORLD COMMODITIES VOLATILITY VS.
AVG. ANNUAL VOLATILITY OF SINGLE STREAM
+50% for Scrap…
SS >10% higher as
marginal input!
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
14.0%
14.5%
16.0%
18.5%
19.0%
22.0%
36.0%
43.0%
Gold
Coking Coal
Platinum
Aluminum
Thermal Coal
Copper
Iron Ore
Oil
Scrap+50%, Single Stream marginal input
- Macquarie Bank/Bloomberg, et. al
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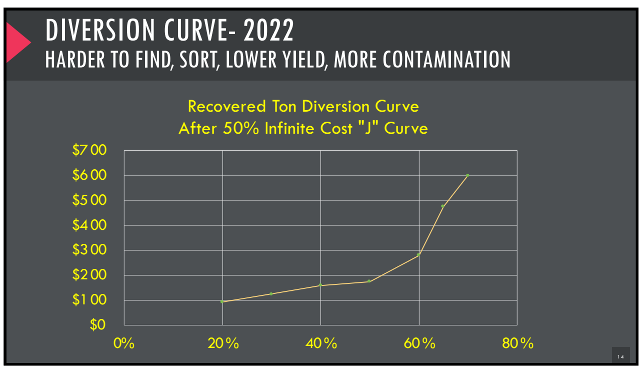
DIVERSION CURVE- 2022
HARDER TO FIND, SORT, LOWER YIELD, MORE CONTAMINATION
Recovered Ton Diversion Curve
After 50% Infinite Cost "J" Curve
$700
$600
$500
$400
$300
$200
$100
$0
0%
20%
40%
60%
80%

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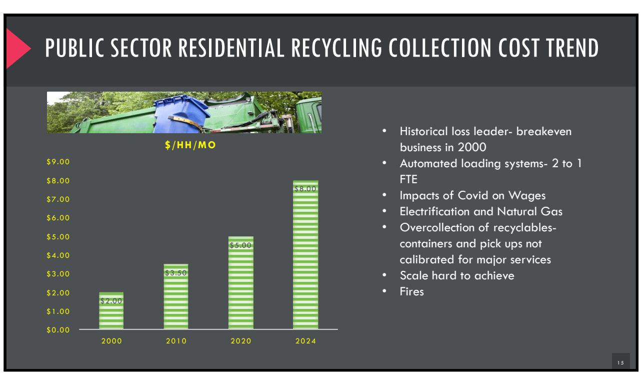
PUBLIC SECTOR RESIDENTIAL RECYCLING COLLECTION COST TREND
$/HH/MO
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$2.00
$3.50
$5.00
$8.00
2000
2010
2020
2024
• Historical loss leader- breakeven business in 2000
• Automated loading systems- 2 to 1 FTE
• Impacts of Covid on Wages
• Electrification and Natural Gas
• Overcollection of recyclables- containers and pick ups not calibrated for major services
• Scale hard to achieve
• Fires

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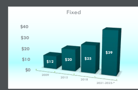
MRF COSTS
COVID LABOR SHORTAGES LEAD TO MASSIVE FLEET RETROFIT/REPLACE- $2.3B

DECADE TRENDS
- **Hub and Spoke, large volume, +40TPH, Automation**
- RIF >50% of manual labor
- Professional management, maintenance, & safety
- Pressure/capital from brands & CPGs
- Increasing contamination

U.S. MATERIAL RECOVERY FACILITY Inbound Processing $/Ton- *					
COST CATEGORY-*	2009	2015	2018	2021-2023-*	Change from 2015
Fixed	$12.00	$20.00	$25.00	$39.00	108%
O&M	$46.00	$54.00	$60.00	$43.00	30%
Residue	$4.00	$8.00	$9.80	$13.00	145%
TOTAL	**$62.00**	**$82.00**	**$94.80**	**$95.00**	**53%**

*-Avg. typical Facilities- from RRS work & research (+- 20%)



FIXED COST
- Tripled Since 2008
- Larger footprint
- More peripheries & technology
- Higher speeds
- Retrofits

O&M
- Investment unprecedented- `$2B over 5-years
- Costs dropping with automation

RESIDUE
- Impact of China-tighter quality standards
- No Education in most programs "Wish" Cycling; recycling messages

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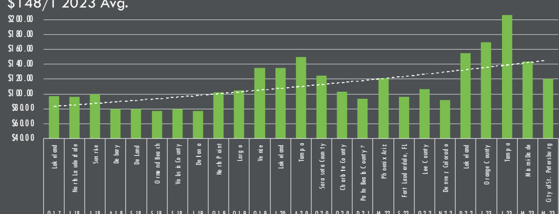
MRF PRICING
PROCESSING FEE RATE TREND: JULY 2023, FLORIDA & COMPARATIVES

JULY 5, 2023. PROCESSING FEE RATE TREND
$148/T 2023 Avg.



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REVENUE SHARE RATE TREND- TYPICAL NEW CONTRACTS PUBLIC COMPANIES
PUBLIC INFORMATION LIMITED

Year	HAULER REVENE SHARE (COST OFFSET)	MUNICIPALITY REVENUE SHARE
1995	80%	20%
2000	75%	25%
2015	50%	50%
2020	30%	70%
2024	20%	80%

- Annuity-based garbage business cannot afford volatility
- Municipalities stuck with majority of offtake

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PRIVATE MRFS ARE LONG-TERM INVESTMENT GRADE
RRS MODEL ESTIMATE $/T

Estimated 2023	
Average Processing Fee New SS Contracts	$ 128.00
20% Revenue Share	$ 14.60
Cost Average Fleet	$ 95.00
Gross Margin	$ 47.60
Required ROI @ 15% Typical CAPEX	$ 33.45
Excess Profit	$ 14.15

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MRF MARKET PRICE AND BEHAVIOR:
HOW IMPORTANT ARE MRF COMMODITIES?

- Recovery from commodities now less than ½ to 1/3 of Process Fee.
- Hub and spoke brings scarce competition, is it time to resurrect the public MRF?
  - ISP domination and consolidation
  - National firms demand recovery from poor contracts with no competition
- Decoupled from LF savings in cost in most new contracts
- Municipal program shut down rate expands in last two years

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