IDENTIFYING WHAT MAKES SENSE TO RECYCLE? AND WHAT ABOUT QUALITY?

Processing Cost Analysis, Adding Materials, & The Issue of Contamination

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1

INTRODUCTION

- ☐ Deciding whether to add materials to the MRF
  - ■ Politics
  - ■ Economics ←
- ☐ How we evaluated the issue
- ☐ Look at current / traditional materials & conclusions
- ☐ Review results for addition of a new material
- ☐ Dealing with the Quality / Contamination Issue

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BUILDING UP THE MODEL

- Economists - SERA model builds up processing costs based on:
  - Equipment – choices of lifetimes, financing costs
  - Labor by position – choice of labor rates
  - Fixed costs / Overhead
  - Materials in/out
  - Map specific materials to equipment & labor
- Other settings
  - Revenue options – low / medium / high by material
  - Disposal fee
  - Waste Composition
  - Efficiency / recovery rates
- Annual costs, average costs, total costs, marginal costs per ton and overall
- Net revenue per ton by material and overall
- 6 plant sizes

Very Small (4.8KTPY)	Medium (42KTPY)
Manual Small (6KTPY)	Large (72KTPY)
Small automated (20K)	Mega (144KTPY)

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RESULTS FOR TRADITIONAL MATERIALS

☐ Profit per ton of commodities processed – conclusions

■ Underlying assumptions (revenue, labor cost, disposal, waste comp, yrs…)

☐ Traditional mix includes materials with costs > revenues (Mixed paper, 3-7 plastics, aseptic, glass) – not just glass

☐ Why are they included?

Profit Per Ton Of Commodities Processed														
	Alum-inum	Ferrous	OCC	ONP	ONP #2	Mix Paper	HDPE Colored	HDPE Natural	PET	3 - 7 Plastics	PP	Aseptic	Glass Mixes	Thous TPY
Profit per Ton - MEDIUM Prices														
Very Small			$71											4.8
Manual Small	$571	-$262		-$33		-$52	$329	$159						6.0
Small	$1,411	$52	$45	$36	$29	$1	$279	$404	$327					20.0
Medium	$1,462	$86	$92	$57	$53	-$23	$376	$348	$395			-$104	-$53	42.0
Large	$1,471	$90	$93	$54	$51	$1	$412	$381	$401	-$92	$87	-$95	-$39	72.0
Mega	$1,471	$91	$98	$58	$55	$0	$411	$357	$401	-$87	$85	-$100	-$39	144.0

$32 labor

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RESULTS FOR TRADITIONAL MATERIALS

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  - ■ Underlying assumptions (revenue, labor cost, disposal, waste comp, yrs…)
- ☐ Traditional mix includes materials with costs > revenues (Mixed paper, 3-7 plastics, aseptic, glass) – not just glass
- ☐ Why are they included?

Profit Per Ton Of Commodities Processed	Alum-inum	Ferrous	OCC	ONP	ONP #2	Mix Paper	HDPE Colored	HDPE Natural	PET	3 - 7 Plastics	PP	Aseptic	Glass Mixes	Thous TPY
Profit per Ton - MEDIUM Prices														
Very Small			$37											4.8
Manual Small	$72	-$465		-$84			-$308	$289	$33					6.0
Small	$1,395	$36	$7	$17	$10	-$15	$198	$387	$284					20.0
Medium	$1,453	$77	$73	$47	$43	-$58	$337	$300	$386			-$217	-$60	42.0
Large	$1,463	$82	$74	$43	$41	-$7	$405	$351	$393	-$99	$79	-$163	-$44	72.0
Mega	$1,465	$85	$83	$49	$46	-$6	$406	$329	$396	-$93	$80	-$166	-$43	144.0

$55 labor

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Profit Per Ton Of Commodities Processed

	Aluminum	Ferrous	OCC	ONP	ONP #2	Mix Paper	HDPE Colored	HDPE Natural	PET	3 - 7 Plastics	PP	Aseptic	Glass Mixes
Profit per Ton - MEDIUM Prices													
Very Small			$71										
Manual Small	$571	-$262		-$33			-$52	$329	$159				
Small	$1,411	$52	$45	$36	$29	$1	$279	$404	$327				
Medium	$1,462	$86	$92	$57	$53	-$23	$376	$348	$395			-$104	-$53
Large	$1,471	$90	$93	$54	$51	$1	$412	$381	$401	-$92	$87	-$95	-$39
Mega	$1,471	$91	$98	$58	$55	$0	$411	$357	$401	-$87	$85	-$100	-$39
Profit per Ton - LOW Prices													
Very Small			$49										
Manual Small	$296	-$301		-$44			-$261	$561	-$58				
Small	$1,136	$12	$23	$25	$18	-$8	$69	$636	$110				
Medium	$1,187	$47	$70	$46	$42	-$32	$167	$580	$178			-$135	-$82
Large	$1,196	$50	$71	$43	$40	-$8	$203	$613	$184	-$98	$38	-$126	-$68
Mega	$1,196	$51	$76	$46	$44	-$9	$201	$589	$185	-$93	$36	-$131	-$68
Profit per Ton - HIGH Prices													
Very Small			$103										
Manual Small	$1,096	-$251		-$26			$179	$989	$562				
Small	$1,936	$62	$77	$44	$36	$13	$509	$1,064	$730				
Medium	$1,987	$97	$124	$64	$60	-$11	$607	$1,008	$798			-$80	-$42
Large	$1,996	$100	$125	$61	$58	$12	$643	$1,041	$804	-$73	$208	-$71	-$28
Mega	$1,996	$101	$130	$65	$62	$12	$641	$1,017	$805	-$68	$206	-$76	-$28
Assumptions:													
Medium Prices	$1,515	$120	$147	$85	$85	$53	$470	$460	$437	$6	$249	$91	-$11
Low Prices	$1,240	$80	$125	$74	$74	$44	$260	$692	$220	$0	$200	$60	-$40
High Prices	$2,040	$130	$179	$92	$92	$64	$700	$1,120	$840	$25	$370	$115	$0

RESULTS FOR TRADITIONAL MATERIALS – WHY INCLUDE "LOSERS"?

☐ Net revenue for **a** material does not have to be positive for plant to benefit.
  - ■ Looking at individual materials does not tell the story

☐ If **(marginal) revenue per ton exceeds MARGINAL** cost per ton:
  - ■ ➔Contributing SOMETHING toward fixed costs of plant / operations
  - ■ Improves profitability for plant
  - ■ Improves profitability for other materials that use some of that shared equipment / labor

☐ Larger vs. smaller plants
  - ■ With more materials running through the plant, you can process more material types

☐ Decision more complicated than material by material

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ADDING A NEW MATERIAL

- What about adding a new material?

→ Name an "unpopular" one?

- Steps to model:
  - Add new material to list, check waste comp
  - Assumptions about recovery rates, and equipment / labor needed to run it
  - Sort into new vs. added – stations, equipment, staff, etc.
  - Some shared with other materials; some may be dedicated. Needs to cover full cost of dedicated…

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ADDING A NEW MATERIAL – STYROFOAM RESULTS

- Two streams and two processing systems
  - Foam only vs. All PS
  - Manual sort PS / densifier (M1) vs. Optical sorter / baler (M2)
- Net profit for most at low wage rate except low prices.
  - Only at high prices for high labor rate. wages)- prices are critical

Right table:

	PS Only - Model	PS Only - Model	All PS, Model 2	Model 2 with grant	Thous TPY
Profit per Ton - MEDIUM Prices					
Small	-$36	-$36			20.0
Medium	$11	$11			42.0
Large	$28	$28	$30	$30	72.0
Mega	$40	$40	$64	$64	144.0
Profit per Ton - LOW Prices					
Small	-$96	-$96			
Medium	-$49	-$49			
Large	-$32	-$32	-$30	-$30	
Mega	-$20	-$20	$4	$4	
Profit per Ton - HIGH Prices					
Small	$104	$104			
Medium	$151	$151			
Large	$168	$168	$170	$170	
Mega	$180	$180	$204	$204	
Assumptions:					
Medium Prices	$160	$160	$160	$160	
Low Prices	$100	$100	$100	$100	
High Prices	$300	$300	$300	$300	

Bottom-left table:

	PS Only - Model	PS Only - Model	All PS, Model 2	Model 2 with grant
Profit per Ton - MEDIUM Prices				
Small	-$133	-$133		
Medium	-$72	-$72		
Large	-$43	-$43	-$38	-$38
Mega	-$20	-$20	$28	$28
Profit per Ton - LOW Prices				
Small	-$193	-$193		
Medium	-$132	-$132		
Large	-$103	-$103	-$98	-$98
Mega	-$80	-$80	-$32	-$32
Profit per Ton - HIGH Prices				
Small	$7	$7		
Medium	$68	$68		
Large	$97	$97	$102	$102
Mega	$120	$120	$168	$168

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STYROFOAM RESULTS – EFFECT ON OTHER MATERIALS

☐ Even in scenarios with negative individual net profit:

- Reduces allocated processing costs for each other traditional material by $2 - $5 per ton
- Increases overall plant profitability
- **Avoid CREAM-SKIMMING (e.g. energy weatherization)**

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OTHER RESULTS AND INFLUENCING FACTORS

- Translating model results to other locations:
  - Waste composition (bottle bill / not, urban/rural), etc.
  - Disposal costs
  - Capture rate / recovery percentage

- Other system considerations
  - Collection largely limited by weight – not an issue for PS
  - Might be for other materials (separate collection model)

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Figure 3.8: Changes in Savings from Avoided Disposal with Changes in Tipping Fees (bas was $40/ton)

		SAVINGS RELATED TO AVOIDED DISPOSAL TIP FEES						
		For each ton through plant at capture level, Cost PER TON AVOIDED DISPOSAL ADDER						
		NOTE: Blue percent is the capture level, or overall percent of recoverables successfully processed & sent to market; '(1-blue percent)' is the residual rate.						
	Tip==>	$10	$25	$40	$55	$70	$85	$100
Blue is	95%	$9.50	$23.75	$38.00	$52.25	$66.50	$80.75	$95.00
percent	90%	$9.00	$22.50	$36.00	$49.50	$63.00	$76.50	$90.00
capture	85%	$8.50	$21.25	$34.00	$46.75	$59.50	$72.25	$85.00
efficiency	80%	$8.00	$20.00	$32.00	$44.00	$56.00	$68.00	$80.00
for mat'ls	75%	$7.50	$18.75	$30.00	$41.25	$52.50	$63.75	$75.00
at the MRF	70%	$7.00	$17.50	$28.00	$38.50	$49.00	$59.50	$70.00
	65%	$6.50	$16.25	$26.00	$35.75	$45.50	$55.25	$65.00
	60%	$6.00	$15.00	$24.00	$33.00	$42.00	$51.00	$60.00
	55%	$5.50	$13.75	$22.00	$30.25	$38.50	$46.75	$55.00
	50%	$5.00	$12.50	$20.00	$27.50	$35.00	$42.50	$50.00
	45%	$4.50	$11.25	$18.00	$24.75	$31.50	$38.25	$45.00
	40%	$4.00	$10.00	$16.00	$22.00	$28.00	$34.00	$40.00

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Figure 3.9: Changes in Costs from Variations in Recovery Percentages (base assumption is $40/ton and 50% and 70% recovery)

COSTS RELATED TO EXTRA DISPOSAL TIP FEES FROM RESIDUALS

For each ton through plant at capture level, EXTRA COST PER TON FROM RESIDUAL DISPOSAL

NOTE: Blue percent is the capture level, or overall percent of recoverables successfully processed & sent to market; '(1-blue percent)' is the residual rate.

Tip==>	$10	$25	$40	$55	$70	$85	$100
95%	$0.50	$1.25	$2.00	$2.75	$3.50	$4.25	$5.00
90%	$1.00	$2.50	$4.00	$5.50	$7.00	$8.50	$10.00
85%	$1.50	$3.75	$6.00	$8.25	$10.50	$12.75	$15.00
80%	$2.00	$5.00	$8.00	$11.00	$14.00	$17.00	$20.00
75%	$2.50	$6.25	$10.00	$13.75	$17.50	$21.25	$25.00
70%	$3.00	$7.50	$12.00	$16.50	$21.00	$25.50	$30.00
65%	$3.50	$8.75	$14.00	$19.25	$24.50	$29.75	$35.00
60%	$4.00	$10.00	$16.00	$22.00	$28.00	$34.00	$40.00
55%	$4.50	$11.25	$18.00	$24.75	$31.50	$38.25	$45.00
50%	$5.00	$12.50	$20.00	$27.50	$35.00	$42.50	$50.00
45%	$5.50	$13.75	$22.00	$30.25	$38.50	$46.75	$55.00
40%	$6.00	$15.00	$24.00	$33.00	$42.00	$51.00	$60.00

BREAKEVEN ANALYSIS

Breakeven Analysis			MRF Covers all costs			Industry funds Densifier		
Model 1: Manual sort PS / densifier, Labor $32K- MRF Type	TPY (thous)	Percent PS in Scenario	EPS Prices Required for Plant to Break Even with 0.9% PS Recov	Tons/yr of EPS Required for Plant to Break Even at $160/Ton (thous)	Pct EPS Content for Plants to Break Even at $160/Ton	EPS Prices Required for Plant to Break Even with 0.9% PS Recov	Tons/yr of EPS Required for Plant to Break Even at $160/Ton (thous)	Pct EPS Content for Plants to Break Even at $160/Ton
Small MRF	20	0.9%	$196	0.22	1.1%	$157	0.18	0.9%
Medium MRF	42	0.9%	$149	0.35	0.8%	$130	0.31	0.7%
Large MRF	72	0.9%	$132	0.54	0.7%	$118	0.48	0.7%
Mega MRF	144	0.9%	$120	0.97	0.7%	$109	0.88	0.6%

Breakeven Analysis			MRF Covers all costs			Industry covers Optical sort equipment		
Model 2: Optical Sorter / baling, Labor $32K- MRF Type	TPY (thous)	Percent PS in Scenario	EPS Prices Required for Plant to Break Even with 1.2% PS Recov	Tons/yr of EPS Required for Plant to Break Even at $160/Ton (thous)	Pct EPS Content for Plants to Break Even at $160/Ton	EPS Prices Required for Plant to Break Even with 1.2% PS Recov	Tons/yr of EPS Required for Plant to Break Even at $160/Ton (thous)	Pct EPS Content for Plants to Break Even at $160/Ton
Large MRF	72	1.2%	$130	0.70	1.0%	$88	0.47	0.7%
Mega MRF	144	1.2%	$96	1.04	0.7%	$59	0.63	0.4%

14

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THE QUALITY (CONTAMINATION) ISSUE

THE QUALITY ISSUE

- Two factors brought it to a head
- 1) Long-term qulty decline in US
  - Not due to SS – There is good SS and bad SS and good / bad DS
  - "Lowering" of qualities and no inspections
  - Long term mill and other complaints
  - CBOT
  - Drive for productivity (ROI) when quality not checked (relatively few loads rejected), helped by Chinese demand
- 2) China
  - Enforcement of quality standards
  - Loads rejected
  - Demand falls, prices fall…

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

☐ Remedies focus – What's been tried?

NOT Successful

- **Cling to dual stream** – Horse out of barn, fewer tons, convenience key/pushback
- **Goals and fines** (UK) – Need right level (x2), actors, authority
- **Moral suasion/ guilt** – Can't sustain long term
- **Voluntary standards & goals, agreements** – collaborative; coll'n guidelines, contract recommendations. Lacked good authority & enforcement; moral suasion not enough (for long – economics or one drop-out can kill)

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

Some Success

- **Split glass** – Take in SS but recommend drop-offs, education
- **Ban or Fee for Plastic Bags** – reduce contamination & downtime
- **Long term contracts** – with clean / suitable sources

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

COULD work, but Imperfect

- **Ban Glass** – Lose tons for goals, pushback from citizens
- **Education** – "Garbage in/Garbage out", bu can backfire (unintended consequences)
- **Facility Designation/Destination** – can do through contracts

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

What is also done

- **<u>Last step at MRFs</u>** – Pretty-ing bales.

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

What could be done – who holds power?

- **MRFs CAN make clean materials NOW**
  - ☐ Slower processing / thinner on belt
  - ☐ Extra technical steps (optical sorters, extra equipment & more cleaning steps)
  - ☐ Management Attention
- **Why don't they do it?**
  - ☐ No Financial reward – Owners should penalize for extra cleaning if no enforcement
  - ☐ End users not acting rationally – They don't pay more for clean bales. Should be willing to pay extra UP TO the cost of pre-processing they currently do. But they don't
  - ☐ **No US inspections → → → → → → → → →**

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CONTAMINATION INFLUENCE – GRESHAM'S LAW

- Econ 101 - Gresham's Law (as applied to MRFs)

➔BAD BALES DRIVE OUT GOOD BALES

unless <u>quality control</u> / or <u>quality rewarded</u>...

Otherwise race to the bottom / lowest acceptable quality. Greatest ROI. Owners should penalize managers if they clean more than market demands.

- *Econ 101-"When a government overvalues one type of money and undervalues another, the undervalued money will leave the country or disappear from circulation into hoards, while the <u>overvalued money will flood into circulation</u>."*
- *==> vs. **Bad money drives out good***
- *... but only if authorities have chosen to enforce a fixed exchange rate.*

*Some options with trust and long-term arrangements, but mutual benefit...

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STRATEGIES TO REDUCE CONTAMINATION - WHAT HAS BEEN TRIED?

Best Long Term Solution?

- **Sorts/ enforcement & education**
  - Make materials a REAL COMMODITY (like CBOT/corn grades)
- Higher prices for cleaner bales
- Negotiate with YOUR facility operator and enforce (examples)
- CBOT-Like for fluctuations

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CONTAMINATION APPROACHES – OTHER TOPICS

- ☐ Market fluctuations
  - ■ Used to have CBOT…

- ☐ Analysis of value relative to processing costs
  - ■ Model – relative to market value
  - ■ Relative to GHG contributions

- ☐ Revision in MRF model
  - ■ Processing service… risk on town… but incentive for quality?

- ☐ Product design upstream
  - ■ Part of an ideal solution…

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SUMMARY AND CONCLUSIONS – MRF MATERIALS

- ☐ Don't let gut reaction / traditional wisdom guide decision
- ☐ If revenue per ton >marginal cost you add to plant profitability
  - ■ Not by material - Plant-wide results matter **– avoid CREAM-SKIMMING**
  - ■ Might make a case for materials beyond the traditional
- ☐ **Maximizing each one-product profits will be profitable, but you will be MORE Profitable in total if you include all materials in which you're covering at least the "specially attributed" costs – look for MR>MC.**
- ☐ Model is tailorable, and we are currently modeling results for other materials.

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SUMMARY & CONCLUSIONS - QUALITY

- ☐ Quality has been long term issue
  - ■ Mills, SS, no inspections, ROI…
- ☐ Many solutions tried – some with potential for addressing part of the problem
  - ■ Sort of work - Split on glass, bag fees, contracts,
  - ■ Could work but imperfect – ban glass, education (consequences)
  - ■ NOT successful long term – cling to dual straam, voluntary options
- ☐ Long term should work:
  - ■ Sorts / enforcement "Product"
  - ■ Higher prices for clean bales
  - ■ Negotiate with your facility and enforce (trust but verify)
  - ■ CBOT for fluctuations

  Pay for clean bales AND enforce it – Or race to the bottom… (Gresham)

- ☐ Rational behavior – MRFs; Irrational – Mills
- ☐ Behavior changes happens in reaction to **self-interest** – incentives and enforcement
- ☐ But also, it can't hurt to give a cleaner start!!,
- ☐ & don't fully blame Single Stream for markets

26

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THANK YOU!!
Questions?

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