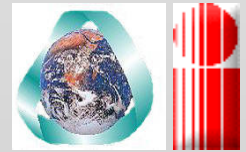




Waste-To-Energy Research and
Technology Council



Survey of Metal Recovery in the U.S. WTE Industry

Werner Sunk

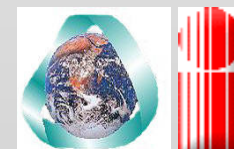
Waste-to-Energy Research and Technology Council (WERT),
Earth Engineering Center, Columbia University

Federation of New York Solid Waste Association
8th Annual Spring Conference and Trade Show
May 6th to 9th, 2007, Bolton Landing, NY



Waste-To-Energy Research and
Technology Council

Status Quo: Metals in U.S. MSW



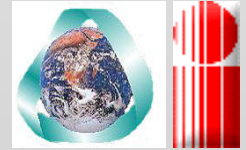
Total tons MSW generated in the U.S	236 mill tons/y (EPA, 2003)	
Total ferrous metals generated in MSW (5%)	12.0 mill tons/y	\$1.2 billion*
Total ferrous metals recovered (36%)	4.3 mill tons/y	\$430 million*
Total ferrous metals landfilled (64%)	7.5 mill tons/y	\$750 million*
Total non-ferrous metals generated in MSW (0.7%) ***	1.7 mill tons/y	\$1.32 billion**
Total non-ferrous metals recovered (21%)	346,000 tons/y	\$277 million**
Total non-ferrous metals landfilled (79%)	1.3 mill tons/y	\$1.04 billion**

* at \$100 per ton (\$180 per ton for clean iron scrap; ISSB 2005, www.steelonthenet.com)

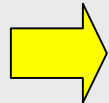
** at \$800 per ton (estimated after survey)

*** mostly aluminum; not including copper, or lead from batteries;
it is assumed, that 50% of the non-ferrous metals in MSW are recovered by recycling

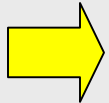
Status Quo: U.S. Steel consumption



Total steel production in the U.S.	91 mill tons/y
Total steel imports by the U.S.	30 mill tons/y
Total steel needs of the U.S.	121 mill tons/y

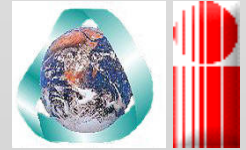


10% of the U.S. steel production are landfilled every year

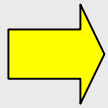


25% of the U.S. steel imports are landfilled every year

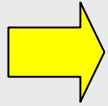
Background of the Survey



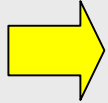
Objectives of Survey:



Equipment used for metal recovery at the front- and back-end of U.S. WTE facilities



Amounts of metals recovered at U.S. WTE plants

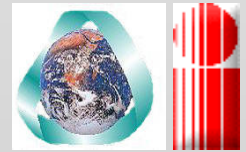


Distribution between front- and back-end metals recovery



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The Questionnaire



Waste-To-Energy Research
and Technology Council

Questionnaire on WTE Metal Recovery

Name of WTE facility and operating company:	
Address:	
Name and e-mail of person responding to this questionnaire:	
Position:	

1. Total Tons MSW processed in 2004?

2. Total tons of ferrous metal recovered in 2004?

% recovered at tipping floor before MSW processing

% recovered after MSW shredding (for RDF plants only)

% recovered from ash

3. Total tons of non-ferrous metal recovered in 2004?

% recovered at tipping floor before MSW processing

% recovered after MSW shredding (for RDF plants only)

% recovered from ash

4. System used for metal recovery (processing and separation):
(Please describe the equipment used on separate sheet as detailed a possible)

pre-combustion post-combustion

Manual

Shredder

Screens/other mech. separation equipment

Magnetic separation

Eddy current separation

other _____

5. Quality of ferrous and non-ferrous metals recovered:

Do you mix the magnetically and mechanically (e.g. grizzly feeder) recovered ferrous metals?

Yes

No

Do you mix the metal fractions recovered before and after combustion?

Ferrous metals Yes

No

Non-ferrous metals Yes

No

If metals are sold separately, which stream is more valuable (per ton of metal)?

Before combustion

After combustion

Do you perform any further on-site metal processing for beneficiation after recovery (such as cleaning, sorting/sifting, bailing, etc.)?

Yes

No

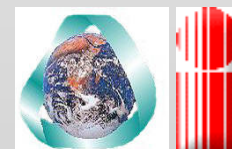
If yes, please describe _____

Thank you for participating in this survey!
Please send your response to Werner Sunk at WERT
(ws2172@columbia.edu; Fax 212 854 5213)



Waste-To-Energy Research and
Technology Council

WTE Plants reached and Coverage



Our survey included

Type of WTE facility	No. of WTE facilities	MSW processed million tons per year	Fe-metal input at 5% of MSW, million tons per year	Fe-metal recovered, tons per year	Non-Fe-metal input at 0.7% of MSW, tons per year	Non-Fe-metal recovered, tons per year
RDF	5	4.4	0.22	160,000	30,000	9,000
Mass-Burn	48	20.4	1.02	440,000	140,000	6,000
Total	53	24.8	1.24	600,000	170,000	15,000

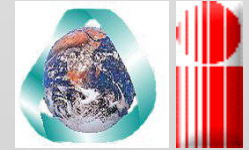
Coverage of the survey

Number of reached WTE facilities¹: **59%** of the U.S. WTE industry

Processed MSW per year¹: **86%** of the U.S. WTE industry

¹ 2004 IWSA Directory and EEC/Bicycle: U.S. WTE plants processed 28.8 mill tons of MSW

Equipment to recover Metals at MB Plants



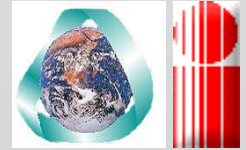
Before Combustion

No. of MB plants operating equipment to recover metals	30	63%
Manual/Mechanical	13	27%
Crane	17	35%
Shredder	0	0%
Bag Opener	0	0%
Trommel Screen	0	0%
Magnetic Separation	0	0%

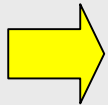
After Combustion

No. of MB plants operating equipment to recover metals	43	90%
Manual/Mechanical	7	15%
Crane with Magnet	1	2%
Shredder	2	4%
Trommel Screen	8	17%
Grizzly Scalper	19	40%
Screen	6	13%
Finger Deck	2	4%
Magnetic Separation	38	79%
Eddy Current Separation	12	25%

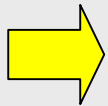
Details of Metal Recovery at MB Plants



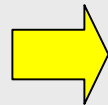
Front-end



**13 plants use manual separation for front-end metal recovery
17 plants use cranes for front-end metal recovery**

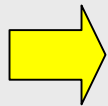


The above plants did not report the amounts of front-end recovery, or reported below 8% of the total ferrous recovery



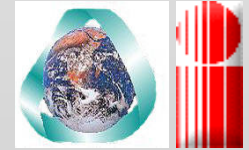
Operation not focused on metal recovery but on removal of bulky pieces to prevent damage of the equipment

Back-end



3 plants cooperate with regional metal recovery facilities to recover metals or improve metal quality before marketing

Equipment to recover Metals at RDF Plants



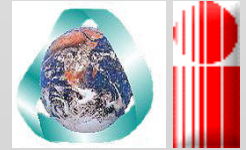
Before Combustion

No. of RDF plants operating equipment to recover metals	5	100%
Manual/Mechanical	2	40%
Crane	1	20%
Shredder	5	100%
Bag Opener	1	20%
Trommel Screen	1	20%
Magnetic Separation	5	100%

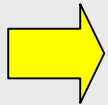
After Combustion

No. of RDF plants operating equipment to recover metals	3	60%
Manual/Mechanical	2	40%
Crane with Magnet	0	0%
Shredder	1	20%
Trommel Screen	0	0%
Grizzly Scalper	0	0%
Screen	0	0%
Finger Deck	0	0%
Magnetic Separation	3	60%
Eddy Current Separation	3	60%

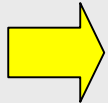
Details of Metal Recovery at RDF Plants



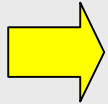
Front-end



All 5 plants operate shredder and magnetic separation at front-end

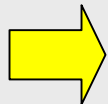


One plant cooperates with a regional metal recovery facility to improve metal quality before marketing

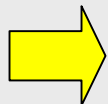


None of the 5 RDF plants reports non-ferrous separation at front-end

Back-end



3 plants recover ferrous and non-ferrous metals at back-end

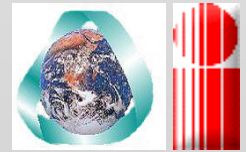


One plant cooperates with a regional metal recovery facility to recover metals from the ash and improve metal quality before marketing



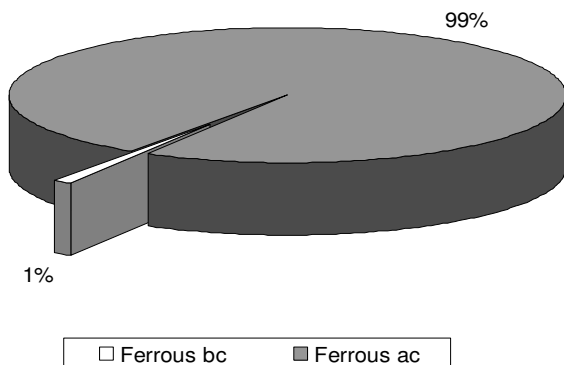
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Front- & Back-End Metal Recovery at MB Plants

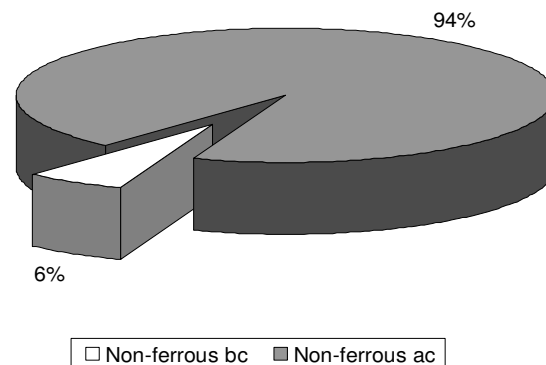


Nr. of WTE plants	Total tons of MSW processed	Ferrous metals			Nonferrous metals		
		Total tons ferrous Metals recovered	Percent ferrous metals recovered, bc	Percent ferrous metals recovered, ac	Total tons non-ferrous Metals recovered	Percent non-ferrous metals recovered, bc	Percent non-ferrous metals recovered, ac
48	20,377,274	439,868	1%	99%	6,714	6%	94%

Ferrous Recovered before (bc) and after (ac) combustion at Mass Burn Facilities



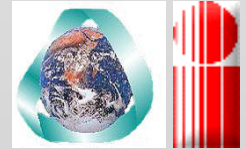
Non-ferrous Recovered before (bc) and after (ac) combustion at Mass Burn Facilities





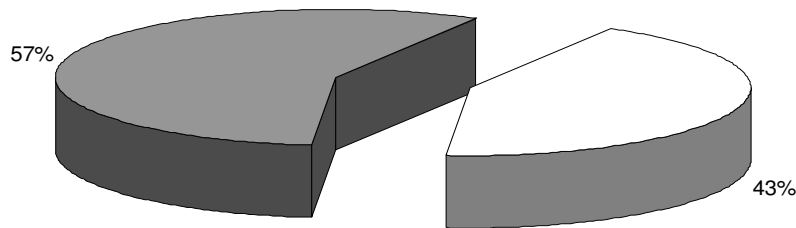
Waste-To-Energy Research and
Technology Council

Total Metal Recovery at MB Plants



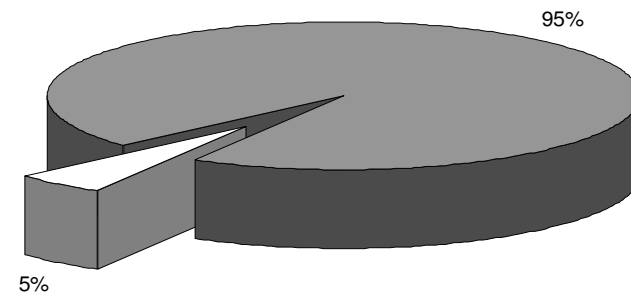
Nr. of WTE plants	Total tons of MSW processed	Ferrous metals			Nonferrous metals		
		Assumed Tons ferrous generated in MSW at 5.0%	Total tons ferrous recovered	Percent ferrous metals recovered	Assumed tons non-ferrous generated in MSW at 0.7%	Total tons non-ferrous recovered	Percent non-ferrous metals recovered
48	20,377,274	1,018,864	439,868	43%	142,641	6,714	5%

Ferrous Recovered vs. Landfilled at Mass Burn Facilities



□ Ferrous recovered ■ Ferrous landfilled

Non-Ferrous Recovered vs. Landfilled at Mass Burn Facilities

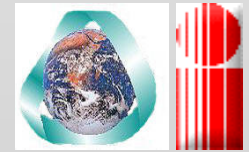


□ Non-Ferrous recovered ■ Non-Ferrous landfilled



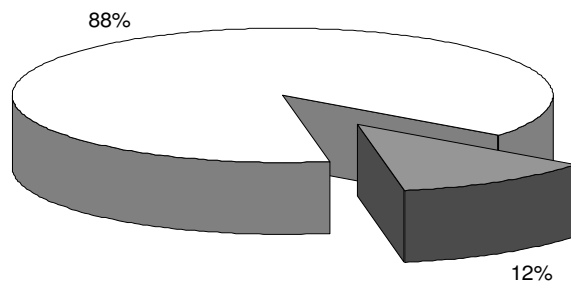
Waste-To-Energy Research and
Technology Council

Front- & Back-End Metal Recovery at RDF Plants



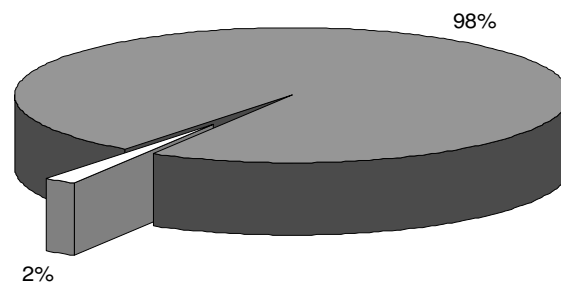
Nr. of WTE plants	Total tons of MSW processed	Ferrous metals			Nonferrous metals		
		Total tons ferrous Metals recovered	Percent ferrous metals recovered, bc	Percent ferrous metals recovered, ac	Total tons non-ferrous Metals recovered	Percent non-ferrous metals recovered, bc	Percent non-ferrous metals recovered, ac
5	4,359,146	152,295	88%	12%	9,164	2%	98%

Ferrous Recovered before (bc) and after (ac) combustion at RDF Facilities



□ Ferrous bc ■ Ferrous ac

Non-ferrous Recovered before (bc) and after (ac) combustion at RDF Facilities

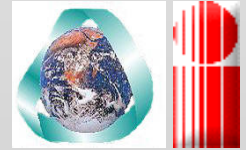


□ Non-ferrous bc ■ Non-ferrous ac



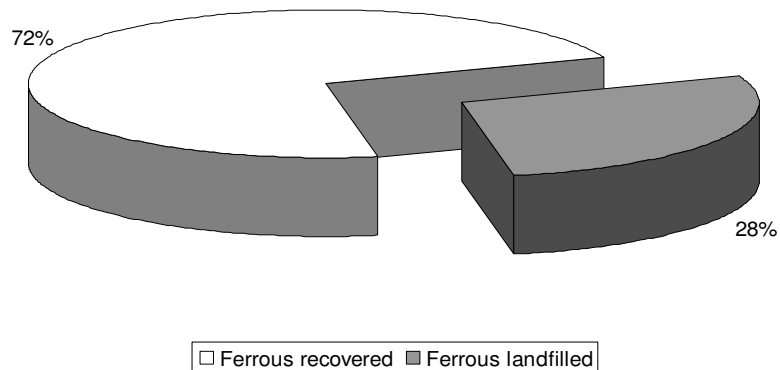
Waste-To-Energy Research and
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Total Metal Recovery at RDF Plants

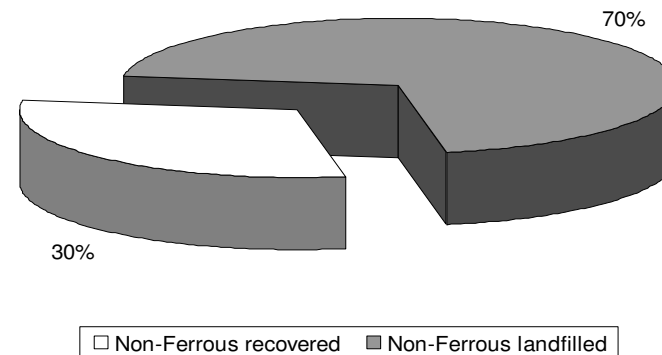


Nr. of WTE plants	Total tons of MSW processed	Ferrous metals			Nonferrous metals		
		Assumed Tons ferrous generated in MSW at 5.0%	Total tons ferrous recovered	Percent ferrous metals recovered	Assumed tons non-ferrous generated in MSW at 0.7%	Total tons non-ferrous recovered	Percent non-ferrous metals recovered
5	4,359,146	217,957	156,295	72%	30,514	9,164	30%

Ferrous Recovered vs. Landfilled at RDF Facilities



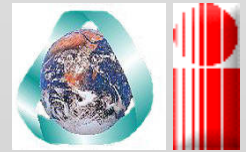
Non-Ferrous Recovered vs. Landfilled at RDF Facilities





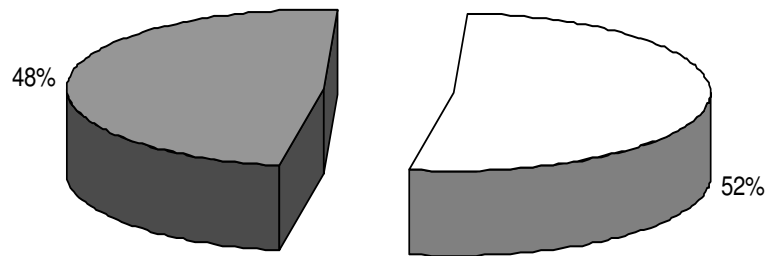
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Summary of Total Metal Recovery at the 53 WTE Plants



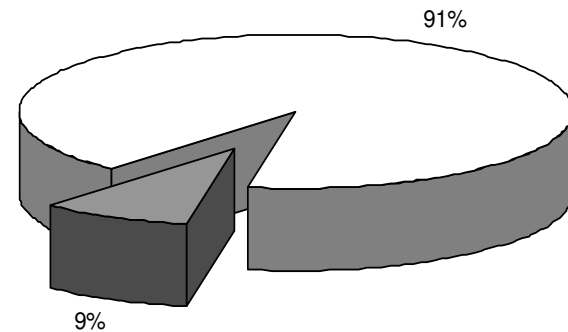
Nr. of WTE plants	Total tons of MSW processed	Ferrous metals			Nonferrous metals		
		Assumed Tons ferrous generated in MSW at 5.0%	Total tons ferrous recovered	Percent ferrous metals recovered	Assumed tons non-ferrous generated in MSW at 0.7%	Total tons non-ferrous recovered	Percent non-ferrous metals recovered
53	24,736,420	1,236,821	596,163	48%	173,155	15,878	9%

Ferrous Recovered vs. Landfilled



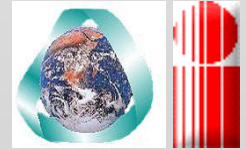
■ Ferrous recovered □ Ferrous landfilled

Non-Ferrous Recovered vs. Landfilled



■ Non-ferrous recovered □ Non-ferrous landfilled

Conclusion: Detailed Recovery Rates



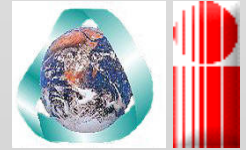
- **Mass burn plants**

ferrous recovery	43%
front-end ferrous recovery	1%
back-end ferrous recovery	99%
non-ferrous recovery	5%
front-end non-ferrous recovery	6%
back-end non-ferrous recovery	94%

- **RDF plants**

ferrous recovery	71%
front-end ferrous recovery	88%
back-end ferrous recovery	12%
non-ferrous recovery	30%
front-end non-ferrous recovery	2%
back-end non-ferrous recovery	98%

Conclusion (cont.): Metal Value in MSW

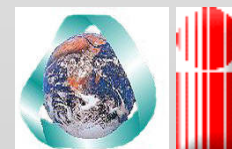


- Total MSW processed **24.8 mill tons**
(all 53 WTE plants)
- Total metals in MSW **1.24 mill tons** ferrous (@ 5%)
(all 53 WTE plants) **0.17 mill tons** non-ferrous metals (@ 0.7%)
- **Estimation: 75% of the metals recoverable and marketable**
- Value of metals **\$ 93 mill** per year ferrous (@ \$100/ton*)
\$102 mill per year non-ferrous metals (@ \$800/ton**)

\$195 mill per year
- Metal value per ton MSW **\$7.86 per ton MSW**

* at \$100 per ton (ISSB 2005, www.steelonthenet.com), ** at \$800 per ton (estimated after survey), *** national average of \$34 per ton (NSWMA's 2002 Tipping Fee Survey)

Conclusion (cont.): Revenue Lost

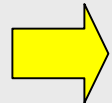
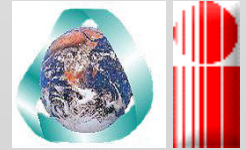


• Total metals recovered (all 53 WTE plants)	596,000 tons ferrous (48%), 15,900 tons non-ferrous metals (9%)
• Total metals landfilled (all 53 WTE plants)	641,000 tons ferrous (52%) 157,000 tons non-ferrous metals (91%)
• Estimation: 75% of the metals recoverable and marketable	
• Valuable metals lost	481,000 tons ferrous 118,000 tons non-ferrous metals
• Revenue lost	\$48 mill per year from ferrous (@ \$100/ton*) \$94 mill per year from non-ferrous (@ \$800/ton**)

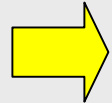
	\$142 mill per year
• Additional costs for landfilling (shipping costs not included)	\$20 mill per year for landfilling metals (@ 34\$/ton***)
• Total revenue lost	\$162 mill per year

* at \$100 per ton (ISSB 2005, www.steelonthenet.com), ** at \$800 per ton (estimated after survey), *** national average of \$34 per ton (NSWMA's 2002 Tipping Fee Survey)

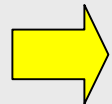
Conclusion (cont.)



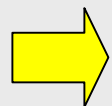
There is room for improvement in ferrous metal recovery for several of the Mass-Burn plants



Non-ferrous metal recovery is low for both Mass-Burn and RDF plants
(2 of the 5 responding RDF plants do not recover non-ferrous metals at all)

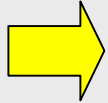
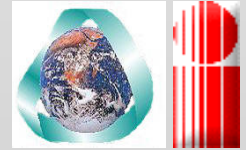


Pay-back periods for investment can be very low
(1 visited plant reported a calculated pay-back period under 2 years for installing additional equipment for non-ferrous metal recovery)

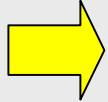


Some WTE plants are already considering to install equipment to recover metals – mostly at the back-end

Conclusion (cont.)

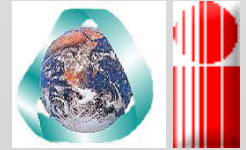


Metal recovery is not a “standard procedure” in the U.S. WTE industry. There is a wide variability in metal recovery even among WTE plants operated by the same company.

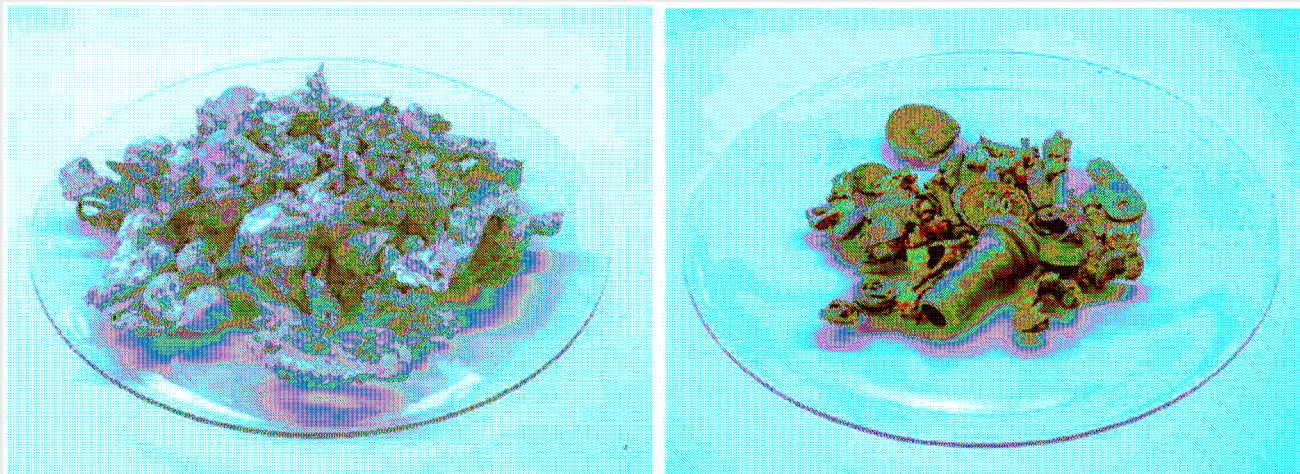


Reasons:

- Different states/county law and regulations,
- Different contracts between the WTE plant, the state/county, and subcontractors



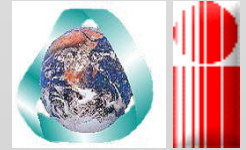
- Encourage the rest of the U.S. WTE industry to participate in the WTERT survey and thus improve our data base,
- Examine **new technologies** to improve metal recovery at WTE facilities regarding quantity and quality,
 - dry ash collection and metal recovery



- In collaboration with industry, analyze effects of **contracts** between the operating company of a **WTE plant**, the **county**, and other **subcontractors** on metal recovery.



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Thank You!

Werner Sunk, M.S.
Waste-to-Energy Research and Technology Council (WERT)
Columbia University
ws2172@columbia.edu