

# Opportunities and Challenges: Construction and Demolition Debris Recycling in the Northeast



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# C&D Waste Generation

- ▶ Wide fluctuations compared to MSW
- ▶ Impacted by natural disasters and the economy
- ▶ Disposal more dispersed than for MSW, and less regulated



# How Much Is Generated Annually?

- ▶ US EPA estimates 166 million tons of **building debris** (2014 Report)
  - Plus 234 million tons of asphalt and concrete waste from roads and bridges; and,
  - 135 million tons from communication, power, transportation, sewer and waste disposal, water supply, and manufacturing infrastructure
- ▶ This compares against 258 million tons of MSW generated
  - But 89 million tons recycled or composted leaving **169 million tons of MSW** left for disposal
- ▶ Many states have no idea how much C&D generated

# Per Capita Estimates

- ▶ MassDEP tracked 1,129,861 tons or .17 tons Per Capita (2015)
- ▶ CT tracked 1,041,643 tons or .29 tons (Green Seal, 2013)
- ▶ DE tracked 220,000 tons or .24 tons (2014)
- ▶ While these are in the ballpark of each other, it depends on what is tracked and counted as C&D

# Roughly How Much C&D Needs to Be Managed in Our Region?

- ▶ Using .29 tons per capita and 15% recycling rate

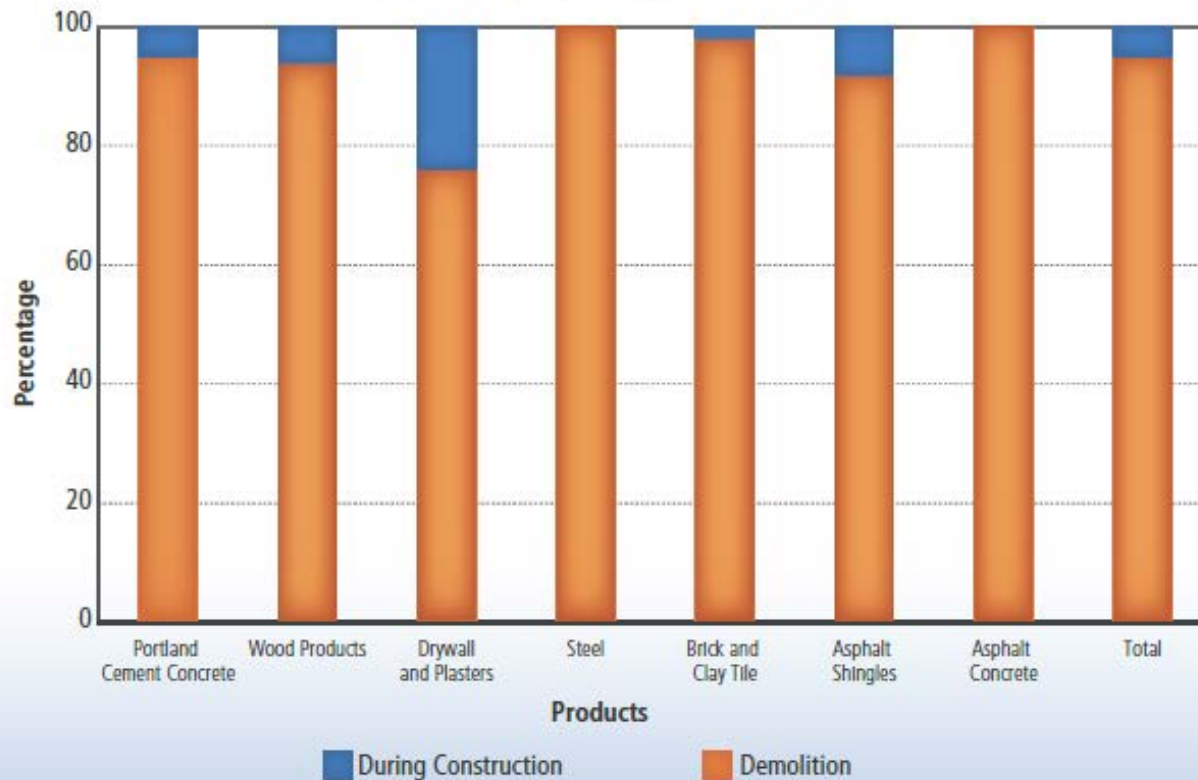
State	2016	C&D Waste (tons)	Recycling (%)	Net Disposal (tons)
New York	19,745,289	5,726,134	15%	4,867,214
Pennsylvania	12,784,227	3,707,426	15%	3,151,312
New Jersey	8,944,469	2,593,896	15%	2,204,812
Massachusetts	6,811,779	1,975,416	30%	1,382,791
Maryland	6,016,447	1,744,770	15%	1,483,054
Connecticut	3,576,452	1,037,171	15%	881,595
New Hampshire	1,334,795	387,091	15%	329,027
Maine	1,331,479	386,129	15%	328,210
Rhode Island	1,056,426	306,364	15%	260,409
Delaware	952,065	276,099	15%	234,684
Vermont	624,594	181,132	15%	153,962
<b>Total: 63,178,022</b>		<b>18,321,626</b>	<b>17%</b>	<b>15,277,070</b>



# When is Most C&D Generated?

*(Source: US EPA)*

**Figure 11. Contribution of Construction and Demolition Phases to Total 2013 C&D Debris Generation**



# What Has Been Done to Reduce C&D Waste Disposal

- ▶ Material bans
- ▶ Processing Requirements
- ▶ Diversion Goals
- ▶ Green Building Requirements (LEED Certification)
- ▶ Economic Incentives:
  - ▶ RECs for Biomass facilities to create demand for B wood
  - ▶ Subsidies for mixed (C&D) waste processing facilities
  - ▶ Market Development Grants
    - Aggregate

# Vermont

- ▶ Universal Recycling law bans clean wood disposal (July 1, 2016)
  - This ban encourages separation and collection of clean wood waste at facilities.
- ▶ **Act 175 (January 2015) requires recycling of Architectural Materials(1) from certain projects if they:**
  - Produce **40 cubic yards or more** of architectural waste.
  - Are **within 20 miles** of a solid waste facility that recycles architectural waste.
  - Are for a **commercial building or residential building with 2 or more units.**

*(1) Clean Wood, Scrap Metal, Drywall, Plywood, Oriented Strand Board (OSB)*



# Massachusetts

- ▶ 50% diversion goal for C&D materials, but the rate has plateaued at around 30%
- ▶ Mixed C&D must be processed before disposal in MA facilities
- ▶ Banned asphalt pavement, brick, concrete, metal and wood from disposal as of July 1, 2006 with hopes of:
  - Supporting the development of in-state processing
  - Preserving disposal capacity in the state
  - Achieving non-municipal solid waste reduction goal

# Massachusetts: Case Study on Impact of Bans and Processing Requirements

- ▶ DSM/NERC contracted by MA DEP to assess opportunities and constraints to increasing diversion beyond 30 percent in 2016
- ▶ DSM analyzed *initial* progress in 2008 for MA DEP

[www.mass.gov/eea/docs/dep/recycle/reduce/06-through/07cdstdy.doc](http://www.mass.gov/eea/docs/dep/recycle/reduce/06-through/07cdstdy.doc)

- ▶ DSM has tracked regional markets through this and other studies



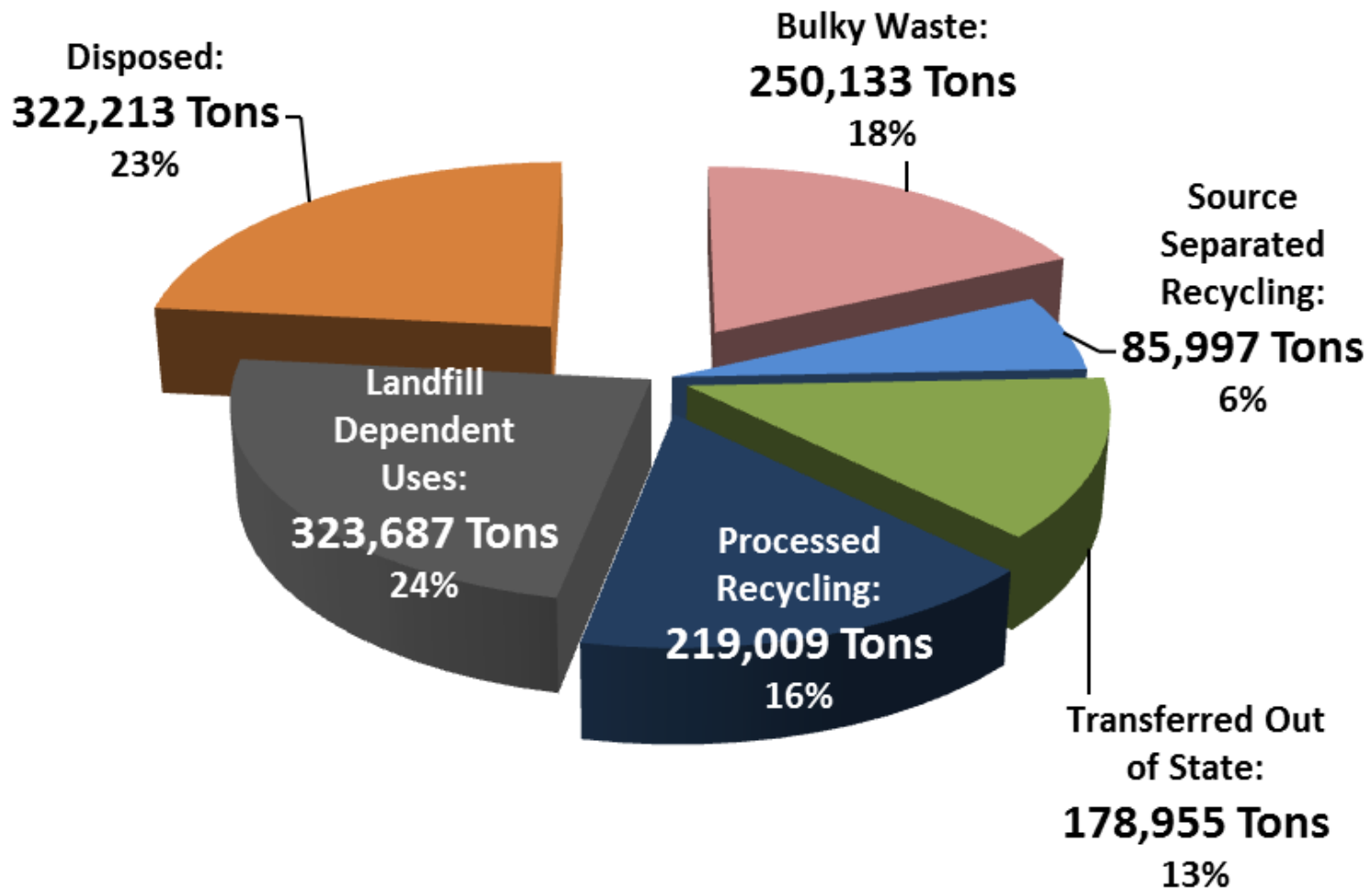
# 2016 Scope of Work



- ▶ Analyzed incoming and outgoing C&D loads at seven facilities to determine where opportunities lie to increase materials recovery
- ▶ Analyzed material flow from annual reports (2015), field work and research
- ▶ Reviewed new technologies that might increase recovery from C&D processing facilities
- ▶ Reviewed market specifications and demand
- ▶ Identified barriers to increased diversion

# Recycling Rate, c. 2015

- ▶ Roughly 25 percent of *mixed C&D processed in-state* (219,000 of 865,000 tons) was recovered for recycling in Massachusetts.
  - Adding source separated materials delivered to processors (86,000 tons), 27% recycling rate for All C&D (in-state and out-of-state)
  - 32 percent if only counting C&D managed in-state
- ▶ Diversion rate greater if landfill dependent uses included
  - Another 324,000 tons, or 31% of C&D waste processed in-state, or 23 percent of all C&D waste.
- ▶ Both exclude any out of state processing generating recyclables



## Material Destinations in 2015

# What Can Be Done to Increase Recovery?

- »» DSM analysis of Massachusetts processors to determine possibility of increasing recovery



# Visual Analysis of C&D Waste Processed

- ▶ Incoming C&D loads at seven facilities, and outgoing residue (from processors only) were visually analyzed
  - Goal to characterize incoming materials and outgoing residue
- ▶ Visual sample data converted to weight based composition of incoming C&D and out-going residue by facility using facility annual reports



## Bulky Waste Loads

Excluded from Totals

# Results, by Weight

INCOMING MATERIAL COMPOSITION	
	Average
Material Category	(%)
PAPER	2%
PLASTIC	2%
GLASS	2%
ORGANICS	2%
C&D	79%
METAL	5%
SPECIAL WASTE	5%
MSW (Bagged)	2%

# Results, By Weight

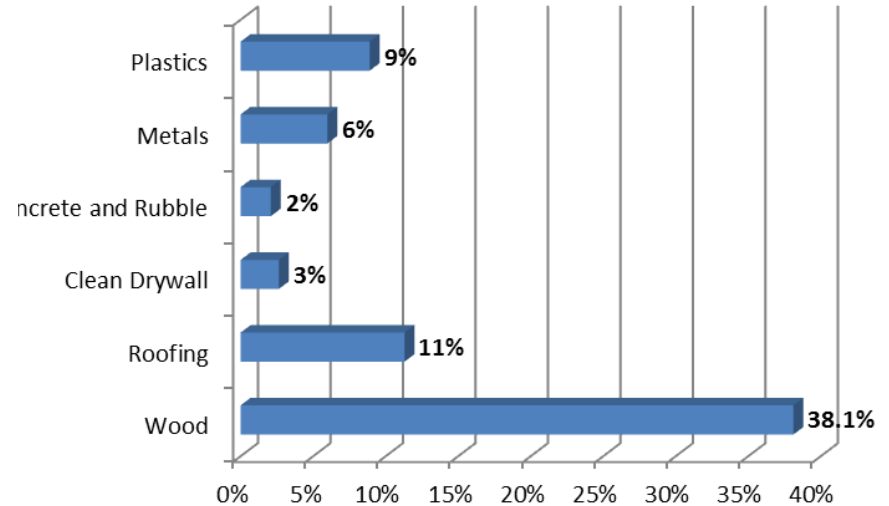
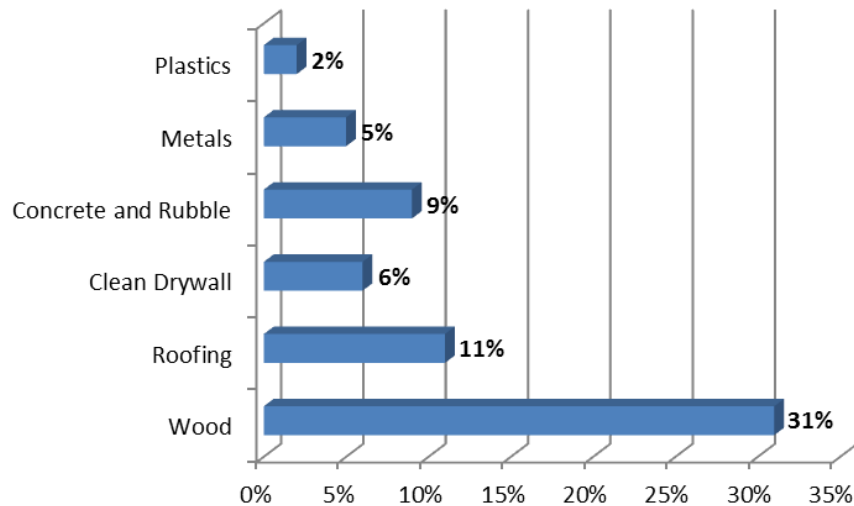
## *C&D Materials Composition*

*Wood is an  
estimated  
39% of  
Incoming  
C&D*

<b>C&amp;D</b>	<b>79%</b>
Concrete/Brick/Rock	<b>2%</b>
Asphalt Paving	<b>0%</b>
Asphalt Roofing	<b>11%</b>
Wood Roofing	<b>1%</b>
Ceiling Tiles	<b>2%</b>
Vinyl Siding	<b>0%</b>
Pallets and Crates	<b>4%</b>
Clean Lumber	<b>12%</b>
Plywood	<b>6%</b>
Other Engineered Wood	<b>6%</b>
Wood Furniture	<b>1%</b>
Painted/Stained Wood	<b>10%</b>
Treated Wood	<b>1%</b>
Clean Gypsum Board	<b>3%</b>
Printed/Papered Gypsum Board	<b>5%</b>
Dirt, Sand and Gravel	<b>5%</b>
Fiberglass Insulation	<b>0%</b>
R/C and Other C&D	<b>11%</b>



# Change in Composition?



2008 Literature, Data

2016 Field

# Estimated Recovery Rates for Mixed C&D Waste

Sorted Material	Processors (%)	Transfer Stations (%)	Overall (%)
OCC	31%	9%	22%
Plastic	6%	0%	3%
Metal	100%	49%	90%
Asphalt/Brick/Concrete	100%	100%	100%
Asphalt Roofing	12%	2%	7%
Clean Gypsum Board	9%	0%	4%
Wood	32%	4%	22%
<b><i>Overall Materials Recovery Rate (1):</i></b>	<b>48%</b>	<b>6%</b>	<b>33%</b>

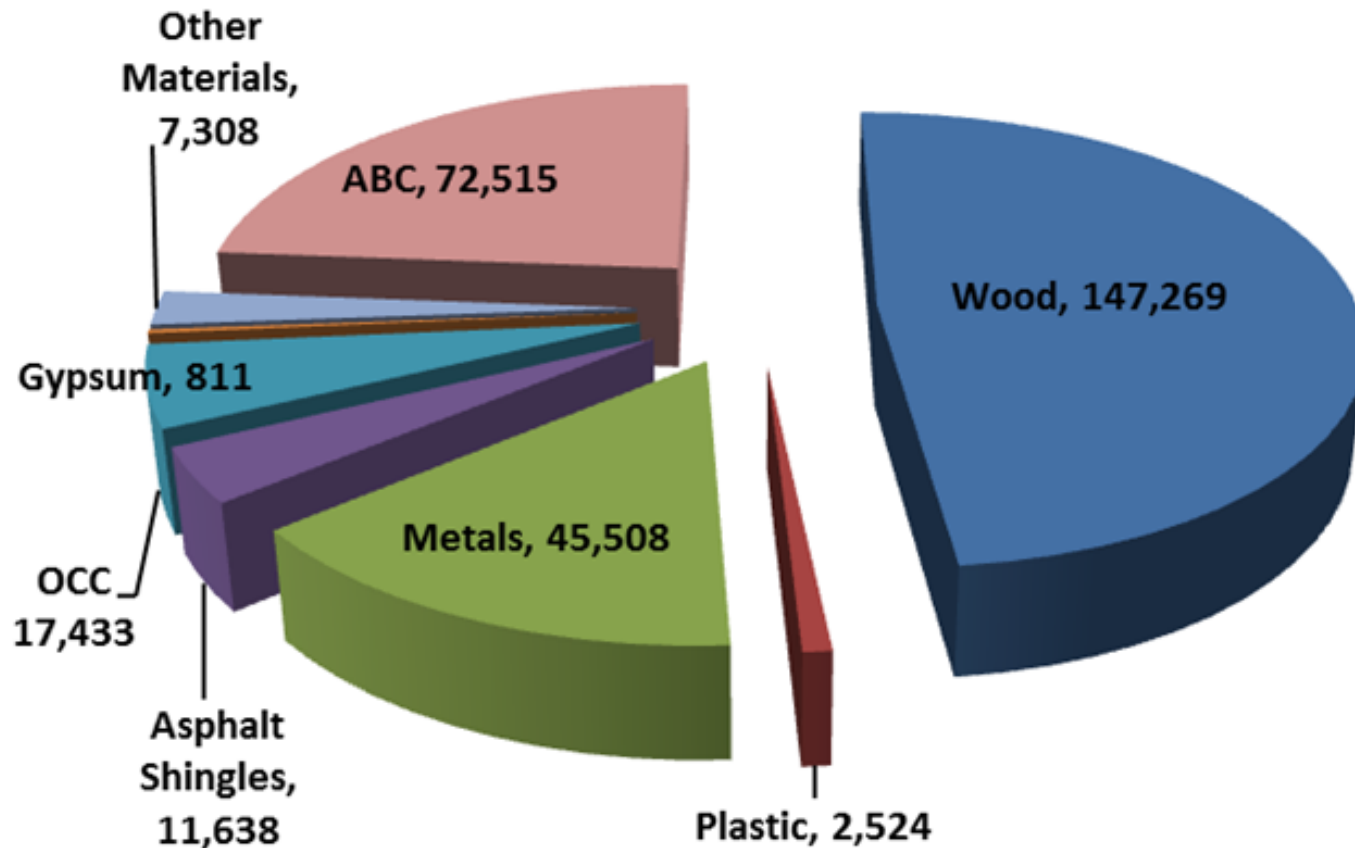
- 1) Excludes recycled materials reported separately as incoming materials
- 3) Excludes electronics, glass, mattresses, tires and other misc. materials recovered in small quantities



# Market Status

»» Based on 2016 MassDEP Study

# Composition of Material Sales (Massachusetts, Reported Tons 2015)



# Waste Wood – Largest Component of C&D Materials in NE

- ▶ Wood Waste Combustion
  - Double the BTU value of green wood chips, but more environmental and operations issues
- ▶ In 2007, there was a robust market for waste wood combustion but markets have tightened:
  - Sappi/Westbrook, Maine (Paper Mill) has capacity to burn waste wood but purchases very little from Massachusetts processors
  - Boralex (now ReEnergy) bio-fuels combustion facilities in Maine all stopped accepting waste wood (due to CT ruling concerning Renewable Energy Credits)
    - Although we have heard that some facilities may be accepting waste wood again
  - Plainfield Renewable Energy (PRE) gasification facility (CT) also purchases waste wood
    - DSM understands from processors that PRE has operational and storage constraints and tighter specifications, especially for fines

# Waste Wood

- ▶ Particleboard
- ▶ Tafisa is the largest single market for waste wood generate by Massachusetts C&D processors
  - ▶ Located in Lac-Magnetic, Quebec
    - Consumed 216,000 tons in 2016, of which 60 percent were sourced from MA and NH
    - (e-mail correspondence from Sylvain Martel)
  - They would like to increase consumption of waste wood, but fines remain a problem
    - Allowable trace metals has been reduced at Tafisa, reducing the amount of fines Tafisa can accept in the “A” wood.
    - Quebec has tightened combustion specifications resulting in tighter specifications for burning waste wood :
      - Tafisa no longer has arrangement with Kruger (Quebec) so tightened its specification for fines (which they were sending to Kruger)

# Fines Markets, “Not Fine”

- ▶ As in 2007 fines continue to be a significant issue for C&D processors
  - Use of fines as Alternative Daily Cover (ADC) ended due to concerns with hydrogen sulfide emissions at landfills
  - Fines tend to have higher concentrations of trace metals and other contaminants
- Bio-mass combustion facilities accepting wood waste have reduced allowable fines
- ▶ Tafisa has also reduced the amount of allowable fines in their material, in part because the fines also contain higher concentrations of lead
- ▶ Result is that there are really no markets for fines, and fines are an inevitable by-product of processing mixed C&D waste:
  - Dumped on a tipping floor
  - Size reduction of incoming material by excavators (prior to conveying to sort line)
  - Grinding of resultant recovered wood, with screening to reduce fines, to meet end users specifications.

# OCC and Metals

- ▶ OCC in mixed C&D loads often contaminated by other materials, and open-top containers create wet OCC
  - Most facilities do not have balers limiting markets
  - So while OCC is positively sorted, recovery rate is much lower than in single stream MRFs, and the resultant value lower.
- ▶ Robust markets remain for both ferrous and non-ferrous metals, although with large swings
  - Metal in the residue is often attached to wood, or is wire sheathing which can be difficult to manually remove, and may not be captured by magnets.

*Wishful Typical  
C&D Load*





# Plastics

- ▶ Chinese import restrictions have reduced the price of lower value plastics, the primary types available in mixed C&D.
- ▶ While bulky rigid plastics especially, including five gallon pails or other containers, have some value, contaminants significantly reduce their value.
- ▶ Plastic film is prevalent in mixed C&D but often relatively highly contaminated reducing its value.
  - And difficult to pull film off picking line as it gets tangled with other materials

# Still Waiting on Gypsum Markets

- ▶ Gypsum recycled from MA facilities typically goes to Pennsylvania where it is made into an agricultural product.
  - ▶ Potential new market in Raynham, but not definite
- ▶ Best method for recycling gypsum is to manage it separately at the job site
  - When delivered in mixed C&D, tends to break into small particles during collection and mixing on the tip floor
  - Typically pulled off tip floor manually from mixed loads
- ▶ Most gypsum recycling facilities require new gypsum, not painted or wallpapered gypsum, which is typical of demolition debris.

# Asphalt Shingles

- ▶ Most asphalt roofing recycled is delivered directly to facilities/end markets
  - A fair amount of mixed C&D from roofing jobs or repairs contain asphalt shingles
  - Main market in Massachusetts is Carneys (Raynham).
    - Other markets are Rooftop Recycling in Boxborough, MA and RAS-Tech located in Brentwood, NH.

# Processing Advancements and Target Materials

- ▶ Wood (dominant material with market value) can be recovered at relatively high rates depending on incoming loads and equipment available:
  - Depends on ease of separation from contaminants, such as pressure treated wood, and difficulty in meeting Tafisa's specification
  - One solution may be to install additional equipment to recover this wood as "A" Wood for sale to Tafisa or to a bio-mass combustion facility.
    - States could assist with the capital cost of up-front conveyors, air separators, disc screens and optical sorters to recover more wood.
    - While optical identification of pressure treated wood is still in the development stage, it appears feasible according to several optical sort manufacturers
  - Approach might also be to install more air separators and disc screens to remove contaminants from "B" wood lines

# Other Potential Markets/Uses

- ▶ Small scale gasification units to convert “B” Wood into energy:
  - ▶ Not feasible because:
    - Processors need electric power (for equipment), not heat
    - Bio-gas produced needs an internal combustion engine to convert to electricity
    - Bio-gas contains tars/impurities that are difficult to fuel a combustion engine without (extensive) clean-up, which puts the cost significantly higher than buying conventional gasoline or diesel fuel
      - Source Ted Pytlar, D&B Engineers and Architects
- ▶ While ferrous metals are removed by magnets, non-ferrous metals are found in the residue that might be valuable.
  - Additional metal recovery won't have much of an impact on the recycling rate, but it could improve processing economics
  - Would involve the addition of eddy current separators with some additional clean-up of the material before separation

# Takeaways

- ▶ Given the markets, processors in Massachusetts are doing a relatively good job of recovering materials from mixed C&D waste
- ▶ Currently recovering roughly 50 percent of marketable materials, resulting in a 32 percent recycling rate for C&D waste managed in Massachusetts
  - Despite the fact that the market for wood waste is more limited now than in 2007
- ▶ Greater recovery requires continued investment in new processing equipment at existing processing facilities and at transfer stations
  - Low tip fees make it difficult for processors to justify running low value C&D through processing lines and constrains investment in new, capital intensive technologies



# Barriers to Increased Diversion

- ▶ Ohio has plenty of cheap disposal capacity so processing has to stay below rail and tip fee costs to be viable in those states where bans are not in place or enforced
- ▶ Most C&D waste is created during demolition
  - While on-site separation creates highest quality product and recovery rate, limited contribution to diversion
- ▶ Wood markets are limited and are primarily combustion
  - Could be boosted by Renewable Energy Credits
- ▶ MA processing requirement has resulted in higher C&D recovery rates
  - But REC's not available for in-state combustion of waste wood