APPENDIX
Diagnostics Report, Oct 26, 2012

Prepared for:
Governor's Modernizing Recycling Working Group

Prepared by:
DSM Environmental Services

Diagnostics Steps

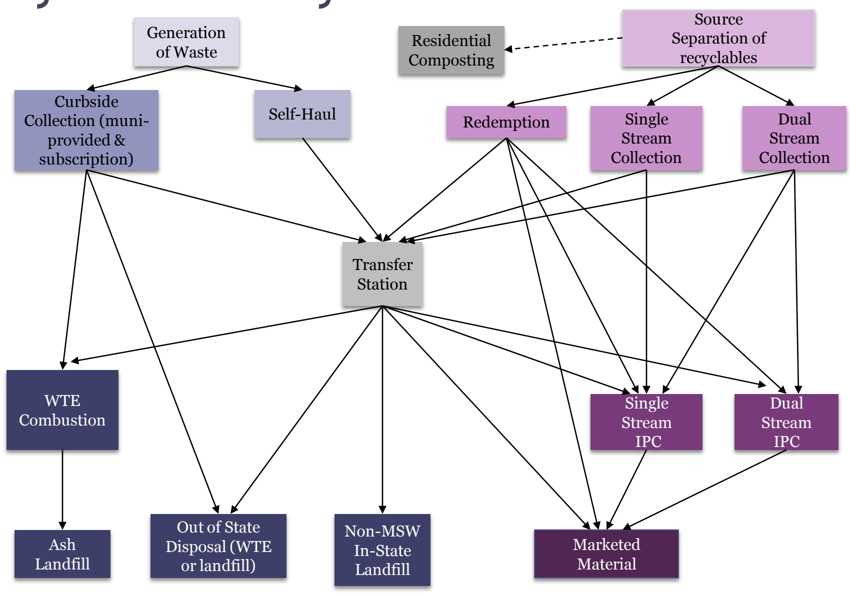
- Systems analysis requiring assessment of the entire solid waste and recycling system including:
  - Infrastructure assessment
  - Institutional analysis
  - Benchmarking materials recovery
  - Cost analysis
  - Assessment of environmental impacts

Limitations

- Data available for our analysis has been limited and required significant manipulation to develop defensible conclusions
  - While high level policy decisions can probably be made with the data available, some conclusions – especially with respect to costs - must be viewed as +/- 25%

Detailed Systems Analysis and Findings

Systems Analysis



Key Points

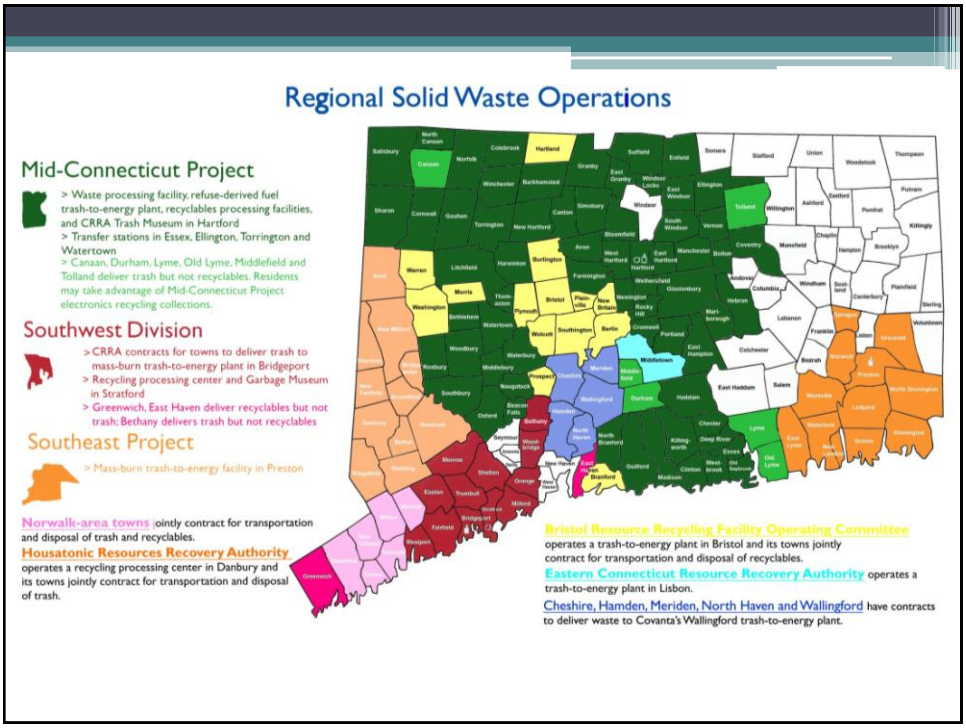
- Regionalization of disposal contracts has occurred in much of the state organized around delivery to RRFs
- But collection is primarily controlled by municipalities and the private sector
- There are an estimated 150 municipal transfer stations, 6 commercial transfer stations, numerous permitted volume reduction facilities, other permitted recycling facilities, and retailers and redemption centers that serve as collection points
- While CT has sufficient single stream processing capacity to manage significant increases in materials recovery, the geographic distribution is probably not optimum
- Cheap out of state landfill costs and developed transfer station infrastructure could result in transfer to out-of-state landfills at end of contracts with RRFs over the next several years

Fragmentation hinders implementation

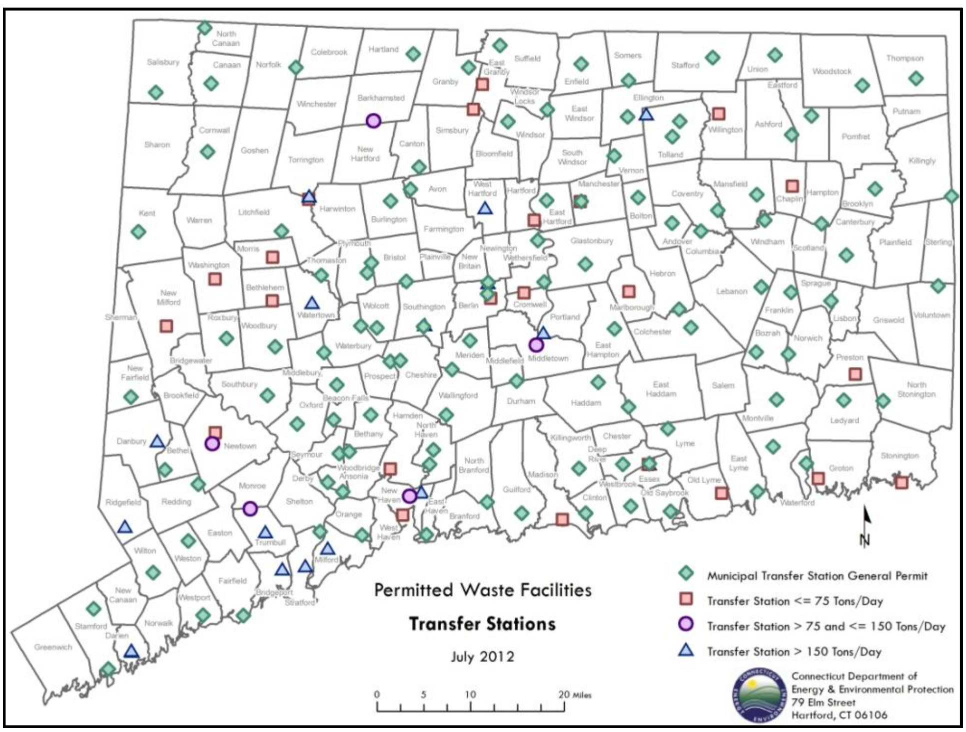
- Responsibility for implementing state plan is highly fragmented
- CT DEEP writes policy but is not solely responsible for implementation
- CRRA has state-wide authority but must fund its activities primarily on revenues from the Mid Conn facility which currently serves only 70 of Connecticut's 169 municipalities
- Municipalities are ultimately responsible for a significant components of the current system
- The private sector plays a vital role in collection, processing and transfer

CT Materials Management: System Components

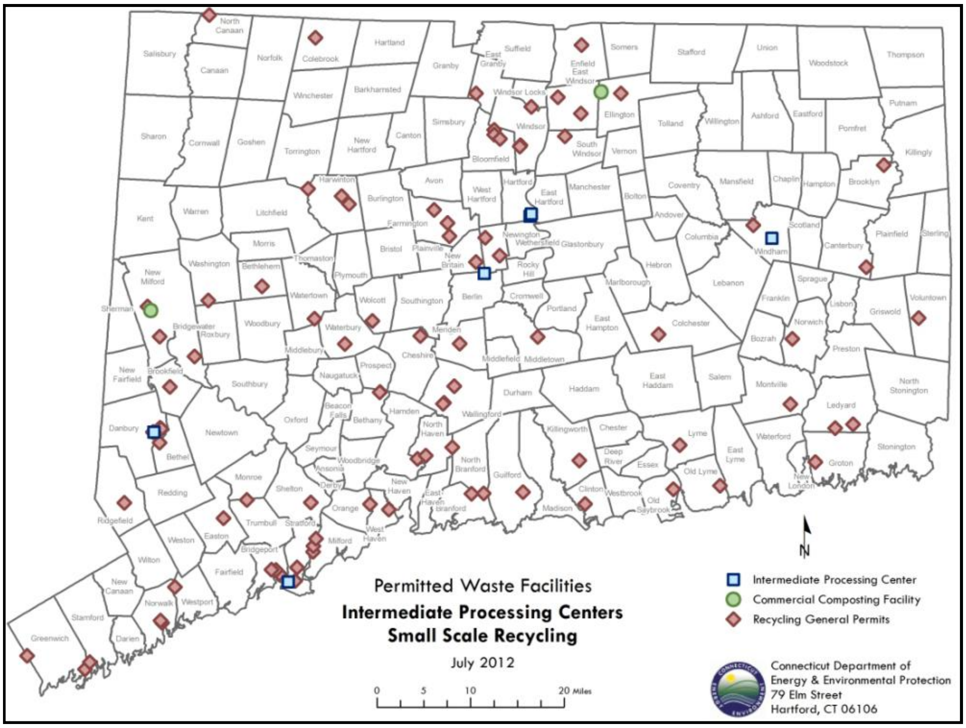
Component	Generation	Collection & Transportation	Aggregation & Transfer	Distribution: Processing, Recovery	Distribution: Disposal
Asset type	Materials	Routes Receptacles Contracts **Municipalities**	Facilities-Public Facilities-Private Permits Redemption Deposits Contracts **Municipalities**	Facilities-Public Facilities-Private Contracts	Facilities-Public Facilities-Private Contracts
Owner	**Municipalities** Private businesses Institutions	Individuals **Municipalities** Private businesses Institutions	**Municipalities** CRRA & Other Regional Authorities Private businesses (Small, few facilities); Private businesses (large, multiple facilities, sometimes same as collection businesses)	**Municipalities** CRRA Recovery (recycling) multiple private businesses Recovery (energy): Private business (Covanta and Wheelabrator for MSW)	**Municipalities** Wheelabrator
Operator	**Municipalities** Private businesses institutions	**Municipalities** Private businesses	**Municipalities** Private businesses	**Municipalities** Private businesses	**Municipalities** Wheelabrator
Regulator	**Municipalities** CT DEEP US EPA	**Municipalities**	**Municipalities** CT DEEP	**Municipalities** CT Siting Council (some) CT DEEP	**Municipalities** CT DEEP US EPA



Regional Solid Waste Operations
Mid-Connecticut Project
> Waste processing facility, refuse-derived fuel trash-to-energy plant, recyclables processing facilities, and CRRA Trash Museum in Hartford
> Transfer stations in Essex, Ellington, Torrington and Watertown
> Canaan, Durham, Lyme, Old Lyme, Middlefield and Tolland deliver trash but not recyclables. Residents may take advantage of Mid-Connecticut Project electronics recycling collections.
Southwest Division
> CRRA contracts for towns to deliver trash to mass-burn trash-to-energy plant in Bridgeport
> Recycling processing center and Garbage Museum in Stratford
> Greenwich, East Haven deliver recyclables but not trash; Bethany delivers trash but not recyclables
Southeast Project
> Mass-burn trash-to-energy facility in Preston
Norwalk-area towns jointly contract for transportation and disposal of trash and recyclables.
Housatonic Resources Recovery Authority operates a recycling processing center in Danbury and its towns jointly contract for transportation and disposal of trash.
Bristol Resource Recycling Facility Operating Committee operates a trash-to-energy plant in Bristol and its towns jointly contract for transportation and disposal of recyclables.
Eastern Connecticut Resource Recovery Authority operates a trash-to-energy plant in Lisbon.
Cheshire, Hamden, Meriden, North Haven and Wallingford have contracts to deliver waste to Covanta's Wallingford trash-to-energy plant.



Permitted Waste Facilities
Transfer Stations
July 2012
Municipal Transfer Station General Permit
Transfer Station <= 75 Tons/Day
Transfer Station > 75 and <= 150 Tons/Day
Transfer Station > 150 Tons/Day
Connecticut Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106
0 5 10 20 Miles

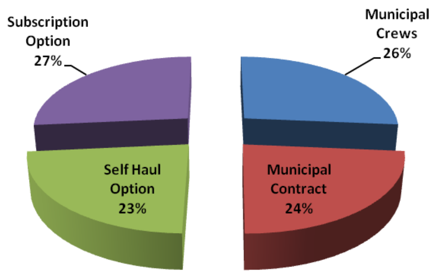


Collection

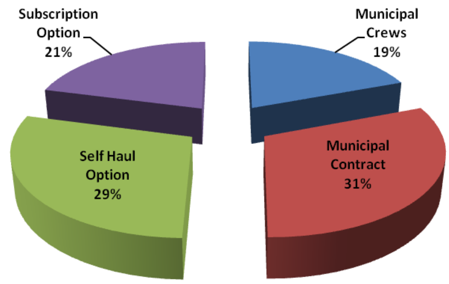
- CT served by a large number of haulers
  - 55 licensed to deliver to CRRA facilities
  - There are no data on the total number of licensed haulers, although range is likely somewhere between 150 – 400
- Only about one-half of households are served by organized collection systems with the rest hauling directly to drop-offs or contracting with private haulers
  - Self haul is typically more expensive when actual miles driven is calculated
  - Subscription residential service is typically more costly than organized (single hauler) collection
- While comprehensive data are not available, it is DSM’s best professional judgment that between 60 and 70% of total residential system costs are represented by collection and transfer costs
  - This may be even higher in CT which has a large percentage of waste going through transfer stations

Residential Collection

Refuse Collection



Recycling Collection



Residential Collection

- Roughly 250,000 households (18%) live in 5 or more unit dwellings, which traditionally have lower recycling access and rates.
- Roughly 71% of households have curbside recycling service options through the municipality or a subscription, leaving 29% with drop-off as the only recycling option.
- **This dynamic is changing with CT nearing full compliance with parallel collection requirements.**

Residential Recycling Collection Methods and Quantities

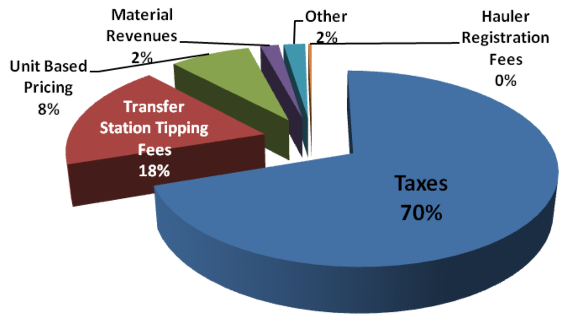
- Roughly 220,000 tons of recycling collected from households in 2011
- Single stream collection has increased these quantities and collection efficiency

Collection Method	Recycling (households)	Recycling (tons)	Current Recycling (lbs/hh)
Organized			
Municipal Crews	269,000	40,000	300
Municipal Contract	431,000	80,000	380
Subtotal:	***700,000***	***120,000***	
Self Haul	380,000	53,000	280
Subscription Service	279,000	47,000	340
Total:	1,359,000	220,000	324

What Might the Residential System Cost?

Collection Option	MSW Collection (households)	MSW Collection Cost ($)	Recycling Collection (households)	Recycling Collection Cost ($)	Total Costs ($)
Typical Costs in Municipal Budgets					
Organized Collection	699,000	$72,280,000	700,000	$25,000,000	$97,280,000
Disposal and Transfer Costs	699,000	$58,020,000	700,000	$0	$58,020,000
Self Haul Option	280,000	$47,050,000	*included*		$47,050,000
Other Solid Waste Management Related Costs		*not included*			$20,000,000
Estimated Municipal Costs:		$177,350,000		$25,000,000	$202,350,000
Other Costs Outside Municipal Budgets					
Self Hauler Transport Cost	280,000	$32,323,200	*included*		$32,323,200
Subscription Collection	407,000	$97,680,000		$39,072,000	$136,752,000
Estimated Additional Costs:		$130,003,200		$39,072,000	$169,075,200
Estimated System Costs:	1,386,000	$307,353,200		$64,072,000	$371,425,200

How Does Local Government Pay for Solid Waste Services?



Based on responses in CT DEEP Municipal Services and Cost Accounting Survey 2008-2010.

What Might the Commercial Sector Pay to Manage MSW and Recycling?

	MSW Disposal			Recycling		
Commercial MSW	(tons)	Unit Cost ($)	Total ($)	(tons)	Unit Cost ($)	Total
Subscription Curbside	53,000	$240	$12,720,000	58,000	$160	$9,280,000
Containerized	720,800	$160	$115,328,000	174,000	$80	$13,920,000
Roll-off and Compactors	265,000	$110	$29,150,000	52,200	$40	$2,088,000
Self Haul	21,200	$170	$3,604,000	5,800	*included*	
Self Haul Costs		*not included*				
Total:	1,060,000		$160,802,000	290,000		$25,288,000

Estiamted Total Commercial System Costs $186,090,000

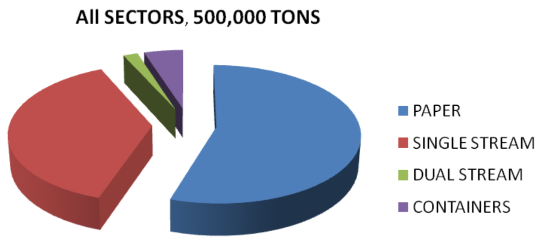
Construction and Demolition Waste Quantities and Costs

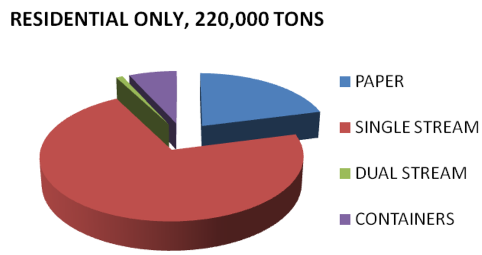
- Data used may be incomplete on quantities or disposition of C&D wastes
- Roughly 330,000 tons of C&D waste were disposed in-state and another 700,000 tons are estimated to be transferred to out-of-state disposal
  - This is in addition to C&D recovery
- A rough estimate is that C&D management adds another $100 million to CT's solid waste management costs
- Based on discussion with C&D processors, and limited DEEP data it is estimated that roughly 7% of C&D waste is recovered for recycling

Materials Recovery

- CT has made significant progress in the development of single stream processing infrastructure
- Legislation requiring parallel collection of mandatory recyclables should continue to boost recovery
- DEEP receives reasonably accurate data from facilities on materials managed in-state
  - However data are not available on significant quantities of commercial recyclables that do not flow through CT processing facilities
- The waste composition data indicate that large quantities of mandatory recyclables and other potentially recoverable materials continue to be landfilled
  - We would expect these quantities to have declined since the waste characterization analysis in 2009
- New bottle bill data show relatively low recovery rates (57%)
- We have developed best professional estimates of potentially achievable materials recovery rates based on the data available

Materials Recovery Facilities, Incoming Packaging Materials (2011)

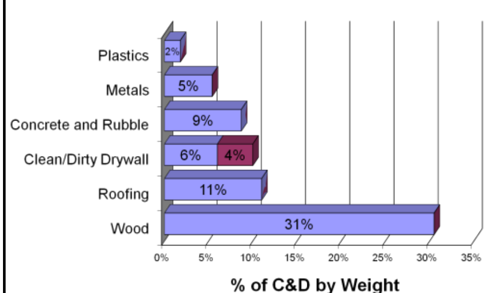




- DEEP receives reasonably accurate data from facilities on materials managed in-state
- However data are not available on significant quantities of commercial recyclables that do not flow through CT processing facilities
- Paper is about 80 percent of the 500,000 tons processed
- Single stream is quickly becoming the predominant collection method

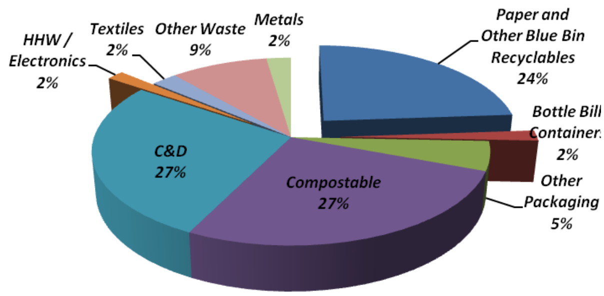
Construction and Demolition Waste

DSM Main Findings from Literature Search (MA DEP Study)



Connecticut's C&D Stream

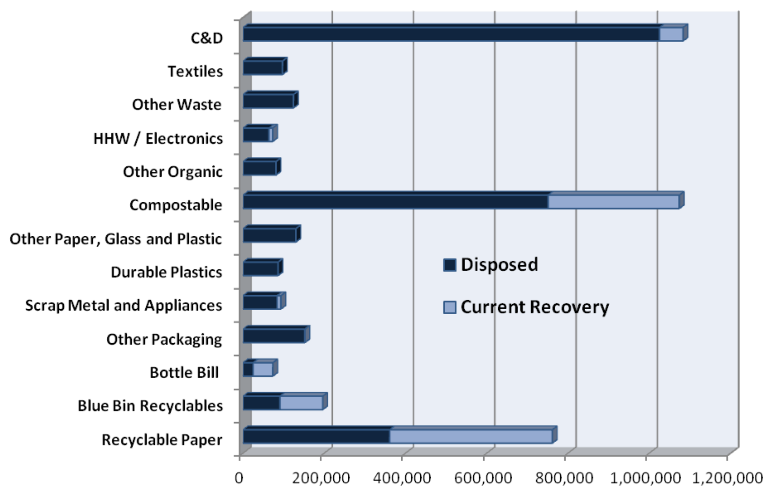
- 750,000 tons handled separately as C&D and 340,000 in MSW
- Estimated 5-7 percent recycling while MA at 33%
- Using MA study results, rough estimates of material available:
  - 300,000 tons of wood
  - 100,000 roofing, mainly asphalt
  - 60,000 tons clean drywall



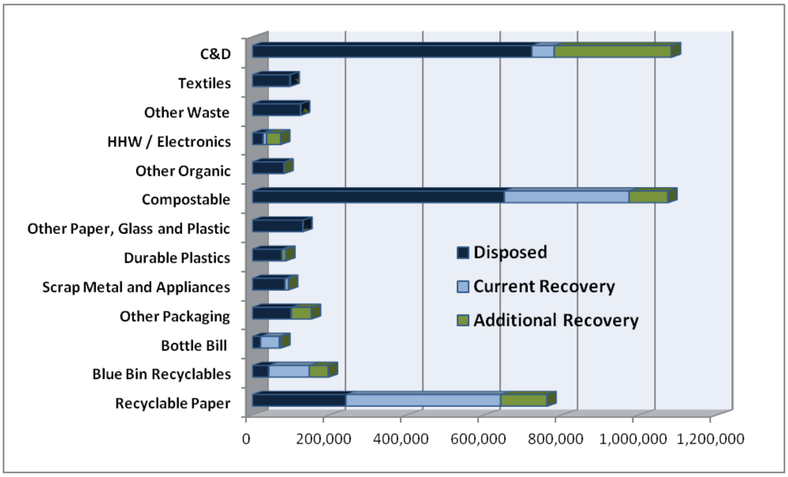
Opportunities for Increased Recovery

- 48% of blue bin materials remain in the waste stream
- 43% of beverage containers are not being recovered
- There are large opportunities for organics and C&D

Current Recovery about 24%



Potentially Achievable Recovery (43%)



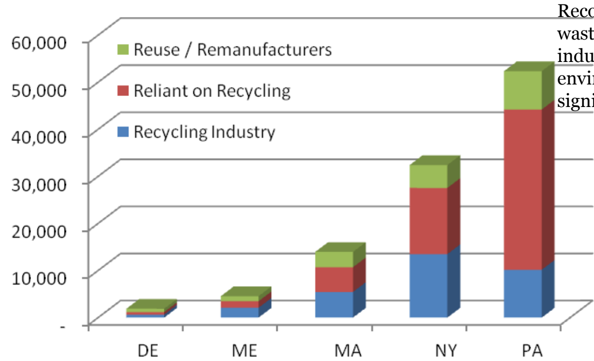
What would be necessary

- Parallel single stream recycling collection and large volume carts for all curbside households
- Unit Based Pricing (PAYT) driving recycling and yard waste diversion
- The addition of more types of packaging to single stream programs
- High recovery under new electronics program
- Increased processing of C&D materials
- Commercial food waste diversion to new facilities
- Film collection programs and incentives

Moving the needle even higher

- Development of plastic processing capacity for a much wider range of plastic materials
- Development of in-state glass processing capacity
- Broad based extended producer responsibility
- Increased processing infrastructure to separate mixed C&D
- Development of organics processing capacity
- Maximizing collection efficiency to pay for additional wet waste/organics collection

From about 2000 jobs in Delaware to over 50,000 in PA (2009), Jobs through recycling are important to State economies



Other Reasons to Aim High: *Jobs and the Recycling Economy*

Jobs estimates in five northeastern states in the recycling, recycling reliant and reuse/remanufacturing industries

Recovering materials from Connecticut's waste stream for use in these types of industries creates jobs and environmental benefits, including significant reductions in GHG emissions

Connecticut's Recycling Economy and Jobs

- Recycling collection, processing and wholesaling operations in CT employ 3000 with a payroll of over $130 million
- CT has a wide range of recycling reliant industries with much greater employment, payroll and contributions than the recycling industries alone:
  - CT paper and paperboard mills use an estimated 50% recycled fiber with Fusion Paper using 100%
  - Roughly 590 jobs at CT mills at a payroll of $43 million currently can be attributed to the recycling economy
  - An additional 100,000 tons recovered and sent to Connecticut mills versus RRF's could create 1800 additional high paying jobs
  - More research is necessary to identify Connecticut's recycling reliant industries and their specific needs

ENERGY RECOVERY

Current System

- Connecticut has highest percentage of waste going to energy recovery in U.S.
  - Just under 70 percent
- Driven by policy of the State 35 years ago
- It was made feasible through explicit State decisions
  - Creation of CRRA with ability to borrow at low cost with implicit State guarantee
  - Flow control to assure steady supply of waste
  - Avoided cost energy rates that became above market
  - Sale of tax credits requiring transfer of ownership to private companies despite public borrowing (except Mid –CT)

Environmental Performance Greenhouse Gas Emissions

- Materials recycling is an important way to reduce GHG emissions
  - Collection, transport and processing of recyclables is a minor contributor to GHG emissions
  - Mining, milling, and manufacturing are large energy consumers
  - Replacing virgin materials with secondary materials is often one of the best ways to reduce GHG emissions
  - However, in CT, with waste going to WTE facilities there may be cases where combustion of some hard to recycle materials is preferable over material recycling

GHG Emissions (cont.)

- Connecticut's current system of burning non-recycled waste to produce electricity slightly reduces GHG emissions over landfilling this waste
  - It also reduces GHG savings associated with recycling because some savings come from reductions in methane generation at landfills
- The picture is not so clear when comparing combustion of organics contained in the waste with composting or anaerobic digestion

EPA WARM Model Results from Increasing Residential Recycling

GHG Emissions Reductions
EPA Warm Model

Total GHG Emissions from:	Combustion (MTCE)	Landfill (MTCE)	Difference (MTCE)
Baseline Recycling:	(186,439)	(181,246)	(5,192)
Increased Recycling	(250,326)	(250,563)	237
Incremental GHG Emissions (MTCE):	*(63,887)*	*(69,317)*	*5,430*

MTCE = metric tons of carbon equivalent

This is equivalent to...			
Removing annual emissions from:	45,932	49,836	Passenger Vehicles
Conserving	26,261,562	28,493,565	Gallons of Gasoline

Important Issue: Biogenic vs. Non-biogenic Materials

Heat contents for select components of municipal solid waste

Biogenic	Heat content (MMBtu/ton)	Non-biogenic	Heat content (MMBtu/ton)
Newsprint	16	Rubber	26.9
Paper	6.7	PET (polyethylene terephthalate)	20.5
Containers and packaging	16.5	HDPE (high-density polyethylene)	19.5
Textiles	13.8	PVC	16.5
Wood	10	LDPE/LLDPE (low-density polyethylene)	24.1
Food waste	5.2	PP (polypropylene)	38
Yard trimmings	6	PS (polystyrene)	20.5
Leather	14.4	Other (plastic)	18.1
Average	11.1	Average	23

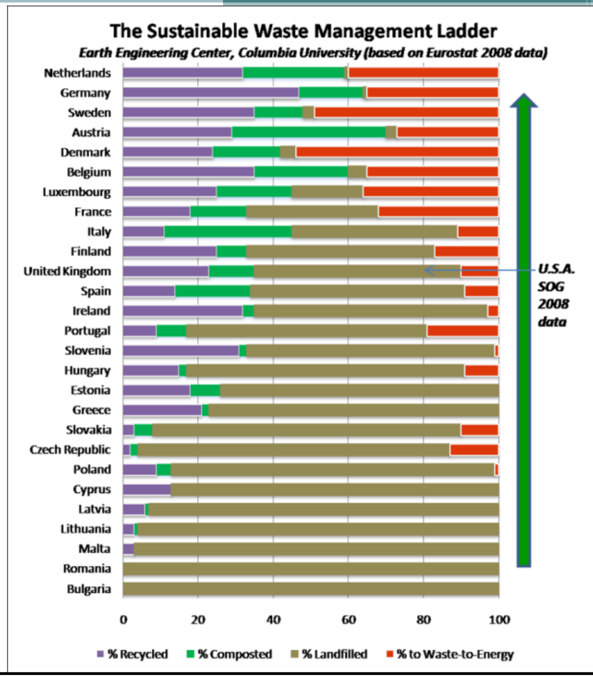
Policy Issue

- Combustion of mixed waste results in emission of 2,988 pounds of carbon dioxide per megawatt hour.
- This is higher than competing fossil fuel:
  - Coal: 2249 pounds per MWH
  - Oil: 1672 pounds per MWH
  - Natural Gas: 1135 pounds per MWH
- However if you assume, as US EPA does that roughly 55 percent of mixed MSW is biogenic, and therefore carbon neutral, combustion of MSW results in the lowest emissions at 1016 (1)

Source: Renewable Energy from Waste, “Clearing the Air”, Fall 2012

European Trends in Sustainable Waste Management

Where Does CT Want To Be In 10 Years?



Impact on GHG Emissions of Alternative Management of Organics

- When food waste is burned most of the energy inherent in the food waste is consumed converting water to steam
  - Net energy recovered is low
- When food waste is composted, the organic material is converted to carbon dioxide (a greenhouse gas)
  - But food is biogenic so the GHG emissions are off-set by growth of more plants; and by application of compost to the soil sequestering some carbon
  - However, composting can go anaerobic creating methane – a potent GHG
- When food waste is used to produce energy in an anaerobic digester the methane is captured to produce energy
  - The net energy is greater than for combustion making anaerobic digestion preferable to WTE facilities with respect to reducing GHG – according to most studies
  - But the technological risks are also greater

How Much Organic Waste Is There

- Residential (tons)
  - Food Waste: 183,000
  - Compostable Paper: 131,000
  - Leaves and Grass: 142,000
  - Other organics: 53,000

Total: 510,000 tons (rounded)

- Commercial (tons)
  - Food Waste: 138,000
  - Compostable Paper: 64,000
  - Leaves and Grass: 30,000
  - Other organics: 22,000

Total: 254,000 tons (rounded)