STATEWIDE ECONOMIC BENEFITS OF CONNECTICUT'S WASTE TO ENERGY SECTOR

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EXECUTIVE SUMMARY

Total statewide economic contribution of waste to energy in Connecticut -- $428 million.

- Direct labor impacts—381 workers in six plants in Connecticut.
- Direct labor earnings-- $32.7million in wages, salaries and benefits paid to workers in WTE sector in Connecticut.
- Job multiplier impact—558 additional full time equivalent jobs created in Connecticut outside the WTE sector. An estimated 1.5 additional jobs are supported by each job at a waste to energy plant.
- Labor income multiplier effect--$27.4 million in wages, salaries and benefits received by Connecticut workers outside the waste-to-energy sector.
- Total jobs impact- 939 full-time equivalent jobs located across Connecticut.
- Total labor income impact-- $60.0 million in wages, salaries and benefits received by Connecticut workers.

If the garbage hauling and transfer infrastructure that supports the six waste to energy plants in Connecticut are included in the analysis, an estimated $651 million in total output and about 10,000 total jobs can be added to the above numbers.

In the future, aside from serving as engines of jobs throughout the state, waste to energy plants are hubs around which alternative energy and recycling eco-parks might be developed. These eco-parks could stimulate further economic activity, given the close proximity of power, and encourage experimentation with new waste to power conversion and recycling technologies.

INTRODUCTION: WASTE TO ENERGY IN CONNECTICUT

Connecticut has been a leader in waste to energy (WTE), since the 1970s. At that time, the state, recognized that its existing methods of disposal, landfills and incinerators, were environmentally unsustainable and in violation of federal and state law. State officials enlisted the technological, managerial and financial skills of the public and private sector to develop a ground-breaking plan to construct a number of waste to energy plants, strategically located throughout the state. As a result, Connecticut has the highest percentage of its waste going to energy recovery than any other state in the U.S., about 70% of its non-recyclable waste.

There are six waste to energy facilities in Connecticut: Wheelabrator Bridgeport, SECONN Preston, Bristol Resource Recovery Facility, Hartford Mid-CT, Wallingford Resource Recovery Facility, and Wheelabrator Lisbon. Five of these plants use mass burn technology, which requires no pre-processing of the waste prior to combustion. In one case, Mid-CT, waste is pre-processed to form a refuse-derived fuel (RDF). These plants processed a total of 6,100 tons of refuse per day and 2.3 million tons per year. About 1.3 million megawatt-hours of base line electricity were generated from the waste, enough to meet the power needs of 111,000 homes.[1] In addition, these plants are recycling about 58,000 tons of ferrous metals and 400 tons of non-ferrous metals per year. Table 1 shows basic characteristics of the six plants in Connecticut.

Table 1: Waste to Energy Plants in Connecticut

Plant Name	Operator	Tons per Day	Tons Per Year	Net MWH	Ferrous Metal Recycled
Bridgeport	Wheelabrator	2,041	732,735	478,410	22,410*
SECONN	Covanta	753	274,787	131,500	5000
Bristol	Covanta	543	198,086	106,622	4621
Mid-CT	NAES	1,859	789,333	390,426	25,299
Wallingford	Covanta	407	148,617	57,979	
Lisbon	Wheelabrator	509	185,685	111,542	1017
TOTAL		6,112	2,329,243	1,276,479	58,347
***Includes 400 tons per year of non-ferrous metal**					

ECOMOMIC IMPACTS OF WASTE TO ENERGY IN CONNECTICUT: MULTIPLIER EFFECTS

The WTE sector contributes to the state's day to day functioning in three major areas: 1) it is the chief method of disposal for most residential and commercial waste; 2) it is the state's largest recycler of municipal post-consumer metals by a factor of two; and 3) it serves as power generator, providing baseline electric power to Connecticut residents and beyond. The revenues, employment, and labor earnings obtained from these activities constitute the direct economic benefits of waste to energy.

[1] **2012-2013 Municipal Waste to Energy in the United States: Yearbook and Directory** (Westport, CT: Governmental Advisory Associates, 2012)

However, in addition, these activities also generate indirect impacts (value of inputs purchased in the first and second round of spending by the WTE sector and in subsequent rounds of spending by supporting industries) as well as induced impacts (value of goods and services purchased by all workers whose earnings are affected by the direct and indirect WTE spending).[2] The data on revenues and employment used in this study are based on a 2011 survey of WTE plants in the United States undertaken by Governmental Advisory Associates, Inc. An economic impact model using BEA RIMS II Multipliers was used to estimate the multiplier effects[3]. Table 2 breaks down approximate aggregate revenues, earnings and employment of the six Connecticut plants.[4]

Table 2: Statewide Economic Impacts of Waste to Energy

	Direct Impact*	Indirect Impact	Induced Impact	Total
Total Revenue	$247,877,000	$85,594,000	$94,571,000	$428,042,000
Employment**	381	209	349	939
Labor Earnings***	$32,652,000	$12,946,000	$14,434,000	$60,032,000
Value Added****	NA	$147,811, 240	$104,221,000	$252,033,000
***Total Revenues, Jobs and Job Earnings of 6 WTE plants in Connecticut**				
****Includes 18 staff of CRRA and Bristol Resources Recovery Authority allocated to WTE**				
***** Using average salary and benefits of $85,700 (Maine Study)**				
******Value added reflects taxes paid, and business and household investments, as well as earnings.**				

As can be seen the total annual revenues earned by the six waste to energy plants are in the range of one-quarter billion dollars. These revenues come from three major sources: 1) fees charged for waste disposal, 2) the sale of electricity to the power grid, and 3) the sale of recovered metals which are recycled prior to combustion as waste comes into the plant or after combustion from the processing of the ash before it is disposed. There are nearly 400 employees in Connecticut working directly at a waste to energy plant or engaged in activities which directly support plant activities, such as billing, interfacing with utilities, overseeing contracts. This direct labor earns about $33 million annually including salary and benefits, computing to an average annual compensation (including benefits) of about $85,700. The reason for such a relatively high salary is that most jobs at a waste to energy plant are skilled positions, requiring knowledge to operate and maintain sophisticated machinery and control technologies. As in any power plant, there is continuous environmental, safety and technical oversight, which also requires a trained workforce.

In order to dispose of more than two million tons of refuse per year and generate over one million megawatt-hours of electricity, these plants draw on the goods and services of many different types of firms from boiler manufacturers, manufacturers of air pollution control equipment, firms specializing in valves, piping, shredders, magnets to those firms that manufacture computers, and various types of instrumentation displays. In addition, the industry relies on a variety of professional inputs such as

[2] RIMS II: An Essential Tool for Regional Developers and Planners, Bureau of Economic Analysis, U.S. Department of Commerce. www.bea.gov. p.5-3

[3] Bureau of Economic Analysis does not endorse any resulting estimates and/or conclusions about the economic impact of a proposed change on an area.

[4] Mid-CT employment numbers include a portion of personnel of the Connecticut Resources Recovery Authority (CRRA) devoted exclusively to WTE. Revenues were obtained from interviews with plant operators and annual financial reports.

accounting and environmental consultant services. The statewide impact of these purchases is $86 million (indirect impact). In addition, these purchases affect all the employees working in the various industries selling their output to the WTE sector. These employees consume additional goods and services. The statewide impact of employee and household consumption as a result of direct WTE activities (induced impact) is $95 million. Finally, the value added portion of revenues that WTE contributes to the state's economy is about $250 million. In addition, to salaries and wages of employees, this category of value added includes taxes paid to government and returns on investment.

In order to assess more closely the impact of the waste to energy sector on the Connecticut economy, one can examine the multiplier effect on specific industrial and commercial categories within the state. Tables 4, 5, and 6 show this break down for revenues, employment and labor earnings. As can be seen in Table 4, the largest impact of the waste to energy industry in terms of output (revenues) is in finance and insurance, retail trade, manufacturing, health sector, professional services, and real estate. Tables 5 and 6 break down multiplier effects for jobs and labor earnings. Jobs and earnings track each other closely. The largest impact of the WTE industry, outside of utilities and waste management is in professional and scientific services, finance and insurance, real estate, health care and retail trade.

Table 4: Breakdown of WTE Multiplier Effect on Output by Industry

Industry Sector	Direct Impact	Indirect Impact	Induced Impact	Total
Waste to Energy	$247,876,858	$0	0	$247,876,858
Agric., forestry, fishing, hunting	0	$47,515	$185,116	$232,631
Mining	0	$3,926	$15,294	$19,220
Utilities	0	$505,066	$1,967,712	$2,472,778
Construction	0	$119,532	$465,690	$585,222
Manufacturing	0	$1,432,893	$5,582,480	$7,015,373
Wholesale trade	0	$1,245,270	$4,851,510	$6,096,780
Retail trade	0	$2,564,994	$9,993,087	$12,558,082
Transportation, warehousing	0	$470,276	$1,832,172	$2,302,448
Information	0	$1,204,118	$4,691,182	$5,895,300
Finance and insurance	0	$3,785,763	$14,749,139	$18,534,902
Real estate and rental and leasing	0	$4,252,113	$16,566,016	$20,818,129
Professional, scientific, and technical services	0	$1,121,813	$4,370,526	$5,492,338
Management of companies and enterprises	0	$280,216	$1,091,708	$1,371,925
Administrative and waste management services	0	$600,096	$2,337,944	$2,938,040
Educational services	0	$490,852	$1,912,336	$2,403,188
Health care and social assistance	0	$3,676,519	$14,323,531	$18,000,050
Arts, entertainment, and recreation	0	$289,015	$1,125,989	$1,415,005
Accommodation	0	$154,322	$601,231	$755,552
Food services and drinking places	0	$890,600	$3,469,734	$4,360,334
Other services	0	$1,133,049	$4,414,300	$5,547,348
Households	0	$6,362	$24,788	$31,150
Sum	**$247,876,858**	**$85,594,337**	**$94,571,484**	**$428,042,679**

Table 5: Breakdown of Impact of WTE Multiplier Effect on Jobs by Industry

Industry Sector	Direct Impact	Indirect Impact	Induced Impact	Total
Waste to Energy	381.0	0.0	0.0	381.0
Agric., forestry, fishing, hunting	0.0	0.0	1.9	2.0
Mining	0.0	0.0	0.0	0.1
Utilities	0.0	55.4	1.7	57.1
Construction	0.0	4.1	1.8	5.9
Manufacturing	0.0	4.1	8.6	12.7
Wholesale trade	0.0	1.8	9.6	11.3
Retail trade	0.0	1.4	57.9	59.3
Transportation, warehousing	0.0	5.3	7.4	12.7
Information	0.0	1.5	6.2	7.8
Finance and insurance	0.0	5.6	23.4	29.0
Real estate rental and leasing	0.0	3.0	49.8	52.8
Professional, scientific, and technical services	0.0	10.4	14.0	24.4
Management of companies and enterprises	0.0	2.1	2.2	4.3
Administrative and waste management services	0.0	102.9	16.7	119.7
Educational services	0.0	0.3	13.4	13.7
Health care and social assistance	0.0	0.1	67.8	67.9
Arts, entertainment, and recreation	0.0	1.3	9.3	10.5
Accommodation	0.0	0.7	2.2	2.9
Food services and drinking places	0.0	4.5	26.1	30.6
Other services	0.0	4.0	23.2	27.2
Households	0.0	0.0	6.0	6.0
Sum	381.0	208.5	349.2	938.7

Table 6: Breakdown of Impact of WTE Multiplier Effect on Job Earnings by Industry

Industry Sector	Direct Impact	Indirect Impact	Induced Impact	Total
Waste to Energy	$32,651,700	$0	$0	$32,651,700
Agric., forestry, fishing, hunting	0	$0	$36,668	$36,668
Mining	0	$0	$0	$0
Utilities	0	$3,821,929	$193,914	$4,015,843
Construction	0	$145,799	$102,502	$248,301
Manufacturing	0	$252,065	$556,918	$808,983
Wholesale trade	0	$122,906	$769,817	$892,723
Retail trade	0	$37,497	$1,796,656	$1,834,153
Transportation, warehousing	0	$272,884	$366,253	$639,137
Information	0	$108,325	$461,829	$570,154
Finance and insurance	0	$372,886	$1,656,755	$2,029,641
Real estate and rental and leasing	0	$77,078	$571,883	$648,961
Professional, scientific, and technical services	0	$647,847	$1,047,665	$1,695,512
Management of companies and	0	$247,903	$256,233	$504,136

enterprises				
Administrative and waste management services	0	$6,539,280	$501,545	$7,040,825
Educational services	0	$6,249	$506,006	$512,255
Health care and social assistance	0	$2,083	$3,666,768	$3,668,851
Arts, entertainment, and recreation	0	$22,915	$190,632	$213,547
Accommodation	0	$22,915	$80,629	$103,544
Food services and drinking places	0	$83,325	$579,215	$662,540
Other services	0	$162,488	$1,033,752	$1,196,240
Households	0	$0	$58,668	$58,668
Sum	$32,651,700	$12,946,374	$14,434,307	$60,032,381

ECOMOMIC IMPACTS OF SOLID WASTE COLLECTION AND TRANSFER IN CONNECTICUT

The above discussion focuses solely on the waste to energy plants themselves, excluding the activities necessary to bring the waste to the plant. In order to encompass the entire waste to energy industry, one could also include the activities of refuse hauling and transfer. Municipal solid waste is picked up by municipalities or private haulers at homes and businesses. Trucks may drive directly to the waste to energy plant or they may transport the waste to a transfer station, where the waste is unloaded and compacted onto larger vehicles, which are then driven to the disposal facility. If collection and transfer activities are included in the economic impact study, numbers change dramatically. This portion of the industry has estimated annual sales revenues of about $332 million and employs about 4000 people in Connecticut.[5] The economic impact of these hauling activities can be calculated using the BEA Rims II multipliers as is shown in Table 7. The initial 4000 jobs generate an additional 5900 jobs throughout the state, or about 1.5 jobs for every hauling job. The $332 million in sales adds an additional $320 million of economic output in Connecticut. If one combines waste hauling with waste to energy, this combined waste management sector is responsible for generating about a total of $1.1 billion in economic output, and about 11,000 direct and indirect jobs!

Table 7: Estimated Economic Impact of Refuse Hauling in Connecticut

	Direct Impact	Indirect Impact	Induced Impact	Total
Total Revenue	$332,065,000	$164,671,000	$154,543,059	$651,279,000
Employment	4000	2691	3257	9948
Value Added	NA	$266,681,000	$94,173,000	$360,854,000

[5] Numbers are estimates only and are derived from *First Draft Diagnostics Report* prepared for Governor's Modernizing Recycling Working Group, Hartford Connecticut, September 25, 2012 by DSM Inc. and *Executive Summary: Economic Impact on Connecticut from Recycling Activity*, November 2012, prepared for the Connecticut Resources Recovery Authority by Connecticut Economic Resource Center Inc. (CERC).

WASTE TO ENERGY AS AN ECONOMIC AND TECHNOLOGICAL ENGINE IN CONNECTICUT

The multiplier analysis assists in understanding the economic ripple effects throughout the Connecticut economy of the $250 million waste to energy industry. However it is limited in that it looks backward to the industries and services which supply the waste to energy sector. It does not examine the positive benefits on industries that make use of the services supplied by WTE facilities. Multiplier analysis also assumes that technology is static; it does not take into account changes in technology and the economic impacts of such changes. Finally, the focus of multiplier analysis by definition is on quantifiable economic changes. It does not assess other benefits that might accrue to the state from a robust waste to energy industry. A waste to energy plant generates baseline power from local, renewable sources. In addition, with the strategic location of plants within Connecticut, the state is able to minimize the transport of garbage out of state, thereby reducing long range transportation costs, as well as disposal liabilities and pollution that accompanies waste transport and land disposal.

Waste to energy plants as technology hubs

WTE plants are an aggregation of diverse dynamic technologies encompassing waste handling, processing, recycling, combustion, and air pollution control systems. They process a non-homogeneous fuel, mixed solid waste, in order to produce energy. They employ a full-time technically skilled workforce, trained to deal with the various challenges involved with converting a variable fuel into steam or electricity. Driven by economic, regulatory and environmental changes, the industry has continued to become more efficient and effective in energy production and emissions control. It has also moved to aggressively recycle metals as the value of this commodity has risen. Thus, each plant to some degree is its own technology laboratory. It is constantly assessing different approaches and types of equipment in order to better process the waste and obtain the highest value from it, while lowering adverse pollution impacts. The existing waste to energy infrastructure in Connecticut is a platform upon which new technological approaches to waste processing might be tested and possibly adapted. The opportunity exists for a public-private partnership between the state and plant owners to experiment with various gasification or other energy from waste alternatives or modify new waste processing, combustion, air pollution control or recycling technologies.

Waste to energy plants as alternative energy hubs

Waste to energy plants in Connecticut provide about 1.2 million megawatt hours of electricity which are sold onto the regional electrical grid. This is an existing and thriving market, albeit with some volatility in pricing. WTE facilities in the state are already providing energy for over 100,000 businesses and households. They are local plants, providing local baseline power from a local renewable source. In the not too distant future, one could envision these plants as alternative energy hubs or as centers of “micro-grids” that could supply businesses and homes in the immediate surrounding area with reliable renewable power. Greater energy efficiencies could be achieved by the creation of a local steam loop, whereby the plant could supply steam for heat, hot water or cooling to customers at reasonable rates.

Such an energy hub could be a driver for economic development or in certain areas stimulate the creation of an alternative energy industrial park or eco-park.

Waste to energy plants as recycling hubs

Waste to energy and recycling facilities often exist in near proximity to each other or side by side. It is a benefit to a recycling plant to co-locate with a disposal facility, since transport and disposal of non-recyclable residue disposal can be a significant cost for the recycling facility. WTE plants are already recycling significant amounts of ferrous metals and are installing non-ferrous metal separation systems, given the economics of the metals market. The large tonnage being processed at WTE plants allows for additional recycling opportunities, if the technology and economics make it feasible. Finally, while there has been considerable research undertaken on the recycling of combustion ash, more work is necessary. Waste to energy plants provide a ready laboratory for alternative approaches to recycling ash, thereby further closing the sustainability loop.

APPENDIX A: A NOTE ON METHODOLOGY

The BEA RIMS ll Model

The source of the multipliers used is the Bureau of Economic Analysis, U.S. Department of Commerce. Any multiplier analysis makes certain assumptions which include:

- **Backward linkages**. It measures links increases in output of a target industry to corresponding increases in demand for inputs from those industries that supply the target industry. Thus, it does not measure the effect on industries that might buy additional product from the target industry.
- **Fixed purchase patterns**. It does not factor in that an industry may alter its mix of labor and capital as a result of changing prices or other factors.
- **Industry homogeneity**. The model assumes all businesses in a certain category behave the same, using the same production processes.
- **Fixed prices**. The model assumes no price adjustment due to supply constraints. Businesses can use as many inputs as needed without any pricing issues.
- **Local supply conditions**. The model creates its regional multipliers based on regional concentrations of an industry relative to its concentration in the nation. Obviously, not all the intermediate goods purchased by an industry come from the target region. However, the model cannot take account of all local leakages to surrounding regions, that is, all purchases of goods from areas outside the given region or purchases outside the region that might result in secondary inputs being supplied from within the region.
- **No time dimension**. There is no specific time dimension implied by the data. It is thought that a certain amount of time must pass before the full range of economic ripple effects are felt.

The Waste to Energy Classification

The industrial classifications used by the BEA are aggregated categories based on the NAICS classification. There is no specific category for waste to energy. However, there are categories for utilities and administrative and waste management services. To do the analysis, waste to energy was treated as a composite of the utility and waste management sector. Revenues from Connecticut's 6 WTE plants were allocated to either the utility or waste management portion of the business. Basically, electricity revenues fell into the utility category; tip fee and recycling revenues fell into the waste management category. The resulting percentage breakdown was applied to both jobs and labor earnings.

Calculation of Refuse Collection Revenues

Revenues for collection was calculated from figures provided in the *First Draft Diagnostics Report* prepared for Governor's Modernizing Recycling Working Group, Hartford Connecticut, September 25,

2012 by DSM Inc. It also relied on data included in *Executive Summary: Economic Impact on Connecticut from Recycling Activity*, November 2012, prepared for the Connecticut Resources Recovery Authority by Connecticut Economic Resource Center Inc. (CERC).