AN ENVIRONMENTAL ANALYSIS OF

CONNECTICUT HOUSE BILL NO. 5118:

"AN ACT CONCERNING THE RECLASSIFICATION OF TRASH-TO-ENERGY FACILITIES AS CLASS I RENEWABLE ENERGY"

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Executive Summary

The state of Connecticut is currently considering reclassifying Waste-to-Energy (WtE) technology as a Class-I renewable energy source. If the state were to implement the "Act Concerning the Reclassification of Trash-to-Energy Facilities as Class-I Renewable Energy," CT Raised Bill No. 5118, Connecticut would classify WtE plants in the same category as the cleanest renewable sources such as wind and solar energy. Promoting WtE as a renewable energy source suggests that the bill would help address the problems of global climate change and local air pollution. The legislation proposes a solution to these environmental problems by giving additional monetary value to WtE through Class-I Renewable Energy Credits. As such, the value of WtE would increase. In addition, we assume that the legislation would also lead to an increase in the percentage of trash incinerated at WtE facilities. This report will analyze the effectiveness of WtE plants in avoiding greenhouse-gas emissions and air pollution, such as nitrogen oxide and particulate matter, as compared to Connecticut's status quo.

Our calculations demonstrate that WtE facilities produce emissions comparable to those resulting from the landfilling of trash. As an energy source, WtE plants actually release more emissions than fossil fuels per unit of energy created. This, however, is an incomplete comparison.

It is important to recognize that WtE technology performs two vital functions in energy recovery: it produces electricity while simultaneously eliminating the need for landfills and long-distance waste hauling. The proposed legislation would have the greatest environmental impact if it led to the incineration of 100 percent of Connecticut's trash, eliminating the need to transport trash to landfills. If the legislation led to this result, total greenhouse-gas emissions in Connecticut would decrease by 0.3 percent, while the total amount of renewable energy generated would increase to 14.5 percent of Connecticut's required renewable energy in 2020.

There are several controversies surrounding this bill. For instance, the financial benefits from Renewable Energy Credits are normally distributed to the renewable energy generator, for instance WtE facilities. However, this legislation stipulates that all proceeds be relinquished to the local municipalities where the energy producer is located. Municipalities could use this money to pay for waste disposal, or tipping, fees, leading us to believe that the bill is also a waste-management strategy. In addition to reviewing the available data to create our own calculations, we also took into account citizen testimony about the proposed legislation. Our findings led us to conclude that this bill advocates two, albeit somewhat antithetical, solutions. First, the legislation could help reduce climate change and local air pollution. Secondly, the bill may also provide municipalities with additional financial resources to pay for waste-disposal fees.

Environmental Problems Addressed

Connecticut Raised Bill No. 5118 could help address two important environmental problems: local air pollution and global climate change. We focused our analysis on nitrogen oxide and particulate matter because these two air pollutants cause a long list of adverse health effects, including asthma, irregular heart beat and shortness of breath.[1] Greenhouse-gas emissions, namely carbon dioxide (CO_2) and methane (CH_4), are a concern for Connecticut because they lead to climate change on a global scale. A warming climate could induce sea-level rise and may result in more frequent severe storms for Connecticut, putting the state at an increased risk of flooding.

Most of Connecticut's landfilled waste is transported out of state using diesel trucks. The burning of the diesel emits nitrogen oxides (NO_x) and fine particulate matter that consists of more than 40 toxic air contaminants.[2] Nitrogen oxides, along with fine particles, play a major role in atmospheric reactions that form smog and ground-level ozone, both of which lead to adverse health effects in Connecticut during the summer months.[3] Particulate matter can be readily inhaled, and, due to its small size, it is not filtered in vehicles' exhaust. As a result, particulate matter penetrates deeply into the human cardiovascular system where it can cause significant damage.[4] According to the Connecticut Department of Environmental Protection, when inhaled these pollutants can cause health effects such as bronchitis and even heart attacks. In addition, diesel particulate matter is a probable carcinogen.[4]

Status Quo

In Connecticut, 68 percent of the municipal solid waste (MSW) is currently incinerated via WtE, 24 percent is recycled, and eight percent is landfilled.[5] Of the eight percent of MSW that is landfilled, seven percent is landfilled out of state.[5] Our calculations later in the report are focused on this eight percent of total MSW that is currently landfilled. By sending currently landfilled trash to WtE facilities, some of the emissions from landfills and trucking will be avoided. This would help to solve the environmental problems mentioned previously. We estimate that the transport of municipal waste to out-of-state landfills produces 193,360 metric tons of carbon dioxide equivalents (CO_2e) annually. Landfills also emit a significant amount of methane and carbon dioxide. We determined that one year of out-of-state landfilling of Connecticut's municipal solid waste generates 349,074 metric tons of CO_2e. A year of in-state landfilling accounts for 29,392 metric tons of CO_2e.

Currently, Connecticut generates 50 percent of its power from nuclear, 44 percent from fossil fuels, 3 percent from renewables, and 3 percent from WtE.[6] In 2010, Connecticut's fossil fuel-powered electricity plants released 8,973,000 metric tons of CO_2e. In this report, our calculations focus on the amount of fossil fuel energy and emissions that WtE can potentially replace by burning the trash Connecticut presently transports to landfills.

Solution

In order to address these environmental problems, the proposed legislation will encourage WtE production. The bill does this by reclassifying the electricity generated by WtE facilities in Connecticut as a Class-I renewable energy source, putting it on par with renewables such as wind and solar. The reclassification would monetize the environmental value of electricity produced from WtE by making it eligible for Class-I Renewable Energy Credits (RECs). RECs are certificates issued for each megawatt-hour of energy generated and are similar to stock certificates in that they can be purchased and traded on the open market.[7] Connecticut law requires that electricity suppliers obtain at least 23 percent of their retail load from renewable energy by January 1, 2020.[8] If electricity suppliers cannot produce enough renewable energy to meet this requirement on their own, RECs can be purchased to make up the difference. The buying and selling of RECs creates a market for WtE in Connecticut, making it more financially competitive with traditional energy.

By creating a market around the incineration of trash, the WtE industry will receive additional revenue, which increases the value of the electricity produced by these energy generators. We assumed that this market for WtE will encourage these facilities to increase energy production by incinerating trash that was previously destined for landfills. In our analysis below, we calculated the emissions avoided and replaced by WtE in order to determine whether or not increasing WtE production is an effective solution for the stated environmental problems.

Analysis

To analyze the potential impact that reclassifying WtE as a Class-I resource has on the environmental problems of global climate change and local air pollution, we made two primary assumptions. First, as stated above, we assumed that the 259,123.69 tons of annual MSW that Connecticut currently sends to landfills (8 percent of total MSW) will be used for WtE. Based on the average efficiency of WtE plants, the additional energy produced by WtE will provide the state with 142,517 MWh of new electricity.[9]

Secondly, we assumed that Connecticut's total power consumption will remain constant, and the new waste-derived electricity will replace an equal amount of power generation from Connecticut's fossil fuels. Our calculations replace coal, oil, and natural gas in quantities that are proportionate to Connecticut's fossil fuel-derived energy portfolio. This means that each MWh of WtE replaces 177 kWh of coal, 27 kWh oil, and 796 kWh of natural gas production. We assume that WtE will not replace Connecticut's nuclear power generation or existing renewable energy production. We make this assumption because nuclear power plants are well established and unlikely to come offline and because the state has a legal commitment to utilize an increasing percentage of renewable energy.[6]

Under these assumptions, we evaluated the bill's impact on the status quo NO_x emissions, particulate matter (PM) emissions, and greenhouse-gas emissions. This analysis compares the emissions per unit of energy production of WtE with those of the fossil fuels it replaces.

Although each fossil fuel emits these compounds at different rates, we simplified the comparison by using a weighted average of the replaced fossil fuels. Additionally, our analysis accounts for the emissions avoided by diverting 259,123.69 tons of MSW from landfills to WtE. This includes the emissions associated with the trucks used to haul waste to out-of-state landfills and the methane emissions released as the MSW biodegrades in landfills.

We found that WtE emits greater quantities of NO_x and greenhouse gases per MWh than Connecticut's fossil fuel mix. On the other hand, WtE emits fewer PM per MWh than fossil fuels. The table below compares the emission intensities of each pollutant for Connecticut's fossil fuels and WtE.

	NO_x	**PM**	**CO_2e**
WtE	2.45 kg / MWh	0.037 kg / MWh	1.18 tons / MWh
CT fossil fuel weighted average	1.41 kg /MWh	0.097 kg / MWh	0.62 tons / MWh

(Source – See Section A)

Based on smokestack emissions alone, WtE does not appear to be effective at reducing NO_x or greenhouse gases. Once we take into account the avoided emissions from landfills and trucking, however, our analysis shows that the legislation, H.B. 5118, could reduce overall emissions of all three pollutants relative to the status quo. The tables below show the inputs and outputs leading to net emission reductions of the air pollutants NO_x and PM.

Nitrogen Oxide Emissions (NO_x)

New WtE emissions 142,517 MWh at 2.45kg NO_x / MWh	**Replaced fossil fuel emissions** 142,517 MWh at 1.41kg NO_x / MWh	**Eliminated trucking emissions** 13,399,912 miles at 0.0162 kg NO_x / mile	**Net emissions**
339,646 kg NO_x	-195,470 kg NO_x	-217,079 kg NO_x	-72,903 kg NO_x

(Source – See section A)

Particulate Matter Emissions (PM)

New WtE emissions 142,517 MWh at .037 kg PM /MWh	**Replaced fossil fuel emissions** 142,517 MWh at 0.097 kg PM /MWh	**Eliminated trucking emissions** 13,399,912 miles at 0.00078 kg PM / mile	**Net emissions**
5,129 kg PM	-13,447 kg PM	-10,452 kg PM	-18,770 kg PM

(Source – See section A)

To complete our net-emissions analysis of greenhouse gases, we needed to select an appropriate value for greenhouse-gas emissions from landfills. The decomposition of one ton of MSW produces 0.05-0.1 ton of methane (CH_4), depending on the waste composition, climate and landfill engineering. We took the average of this range, 0.075 tons of methane or 1.725 tons of carbon dioxide equivalent (CO_2e) per ton MSW (using a global-warming potential of 23).[10] The table below displays the inputs and outputs leading to net emission reductions of greenhouse gas emissions.

Greenhouse Gas Emissions

New WtE emissions 142,517 MWh at 1.18 tons CO_2e / MWh	**Replaced fossil fuel emissions** 142,517 MWh at 0.62 tons CO_2e / MWh	**Eliminated trucking emissions** 13,399,912 miles at .00485 tons CO_2e / mile	**Eliminated landfill emissions** 259,123 tons MSW at 0.79 tons CO_2e / ton MSW	**Net emissions**
168,170 tons CO_2e	-88,360 tons CO_2e	-64,922 tons CO_2e	-204,707 tons CO_2e	-189,818 tons CO_2e

(Source – See section A)

Landfills can decrease their carbon footprint by flaring the excess CH_4, which converts the CH_4 to the less potent greenhouse gas CO_2, or capturing and combusting it to produce energy. These methods reduce landfill emissions to 0.48 tons CO_2e per ton MSW.[10] According to the United States Environmental Protection Agency, approximately 25 percent of the landfills in the U.S. are equipped with methane-capture technology that results in energy generation.[11] However, even if we assume that all of Connecticut's landfills were equipped with methane-capture technology, the net emission reductions from H.B. 5118 would still exceed 109,000 tons CO_2e.

Replacing fossil fuels with new WtE production reduces NO_x, PM, and greenhouse-gas emissions relative to the status quo. If our assumption that reclassifying WtE as a Class-I renewable energy source would yield this result is correct, then H.B. 5118 would help address the environmental problems of local air pollution and global climate change.

Although we have concluded in our analysis that the bill could effectively combat the stated environmental problems, our calculations were based on several assumptions. Some aspects of the legislation are also highly debated, and these controversies may affect our conclusion from the performed analysis.

Controversies

Stakeholders in Connecticut debating the merits of this bill have focused on three central arguments: whether waste-to-energy is replenishable or clean enough to be on par with wind and solar, how WtE would affect the renewable market, and if the legislation is a waste-management strategy or an efficient energy policy. "Renewable," in the most basic definition of the term,

states a resource is inexhaustible through use. Because WtE relies on MSW, its fuel consists of mixed materials, some of which are considered renewable, such as paper and food, and some of which are not, including plastic and other petroleum-based products. Approximately 60 percent of MSW consists of renewable biomass, while 40 percent consists of plastic and other nonrenewable products.[12] This bill, however, does not make a distinction between the various types of waste.

While the formal definition of renewable means a resource is inexhaustible, public opinion believes renewable energy should also be "clean" in terms of greenhouse-gas emissions and air pollution. Supporters of the bill argue that WtE is clean because it reduces the use of fossil fuels, eliminates methane released from landfills and meets Clean Air Act standards for air pollution. Opponents, however, disagree. They say that current Class-I renewable sources emit negligible emissions, while WtE plants on average emit 3,685 pounds of CO_2 and 6.7 pounds of nitrogen oxides per MWh.[13] Additionally, WtE plants in Connecticut have repeatedly violated Clean Air Act standards. The most recent incident occurred in 2010 at a WtE plant in Wallingford. The plant emitted the carcinogen dioxin at 250 percent above the legal limit.[14]

Related to concerns about whether or not WtE is clean enough, the Connecticut Department of Energy and Environmental Protection (DEEP) is also concerned that an influx of WtE RECs would dominate the renewable energy market and take revenue away from current renewable energy sources.[15] In our research, we calculated that if RECs were issued for all of the energy that Connecticut's WtE plants could produce under our assumptions (current WtE production plus increased production using landfilled waste), waste-to-energy RECs would make up 14.5 percent of the state's renewable energy market. While this is a significant portion of the market, there is still room for production from other renewables. Therefore, WtE is unlikely to monopolize the entire CT renewable energy market.

Finally, the legislation is unusual in that it stipulates that the additional revenue received by WtE plants from Class-I RECs must be given to the local municipalities surrounding the facility.[16] Several Connecticut mayors testified in front of the state legislature in support of this bill, stating new revenue from RECs would help municipalities pay for rising waste disposal fees.[17, 18] However, opponents, including the Connecticut DEEP and other environmental groups, argue that waste disposal should have no bearing on reclassifying WtE as a Class-I renewable energy source.[15, 19]

Conclusion

The question of whether WtE is a renewable energy source merits skepticism and further debate. It is unlikely that WtE will have any effect on the development of more traditional renewables, such as solar and wind. Even if all the trash currently landfilled in Connecticut were incinerated for WtE, the relatively small percentage of renewable energy produced (14.5 percent of the total mandated by 2020) would still allow for plenty of growth for other renewable sources. The

controversy surrounding the effect the legislation will have on other renewable markets has also brought into question the overall impact of the bill. Even if all of our assumptions pan out, the amount of additional renewable energy created is small compared to Connecticut's 2020 renewable standards.

We conclude that House Bill 5118 has the potential to lower greenhouse-gas emissions and air pollution in the state of Connecticut. We must emphasize, however, that the reduction would be relatively small overall. Our analysis finds that while the bill may have been partially created to serve as an efficient waste-management strategy, the legislation is capable of reducing greenhouse-gas emissions and air pollution, thereby helping to address climate change and local air pollution for the state of Connecticut.

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