Renewable Energy Portfolio Standard Lifecycle Greenhouse Gas Analysis

DOER
Massachusetts Department of Energy Resources

With Support from Sustainable Energy Advantage and Antares Group Incorporated

Appendix B

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Contents

1. Introduction

The purpose of this section is to evaluate the potential lifecycle greenhouse gas emissions impact of the 2019 proposed Renewable Energy Portfolio Standard (RPS) modifications. This section seeks to determine whether the proposed RPS would result in a change to lifecycle greenhouse gas emissions from Eligible Woody Biomass Generation Units.

2. Approach

As part of the Class I and II RPS programs, in June 2013, Massachusetts issued the *Overall Efficiency and Greenhouse Gas Analysis Guideline* (herein referred to as the greenhouse gas emissions tool). The guideline was the culmination of extensive stakeholder engagement and memorialized the underlying findings of the *Massachusetts Biomass Sustainability and Carbon Policy Study*,[1] often referred to as the Manomet Study, whose key findings concluded that:

- combusting biomass to generate electricity and/or heat results in a carbon debt that must be made up for over time,
- the characteristic of the biomass feedstock affects the amount of time for the carbon debt to be recovered, and
- the sustainable management of forests is critical to ensuring carbon can be sequestered.

The greenhouse gas emissions tool establishes a multi-year accounting approach for the lifecycle greenhouse gas emissions emitted from the Generation Unit in a single year, referred to as the single year analysis. The single year analysis is the method used to determine whether a Generation Unit has met its regulatory requirement to reduce lifecycle greenhouse gas emissions by 50%. The greenhouse gas emissions tool also provides information on an alternative approach, referred to as the multi-year analysis. Under the multi-year analysis, the Eligible Biomass Woody Fuel Generation Unit assumes the feedstock characteristics and the electricity generated in year 1 are duplicated in every year for the duration of the analysis. The single year analysis is a preferred approach to the multi-year analysis as it is based on the actual feedstock characteristics and electricity generation for the time-period assessed. Therefore, the greenhouse gas emissions tool proposed in 2019 maintains the single year analysis approach and is the basis for analyzing the lifecycle greenhouse gas emissions impact of the proposed regulatory changes.

a. Increased Biomass Electric Production

The first analysis quantified the change in lifecycle greenhouse gas emissions from the 248 GWh of incremental electric production from biomass Generation Units in the Base Case (table 9), and the 800 GWh of incremental electric production from biomass Generation Units in the low cost case (table 10), as determined in Section 3 of the Renewable Energy Portfolio Standard Technical Analysis of Biomass.

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[1] Manomet Center for Conservation Sciences, Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources. Walker, T., et. al, 2010

The assessment evaluated the lifecycle greenhouse gas emission reductions over a 20-year timeframe (2013 requirement) and a 30-year timeframe (2019 proposed requirement). The assessment was done for both the base case (table 9) and the low-cost case (table 10).

The inputs entered into the greenhouse gas emissions tool included the number of megawatt hours generated from Section 3. Data from Appendix A was input for the total amount of fuel consumed and the biomass feedstock composition. Across all scenarios, the type of fuel (wood chips), the higher heating value of the fuel (4,250 Btu/lb), and the comparison technology (natural gas-combined cycle) were kept constant. To assess the impacts of the proposed changes, it is assumed the biomass plant would offset electricity generated from a new natural gas combined cycle Generation Unit because ISO-NE forecasts identify natural gas as the primary source of electricity over period of time modeled.[2]

In response to feedback received from commenters during the public comment period, an additional analysis was undertaken on the base case and low-cost case to alter the decay rates for Forest Derived, Non-Forest Derived Residues, and Forest Salvage. The decay rate of biomass fuel represents the half-life of the biomass feedstock naturally decomposing and releasing greenhouse gas emissions. It is an important factor in comparing the lifecycle greenhouse gas emissions from combusting the wood versus natural decomposition. In 2013, the decay rate for residues was calculated by taking the average of the Forest Derived and Non-Forest Derived Residues decay rates. These two decay rates were determined from a selection of peer-reviewed literature studies.[3][4][5][6] Forest Salvage was assigned the same decay rate as residues. Instead of using the average value, the additional analysis undertaken updated the greenhouse gas emissions tool to assign an individual decay rate to Forest Derived and Non-Forest Derived Residues. In this case, Forest Salvage was given the same decay rate as Forest Derived Residues, which has a longer recovery time compared to Non-Forest Derived Residues.

b. Stress Test

The second analysis assessed the greenhouse gas emissions reductions from a Generation Unit that met the minimum requirements from the 2013 regulations and compared against a Generation Unit that met the minimum requirements of the 2019 proposed regulations. This "stress test" was intended to show the least amount of greenhouse gas emissions reductions capable from a Generation Unit participating in the RPS program.

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[2] ISO-NE, New England's Forecast report of Capacity, Energy, Loads and Transmission (CELT Report), 2019; https://www.iso-ne.com/system-planning/system-plans-studies/celt

[3] Sharma, Wang, and Altizer, Modeling forest biomass in atmospheric carbon reduction in West Virginia; Proceedings of the 33rd Annual Meeting of the Council on Forest Engineering: Fueling the Future, 2010.

[4] Domke, et al., Assessment of Carbon Flows Associated with Forest Management and Biomass Procurement for the Laskin Biomass Facility, University of Minnesota, 2008.

[5] Mattson, et al., Decomposition of woody debris in a regenerating, clear-cut forest in the Southern Appalachians, Canadian Journal of Forest Research, 1987.

[6] Morris, Biomass Energy Production in California: The Case for a Biomass Policy Initiative, NREL, 2000.

To undertake this analysis, several baseline assumptions were required for each scenario. For the analysis on the existing 2013 regulations, the annual tons of feedstock consumed was estimated at 539,738 tons.[7] The gross overall efficiency was assumed to be 50%, which is the minimum efficiency required to be eligible under the RPS program. The analysis further assumed that the Generation Unit would achieve 50% lifecycle greenhouse gas emissions over 20 years, which was the least amount of reductions possible to maintain eligibility. The variable in this analysis was the feedstocks types, with the result being the maximum percent of Forest Derived Thinnings that could be used at a Generation Unit while still achieving 50% lifecycle greenhouse gas emissions over 20 years. For the analysis on the 2019 proposed regulations, it was assumed that the same tonnage of feedstock was consumed (539,738), but that this feedstock would be 95% Non-Forest Derived Residue, which would be required in order to waive the overall efficiency requirement of 50%. The remaining 5% of the annual tonnage is attributed to Forest Derived Thinnings, as it has the least reduction of lifecycle greenhouse gas emission. Since the consumption of 95% Forest Derived Residues would result in no overall efficiency requirement, the gross overall efficiency was assumed to be 22%, which depicts the average efficiency of the Generation Unit previously participating in the RPS program[8]. A summary of the assumptions are listed in Table 1. Additionally, the stress test assessment compared the lifecycle greenhouse gas emissions reductions over a 20-year and 30-year timeframe. Assessing both timeframes allowed for the analysis to isolate the percentage of greenhouse gas emission reductions attributed to the increase in the timeframe versus other proposed regulatory changes.

Table 1. Stress Test Inputs

	2013 Regulations Case	2019 Regulations Case
Feedstock Consumed (tons)	539,738	539,738
Generation Unit Efficiency	50%	22%
% Forest Derived Thinnings	TBD	5%
% Non-Forest Derived Residues	TBD	95%
20 Year Lifecycle Green House Gas Emissions Reductions	50%	TBD
30 Year Lifecycle Green House Gas Emissions Reductions	TBD	TBD

c. Corrections

Two corrections were made to the greenhouse gas emissions tool prior to any lifecycle greenhouse gas analysis. First, the 2013 greenhouse gas emissions tool assumed that green chips had a moisture content

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[7] This number was a calculation of the average number of tons consumed in a year by a Generation Plant participating in the RPS program between 2013-2015.

[8] EIA, Form EIA-923, https://www.eia.gov/electricity/data/eia923/

of 40%, resulting in a higher heating value of 5,100 Btu/lb. The consultants confirmed that a 50% moisture content assumption used in the 2019 greenhouse gas emissions tool was a more accurate value for green chips used at electric biomass Generation Units. To keep this variable constant, the higher heating value of the fuel in the 2013 greenhouse gas emissions tool was corrected from 5,100 Btu/lb to 4,250 Btu/lb, which represents the heat value of green chips with 50% moisture content. Second, in reviewing the 2019 greenhouse gas emissions tool, the parasitic load attributed to the running of pump motors and meters was listed as 6%. This was corrected to 8% to align with the 2013 greenhouse gas emissions tool, which more accurately quantified the parasitic load of biomass Generation Units.

3. Analysis and Results

a. Increased Biomass Electric Production

In all cases modeled in the incremental generation analysis, positive greenhouse gas emissions reductions over 50% were achieved. The difference in reductions between the base case and low-cost case are primarily attributed to the amount of generation occurring in each case.

Figure 1. Lifecycle Greenhouse Gas Emissions Reductions- Average Decay Rate

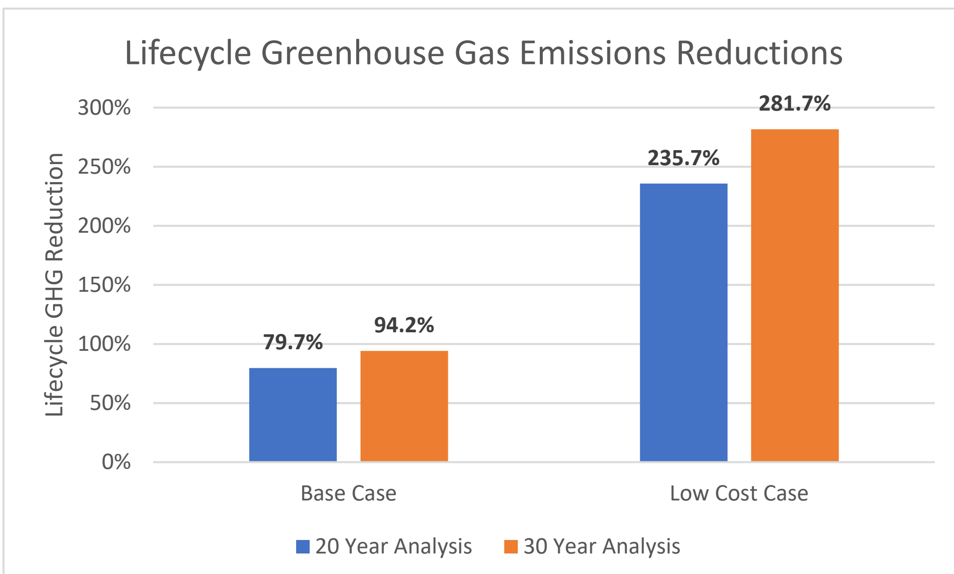
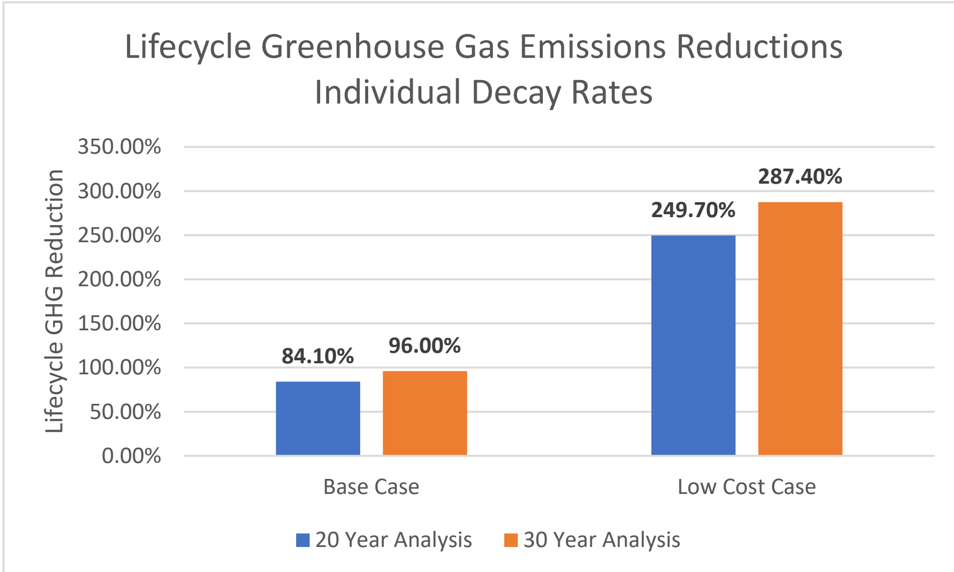


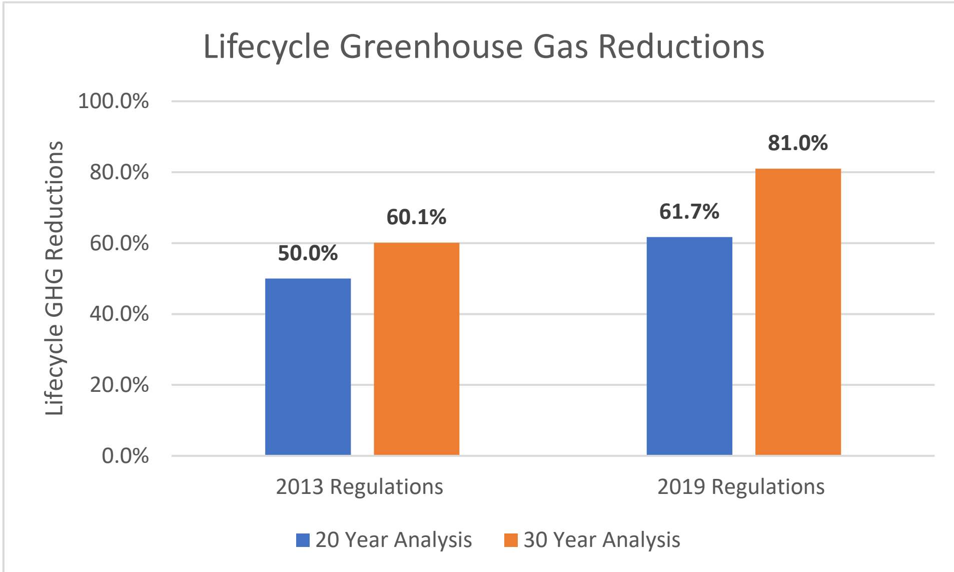
Figure 2. Lifecycle Greenhouse Gas Emissions Reductions- Individual Decay Rate



b. Stress Test

Based on the 2013 regulations, the assumptions utilized in the greenhouse gas emissions tool led to a Generation Unit able to use up to 35.9% of Forest Derived Thinnings, while remaining eligible under the RPS Program by achieving 50% reduction of lifecycle greenhouse gas emissions. Conversely, based on the proposed 2019 regulations, a Generation Unit producing the same amount of energy, but utilizing 95% of the feedstock from Non-Forest Derived Residues would result in 61.7% emissions reductions over 20 years, which is 11.7% more lifecycle greenhouse gas emission reductions compared to a Generation Unit meeting the minimum requirements of the existing regulations, see Figure 3. In both scenarios, the 30-year analysis resulted in larger emissions reductions, as the timeframe over which carbon could be sequestered was longer. However, the comparison between 2013 regulations and 2019 regulations over both a 20 year and 30 year timeframe provides further insights. All else being equal, the lifecycle greenhouse gas emissions are expected to be greater over a 30 year timeframe versus a 20 year timeframe due to the longer period of time for carbon to be sequestered. Yet Figure 3 illustrates the opposite. When comparing the 2013 regulations requirements over a 30 year timeframe and comparing to the 2019 regulations over a 20 year timeframe, there is an increase of 1.6% additional lifecycle greenhouse gas emission reductions, rather than decrease that would be expected over a shorter period of time. This indicates that the type of feedstock consumed is more critical to emissions reductions than the timeframe of the calculation.

Figure 3. Lifecycle Greenhouse Gas Emission Reductions for the Generation Units Meeting Minimum Requirements



4. Findings and Conclusions

Based on the analysis conducted there are several key findings and conclusions regarding the impact of the 2019 proposed changes to the RPS regulations as they relate to lifecycle greenhouse gas emissions. These include:

- As indicated in the Stress Test, if the proposed changes to the regulations are not implemented, there is a lost opportunity to reduce lifecycle greenhouse gas emissions, by a minimum of 11.7%.
- Encouraging preferred feedstocks, such as Non-Forest Derived Residues, is more impactful on the total reduction of lifecycle greenhouse gas emissions compared to requiring a shorter timeframe.
- The proposed changes to the regulations will result in a positive reduction in lifecycle greenhouse gas emission that is over the 50% minimum threshold, though the magnitude of the reductions are limited due to the minimal amount of incremental electricity generated from biomass plants utilizing RPS compliant feedstocks.