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EE 538

Project Report

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<div align="center">Creating a Municipal Solid Waste Forecasting Tool</div>

1 Introduction

For my project, I collaborated with employees of the Town of Dennis, Massachusetts to create a model for projecting municipal solid waste generation and disposal costs. The permanent resident population is 14,664 – however the town's location in Cape Cod attracts seasonal visitors that nearly quadruple the population. While residents have the option to hire private haulers for their waste disposal needs, Dennis also offers waste collection services at the Yarmouth Transfer Station – allowing residents to utilize a pay-as-you-throw (PAYT) program or purchase household disposal passes for a higher fee. A majority of the waste that enters the transfer station is taken to SEMASS Covanta, one of five waste-to-energy facilities in MA that is nearing capacity and increasing fees at a rapid rate. The Department of Public Works (DPW) for Dennis is interested in projecting municipal solid waste composition, generation, and disposal costs as it prepares new budgets and disposal contracts. Additionally, it is important to the town to consider how implemented programs, laws, and regulations around waste will impact the waste stream in the future. For these reasons, I built a municipal solid waste forecasting model in Excel that is based on historical data and provides a platform for assessing future waste scenarios.

2 Weekly Meetings

I was able to successfully achieve my project goals for the Town of Dennis in large part to the assistance of Julie Kennie, a volunteer for the Climate and Coastal Resiliency Committee in Dennis. During our weekly meeting, we would discuss research, timelines for objectives, and identify points of contact in Dennis DPW, Mass DEP, and the MA Zero Waste Caucus with whom have a stake in the tool and could provide valuable information and insights.

The research process covered a range of factors impacting municipal solid waste generation and costs. For one, it was important to understand what the Town of Dennis is doing to increase diversion rates of waste from incineration. I learned that the town's largest waste component with potential for high diversion is organic materials and that there is a big push for new transfer station signage and town awareness campaigns to better inform residents about composting options and benefits. Additionally, due to the high number of seasonal rental properties, the town is facing concern for mattress disposal counts. Further research consulted sustainability reports of foundations tracking plastic packaging waste generated by businesses. With 24% of waste in Dennis composed of paper and plastic material, Julie and I felt that the model should incorporate expected changes in purchased materials as there becomes a larger push for zero-waste in industries. This will have implications on the potential diversion rate from incincineration and on recycling costs to the town and demand for reliable recycling haulers. Furthermore, the Zero Waste Caucus is a group of nearly 40 legislators in MA that are proposing new laws such as Extended Producer Responsibility for mattresses and paint (which would shift responsibility of disposal costs from the town to the retailers) and plastic waste bans. Overall, there are many

possible scenarios that could affect the waste stream in Dennis and I built a model that breaks down three key areas: government action, town action, and company commitments to sustainability.

Another integral part of my weekly meetings with Julie was creating a timeline for my project objectives to ensure successful completion of goals by the end of the semester. From Julie, I learned about the "Critical Path" technique for project planning. This method involves setting dates for specific objectives that must be accomplished in established order and on time, or there is a risk of missing the final deadline. Throughout this critical path are less-specific side tasks that happen alongside meeting each goal, such as research and outreach calls and emails to gather information. On my critical path were presentations of my project development to various stakeholders like the DPW, Mass DEP, and transfer station management. Along the way, I was able to have meetings with Kirstie Pecci – Executive Director of the non-profit Just Zero – and Courtney Butler – aide to representative Christopher Flanagan. In these meetings, I was able to form new understandings of major factors impacting waste generation that can be incorporated into the model projections.

3 Presentations to Stakeholders

Preparing presentations was a crucial component of meeting my project objectives. During my presentations, I outlined knowledge of the Dennis waste landscape and external influences imparted by the state government, Dennis municipality, and business market conditions. I prepared questions specific to my audience such as

- What capabilities do you expect this model to have?

- What component of the waste stream is of most concern?

- What factors do you see having and/or not having the largest impact on waste in the future?

- When will Dennis become an exporter of MSW and how will this affect disposal costs?

Answers to these questions guided the way I went about building the functions of the model and directed my research towards influences on waste generation that stakeholders are most interested in projecting.

These presentations were also a great opportunity to practice my communication skills and learn to tailor ideas towards specific audiences. For example, Chad Contonio is the Transfer Station Foreman that works directly on-site dealing with waste disposal management. Chad has a unique perspective because he sees the waste coming into the transfer station everyday and could offer insight into the "problem areas" of waste disposal from first-hand visual experience. For Chad, he is most concerned with the increasing disposal of mattresses and unreliable haulers to pick them up from the transfer station. He informed me that there is difficulty in enforcing proper mattress disposal as well as contracting new haulers due to the large volume. These factors both lead to increasing costs to the households disposing of this particular item. On the other hand, Michael Lavin is a stakeholder in this model that prepares the waste budget for the town and organizes contracts with waste haulers. For Mike, knowing the expected cost of disposal is of vital importance.

Kirstie Pecci was another source of valuable information in regards to making educated assumptions about paper and plastic waste into the future. Just Zero specializes in crafting model bills for legislators working on environmental sustainability efforts. In terms of what will have the largest impact on paper and plastic waste, Kirstie believes the most impact will come from

the adoption of reusable and refillable materials. This is a factor built into the model that users can weight as more data becomes known on the availability of reusable/refillable packaging alternatives and consumer preferences for such materials.

4 The Final Tool

The forecasting component of the tool is based upon historical data of waste generation and disposal costs for Dennis provided to me by Kari Parcell, Municipal Assistance Coordinator for the Massachusetts Department of Environmental Protection. Kari works to serve communities in Barnstable County, such as Dennis.

An exponential smoothing equation is utilized to forecast waste generation and SEMASS tipping fees for the years 2023 through 2050. This equation was chosen as the optimal method because it allows for diminishing weight factors on historical values, giving the most weight to the value one period before the forecast value. Key takeaways from the baseline predictions are:

- Without any changes in market conditions, waste generation will remain steady around its current rate through 2050
- Tipping fees have risen nearly 200% in the last decade and are projected to continue along this rapidly increasing trend

The modeling component of the tool allows the user to separate expected waste generation by category for a specific year and apply qualitative assumptions related to expected changes in market conditions. These qualitative assumptions can be applied as a percentage increase or decrease in each waste category and are based on impacts by government, the municipality, and

business actions. Once applied, a new forecasted value for waste in the chosen year will be generated. The user can then replace the forecasted value based on historical data with the forecasted value based on applied qualitative assumptions. Once the change is made, the forecasted waste generation and disposal cost estimates in succeeding years will automatically update to reflect the impact of anticipated changes in market conditions.