Executive Summary

Assessment of Massachusetts' Waste-Sites for Potential Photovoltaic System Development

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The Problem

The Commonwealth of Massachusetts has identified climate change as a major threat. In 2011, the state legislature passed the Clean Energy Results Program (CERP) which is meant to increase the production of renewable energy within the state by 1600MW by 2020 (MassDEP, 2012). Climate change has negative effects on the environment, human health, and the economy (Maibach, 2015). Amongst the effects climate change has on the environment are warmer temperatures and altered precipitation patterns. Climate change results in increases in droughts, air pollution, sea-level rise, coastal flooding, ocean acidification, and disrupted ecosystems (Maibach, 2015). Climate change has negative effects on human health due to increasing the impacts from extreme weather events, decreased air quality, and illnesses transmitted by food, water, and disease-carriers such as mosquitoes and ticks (Maibach, 2015). Due to Massachusetts having a vast coastline, the state is expected to experience significant economic impacts caused by sea level rise. A sea level rise of 0.65 meters (26 inches) in Boston by 2050 could damage assets worth an estimated $463 billion (Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee, 2011). A step Massachusetts is taking to mitigate the effects of climate change is through CERP, and an increased focus of renewable energy within the state.

The installation of photovoltaic (PV) systems on waste-sites is a viable way of decreasing the use of fossil fuels within the state of Massachusetts (MassDEP, 2012). A waste-site in the context of this project is defined as a parcel of land that has been artificially contaminated and poses a danger to humans and the environment and, as a result, it cannot be used for many redevelopment purposes. A possible option for cleaning up and redeveloping these waste-sites is the installation of PV systems. These PV systems can benefit society by producing renewable energy and decreasing the emissions that current sources of energy create (Solar energy: The way of the future, n.d.). The Massachusetts Department of Environmental Protection (MassDEP) identified waste-sites all over the state that lack a redevelopment solution, and may be viable for PV development. PV installation has been proven to not only promote renewable energy development but also site clean-up.

Goal

The goal of this project was to identify waste-sites that are viable and sustainable for PV development, depending on each site's environmental, economic, and social characteristics.

Methodology

To identify sites with potential for a PV installation we conducted an assessment of 83 waste-sites. These sites were classified as Tier1D zoning sites, meaning they are areas with contamination that have not been remediated because the owner does not have the financial

means to do so. Each waste-site was evaluated by the team to determine its environmental, economic, and social viability and sustainability using three different methods.

First, each site was analyzed using the RE-Powering America's Decision Tree Tool to determine if the site would be environmentally viable and sustainable. Variables like usable acreage, distance to transmission lines and graded roads, wetlands, and sloping were considered in order for the site to pass the environmental assessment. We used Google Earth Pro, ArcGIS, and the Release Tracking Number (RTN) database to find the answers required by the Decision Tree Tool.

Second, the National Renewable Energy Laboratory's (NREL) PVWatts economic tool was used to obtain estimates for the revenue and power output of a site. The tool required mapping the location of the site and used the weather information from a nearby big city to obtain the estimated values. The report gave values for solar radiation, AC energy, and energy for each month of the year, as well as giving an annual value for the site.

Third, to assess the social viability we conducted a number of interviews with developers and town officials from towns that already had a PV system in a site, to investigate the community support or opposition encountered. The purpose of this step was to create guidelines for developers to use in order to meaningfully address community concerns and opposition when proposing a new project to another town. Reducing community opposition is important because it can significantly reduce the development time of a project if the developer approaches the community in the most appropriate way.

After analyzing the environmental, economic, and social viability of each site we printed relevant information related to it and organized individual folders for each site. The folders consisted of RTN database article used, a Google Earth Pro overview of the site, the evaluation of the Decision Tree Tool, and, if the site was considered to be environmentally sustainable, the report from the PWatts economic tool. These files were presented to MassDEP for it to make them public and attract developers into being interested in developing new sites.

Findings

Of the sites analyzed for PV development, 51% (43 out of 83) were determined to be viable and sustainable. Developers will have to conduct more calculations in-house in order to completely determine if a site will be viability and sustainability in their financial plan. When analyzing the characteristics of each site we used the following resources:

- RTN database
- Google Earth Pro
- ArcGIS
- RE-Powering America's Land Decision Tree Tool
- NREL's PVWatts tool
- Town/City officials, MassDEP
- Interactions within communities

These resources had varying impacts on determinations of sites' viability and sustainability. The findings discuss the most influential and common characteristics that impact the viability of a site for PV development.

- **Usable Land:** Usable land on a potential site is important when determining the estimated energy production on the site. We determined usable land on the sites using

Google Earth Pro and ArcGIS layers. Wetlands and shading pose huge impacts on sites as well because PV systems need optimal sunlight and Massachusetts does not allow any installations within 100 feet of a wetland area (310 CMR 10.00 wetlands protection act regulations, 2014). Economic profitability is directly related to the usable size of the site. Using NREL's PVWatts tool an estimated projected revenue was produced from the size of the site. This indicates the financial output of a PV development on a waste-site. Factors such as construction and labor costs, solar panel costs, and Payment in Lieu of Taxes (PILOT) can also be factored into this analysis when developers look further into a site for redevelopment.

- **Transmission Lines:** Transmission lines are developer's number one concern for any new project. It is very expensive to upgrade transmission lines and install new grid infrastructure (~$500,000/mile) so determining the distance of a waste-site to transmission lines is critical (Zensky, 2017). Sites evaluated varied in locations from rural areas to urban environments often in industrial areas. This distance between waste-sites and transmission lines was determined from Google Earth Pro images. Obtaining more detailed information about grid capabilities was not completed because a developer must contact the local utility and complete applications to gain insight on the specific capabilities and capacities of the local grid. That information was not available to the team, so further analysis will need to be completed by the developer if they wish to pursue a site.

- **Distance to Graded Roads:** Similarly, to how distance from a waste-site to transmission lines is often prohibitive to PV development, the distance between a waste-site and the nearest graded road is also often prohibitive to PV development. For many rural waste-sites, there are large distances between where a site is located and where the nearest graded road capable of supporting traffic necessary for the construction of a PV system is located. This distance was determined by analyzing a Google Earth Pro image and estimating the distance between the edge of a waste-site and the nearest graded road. If this distance is greater than a half mile, the cost of constructing an interconnection is often prohibitive to developing a PV system on that particular waste-site. Graded roads are important for PV development because they are the main access point to the site for construction vehicles and workers.

- **Redeveloped or In-Use Land:** Through our analysis of the 83 waste-sites we have identified nine cases in which the waste-site is still in use by the site owner. In these cases, the site is still being actively used and it is unlikely that the owner would be willing to cease activity for the purpose of PV development. Some examples of waste-sites that are still in use are junk yards and manufacturing facilities. Ten of the waste-sites analyzed had already been remediated and redeveloped with something other than a PV system. Examples of redevelopment included housing developments, a post office, and a grocery store. Google Earth Pro images were studied to determine if a site was redeveloped and in use again.

- **Conservation Commission Contingencies:** Finding from interviews with developers and town officials showed that Conservation Commissions can impose a financial burden on developers. For example, at the General Latex/DOW property in Billerica the

Conservation Commission reassessed the land because it was located near wetlands and discovered new wetlands which made the development plans change from a 4MW installation to a 3.74MW installation. The Conservation Commission also required the developers to leave some trees on the parcel at least 12 feet in height and not cut the entire tree down. These requirements lowered the power output and therefore the potential profit the developer saw from the site, as well as imposing an increased development cost.

- **ITC Tariffs:** Another factor that plays a role in a developer's decision is the International Trade Commission's (ITC) solar panel tariff. The new tariff proposed by the ITC would place a $0.40/watt surcharge on PV cells and a floor price of $0.78/watt on modules (Hill, 2017). The tariff would force many developers to purchase more expensive solar panels made in the United States, raising development costs, and as a result an estimated 88,000 jobs could be lost in the US Solar Industry (approximately 1/3 of workers). In addition, this has the potential to put a stop to billions in private investments for solar development, causing 2/3 of expected installations in the next five years to completely cease (Hill, 2017). If the tariff is approved the progress of renewable energy development in the United States is predicted to slow down drastically (Hill, 2017).

- **Community Relationships and Interactions:** Developing municipal owned land can often cause community kerfuffle if the PV development can be viewed from their homes, roads, or walkways. First impressions and good information are essential when developing waste-sites located on public land because residents who might be against an installation will bring forth their concerns and fight the process of development, prolonging the project (Martinage, 2016). In the cases of developments built on private land, these complaints do not impact the project because the land is privately owned and the owner can choose to develop the land with little community engagement and interaction.

Steps for Viable and Sustainable PV Development

Through our analysis of waste-sites for PV development, as well as our findings from interactions with developers and town officials, we have identified a number of key points that will contribute to reducing the obstacles faced when attempting to install a PV system. The recommendations provided below are intended to help with the work done by the developer when interacting with a community and dealing with concerns and questions from the Conservation Commission in different towns.

Engage Conservation Commission: Due to widely varying Conservation Commission regulations, we recommend that MassDEP suggest developers be proactive and engage with local Conservation Commissions early in the development process to determine if there are environmental permitting or other requirements for PV development. We recommended that MassDEP notify developers on how to contact local Conservation Commissions, through email, phone, or attendance at Commission meetings, enabling developers to learn the requirements and actions that must be taken to gain approval and permitting for a PV development. Contact information can be acquired through municipality websites.

Alert residents to PV development: Through interviews with developers, we have determined that the most common opposition to PV development is the aesthetic of the installation itself. The community members most likely to cite aesthetics as the primary reason to oppose a PV development are those neighboring the site. Therefore, we recommend the MassDEP encourage developers to notify residents within 500 feet of a potential PV installation of the details of the installation, as well as the dates and times of local government discussions regarding the development. Such communication helps provide the community with factual and accurate information regarding the site, as well as giving residents an opportunity to voice their opinion on the development at a local government meeting, helping to create healthy developer-community relationships.

Improve aesthetics with tree buffer zone: While community opposition surrounding the aesthetics of a PV installation usually does not prevent the development of a PV system, creating a healthy developer-community relationship is still important. Addressing community concerns helps create this healthy relationship. As a result, we recommend the MassDEP encourage developers to include a buffer zone of trees in their development plans if the site is in a location where the PV installation has a major aesthetic impact on the area.

Determine development cost through in-house financial tools: The PVWatts economic tool determines the potential profit generated by a PV development from the useable size of a waste-site. Determining the cost associated with developing PV on a waste-site varies depending on characteristics such as choice of EPC, transmission line distance and condition, and distance to graded roads. We recommend MassDEP be transparent about the profit estimated by PVWatts so that developers can consider the information when doing an in-house financial analysis to determine the costs of development. With an in-house analysis, a developer can compare costs and projected profit to determine if the site is worth the investment.

Consult utility to assess transmission line status: Determining the condition and distance of the nearest transmission line to the waste-site is one of the most important aspects of determining the viability of a site. While the distance to transmission lines is relatively simple to determine, and the condition of a transmission line can be guessed by the local development, it is impossible to determine the specific capabilities of the local grid without engaging in discussions with the local utility. Therefore, we recommend that MassDEP encourage developers to contact local utilities immediately at the start of the PV development process, to determine the condition of the process, local grid as early in the development process as possible.

Highlight lessons learned from previous PV developments: We recommend using highlights of previous PV site development to promote PV development on future waste-sites in Massachusetts. Highlighting the benefits of PV development in communities across Massachusetts can show the communities of potential future PV sites the benefits they might also experience by developing PV systems in their local waste-site. MassDEP can highlight the success of waste-site redevelopment with PV, boosting community support for such redevelopment. These highlights can include greenhouse gas emission reduction, number of houses powered, and the number of equivalent vehicles taken off the road based on greenhouse gas emission reduction, and how targeting waste-sites for PV development helps clean up local contaminated land.