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The current and future land assessment analysis and property taxes analysis of the land of proposed solar farm in Spotsylvania County

Abstract

Anthropogenic global climate change is threatening our planet. Human energy demand and consumption has been rapidly increasing throughout the world. In order to combat global climate change from greenhouse gases emissions, increase in renewable energy development is crucial. Solar energy is one of the fastest growing renewable energy source in the world and in the United States. In Spotsylvania County, Virginia, a solar energy company called sPower proposed one of the biggest solar farms in the East Coast. Because of the size, scale, economic viability, environmental concerns, and more, there has been push back from the concerned citizens of the Spotsylvania County. Although there were numerous methodology, scale, and criteria to assess the economic viability of the proposed solar farm, there has been a lack of consensus on which information is unbiased and accurate. This report hopes to address the economic viability of the Spotsylvania County solar farm project by analyzing land assessment and property tax values in an unbiased stance. To put Spotsylvania County situation into perspective, Amazon Solar Farm US East in Accomack County, Virginia was used as a case study as well. Although this report uses one specific methodology to analyze land assessment and property tax values, further studies are needed to be done to create a methodology where tax reduction and other factors are taken into a consideration.

Introduction

Anthropogenic global climate change is threatening our planet. Anthropogenic global climate change refers to the climate change caused by human activity. According to a special report by Intergovernmental Panel on Climate Change (IPCC), anthropogenic activities caused the rise of 1 degree celsius of global warming since the pre-industrial period (IPCC). If the current global warming continues, global warming will likely to reach 1.5 degree celsius between 2030 and 2052 (IPCC). The current greenhouse gas emissions and the Earth's energy imbalance of the natural system with climate sensitivity and positive feedback loop, global warming is further stimulated at a faster pace (Kitchen, 2017). In 2018, carbon dioxide emissions exceeded 37 billion tonnes, recording the highest Carbon emissions historically (IPCC). In the United States, the overall CO_2 emissions reached 5,319 million metric tonnes in 2018, increasing by 3.4 percent (Plumer, 2019). Earth's energy imbalance refers to the imbalance between the energy absorbed into the Earth and the energy emitted out to the space (Hansen, 2011). Such imbalance stimulates climate forcing, which drives climate change (Hansen,2011). Positive feedback loop amplifies climate response, triggering climate change at even faster rate (Hansen, 2011). Anthropogenic global climate change acts as a threat multiplier that induces the disruption of the ecosystem, biodiversity, and human lives. The need to find solutions toward reduced greenhouse gas emissions and sustainable growth is urgent.

In order to combat anthropogenic global climate change, countries around the world are striving toward greenhouse gas mitigation. In the United States, renewable electricity doubled its generation since 2008, reaching 742 million megawatt hours (MWh) in 2018 (Marcy, 2019). It is providing 17.6% of the total electricity generated in the United States. Of 743 MWh of renewable electricity generated, 13% was from solar generation (Marcy, 2019). Solar electricity

generation increased from 2 million MWh in 2008 to 96 MWh in 2018, making up 2.3% of the total electricity generated in 2018 (Marcy, 2019). Of 96 MWh of solar generation, 96% of it was generated using utility-scale solar (Marcy, 2019). Utility-scale solar refers to the solar facility that generates solar power and feeds to the grid, mostly with power purchase Agreement (PPA) with a utility company (Donnelly-Shores, 2013). Solar generation rapidly increased in last decade because of growth in technology, decrease in cost with more competition in domestic and global market, and implementation of government policies such as American Reinvestment and Recovery Act and Production Tax Credit and Investment Tax Credits (Marcy, 2019). Technological improvement, cost reduction, and policy enactment led solar energy to be fastest growing and economically viable source of renewable energy.

Solar generation economic viability can be measured in different criteria. Some of the key criteria include cost of electricity, tax credit, renewable energy credit, adjacent property value and tax, cost of maintenance, solar farm property value and tax, Power Purchase Agreement (PPA), and more. Among many ways to measure the economic viability of a solar project, this paper hopes to address current and projected land assessment values and also property tax values to accurately demonstrate the change caused by solar farm installation.

Both sPower and Concerned Citizens of Spotsylvania County argue against each other to support how solar farm project will benefit and harm the economy of the greater solar farm areas, respectively. sPower focuses their analysis on how the solar farm project would add jobs to the community, increase income sources, and increase tax revenues generated from land use change from agricultural to industrial (Mangum, 2019). sPower briefly provides economic activity generated from land usage change from agricultural to industrial in their Economic and Fiscal Contribution to Spotsylvania County report, but fails to provide sufficient explanation to

back up the numbers given. In their report, sPower states that there will be total of 228 employment, $1,190,154 labor income, and $2,776, 338 overall economic output (Mangum, 2019). However, there is a lack of explanation to how they came up with the numbers provided in the report, making the concerned citizens of Spotsylvania County to rage against insufficient information and explanation provided by sPower. The report does not address what are included and not included in the proposed overall economic output generated due to the installation of the solar farm.

Because of the lack of information provided by sPower, Concerned Citizens of Spotsylvania County argues that they in fact will experience decreases in property value and tax revenues. The Concerned Citizens of Spotsylvania County is focused on the economic impact of the greater solar farm project areas rather than the economic impact the proposed land would generate. From the conversation we had as a class with the concerned citizens of Spotsylvania County, the concerned citizens proposed new houses, gas stations, and corner stores as alternative projects to the proposed land area. However, the proposed alternatives were a list of what could go into the land rather than having a set plan with a developer to execute the alternatives.

In the 2019 report, sPower states that there will be roll back real property taxes of $579,121 and the annual County tax revenue from real estate of $101,121 for the first year (Mangum, 2019). Roll back tax refers to the difference in tax amount because the land is changed from one type of use to another (Spotsylvania County Commissioner of the Revenue, 2019). However, one of the concerned citizens of Spotsylvania County, Sean Fogarty, stated that because of the rollback taxes for the first year, the net revenue should be only $436,152, not $600,000 sPower has been arguing (Fogarty, 2018). Fogarty was arguing based on the 2018

report that is not available anymore online. There seemed to be large gaps, miscommunication, and biased argument on property tax assessment. After first year, sPower would pay $101,121 of annual County tax revenue from real estate (Mangum, 2019). Real estate tax in this context refers to property tax on immovable property such as land and houses (Spotsylvania County Commissioner of the Revenue, 2019). However, a concerned citizen and a local real estate agent, Kathleen Hayden, voiced a concern that Spotsylvania will experience a value decrease of up to 30% on real estate (Hayden, 2019).

Because there is a discrepancy of scale between the two groups in talking about some vague numbers of economic activities and the greater area of economic impact, the arguments are biased and incomparable. Although both of the groups argue the economic viability of the project from their stand points, there is a lack of unbiased analysis of the changes in land value and property taxes the solar farm installation would bring to the proposed land. Because the proposed land areas are zoned agricultural and mostly used for timber production, the change of land use to solar farm projects would cause change in value assessment as well. In order to compare before and after solar farm installation in an unbiased stance, the geography of the analysis was confined to the land of the proposed solar farm area only. This is to reconcile the discrepancy of the scale at which values are assessed.

Literature Review

Spotsylvania Concerned Citizens and sPower propose land value analysis for the land of the proposed Spotsylvania solar farm. Although Spotsylvania Concerned Citizens are concerned about the significant decrease of property value in the region, there is less information and concerns about the land value of the proposed land once it is utilized as a solar farm and later

decommissioned. In sPower's Economic and Fiscal Contribution to Spotsylvania County report that breaks down the economic impact of the solar farm project on Spotsylvania County, sPower focuses on the revenue generated because of the transformation of the usage of agricultural land to an industrial usage (sPower, 2019). Because there is a lack of information on land value analysis important to the economic impact of the decision, a comprehensive land value analysis can impact the decision-making process. In my land value analysis of the proposed land, the plan is to provide a descriptive characterization of the land. A descriptive characterization of the land in land value analysis is based on Location Theory. Location Theory tries to understand why things are where they are in the hopes of gaining a comprehensive understanding of locational decision making and what makes the land to be the best piece of land to be used for the specific purpose (Murray, 2013). Location Theory is a suitable theoretical framework for a land value analysis using Geographic Information System (GIS). Location Theory can provide the context of the decision made by sPower on this specific piece of land to develop. In the case of Spotsylvania solar farm project, sPower is purchasing an empty timber lot to develop it. When the land is sold because the bid of proposed land use is higher than the bid of the land as a potential agricultural plot, it is called bid rent theory (Elbarmelgy, 2014). Bid rent theory entails the location theory as the proposed land area of the Spotsylvania county was seen to have the higher bid as a solar farm rather than the bid of a timber lot. However, according to the Spotsylvania Concerned Citizens, the decision made by sPower based on these two theories is biased and under-emphasizes the negative economic impact the solar farm will have to the community of Spotsylvania. In order to provide an unbiased information on current and future land value, I plan to use Hedonic pricing method to execute the land value analysis of this project. Hedonic pricing method assesses land value, accounting multiple layers of factors about

the land being analyzed (Elbarmelgy, 2014). The hope is to provide an unbiased, comprehensive land use analysis for the land proposed for the solar farm project.

In North Carolina, there are over 100 utility-scale solar projects across 50 counties (Davidson, 2015). North Carolina experienced approximately 1,000-10,000% increase in county tax generated from solar farm installations (Davidson, 2015). In order to assess the economic impact of utility-scale solar installations on local revenue, a group of students from The University of North Carolina at Chapel Hill collected data from 121 different projects across 54 counties in North Carolina. From the collected 121 solar installation projects, they collected real property tax generated to compare it to the tax generated before the solar farms were installed. From the data and analysis, they found that there was an average increase of $20,000 in property taxes generated per solar farm in North Carolina (Davidson, 2015). Solar installations became a significant source of local government tax revenue for North Carolina (Davidson, 2015). After the literature review, case study review, and and theoretical review, a similar methodology was applied to the Spotsylvania County proposed solar farm parcels in order to assess the economic viability of the project.

Methods

In order to assess the economic viability of solar farm project proposed in Spotsylvania, Virginia, the current and future land assessment values, as well as the current and future property tax information of the land of proposed solar farm in Spotsylvania was analyzed. For both of the current and future land value analysis, Geographic Information System (GIS) was used as the main source of spatial and statistical analysis tool. In making of these four maps, the hope is to show the current and future land assessment and property tax generated from the proposed land use change.

Spotsylvania County solar farm 2018 land assessment map depicts the current land assessment of the land of the proposed solar farm. For the current land assessment, county-wide parcel data was downloaded from the Spotsylvania County GIS database to be overlaid with the Spotsylvania County solar farm site polygons (Spotsylvania County Commissioner of the Revenue, 2019) . Spotsylvania County solar farm site polygons were created using the georeferencing tool. The county-wide parcel data was intersected with the solar farm site polygons to confine the geography and data only to the solar farm site. The intersected layer contained the data from the parcel data in the geography of the solar farm stie polygons.

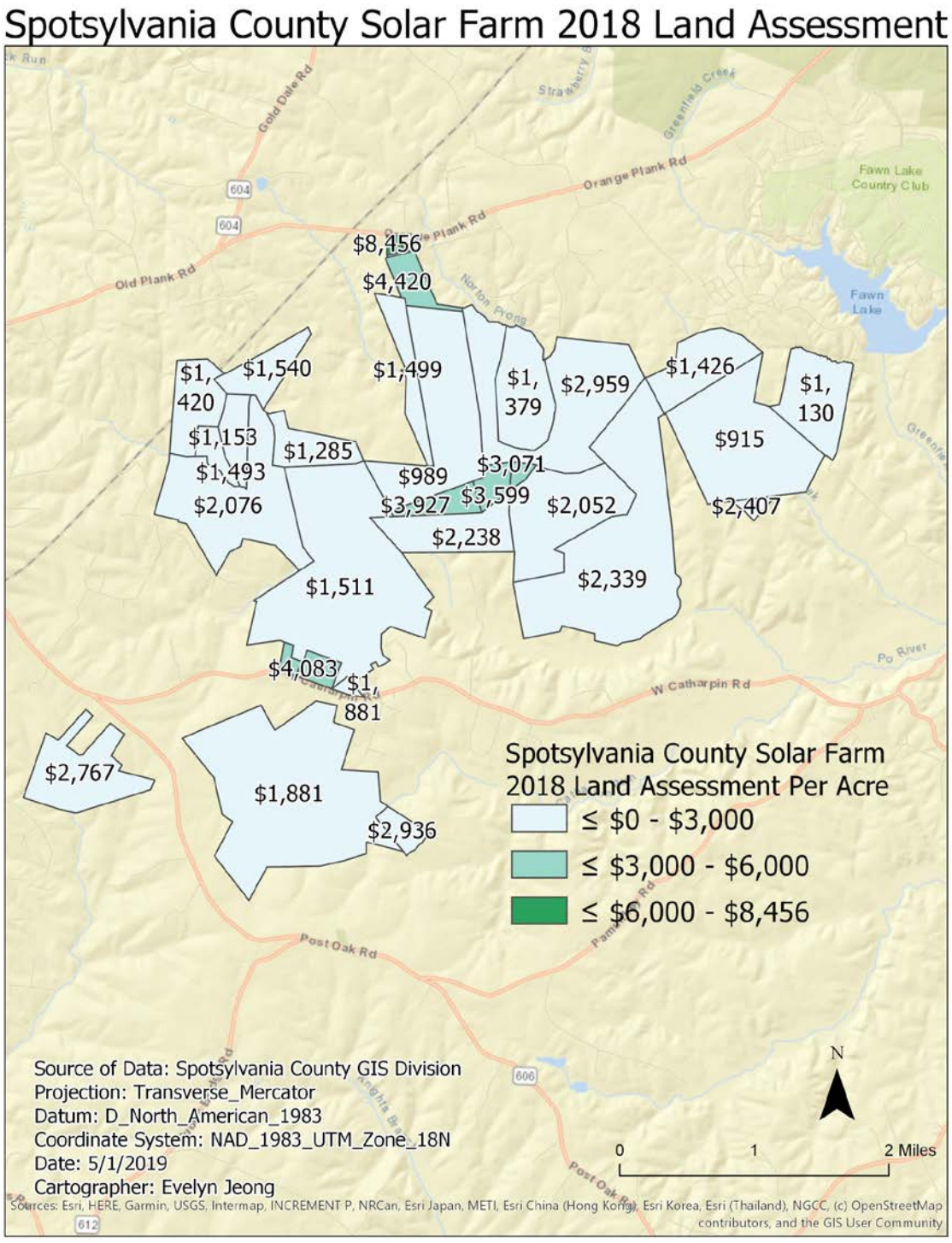
Property tax is a real estate tax calculated proportional to the value of the property (Kagan, 2018). Tax rate is calculated by a local government and property tax is paid by the owner of the property. Property taxes are generally calculated by adding land assessment and building assessment and multiplying the local government tax rate to the added value. When solar farm is installed on a vacant land or lot, there is no building thus there is no building assessment. For vacant land or lot, the equation to calculate property tax becomes land assessment multiplied by the local government tax rate. For Spotsylvania County, property tax rate is $0.833 per $100 of assessed value (Spotsylvania County Commissioner of the Revenue, 2019). For the proposed land of the solar farm property tax calculation equation would be land assessment multiplied by 0.00833. In order to calculate current and projected property tax, current and projected land assessment is the first step to the equation.

In order to provide a rich pool of data to assess the impact of solar farms on land assessment and property tax projection, we gathered land assessment values before solar farm installation and most current assessments of nineteen of the existing solar farms on the East Coast. Using the past land value before solar farm installation and the current land value after

solar farm installation, we calculated the rate of change of each parcel of land. The calculated rate of change of each parcel of the land was averaged out for average rate of change value. The rate of change was calculated to be 1.46661 or 146.661%.

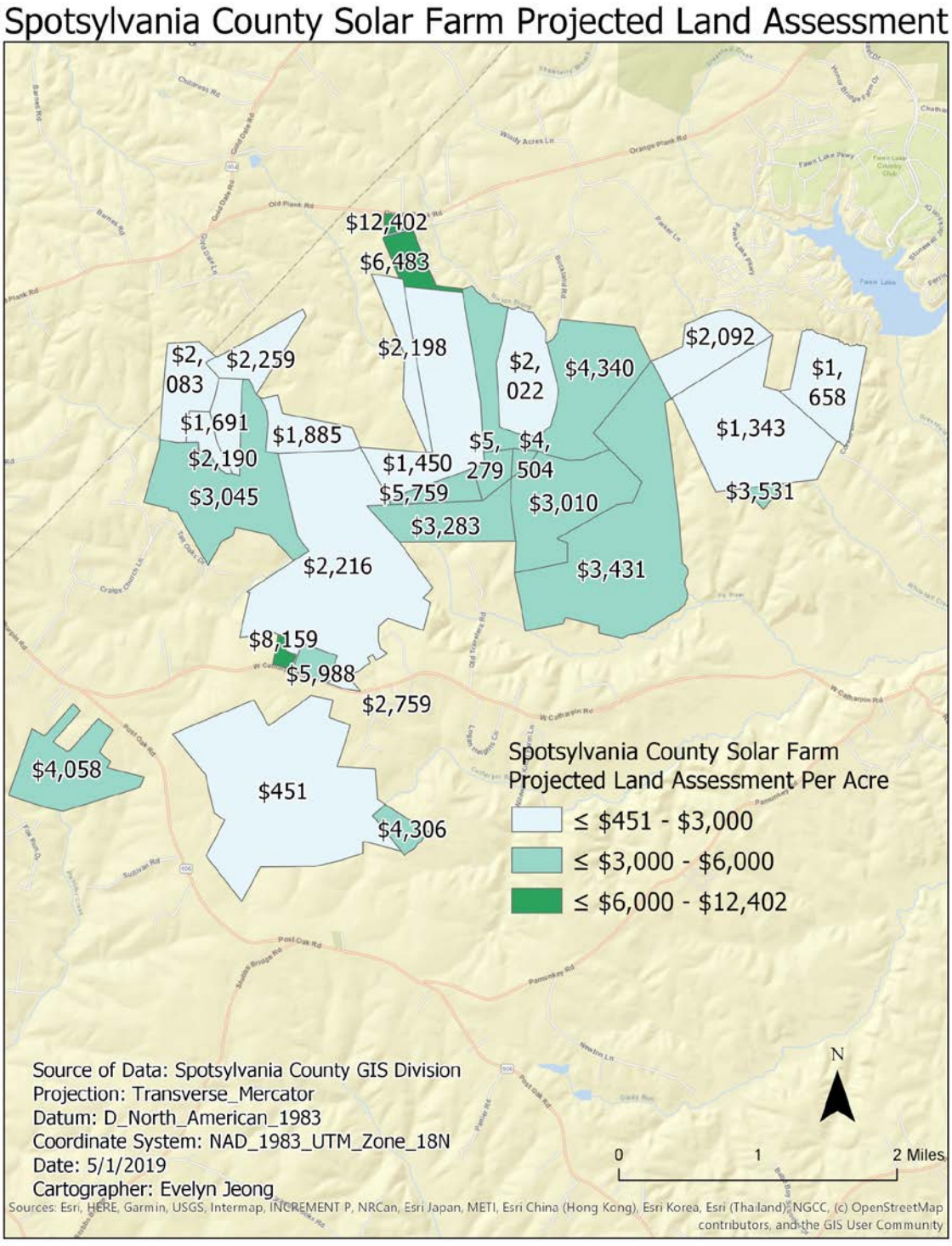
Results

Figure 1. Spotsylvania County Solar Farm 2018 Land Assessment Per Acre



The map presents the 2018 land assessment values provided by the Spotsylvania County GIS Division for each polygon (Spotsylvania County Planning and Community Development, 2019). The graduated symbols represent the 2018 land assessment values divided in three different breaks to simplify the visualization of the land assessment value per acre. Lightest green category includes parcels that have less than $3,000 land assessment value per acre, whereas the middle green category represents parcels that have less than $6,000 land assessment value per acre. The darker green category is parcels that are less than $8,456 land assessment value per acre, which is the highest assessed 2018 land assessment value. Each parcel is labeled with the assessed values per acre. Only one parcel falls under the darker green category, within $6,000 and $8,456. Five parcels fall under the middle green category of $3,000 and $6,000. Other 24 parcels fall under the light green category within $0 and $3,000.

Figure 2. Spotsylvania County Solar Farm Projected Land Assessment Per Acre



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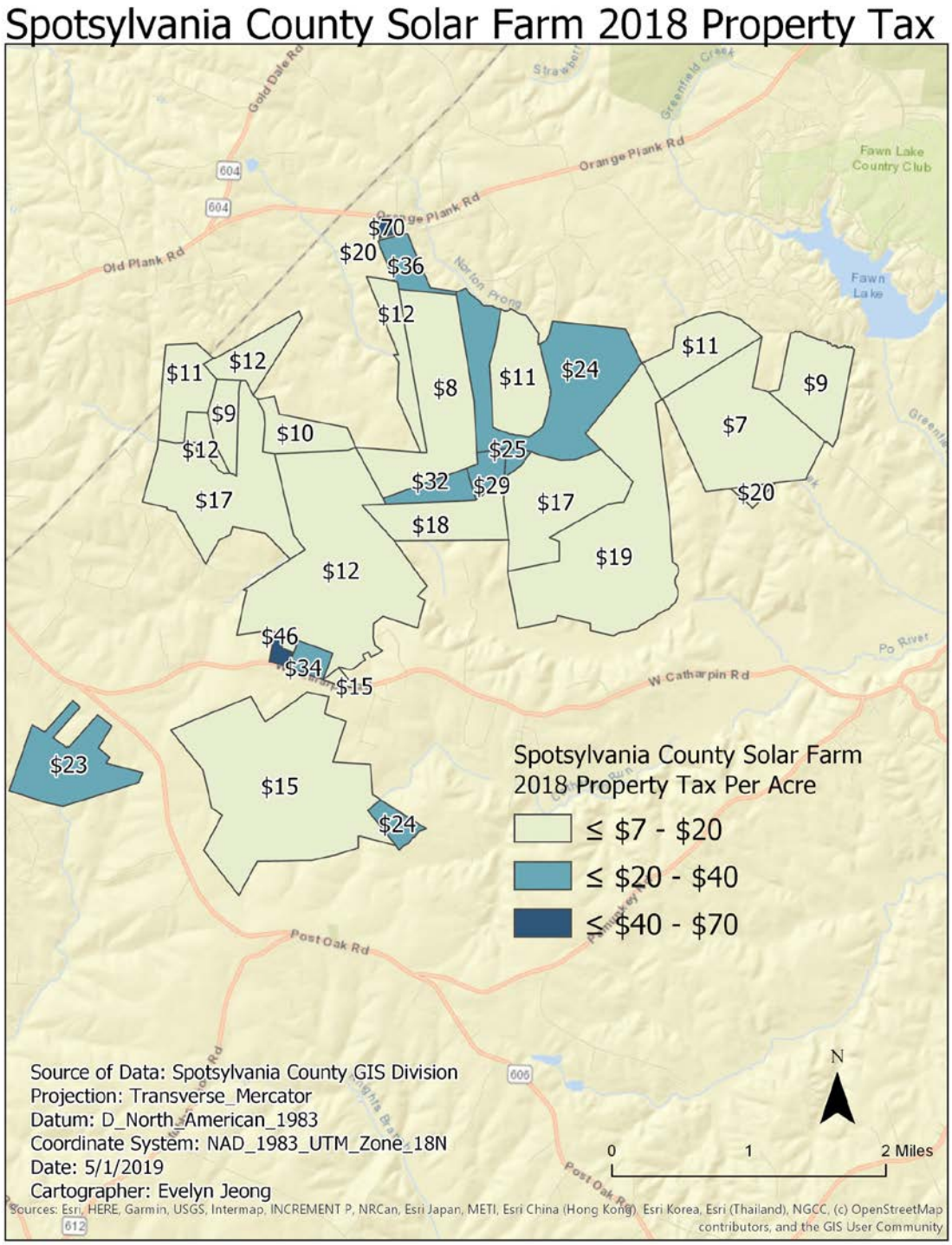
Spotsylvania County solar farm projected land assessment map portrays the projected land assessment of the land of the proposed solar farm. Through the future land value analysis,

the hope was to convey the land value projection after the installation of solar farms. The average rate of change value of 1.46661 was applied to the 2018 land assessment value of the Spotsylvania County solar farm site parcels to calculate projected land value of the proposed land of the solar farm.

The map presents the projected land assessment values after applying the average rate of change value to the 2018 land assessment value provided by the Spotsylvania County GIS Division for each polygon (Spotsylvania County Planning and Community Development, 2019). The graduated symbols represent the projected land assessment values divided in the same three different breaks applied to the 2018 land assessment value per acre to better compare the two maps. Lightest green category includes parcels that have less than $3,000 land assessment value per acre, whereas the middle green category represents parcels that have less than $6,000 land assessment value per acre. The darker green category is parcels that are less than $12,402 land assessment value per acre, which is the highest assessed projected land assessment value. Each parcel is labeled with the assessed values per acre. Only three parcels fall under the darker green category, within $6,000 and $12,402. 12 parcels fall under the middle green category of $3,000 and $6,000. Other 15 parcels fall under the light green category within $0 and $3,000.

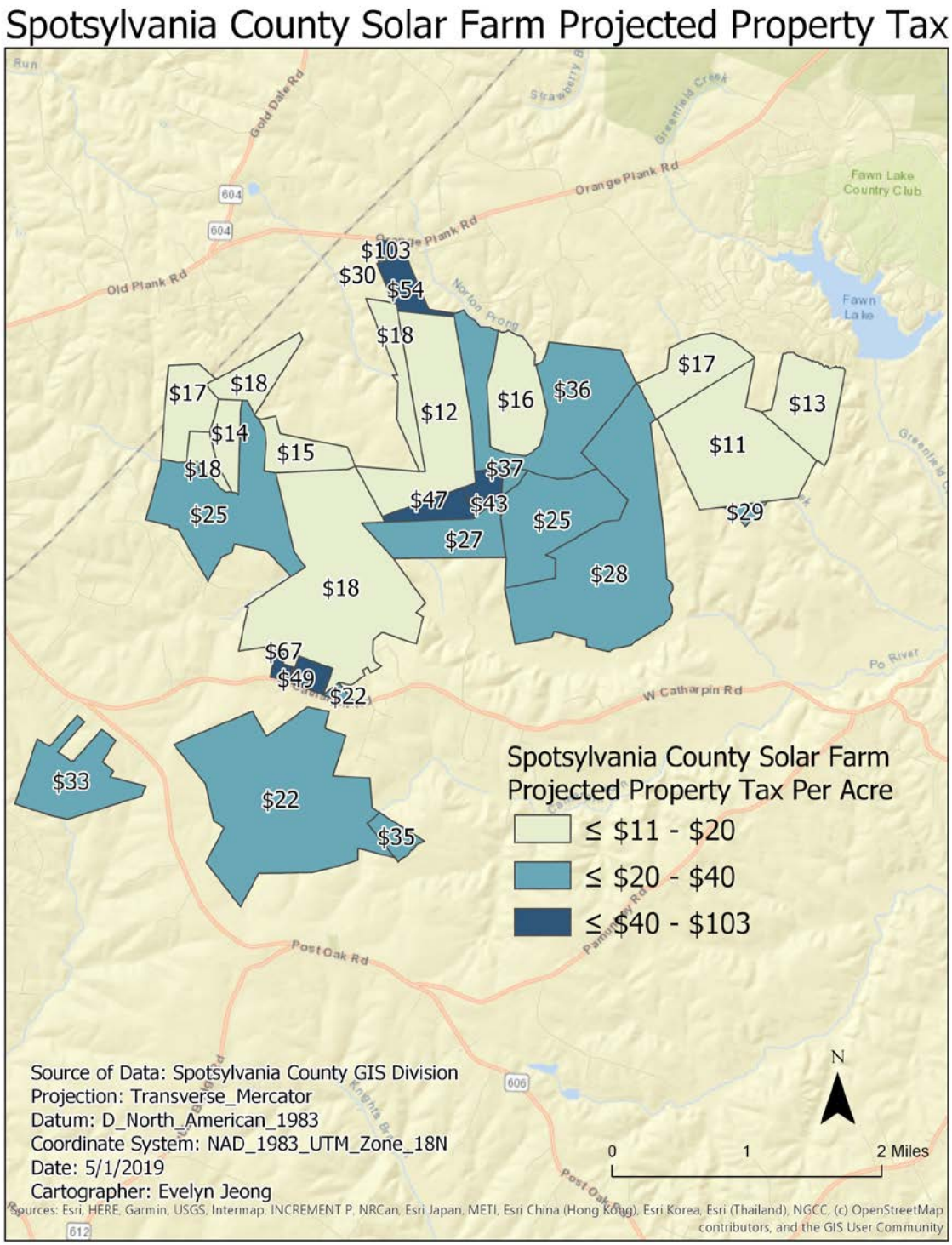
Figure 3. Spotsylvania County Solar Farm 2018 Property Tax Per Acre



Given the current 2018 land assessment values for each parcel, 2018 property tax was calculated using the equation, land assessment multiplied by 0.00833 for Spotsylvania County

property tax rate. Once property tax for each parcel was calculated, each parcel was normalized by land area in acre. The graduated symbols represent the 2018 property tax values divided in three different breaks. Lightest blue category includes parcels that have less than $20 2018 property tax value per acre, whereas the middle blue category represents parcels that have less than $40 property tax value per acre. The darker blue category is parcels that are less than $70 property tax value per acre, which is the highest assessed 2018 property tax value. Among 30 parcels, only two parcels fall under $40 to $70 property tax per acre. Eight parcels fall under middle blue category with $20 and $40 property tax value per acre. 20 remaining parcels fall under the light blue category of $7 and $20.

Figure 4. Spotsylvania County Solar Farm Projected Property Tax Per Acre



Given the current projected property tax values for each parcel, projected property tax was calculated using the equation, land assessment multiplied by 0.00833 for Spotsylvania County property tax rate. Once projected property tax for each parcel was calculated, each parcel was normalized by land area in acre. The graduated symbols represent the projected property tax values divided in the same three different breaks. Lightest blue category includes parcels that have less than $20 projected property tax value per acre, whereas the middle blue category represents parcels that have less than $40 property tax value per acre. The darker blue category is parcels that are less than $103 property tax value per acre, which is the highest assessed projected property tax value. Among 30 parcels, five parcels fall under $40 to $103 property tax per acre. 11 parcels fall under middle blue category with $20 and $40 property tax value per acre. 14 remaining parcels fall under the light blue category of $11 and $20.

The total current and projected land assessment and property tax summary is as follows. Current land assessment total is $13,962,800 and the projected land assessment total is $18,477,965. The current property tax total is $116,310 and the projected property tax total is $153,921.

Discussion

The land assessment analysis and property taxes analysis reveal that solar farm installation is an economically more viable option. The projected land assessment total is 4.5 million dollars higher than the current land assessment total. Thus, the projected property tax total is 37 thousand dollars higher than the current property tax total. Spotsylvania will experience an increase in land assessment value, and will generate more property tax from solar farm installation compared to the current agricultural land use. Despite the fact that land assessment value and property tax value will go up due to the solar farm installation,

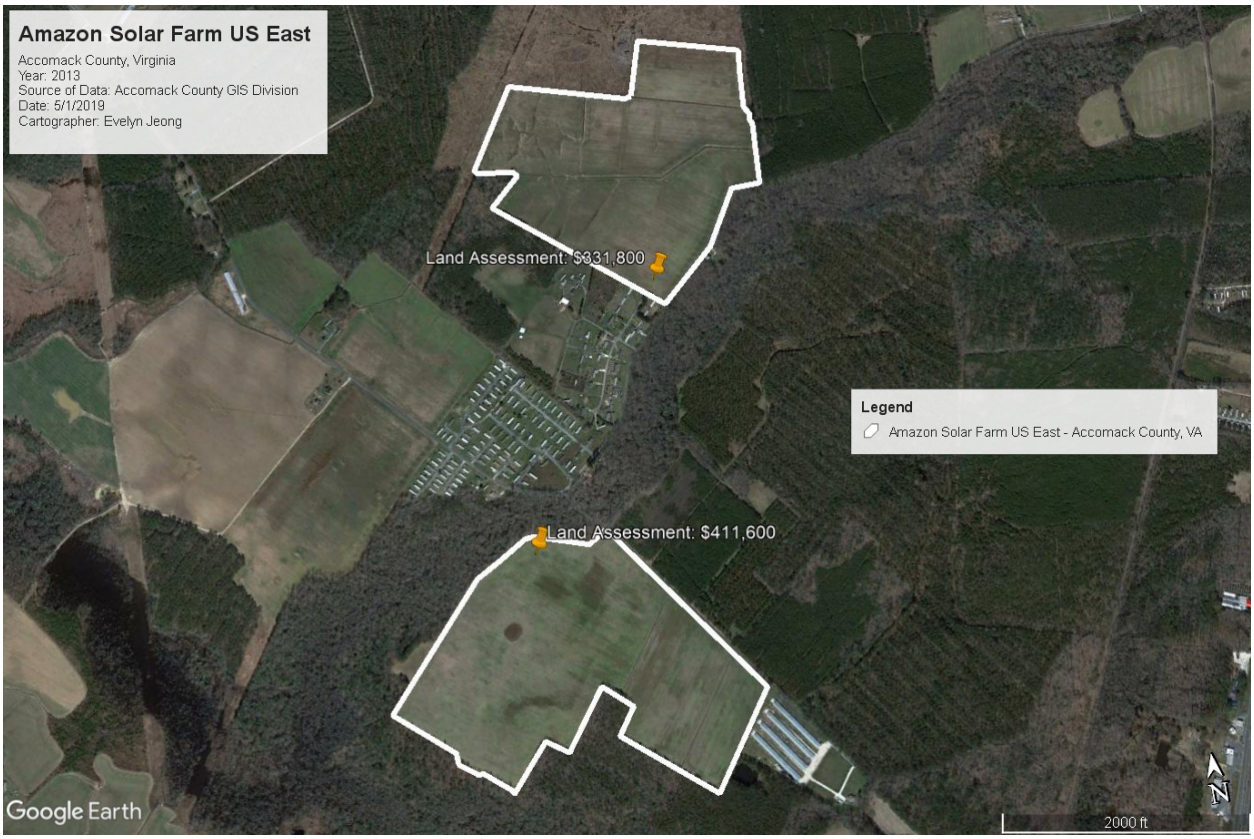
governmental tax reduction programs need to be considered. Most solar energy projects qualify for different types of tax reduction (Barnes, 2013). These tax reductions are at different scale, accounting local, state, and federal government (Barnes, 2013).

In fact, many other states such as North Carolina experienced a similar pattern of economic impact generated by land use change from agricultural land to solar farm installation. According to the North Carolina Solar and Agriculture report by NC Sustainable Energy Association, over $2 billion was invested in solar farm installation between 2007 to 2015 and North Carolina generated over $351 million business-related renewable energy tax credits (Aldina, 2017). Solar farm installation on agricultural land is generally more profitable for landowners (Aldina, 2017). Although it is difficult to determine how much of those total tax is directly generated from solar installation on agricultural land, the overall economic viability is proven to be better for solar installation.

Case Study: Amazon Solar Farm US East in Accomack County, Virginia

Amazon Solar Farm US East in Accomack County, Virginia is used as a case study to show land assessment increase before and after the installation of the solar farm. The land assessment values and the property tax information were obtained from the official Accomack County website. The base maps were made using Google Earth Pro to depict current and historical satellite view of the solar farm in Accomack County. The land assessment data was collected from Accomack County GIS Division (Accomack County Planning and Community Development, 2019).

Figure 5. Amazon Solar Farm US East 2015 Land Assessment



In the Amazon Solar Farm US East 2013 map, the map presents of the parcels before solar farm installation (Figure 5). The two parcels are highlighted in white with the labels of the 2015 land assessment values for each. The upper parcel was assessed $331,800, and the lower parcel was assessed $411,600 (Figure 5).

Figure 6. Amazon Solar Farm US East 2018 Land Assessment

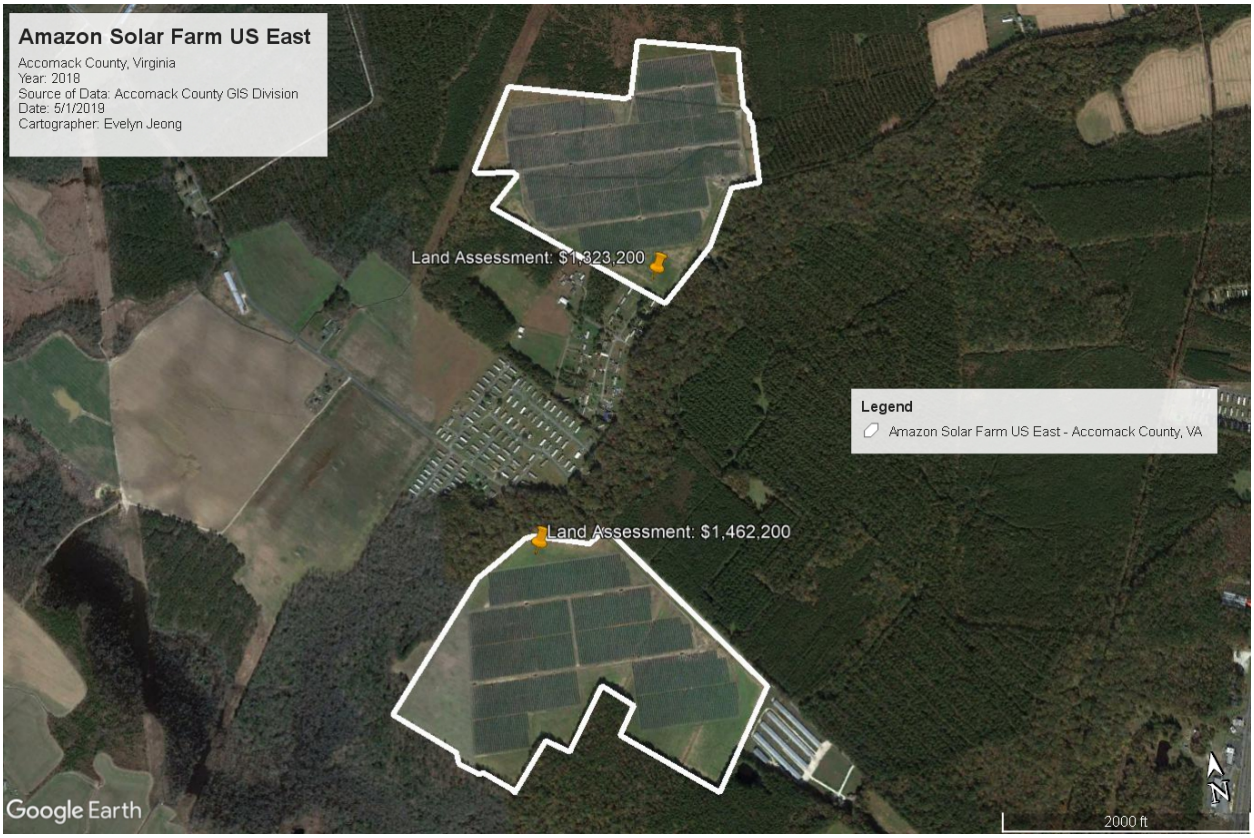


Figure 6 portrays after solar farm installation in 2016 with 2018 land assessment values for each. The upper parcel was assessed $1,323,200, and the lower parcel was assessed $1,462,200 (Figure 6).

Figure 7. Amazon Solar Farm US East 2015-2018 Land Assessment Change

From 2015 to 2018, the upper parcel experienced 300% increase in its land assessment, and the lower parcel experienced 255% increase in its land assessment (Figure 7). Solar farm installation in Accomack County led to an increase in land assessment.

Conclusion

Climate change is threatening our planet. Anthropogenic greenhouse gas emissions amplified climate change and there is a urgent call to direct human energy consumption to renewable energy. Solar is one of the fastest growing renewable energy sector, attracting countries, businesses, institutions, NGOs, individuals, and more. In this study, economic viability of the solar farm installation in Spotsylvania County is discussed. Moving forward, there needs to be more future studies to create better methodologies to do land assessment and property tax calculation on the given land in terms of solar farm installation. Although there are more

comprehensive and adjacent property value analysis currently available, current scholarly sources lack studies in projected land assessment and property tax on the land of the solar farm installation. For future studies, the hope is to take tax reduction into consideration as most of the solar farms are eligible to be enrolled in tax reduction program. Because different stakeholders are interested in different parts and results of the projects, there are large amount of biased information given without clear standard methodology to project the economic viability of solar farm projects. The hope was to provide less controversial information on the proposed Spotsylvania County solar farm project. In order to move toward more renewable energy, there needs to integrity in information provided from different stakeholders as well as cultural education on the impact of these solar farms.

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