The University of North Carolina at Chapel Hill

Analyzing the Impact of Utility-scale Solar Installations on Local Government Revenue in Counties Across North Carolina

Alsey Davidson, Evan Kirk, Kyle Harris, Daniel Parker,
Will Mueller, Alex Wilhelm, and Charlie Egan

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Dr. Andrew George

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Abstract

Data analysis on over 100 utility-scale solar projects in over 50 counties across North Carolina shows that solar farms increase county taxes derived from the land on which the projects are constructed by approximately 1,000-10,000%. If the current state tax abatement on lands with solar energy electric systems were to go away, counties would receive five times the current amount of tax money from these projects; however, solar companies would not be able to absorb these costs and would be unable to sustain themselves profitably. If these companies went bankrupt, the incremental increases from agriculturally zoned to commercially zoned that counties are benefitting from would be eliminated. The current state tax abatement of 80% is critical to solar companies continuing to thrive at both the state and county level in North Carolina and allows counties across the state to benefit from increased property taxes coming in as local government revenue.

Introduction

The solar industry in North Carolina has experienced significant growth over the past decade. Specifically, the Solar Energy Industries Association ("SEIA") approximates that the state expanded from less than 1 MW in 2007 to 1,088 MW in installed capacity as of December 2014 (SEIA). SEIA, to put these numbers in context, estimates that this tremendous progress places North Carolina fourth nationally in terms of cumulative solar electric capacity. Furthermore, SEIA notes that North Carolina installed the second greatest amount of new capacity, 76 MW of utility-scale projects, among all states in Q2 2015. California was the only state to surpass North Carolina over this period with 840 MW of new, combined capacity[1].

Approximately 189 solar companies, the entities responsible for this growth, conduct operations within North Carolina[2]. The Solar Foundation's 2014 National Jobs Census estimates that these businesses collectively employ nearly 5,600 North Carolina residents[3]. Although all areas of the solar industry's value chain have representation among these companies, additional findings from the Solar Foundation indicate that North Carolina solar jobs concentrate in installation, manufacturing, and project development activities[4]. The top project developers operating in-state, according to Duke University's Center on Globalization, Governance, and Competitiveness ("DUCGCC"), include such firms as Strata Solar (271 MW), O2 Energies (32 MW), and Community Energy, Inc. (28 MW)[5].

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[1] Anon, (2015). [online] Available at: http://www.seia.org/sites/default/files/Q2%202015%20SMI%20Fact%20Sheet.pdf [Accessed 9 Dec. 2015].
[2] Ibid.
[3] Pre.thesolarfoundation.org, (2015). *North Carolina | The Solar Foundation*. [online] Available at: http://pre.thesolarfoundation.org/solarstates/north-carolina [Accessed 9 Dec. 2015].
[4] Pre.thesolarfoundation.org, (2015). *North Carolina | The Solar Foundation*. [online] Available at: http://pre.thesolarfoundation.org/solarstates/north-carolina [Accessed 9 Dec. 2015].
[5] Brun, L., Hamrick, D. and Daly, J. (2015). *The Solar Economy Widespread Benefits for North Carolina*. [online] cggc.duke.edu. Available at: http://www.cggc.duke.edu/pdfs/02152015Duke_CGGC_NCSolarEnergyReport.pdf [Accessed 9 Dec. 2015].

North Carolina's investment in the development of the solar industry has affected both urban and rural areas in the Eastern, Central, and Western regions of the state. The greatest amount of solar investment dollars, according to the DUCGCC, has flowed to the counties of Catawba, Robeson, Wayne, Cleveland, Beaufort, Duplin, Nash, Columbus, Scotland, and Lenoir[6]. Collectively, thesecounties account for approximately 50% of what North Carolina has invested in the solar industry since 2007 to 2014, which the CGCC values at roughly $2.04B[7].

The growth of the solar industry in North Carolina has primarily stemmed from decreasing costs that have come about as a result of two factors: 1) supportive legislation and 2) decreased component prices. In terms of legislation, solar developers in North Carolina have the ability to leverage both state and federal tax credits to offset construction expenses. The state provides, among other financial opportunities, a 35 percent investment tax credit on renewable energy projects. On the federal level, these projects receive an additional 30 percent investment tax credit[8].

Decreased component prices, in addition to the supportive legislation, have also bolstered North Carolina's solar industry. IBIS World analysts note that the price of semiconductors and other electric parts utilized in manufacturing have fallen nearly 15 percent since 2007. By 2021, these analysts anticipate prices to continue to decline another 5 percent. Adding to this evidence, SEIA finds that the overall cost to install solar has decreased by 73 percent nationally since legislators established the federal investment tax credit in 2006[9].

Solar farms offer a wide array of economic, environmental, and political benefits for their surrounding communities and North Carolina as a whole. As it has developed over the past decade, the solar industry has a proven record of creating jobs. The Solar Foundation measured that the solar industry employed 22 percent more workers in the period from 2013 to 2015[10]. Moreover, the construction solar projects in rural areas has dramatically increased the tax value of the land on which they are built, which has provided a financial boost to some of the poorest counties in North Carolina. According to the DUCGCC, approximately 31.1% of North Carolina's total investment in solar projects from 2007 to 2014 has flowed to counties where at least one in five residents live below the poverty line[11][12].

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[6] Ibid.
[7] Ibid.
[8] Programs.dsireusa.org, (2015). *DSIRE*. [online] Available at: http://programs.dsireusa.org/system/program?state=NC [Accessed 9 Dec. 2015].
[9] Anon, (2015). [online] Available at: http://www.seia.org/sites/default/files/Q2%202015%20SMI%20Fact%20Sheet.pdf [Accessed 9 Dec. 2015].
[10] Pre.thesolarfoundation.org, (2015). *North Carolina | The Solar Foundation*. [online] Available at: http://pre.thesolarfoundation.org/solarstates/north-carolina [Accessed 9 Dec. 2015].
[11] Indexmundi.com, (2015). *North Carolina Poverty Rate by County*. [online] Available at: http://www.indexmundi.com/facts/united-states/quick-facts/north-carolina/percent-of-people-of-all-ages-in-poverty#chart [Accessed 9 Dec. 2015].
[12] Brun, L., Hamrick, D. and Daly, J. (2015). *The Solar Economy Widespread Benefits for North Carolina*. [online] cggc.duke.edu. Available at: http://www.cggc.duke.edu/pdfs/02152015Duke_CGGC_NCSolarEnergyReport.pdf [Accessed 9 Dec.

Environmentally, solar industry has benefited North Carolina through reducing the state's carbon footprint. Researchers from the National Renewable Energy Laboratory ("NREL") estimate that utility-scale, solar photovoltaic installations produce only 24 metric tons of CO_2 per GWh of net lifetime energy output, which represents 4.95%, 3.31%, and 2.49% of the CO2 that gas, oil, and coal-fired plants, respectively, emit[13]. Older, less conservative research, however, places these figures even lower. The Department of Energy's Robert San Martin approximated that solar photovoltaic installations generate 5 metric tons of CO_2 per GWh of net lifetime energy output – nearly five times less than the more recent NREL study estimates[14]. It seems likely that the true CO_2 efficiency of solar lies somewhere in this established range.

Politically, North Carolina's solar industry has made significant contributions towards the goals outlined in the state's Renewable Energy Portfolio Standards ("REPS"). The REPS, first outlined in Senate Bill 3 in August 2007, detail specific requirements that utilities must satisfy with respect to how much energy they derive from renewable sources which gradually escalate over the period of 2010-2021. Ultimately, in 2021, this legislation will require utilities to produce 12.5% of the power they generated in 2020 from renewable sources or adopt energy efficiency technologies that also count, up to a certain point, towards the percentage[15].

Despite its tremendous growth and benefits, various politicians and conservatively-biased organizations have fought against the solar industry in North Carolina. These individuals and groups have argued, among other points, that investment in renewable energy will yield a significantly negative return. For example, the John Locke Foundation ("JLF"), self-proclaimed as conservatively aligned, published a report entitled "The Economic Impact of North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard" in August 2009 which condemned the state's REPS as a policy that would slow the growth of disposable income, employment, and state GDP over its lifetime[16]. This report seems to be part of a series of similar publications opposing REPS legislation in many other states.

Generally speaking, the subsequent response from academia exposed how the reports from JLF utilized questionable methodology to arrive at a targeted conclusion which demonstrates the broader tendency to misconstrue evidence to provide legitimacy to their anti-renewable agenda. Dr. Alberta H. Charney, a senior economic researcher at the University of Arizona, published an article entitled "Comparison of UA, REMI, and STAMP Simulations of Tax/Spending Increases" which illustrates an example of this response. In particular, she notes that JLF's State Tax Analysis Modeling Program ("STAMP") places inaccurate assumptions and restrictions

[13] Kreith, F., Norton, P. and Brown, D. (2015). *C02 Emissions from Coal-Fired and Solar Electric Power Plants*. [online] NREL. Available at: http://www.nrel.gov/docs/legosti/old/3772.pdf [Accessed 9 Dec. 2015].
[14] Ibid.
[15] Programs.dsireusa.org, (2015). *DSIRE*. [online] Available at: http://programs.dsireusa.org/system/program?state=NC [Accessed 9 Dec. 2015].
[16] Tuerck, D., Head, M. and Bachman, P. (2015). *The Economic Impact of North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard*. [online] John Locke Foundation. Available at: http://www.johnlocke.org/acrobat/policyReports/bhionncsb3.pdf [Accessed 9 Dec. 2015].

around government spending that force the generation of results against the implementation of REPS policies[17].

Similar to the work of Charney and others, this paper, a summary of the capstone project of seven student researchers at the University of North Carolina at Chapel Hill, will provide evidence contrary to the popular stance that solar farms decrease the tax value of land. Specifically, the following sections will: 1) review literature from a variety of sources to place the issue in context, 2) discuss the methodology utilized to collect data, 3) provide quantitative and qualitative analysis of the data that the student researchers collected 4) and offer commentary that surveys the results and findings of the project.

Literature Review

The role of uncertainty in capitalist markets has long been known to influence the investment and planning strategies of firms[18]. In the renewable energy industry, the largest source of uncertainty is from government taxes and subsidies – namely, whether and/or when incentives will expire or change at the state and federal levels. Specifically, there are five primary types of uncertainty for renewable energy firms that are subject to climate policy: (i) whether/when carbon constraints will be imposed; (ii) the form of regulation; (iii) stringency of emission controls; (iv) levels of allocation of emission permits; and (v) volatile oil prices[19]. While each of the five types is important, the literature suggests that whether/when carbon constraints will be imposed is by far the most decisive factor influencing uncertainty. In the United States, it is the cyclical pattern of expiration and short-term renewal of incentives like subsidies and tax credits that contributes to firms' decisions to hold off on making long-term investments like large-scale solar or wind farms[20].

Among all U.S. states, there is a strong negative correlation between firm investment in new assets and the number of times that states passed and subsequently repealed laws designed to restructure the electricity industry[21]. Even if a state has seemingly committed to renewable energy investment by establishing a Renewable Portfolio Standard, if that state has a history of regulatory policy instability, there is a dramatically less robust wave of investment than in states that have not exhibited regulatory policy instability in the past. This means that firms won't make investments in new assets when clean energy incentives are constantly in a state of flux.

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[17] Charney, A. (2015). *Comparison of UA, REMI, and STAMP Simulations of Tax/Spending Increases: Economic and Business Research Center : Eller College of Management : The University of Arizona*. [online] Ebr.eller.arizona.edu.

[18] Agnolucci, P. (2006). Use of economic instruments in the german renewable electricity policy. *Energy Policy, 34*(18), 3538-3548; Jacobsson, S., & Lauber, V. (2006). The politics and policy of energy system transformation—explaining the german diffusion of renewable energy technology. *Energy Policy, 34*(3), 256-276.

[19] Yang, M., Blyth, W., Bradley, R., Bunn, D., Clarke, C., & Wilson, T. (2008). Evaluating the power investment options with uncertainty in climate policy. *Energy Economics, 30*(4), 1933-1950.

[20] Barradale, M. J. (2010). Impact of public policy uncertainty on renewable energy investment: Wind power and the production tax credit. *Energy Policy, 38*(12), 7698-7709.

[21] Fabrizio, K. R. (2013). The effect of regulatory uncertainty on investment: Evidence from renewable energy generation. *Journal of Law Economics & Organization, 29*(4), 765-798.

Firms describe themselves as "paralyzed" when there is uncertainty as to whether incentives will continue. Within this environment, firms will instead choose to invest in smaller projects in order to reduce the impact of possible regulatory penalties if climate laws change and they will look to build shorter lead-time projects in order to reduce the possibility that the project's usefulness will be different from the original expectation[22]. In North Carolina, the single greatest sources of uncertainty comes from the possibility of the expiration of the 80% tax abatement program for solar systems. A reduction in this tax relief program would have a dramatic impact on NC's solar industry.

Since July 1st, 2008, North Carolina has exempted 80% of the appraised value of "solar energy electric system[s]" from property taxes, where "solar energy electric system[s]" refers to all equipment used directly and exclusively for the conversion of solar energy to electricity (N.C.G.S. § 105-275). The incentive applies to commercial, industrial, residential, and agricultural sectors. Residential solar systems that are "owned by individuals and not used to produce income or in connection with a business" may be entirely exempt from property taxes[23]. This program has contributed to the rapid growth in NC's solar industry in the past decade. In 2014, this consisted of 450 solar firms which brought in approximately $1.64 billion in revenue. NC now ranks second nationally in solar electric capacity[24].

The abatement program is at risk of being repealed by the North Carolina General Assembly. This has been spearheaded, at least in part, by groups who argue that the program is an economic drag on the state and an unfair support for solar firms. The John Locke Foundation suggests that counties are currently losing $13.65 million in property taxes as a result of the abatement program. They also claim that the loss of $3.41 million in property taxes would occur if "100% of the solar farms [were to] go away" would be a better alternative because it would result in "lower taxes, fewer regulations, stronger infrastructure, [and new] companies" as well as lower energy costs and higher job growth[25]. Subsidization is crucial for renewable energy in states like North Carolina because the purpose of incentive programs, such as the 80% tax abatement, is to enable solar firms to operate on equal footing with fossil fuels in a distorted energy market. Fossil fuel companies themselves have a long history of enjoying government assistance.

Research Methods

The purpose of this study is to identify and analyze distributed utility-scale photovoltaic solar energy facilities in North Carolina. As defined by the National Renewable Energy Laboratory, "Distributed systems are often integrated into the distribution grid interconnecting below 69

[22] Teisberg, E. O. (1993). Capital investment strategies under uncertain regulation. *The Rand Journal of Economics, 24*(4), 591-604.
[23] North Carolina Department of Revenue. (2011). Solar Energy Electric Systems Memo. Retrieved from http://www.dornc.com/taxes/property/memos/solar_energy.pdf
[24] Solar Energy Industries Association. (2015). Solar Spotlight: North Carolina. Retrieved from http://www.seia.org/sites/default/files/NC%20State%20Fact%20Sheet_9.8.15.pdf
[25] Gray, B. (2015). The problem with solar largesse. Retrieved from http://lockerroom.johnlocke.org/2015/05/06/the-problem-with-the-solar-largesse/

kilovolts, which is generally considered the level at which transmission service begins."[26] In North Carolina, utility-scale solar energy consists of developer and/or investor-owner solar farms installed in counties of varying economic levels that sell energy production directly to the electrical utility. In addition, utility-scale solar includes power generating facilities that have power purchase agreements ("PPA") with utilities that guarantees utility commitment to purchase energy from the facility for the life of the contract.[27] This study only includes utility-scale solar energy and does not include commercial, industrial, or residential solar. All utility-scale solar farms in North Carolina are ground-installed systems and do not include any solar roof mounting systems.

To identify a representative population of operating utility-scale solar farms in North Carolina, this study relied on data provided by the North Carolina Utilities Commission ("NCUC"), a regulatory agency created by the General Assembly to regulate public utilities in North Carolina. NCUC maintains a spreadsheet of registered distributed utility-scale photovoltaic renewable energy projects in North Carolina which includes key qualitative and quantitative data of system sizing, location, and material specifications specific to each project.[28] The most relevant information from NCUC's database for this paper included: identification number, project developer and/or owner, project name, type of facility, and nameplate system capacity. This database is constantly updated by NCUC to accurately measure North Carolina's current population of utility-scale solar farms. This population, which was downloaded and used as of August of 2015, served as the initial representative population of registered farms in North Carolina for this study. Consequently, this study did not analyze any information made available by NCUC after August, 2015.

To further concentrate this study's population to only include solar farms with sufficient tax data, further research was necessary to eliminate solar farms from the original population provided by NCUC. NCUC's original population was not the most representative population of solar farms for this study because a truly comparable population with sufficient tax data would only include solar farms that came online in 2014 or sooner. Since many solar developers have not paid off their tax liabilities in 2015, tax data in 2015 was not fully available for farms that came online in 2015. Additionally, solar facilities are not responsible for business personal tax liability until the first full year of operation, therefore, solar facilities whose PPA began in 2014 are responsible for real property tax liability but aren't responsible for business personal tax liability until 2015. Thus, the population of facilities relevant to this study consists of two separate subpopulations; the first subpopulation included only solar farms that came online in 2013 or sooner and was representative of North Carolina's population of farms paying both real property taxes and business personal taxes. The second subpopulation included all solar farms that came online in 2014 or sooner and was representative of North Carolina's population of solar farms paying only real property taxes. The first subpopulation consisted of 54 facilities and the second

[26] Mendelsohn, Michael, Travis Lowder, and Brendan Canavan. *Utility-Scale Concentrating Solar Power and Photovoltaics Projects: A Technology and Market Overview*. Tech. no. SM10.2442. NREL, n.d. Web. 2012.
[27] Mendelsohn, Michael, Travis Lowder, and Brendan Canavan. *Utility-Scale Concentrating Solar Power and Photovoltaics Projects: A Technology and Market Overview*. Tech. no. SM10.2442. NREL. 2012.
[28] "Renewable Energy and Energy Efficiency Portfolio Standard (REPS)." *Renewable Energy and Energy Efficiency Portfolio Standard*. North Carolina Utilities Commission, Aug. 2015. 25 Aug. 2015.

subpopulation consisted of 67 facilities. In total, data was collected for 121 of the 151 facilities operating as of December 2014.

To determine which farms in the original population provided by NCUC belonged in each of the subpopulations, this study used SNL Financial, an online database consisting of financial and operational data about all energy generating facilities across the United States.[29] SNL Financial expedited this study's data mining process because it provided a consolidated database of qualitative and quantitative information gathered from NCUC documents and Federal Energy Regulatory Commission ("FERC") filings concerning all solar farms registered in North Carolina. SNL Financial provided each solar farm's operation start date/online date and made it possible to determine which solar farms out of NCUC's original population of all farms in North Carolina belonged in each of the subpopulations.

Since North Carolina does not have one database containing all tax payment information, a significant portion of this study required searching through each individual county's online tax database to find business personal and real property tax payments for every solar farm. To effectively search through county-specific tax records, this study required collecting qualitative and quantitative data for each farm in order to find tax data on county websites as each site required different search criteria to ascertain tax information. The majority of this search criteria was available on a solar generating facility's Registration Statement and/or FERC Form 556, which was found in NCUC's online portal.[30] For every solar farm, solar developers must file a Registration Statement through the Clerk's Office of the NCUC outlining locational information such as parcel number, address, landowner name(s), and/or latitude and longitude values. Farms seeking Qualifying Facility ("QF") status for energy generating facilities greater than 1,000 kW are required to file an application for QF status from NCUC through a FERC Form 556. Due to the Public Utilities Regulatory Act of 1978 ("PURPA"), generating facilities that meet the size and fuel specifications of the Electronic Code of Federal Regulations, can receive special rates and regulatory treatment.[31] Due to the economic benefits of qualifying as a QF, this study could rely on finding a FERC Form 556 for a large portion of facilities larger than 1,000 kW in size. The consistency of QF applications was important to this study because the FERC Form 556 contained: address, facility name, developer and/or owner, utility interconnection, and owner/developer contact information.

After collecting locational and ownership information from Registration Statements and/or FERC Form 556 filings, this study used the information to search county-specific tax websites or county GIS databases in order to verify parcel information and find real property tax paid in 2014, as well as parcel acreage size and applicable tax rates. Registration Statements were located in NCUC's docket porthole using an identification number or SP number (i.e. SP-2741 for Bladenboro Solar Farm in Bladen County) as search inputs.

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[29] "Business Intelligence Services." *Business Intelligence Services*. SNL Financial, 07 Oct. 2015.
[30] "Search for Dockets." *Dockets*. North Carolina Utilities Commission. Sept. 2015. <http://starw1.ncuc.net/NCUC/portal/ncuc/page/Dockets/portal.aspx>.
[31] "FERC: Qualifying Facilities - What Is a Qualifying Facility?" *FERC: Qualifying Facilities - What Is a Qualifying Facility?* Federal Energy Regulatory Commission, 3 Feb. 2012 07 Dec. 2015. <http://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp>.

The real property tax for which the solar company is responsible isn't necessarily the same as the amount paid for the parcel. Often a solar farm is on more than one parcel or only occupies a portion of the parcel on which it is located, therefore, the solar company is only responsible for the real property tax paid for the acreage on the solar farm itself. This percentage is obtained by dividing the acreage of the solar farm by the deeded acreage of the parcel or parcels. Information on the acreage of the solar farms, if available, was obtained through specific zoning information within the parcel detail sections on the county websites. Additionally, exact acreage data was obtained for all Strata Solar farms from Strata Solar. The acreage of solar farms for which information was not available was estimated using the average acres per megawatt of the farms for which complete data was available. The average acres per megawatt was multiplied by the nameplate capacity of the facility to attain the estimated solar farm size. If the estimated farm acreage was larger than the parcel acreage, it was assumed that the company was responsible for 100% of the real property tax bill. For all other farms, the percentage the real property tax for which the company was responsible was calculated by dividing the farm size by the deeded acreage of the parcel or parcels. Consequently, the real property tax amount paid by the solar company is the proportion of the parcel leased by the solar company multiplied by the billed amount for 2014.

$$RPT = (Property\ Evaluation)(Applicable\ Tax\ Rates)(\frac{Acreage\ of\ Farm}{Acreage\ of\ Parcel})$$

The business personal (BP) tax paid in 2014 for Strata Solar projects was obtained from Strata Solar, a utility-scale solar energy developer in North Carolina. Additionally, tax information for projects in Beaufort, Franklin, Hertford, Person, and Washington counties was obtained from the county tax assessor offices. Because of time constraints, the BP tax for remaining projects was estimated using the cost of the facility reported by SNL Financial. This was determined by taking the estimated cost per kilowatt, multiplying that by one thousand (to convert to megawatts), and multiplying that by the nameplate capacity in MW to get the estimated initial cost of the facility. The estimated cost per kilowatt reported by SNL Financial is reported to be within 10% of the actual cost. The taxable value of the facility for the business personal tax is 20% of the initial cost of the equipment and machinery of the facility multiplied by a depreciation constant, as explained in the literature review. This constant is found within the 18-year schedule T depreciation schedule, available through the North Carolina Department of Revenue.[32] The applicable tax rates for each farm are the same as the tax rates that determine the real property tax, and can be found within the parcel tax bills. Thus, the estimated business personal tax is as follows:

$$BPT = (Cost\ per\ KW)(Nameplate\ Capacity)(1000)(0.2)(Depreciation\ Constant)(Applicable\ Tax\ Rates)$$

[32] North Carolina Department of Revenue. Local Government Division. *2015 Cost Index & Depreciation Schedules*. Jan. 2015. <http://www.dor.state.nc.us/publications/cost_archive/15archive/2015_costindex.pdf>

Analysis

Starting with a list of all the operating utility scale solar farms in North Carolina in 2013, data for 121 different projects across 54 counties in the state was collected and analyzed. Data couldn't be found for all the projects in the initial list obtained from NCUC. The average capacity of the projects for which data was found ranges from 1 MW to 20 MW. The average acreage that each solar farm occupies ranges from 8.39 to 167.77. This demonstrates the diversity in size, both in terms of acreage and generating capacity, of solar projects in North Carolina.

In order to determine how individual counties benefit from these solar projects, each county was classified into a tier based on its average level of economic well-being as defined by the North Carolina Department of Commerce.[33] These tiers are based on a variety of factors including unemployment rates, median income, and population growth. Tier 1 counties are the most economically distressed, tier 2 are in the middle, and tier 3 are the least distressed counties in the state. There are many different and interesting relationships between the solar projects in the sample size and the county tier in which the projects are located. The data show that the highest amount of taxes paid for solar farms in 2014, both real property and business personal, goes to tier 1 counties.

Additionally, the data show that the largest number of projects are also in tier 1 counties. Of the 121 total projects in this study that paid real property taxes in 2014, 58 are in tier 1, 49 are in tier 2, and 14 are in tier 3. An important note is that county tax data from some Duplin County projects could not be retrieved and were not included in this study. This is especially significant since Duplin is a tier 1 county and there were 11 projects located in that county according to the NCUC spreadsheet. Had this information been available and included in the dataset, an even higher proportion of projects would have been located in tier 1 counties. Additionally, the solar projects were divided into regions based on their geographic locations. The mountainous third of North Carolina are region 1, the piedmont is region 2, and the coastal plain is region 3. Of the 121 total projects in the dataset that paid real property tax, 4 are in Region 1, 44 are in Region 2, and 73 are in Region 3. This shows that the biggest proportion of projects are in the eastern region of the state (see Exhibit 1). Furthermore, this means that the majority of tax money from these solar projects are going to rural counties in the Eastern third of the state and these counties benefit the most from having solar projects because they receive the highest amount of tax revenue from them.

[33] "2016 County Tier Designations." *NC Commerce*. N.C. Department of Commerce, 4 Dec. 2015. Web. 7 Dec. 2015.

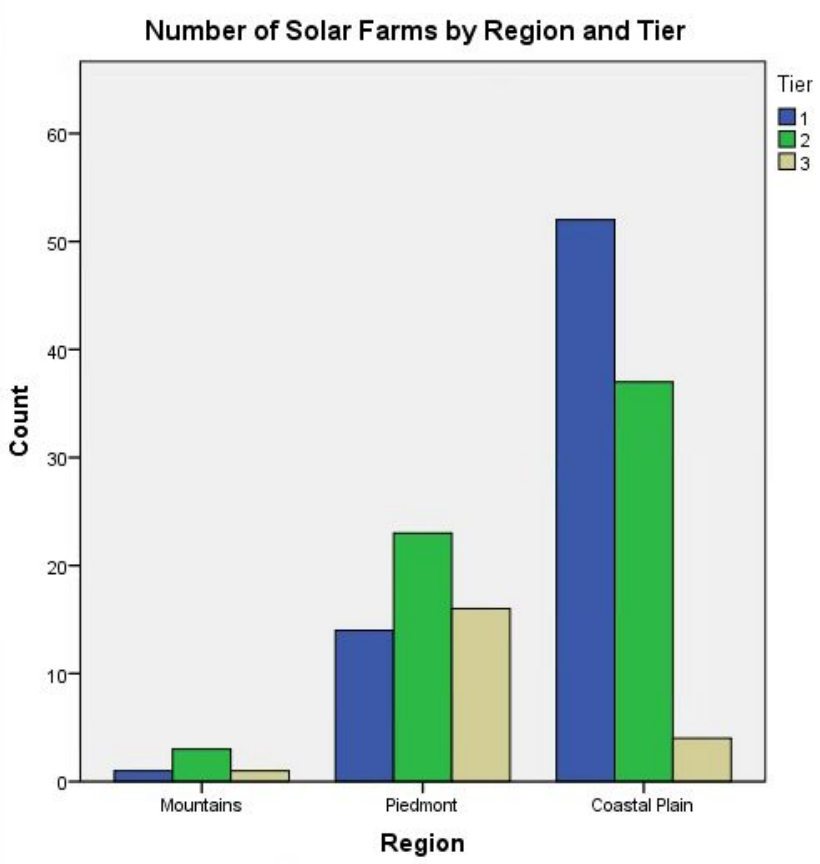


Exhibit 1. Projects that paid Real Property Tax in 2014 by Region and Tier

The average project size from the dataset is 4.45 MW. This suggests that most projects are around 5 MW which is considered to be "medium-sized." by the solar industry. This number will likely increase as projects begin to expand in size and companies start building larger projects to achieve economies of scale.

Companies that own or operate solar farms are required to pay a real property tax every year. This tax rate is a sum of the applicable tax rates for the county, city, and/or fire districts in which the solar farm is located. The total real property (RP) taxes paid in 2014 for all 121 solar projects was $127,940.74. Many of the solar projects included in this study are located on agricultural zoned parcel(s) as they have yet to be reassessed. Thus the real property tax for many of the solar farm parcels will increase when the land is assessed, as the tax rate for commercially zone land is higher than agriculturally zoned land. Still, the average RP tax paid for the solar projects in the sample was $1,057.36.

Utility scale solar projects also have to pay a business personal (BP) tax as explained in the methods section of the paper. Only 61 of the 121 total projects that paid real property taxes in 2014 also paid business personal taxes. The total BP tax paid by all companies who paid taxes in 2014 was $1,470,954.32. This is over ten times the amount paid in real property taxes. The average BP tax paid was $24,114.01. Without the current 80% property tax abatement that is currently in effect in North Carolina, the total BP tax paid would be $7,354,771.60 and the

average BP tax paid would be $120,570.05. Although the average tax amount collected without the abatement would be much larger than what is currently collected, such an increase would seriously threaten the financial stability of solar companies in the state.

	Real Property	Business Personal
Total	$127,940.74	$1,470,954.32
Average	$1,057.36	$24,114.01
Minimum	$27.20	$5,803.75
Maximum	$7,764.00	$57,261.38

Exhibit 2. Statistics about Operating Utility Scale Solar Projects in North Carolina

The data also show that both the total RP and total BP taxes paid in 2014 are highest for projects in tier 1 counties. Interestingly enough, tier 3 has the highest average RP tax bill per farm even though tier 1 has the highest average BP tax bill per farm. This might simply be due to higher average land value in less economically distressed areas of the state. See Exhibits 3 and 4 for the breakdown of average taxes per tier.

Tier	Sum	Average
1	$64,473.30	$1,111.61
2	$42,946.50	$876.46
3	$20,520.94	$1,465.78

Exhibit 3. Average Real Property Tax paid by Tier

Tier	Sum	Average
1	$880,453.83	$27,514.18
2	$443,350.06	$20,152.28
3	$147,150.43	$21,021.49

Exhibit 4. Average Business Personal Tax paid by Tier

The collection of data for this study had multiple limitations. Understanding these limitations is important for proper replication of this study to improve the results or obtain results for future tax years. One of the biggest issues faced while collecting tax data is that not all tax information was easily accessible. Multiple projects had to be eliminated from the final dataset because the necessary tax figures from various county websites and other sources of information could not be found. These omissions may have limited the accuracy of the conclusions reached in this study.

The sample size also does not include all the solar projects currently in operation in North Carolina. Instead, the sample size just includes the farms that filed paperwork by 2013, and began a PPA by the end of 2014. Additionally, tax information from Duplin county was unavailable for this study due to multiple issues with the property tax website and a lack of response from the Duplin County Tax Office by email. Another limitation to this study is that many solar farms came online in 2014 and thus did not pay business personal taxes that year. The sample size for the study, therefore, is much smaller for the projects that paid business

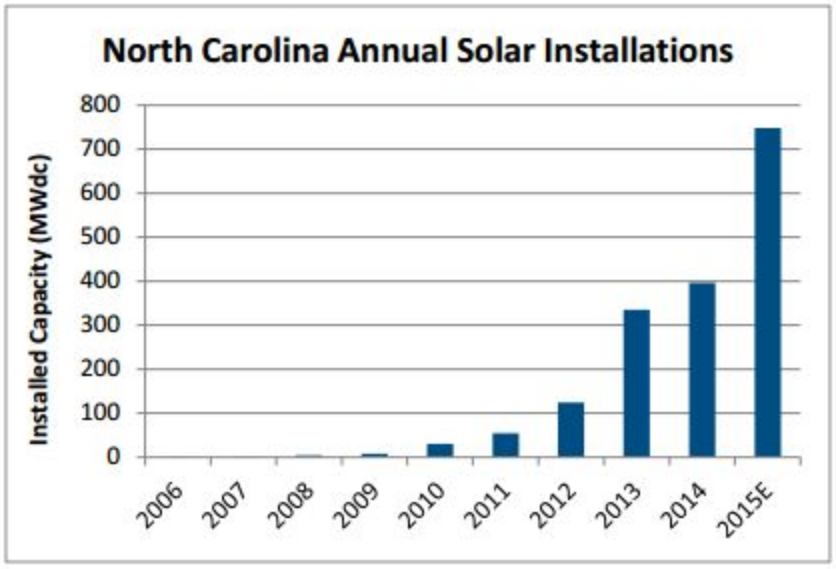
personal tax than all the operating farms in North Carolina because there were so many farms that did not pay any business personal tax in 2014. In total, only 61 of the 121 operating farms from the study's dataset paid a business personal tax in 2014 and thus these are the only farms included in the BP dataset.

Results and Recommendations

With data findings showing a greater than $20,000 average increase in property taxes paid per solar farm in North Carolina, it is clear that solar energy has become a significant source of local government tax revenue. A 2013 report published by the NC Clean Energy Technology Center, U.S. Department of Energy's Sun Shot Initiative, and Meister Consultants Group shows that in most states, property taxes comprise well over 50% of local government revenue.[34] Thus, solar energy is increasing the single largest source of revenue for North Carolina county governments. As mentioned in the previous section, at a statistically significant level, the largest number of solar installations are located in the most economically distressed counties (tier 1) of North Carolina. This means that most of the new tax revenue from solar farm development is going to the counties which stand to benefit most.

There have been several policy incentive totals employed in North Carolina that have made the state a favorable environment for utility-scale solar development. Two of the most noteworthy incentives are the 35% state renewable energy investment tax credit (ITC) and the 80% property business personal property tax abatement. The 35% renewable energy ITC was established in 1999 and was "designed to enable renewable energy companies to increase market scale and reduce per unit costs until each resource can be a part of a least cost electricity resource mix without incentive."[35] The 80% property tax abatement was established in 2008 as a significant reduction in the taxable liability of the "appraised value of a solar energy electric system from property tax."[36] The combination of these two policy incentives is strongly correlated with the recent exponential increase in the annual installation of new solar capacity in North Carolina. As a result, North Carolina's cumulative installed solar capacity ranks 4th nationally.[37] The graph below illustrates the growth in solar energy installations following the 2008 implementation of the 80% property tax abatement for solar electric systems.

[34] Barnes, Justin, Chad Laurent, Jayson Uppal, Chelsea Barnes, and Amy Heinemann. "Property Taxes and Solar PV Systems: Policies, Practices, and Issues." North Carolina Clean Energy Technology Center, U.S. DOE SunShot Initiative, and Meister Consultants Group, 1 July 2013. Web. 7 Dec. 2015.
[35] "The North Carolina Renewable Energy Investment Tax Credit." North Carolina Sustainable Energy Association (NCSEA), 2014. Web. 7 Dec. 2015.
[36] "Property Tax Abatement for Solar Electric Systems." DSIRE. North Carolina Clean Energy Technology Center, 1 Dec. 2015. Web. 7 Dec. 2015.
[37] Kimbis, Tom, and Shayle Kann. "Solar Market Insight Report 2015 Q2."Solar Energy Industries Association (SEIA). SEIA and GTM Research, 1 Sept. 2015. Web. 7 Dec. 2015.



This graph clearly illustrates that the installed capacity of solar energy in North Carolina has grown at an exponential rate since 2008. While it is difficult to isolate the cause of growth to the timing of the 80% property tax abatement, there is certainly a positive correlation. The property tax abatement has lowered the operating cost for utility-scale solar photovoltaic systems in North Carolina and has allowed solar companies to thrive in a favorable policy environment.

Recent efforts by North Carolina environmental and solar interest groups to extend the 35% state renewable energy ITC, which is scheduled to expire December 31, 2015, have proven unsuccessful. As a result, the 35% ITC will expire at the end of 2015. In the context of the expiration of the ITC, the 80% property tax abatement, for solar companies, takes on a greater importance.

Using tax data from over 100 solar projects across more than 50 counties in North Carolina, this study shows the per-project impact solar installations have on county property tax revenue. Installation of utility-scale solar farms on agriculturally zoned parcels of land has resulted in a per parcel property tax increase of 1,000% to 10,000%. By adding solar panels to the plot of land, the appraised value for the real property tax increases tremendously as the land transitions from being taxed as an agriculturally zoned plot of land to a commercially zoned plot of land. Additionally, the solar farm equipment and machinery is taxable as business personal property.

The current 80% property tax abatement for land with a solar energy electric facility has allowed companies to afford this increase in property taxes paid to the county. Without the tax abatement, the business property taxes paid by the solar company to the county would be five times larger than what is currently paid. While this increase would mean higher revenues to the local government from property taxes, it would also mean significantly higher costs for solar companies. The existing property tax abatement allows for solar companies to have cash on hand to pay their investors. Without cash on hand, the company losses liquidity becomes significantly less financially stable.

In April 2015, NC House Bill 681 was proposed with the inclusion of an amendment to repeal the 80% property tax abatement for solar energy electric facilities.[38] This bill sounded an alarm for solar companies in North Carolina because it threatened their business structure. To the relief of these companies, the bill did not gain enough momentum to become law. Nevertheless, the this bill's proposal has stirred new conversation about critical policy for North Carolina's solar industry. Should a legislative repeal of the tax abatement occur in the future, the financial stability of many of North Carolina's solar companies will once again be threatened.

According to the Solar Energy Industries Association (SEIA), there are 38 states in the U.S. that currently offer property tax abatements for renewable energy projects.[39] In a residential and small business context, these property tax abatements "allow businesses and homeowners to exclude the added value of a solar system from the valuation of their property for taxation purposes."[40] The purpose of each of these states' tax breaks is to incentivize renewable energy investment in order to diversify each state's electricity portfolio, resulting in a least cost mix of electricity generation. If North Carolina were to repeal the 80% property tax abatement, they would join the 12 state minority that does not incentivize renewable energy investment via property tax abatements.

The North Carolina General Assembly's website shows that the last action of NC House Bill 618 was "serial referral to judiciary II stricken" on April 14, 2015.[41] This means that the bill is not permanently dead, but is currently tabled. Even though HB 618 is currently tabled, some lawmakers in North Carolina still advocate repealing the 80% property tax abatement.

To better facilitate the study of the economic impact solar has had on county government revenue in North Carolina, a statewide database for taxes collected is necessary. Currently there is no central database with tax data for individual utility scale renewable energy facilities. Furthermore, most county tax department websites differ significantly in both layout and function, while some counties don't have tax data available online. A statewide database for tax bill history by parcel would facilitate further study of the renewable energy industry's effect on county tax bases and property values.

Conclusion

Overall, this study has shown that utility-scale solar development significantly increases the taxable value of the parcel being developed. Analysis of North Carolina solar facility data has shown that, at a statistically significant level, the most solar installations are located in the poorest counties (Tier 1). This means that the most economically stressed counties are receiving the most solar investment. This study has proven that, despite the 80% tax abatement, the

[38] "House Bill 681: NC Energy Ratepayers Protection Act." General Assembly of North Carolina, 14 Apr. 2015. Web. 7 Dec. 2015.
[39] "Solar Tax Exemptions." Solar Energy Industries Association (SEIA). Web. 7 Dec. 2015.
[40] Ibid.
[41] "House Bill 618 Information/History (2015-2016 Session)." North Carolina General Assembly (NCGA). 14 Apr. 2015. Web. 7 Dec. 2015.

taxable value of a parcel with a solar farm is significantly larger than the taxable value of that same land under agricultural zoning. Furthermore, for continued growth and investment in North Carolina's solar industry, the tax exemption is critical. Without the abatement, solar companies do not have enough cash to pay their investors and reinvest in new projects. If North Carolina is to remain among the top five states in total solar capacity and the number two state in annual new capacity installation, it is essential that the 80% property tax abatement remains in place.

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