Assessing Barriers and Viability of Commercial Solar Installations in Orange County

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ABSTRACT: This report sets out to assess the political framework, financial viability, and technical feasibility of commercial solar energy in Orange County, NC. The central goal accomplished through research was to determine what existing barriers exist to solar implementation for these potential commercial installations, and how these barriers can be broken. The project produced quantifiable solutions that should be both instructive and encouraging for commercial installation opportunities. There is ample sunlight, conductive investment atmosphere in North Carolina, as well as local interest and support in Orange County. In conclusion we offered means of capturing the current solar energy momentum and future improvements that could increase the efficacy of the industry.
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1.0 INTRODUCTION

The problem of identifying the existing barriers to commercial solar energy development and how these barriers can be broken to create quantifiable solutions proves to be a complicated and inter-disciplinary topic. For the purposes of this paper the subject has been conveniently divided between policy, financial, and technological frameworks that are responsible for shaping the clean energy environment. This paper was written with the explicit aim of supporting the installation of commercial solar projects in North Carolina and, more specifically, Orange County. The policy portion of the paper gives a detailed overview of the political structure governing solar installation, examining solar implementation to contextualize the environment in which financial and technological solutions must operate. Financial analysis compares North Carolina electric utility rates versus the levelized costs of solar energy, as well as analyzing local commercial solar projects by modeling cash flows. The financial model also projects a rate of return for future Orange County commercial installations. Finally, the technical portion of this project will take available data specific to Orange County and synthesize it in a model outputting relevant data to solar installers, commercial owners, and joint venture partners.
2.0 POLICY

2.1 Introduction

Renewable energy policies come in a variety of packages that influence the installation and effectiveness of alternative energy production. The United States is a federal union with multiple levels of governance that function together and in opposition at times. “When there is no clear national direction for energy initiatives, regulators are more likely to work at cross-purposes, as is reflected by the fragmented sub-national approaches to natural gas fracking regulation.”¹ Various federal, state, and local levels of renewable energy policy make the implementation of energy alternatives a complex issue dominated by a nexus of interconnected interests and constituencies. Where regulatory jurisdiction is highly uncertain, federalism can contribute to policy inaction – a stalemate in which neither subnational nor national decision makers perceive that they have the prerogative to act to solve complex regulatory problems.² There is more at stake in the policymaking world than the discrete threat of global warming, and to focus so exclusively on carbon would be doing a disservice to the broader political and socio-economic climate that informs policy decisions. Sustainability is not merely an environmental concept, but one of equity and economy as well.

The solar market, while relatively young, is an increasingly important and vital part of the American economy. However, despite the huge hypothetical potential for clean energy production and decades of policy support for the development of renewable energy technologies, they are not yet a significant part of the existing energy regime. This is often explained by the high production costs being the main barrier for market diffusion, but many additional barriers have also been identified: “market barriers (e.g. market failures and distortions), institutional barriers (e.g. lack of legal frameworks and institutions), technical barriers (e.g. lack of codes, standards, and skilled people), and social barriers (e.g. user acceptance and awareness).”³ It is often taken for granted that a fundamental obstacle

² Rossi and Hutton, 2013
to the solar industry is the necessary presence of the sun. Except for Concentrating Solar Power (CSP), solar electrical production is only available during daylight hours. Additionally there is a technological lag between solar production and storage capacity that must be bridged to accommodate the fundamental intermittency of the solar energy resource. Once all of the practical and technological barriers are cleared, for the industry to prosper it must also garner political favor, which seems, at times, to be the most difficult barrier to surmount.

A fundamental barrier to solar implementation is the interaction between cost and policy, which is termed transaction costs. Transaction costs “are the indirect costs incurred by all parties involved in creating and using a policy.” They are incurred through activities such as information collection, legislation development, hiring and training staff, lobbying, contracting, record keeping, reporting, monitoring, implementation and enforcement. Without an understanding of these costs, decision makers may be limited in their assessment of a policy’s past, current or future efficiency. “The greater the uncertainty and less observable the policy outcomes, the higher the transaction costs due to the cost of information collection and monitoring and enforcement.” The causes of transaction costs vary between public and private parties. For example, often the public party or policy administrator bears most of the transaction costs in creating the policy instrument and private parties bear the costs later when they use the instrument. Transaction costs also vary over time and can be heavily influenced by activities conducted in the initial stages of policy development. For example, costs incurred during policy development may reduce costs incurred in implementation and ongoing use. Therefore, transaction costs need to be analyzed throughout a policy’s lifetime rather than just at a specific stage. The cost may also depend on the market instrument itself, i.e. whether it is market-based or regulatory. For example, when creating a market-based policy, uncertainty will increase the transaction costs of deciding what should be purchased and ranking these purchases.

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4 http://energy.gov/articles/top-10-things-you-didnt-know-about-concentrating-solar-power
6 Ibid.
8 Ibid.
9 Ibid.
Coggan et al. found that the costs of developing and establishing a policy may be lower, but greater costs may be incurred due to activities such as monitoring and enforcement. In order to inform decision making, greater understanding is needed about the factors that influence transaction costs across the whole suite of policy instruments.

Despite these apparent barriers to distributed generation, in 2013 North Carolina, along with Massachusetts, California and Arizona, saw growth in the number of nonresidential solar installations. Most states experienced a reduction in installations coinciding with the end of the Treasury Grant Program in 2012--projects that began construction by the end of 2012 remained eligible for the program, but no new projects could be accepted. When incentive programs end, it is typical to see a surge of applications before the deadline and then a drop in installations after the deadline has passed. Falling PV prices and continued availability of the federal business energy investment tax credit (ITC) meant that the loss of this incentive resulted in only a minor drop in installations nationally, while NC proved the exception to the rule, actually demonstrating continued modest growth even in the absence of the Treasury Grant. Figure 1 illustrates the underlying growth of solar in the renewable energy market.

![Figure 1: New U.S. Electric Generation Installed in 2013 by Technology](image)

In 2013 solar installations, including photovoltaic (PV) and concentrating solar power (CSP), accounted for 31 percent of new electricity generation installed during the year. Within this solar subset, PV can be installed almost everywhere CSP can, but not the other way around. Current commercial CSP technology needs higher

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11 Ibid.
levels of irradiance (typically those of the sunbelt countries), access to water (just like a coal plant) and large-scale deployments (typically more than 20 MW, compared with the few kW of a residential PV system). This means that there are more tech companies, investors and policy makers interested in PV than in CSP.\(^{12}\)

For distributed generation the installation of renewables must be approached from the perspective of demand as well as supply. Alternative energy demand encounters barriers to entry with cost, complexity, and consumer inertia.\(^{13}\) While on the opposite side of the equation, suppliers cannot afford the excess economic burden of pursuing and acquiring new leads. Both consumers and suppliers can recognize the financial benefits that solar can provide, but only if the market is framed to properly value this behavior. Governance and policymaking are responsible for framing these benefits.

Beyond the indirect subsidization (i.e. tax incentives) of distributed generation, North Carolina has taken more active measures to spur changes in the behavior of utilities that otherwise function as natural monopolies in an environment that is free from competition. While net metering allows individual producers to be compensated for excess energy production, and tax incentives and rebates offset much of the financial burden of installation, the overarching state energy policy is the Renewables Portfolio Standard (RPS). RPS has yet to be implemented as a federal policy, but states, with discretionary power to regulate utilities, have independently developed an array of portfolio standards that can reflect the political climate and inclinations of the state legislatures. NC requires that all investor-owned utilities in the state to supply 12.5% of 2021 retail electricity sales from eligible energy resources.\(^{14}\)

While the state RPS sets a minimum threshold for a Utility’s renewable energy production (or, alternatively, increased energy efficiency), there must be a foundation of incentives and disincentives in place to both encourage alternative energy development as well as discourage further carbon emissions. A general rule of thumb for tax policy is to fine for bad practices (often negative externalities), and incentivizing good behavior.

Economist Arthur Pigou was influential in developing the concept of market externalities, which, in this instance, are the carbon emissions, environmental damages,
and public health hazards associated with fossil fuel combustion. In principle, these taxes should be utilized to discourage poor practices, which impose an “external” burden on the market that may not be reflected in the price of the particular product. Such Pigovian taxes are applied to a market activity that is generating negative externalities (costs for somebody else). The tax is intended to “correct” or “internalize” an inefficient market outcome, and does so by being set equal to the negative externalities. In the presence of negative externalities, the social cost of a market activity is not covered by the private cost of the activity. In such a case, the market outcome is not efficient and may lead to over-consumption of the product. A particularly relevant and often cited example of such an externality is environmental pollution.

Subsidies, in contrast to the punitive nature of Pigovian taxes, are designed to incentivize good behavior. Direct subsidies in the form of cash grants and interest free loans do not exist for US renewable power projects. Additionally, for small-scale and distributed generation energy projects the aforementioned Pigovian carbon taxes have little bearing on the customer’s decision whether to install non-utility scale renewable energy projects. Small-scale generators may care little for the price of carbon avoided by installing solar panels, which is only implicitly beneficial by raising the cost of otherwise more polluting fossil fuels to a truer market valuation; like most economic entities, they are looking for more direct incentives. Taxes that more apparently benefit renewables come in the form of tax rebates and abatements for installation. These tax refund policies tend to exist on federal and state levels to encourage installation in (relatively) infant industries. Renewable tax breaks create a more competitive pricing for newer technologies that have higher initial costs (i.e. not cost competitive) in the open market.

Most of the renewables industry has yet to reach unaided grid parity, the point when the alternative energy source can generate electricity at a levelized cost that is less than or equal to the price of purchasing power from the electricity grid. Reaching grid parity is considered to be the point at which an energy source becomes a contender for widespread development without subsidies or government support. It is widely believed that a wholesale shift in generation to alternative energy will take place when they reach

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16 Ibid.
grid parity. Policymaking and the dissemination of information (to both consumers and suppliers) will ultimately be responsible for the success or stagnation of renewable energy growth.

2.2 The Smart Meter and Net Metering

The *smart meter* is a fundamental infrastructural development required for the inclusion of solar power into the grid, and represents the first step towards developing a sustainable renewable energy economy not founded exclusively on tax credits for installation. *Net metering* attracts more than high-minded and enlightened environmentalists by providing economic enticements for long-term distributed renewable energy production. Smart and net metering reframe the issue of installing solar panels; installation is no longer a singular and selfless act that is only partially compensated by tax credits, but an economic boon that pays itself off many times over during its 25 year lifespan. At its core, net metering is a simple option for consumers to offset their monthly electricity bills by producing their own electricity. It allows customers to send excess energy back to the grid, and receive a 1:1 kilowatt-hour credit for that energy. In 2013, 95 percent of distributed installed capacity was net metered. Thus the solar industry is not restricted to philanthropists and staunch environmentalists, but represents an economic opportunity that can be understood and profitable in the American capitalist paradigm.

A smart meter is a digital electric meter that measures and records usage data hourly, or more frequently, and allows for two-way communications between the utility and the customer, which enables the requisite record keeping for net metering. In North Carolina net metering is available to all customers who own and operate systems that generate electricity using solar energy, wind energy, hydropower, ocean or wave energy, biomass resources, combined heat and power (CHP), or hydrogen derived from eligible renewable resources.

In general, any customer net excess generation (NEG) during a billing period is carried forward to the following billing period at the utility’s full retail rate, and then surrendered to the utility at the beginning of each summer billing season with no

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18 Munoz et al. 2014
19 IREC Report 2014
20 NCUC Docket No. E-100, Sub 83
compensation for the customer. The utility also owns the Renewable Energy Credits (REC) unless the user opts to net meter under a time-of-use (TOU) tariff with demand changes. The treatment of generation and NEG for customers on TOU-demand tariffs is more complicated (to prevent price manipulation, or “gaming” the system). For these customers, on-peak generation is used to offset on-peak consumption, and off-peak generation is used to offset off-peak consumption. Any remaining on-peak generation is then used to offset off-peak consumption. Off-peak generation may only be used to offset off-peak consumption.21

As a matter of regulatory oversight utilities must file annual reports with the North Carolina Utilities Commission (NCUC) indicating the number of net-metering applicants and customer-generators, the aggregate capacity of net-metered generation, the size and types of renewable-energy systems, the amounts of on-peak and off-peak generation credited and ultimately granted to the utility, and the reasons for any rejections or removals of customer-generators from a net-metering arrangement.22

2.3 Renewable Energy Portfolio Standard

Beyond indirect subsidization (i.e. tax incentives) of distributed generation, NC has taken active measures to spur changes in the behavior of utilities that otherwise function in a monopolistic vacuum that is free from competition. While net metering allows individuals to be compensated for capped amounts of excess energy production, and tax incentives and rebates offset much of the financial burden of installation in the long-term, the state has also set a mandatory minimum threshold for renewables implementation in the form of the Renewables Portfolio Standard (RPS).23 RPS for electricity are politically popular in many US states although economic analysis suggests, “they are not first-best policies.”24 Although advocates claim that an RPS will stimulate job growth, Lyon and Yin find that states with high unemployment rates are slower to adopt an RPS. Local environmental conditions and preferences have been found to have no significant effect on the timing of adoption. Overall, RPS adoption seems to be driven more by political ideology and private interests than by

21 Ibid.
22 Ibid.
23 NC. Gen. Stat. § 62-133.8
local environmental and employment benefits, “raising questions as to when environmental federalism serves the public interest.”  

It should be noted that in the 2013 political battle to repeal the North Carolina RPS an RTI study presented data on the actual benefits of the state’s RPS that successfully overcame the ideological partisanship of the legislature.  

The report by Research Triangle Institute and La Capra Associates was prepared for the North Carolina Sustainable Energy Association, and estimated the total economic benefit to the state from its clean energy investments at $1.7 billion. In addition to the economic boom and job creation (21,163 job years growth in net employment from 2007-2012), it was also found that there is no appreciable rate impact to residential, commercial, and industrial customer groups forecast through 2026 as a result of state renewable energy and energy efficiency policies.

In North Carolina utilities must generate or procure a certain percentage of electricity from renewable energy. The state also has a “carve-out” that enumerates an increasing schedule of solar energy production in the utility’s portfolio.  

The opportunity to acquire solar energy through renewable energy credits has created a market with increased demand for distributed solar. RPS has yet to be implemented as a federal policy, but states have independently developed an array of portfolio standards that can reflect the political climate and inclinations of the state legislatures. NC requires that all investor-owned utilities in the state to supply 12.5% of 2021 retail electricity sales from eligible energy resources. Municipal utilities and electric cooperatives must meet a target of 10% renewables by 2018 and are subject to slightly different rules.

Utilities may demonstrate compliance by procuring renewable energy credits (RECs) earned after January 1, 2008. Under NCUC rules, a REC is equivalent to 1 MWh of electricity derived from a renewable energy source, or an equivalent amount of thermal energy in the case of combined heat and power (CHP) and solar water heating, or 1 MWh of electricity avoided through an efficiency measure. The law explicitly states that RECs do not include credit for emissions reductions from oxides of sulfur and nitrogen, mercury or...

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25 Ibid.
27 Ibid.
29 N.C. Gen. Stat. § 62-133.8
carbon dioxide. RECs must be purchased within three years of their generation, and must be retired within seven years from when their cost was recovered. Utilities may use unbundled RECs from out-of-state renewable energy facilities to meet up to 25% of the portfolio standard.\textsuperscript{30}

NC RPS sets the overall target for renewable energy, and includes a technology-specific carve-out of 0.2% for solar production by 2018.\textsuperscript{31} This represents a small portion of the state’s energy budget, but nonetheless sets only the minimum threshold for solar energy. The state may well exceed this projection at current rates of growth (particularly with the incentives for distributed generation in the private or non-utility scale installations that can be purchased for Renewable Energy Credits), and solar may prove to be a greater force in NC’s renewable energy agenda.

2.4 Indirect Subsidies

2.4.1 Federal Tax Incentives

“Federal investment is critical to the success of the renewable energy industry. That’s not a new idea. The same was true for coal, which would not have been economically feasible without tax exemptions and incentives. It was also true for offshore oil drilling, which was deemed unprofitable without royalty waivers and favorable packaging of federal leases.”\textsuperscript{32}

The initial incentives for any solar installation are the tax incentives associated with installation. On the federal level The Business Energy Investment Tax Credit\textsuperscript{33} (ITC) is equal to 30% of expenditures, with no maximum credit. Eligible solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. Hybrid solar lighting systems, which use solar energy to illuminate the inside of a structure using fiber-optic distributed sunlight, are eligible. Passive solar systems and solar pool-heating systems are not eligible. Tax credits for both residential and commercial installations are in place at

\textsuperscript{30} Ibid.
\textsuperscript{31} Ibid.
\textsuperscript{33} 26 USC § 48
current levels through the end of 2016. Then the residential ITC will expire and the commercial ITC will revert from 30 percent to 10 percent. With this stable incentive, developers and installers can plan and market their products, and consumers can make rational decisions without arbitrary incentive deadlines.

Federally, the government also offers the Modified Accelerated Cost-Recovery System\(^{34}\) (MACRS), which allows businesses to recover investments in certain property through depreciation deductions. The MACRS establishes a set of class lives for various types of property, ranging from 3 to 50 years, over which the property may be depreciated. Qualifying solar energy equipment is eligible for a cost recovery period of five years. For equipment on which an Investment Tax Credit (ITC) or a 1603 Treasury Program grants (payments for specified energy property in lieu of tax credits)\(^{35}\) is claimed, the owner must reduce the project’s depreciable basis by one-half the value of the 30% ITC. This means the owner is able to deduct 85 percent of his or her tax basis deductions.

2.4.2 North Carolina Tax Incentives

The \textit{NC Property Tax Incentive}\(^{36}\) exempts 80% of the appraised value of a "solar energy electric system" (photovoltaic, or PV, system) from property tax. Furthermore the \textit{NC Corporate Tax Credit}\(^{37}\) exempts 35% of the cost of eligible renewable energy property constructed, purchased or leased by a taxpayer and placed into service in North Carolina during the taxable year. The Credit must be taken in five equal installments beginning with the year in which the system is placed in service. A maximum of $2.5 million can be used per installation for all solar, wind, hydro, geothermal, combined heat and power (as defined by Section 48 of the U.S. Tax Code), and biomass applications used for a business purpose, including PV, day lighting, solar water-heating and space-heating technologies. The allowable credit may not exceed 50% of a taxpayer’s state tax liability for the year, reduced by the sum of all other state tax credits.

\(^{34}\) For renewable energy technologies classified as five-year property (26 USC § 168(e)(3)(B)(vi)) under the MACRS, which refers to 26 USC § 48(a)(3)(A)

\(^{35}\) “The purpose of the 1603 payment is to reimburse eligible applicants for a portion of the cost of installing specified energy property used in a trade or business or for the production of income. A 1603 payment is made after the energy property is placed in service; a 1603 payment is not made prior to or during construction of the energy property.” Source: US Department of Treasury at \url{http://www.treasury.gov/initiatives/recovery/Pages/1603a.aspx}

\(^{36}\) N.C. Gen. Stat. § 105-275 (section 45)

Unfortunately these state tax incentives are expiring at the end of 2015. However, in the perversity of the market this expiration date may actually create a brief boom in the NC solar market as individuals and businesses rush to take advantage of tax incentives while they are still in effect. For the expansion of the solar industry to continue, however, these incentives must be extended in some form. Solar industry in NC has yet to reach grid parity, and therefore cannot compete independently with such inexpensive (and polluting) fossil fuel sources in an open energy market. There are certainly vested interests of utilities in state government, but they cannot remain blind to the growing environmental and economic insolvency that fossil fuels represent for the future. To reject solar energy on the basis of current pricing is to sacrifice the benefits that it could (and would) provide to the future.

2.5 Third Party Ownership

The dominant ownership model for nonresidential distributed installations has long been third-party ownership. In recent years this third-party ownership has expanded to become the dominant ownership model in all sectors. This structure may take the form of a lease or a power purchase agreement (PPA).

A solar power purchase agreement (SPPA) is a financial arrangement in which a third-party developer owns, operates, and maintains the photovoltaic (PV) system, and a host customer agrees to site the system on their roof or elsewhere on their property and purchases the system’s electric output from the solar services provider for a predetermined period (Figure 1.2). “This financial arrangement allows the host customer to receive stable, and lower cost electricity, while the solar services provider or another party acquires valuable financial benefits such as tax credits and income generated from the sale of electricity to the host customer.”

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38 Ibid.
39 Personal communication: Stew Miller, Yes! Solar Solutions
SPPA arrangements enable the host customer to avoid many of the traditional barriers to adoption for organizations looking to install solar systems: high up-front capital costs; system performance risk; and complex design and permitting processes. In addition, SPPA arrangements can be cashflow positive for the host customer from the day the system is commissioned.42

North Carolina’s SPPA is operated through NC GreenPower, a statewide green power program designed to encourage the use of renewable energy. NC GreenPower offers production payments for grid-tied electricity generated by solar and other renewables. Payment arrangements for electricity generated by most renewable energy systems may be available by submitting proposals for consideration when NC GreenPower issues an RFP (Note: the most recent RFP closed November 25, 2014). However, owners of small solar

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42 Ibid.
energy systems (5 kW or less) may currently apply to receive program incentives at any
time. Owners of small solar energy systems are encouraged to review and fill out an online
application, available on the NC GreenPower web site. Currently, Owners of small solar-
electric systems enrolled in NC GreenPower receive $0.06/kWh from the program, plus
approximately $0.04/kWh from their utility under the power-purchase agreement, for a
total production payment of about $0.10/kWh. Note that customer-generators who choose
to net meter are not eligible to participate in the NC GreenPower Program.43

NC GreenPower is an independent, nonprofit organization created by state-
government officials, electric utilities, nonprofit organizations, consumers, renewable-
ergy advocates and other stakeholders. It began operation in October 2003 as the first
statewide green-power program in the United States. North Carolina’s three investor-
owned utilities -- Dominion North Carolina Power, Duke Energy and Progress Energy -- and
many of the state's municipal utilities and electric cooperatives are participating in the NC
GreenPower Program.44

2.6 Feed-In Tariffs

Feed-in tariffs (FITs) are a policy designed to encourage competitive pricing of
alternative energy to reach grid parity. The first form of FIT was implemented in the US in
1978 under President Jimmy Carter, who signed the National Energy Act (NEA). This law
included five separate Acts, one of which was the Public Utility Regulatory Policies Act
(PURPA). The purpose of NEA was to encourage energy conservation and develop new
energy resources, including renewables such as wind, solar and geothermal power. Within
PURPA was a provision that required utilities to purchase electricity generated from
qualifying independent power producers at rates not to exceed their avoided cost.45 This
free market approach presented investment opportunity and government encouragement
for more development of environmentally-friendly, renewable energy projects and
technologies; the law created a market in which non-utility independent power producers
developed, Although recently PURPA has been depreciating, as many of the contracts made
under it during the 1980s are expiring, and some energy market players failed. It remains

44 Ibid.
relevant, particularly as it does not discriminate between independent power producers. The standard contracts under the Federal Energy Regulatory Committee (FERC) for facilities less than five megawatts has unwittingly also encouraged the growth of small natural gas plants. PURPA is also waning in significance as a result of electric deregulation and open access to electricity transportation by utilities has created a vast market for the purchase of energy and State regulatory agencies have therefore stopped forcing utilities to give contracts to developers of non-utility power projects.

FITs more generally are an economic policy created to promote active investment in and production of renewable energy sources. FITs typically make use of long-term agreements and pricing tied to costs of production for renewable energy producers. By offering long-term contracts and guaranteed pricing, producers are sheltered from some of the inherent risks in renewable energy production, thus allowing for more diversity in energy technologies.

The importance of PURPA, however, does not stem from any resultant successes of the legislation, but rather the precedent the statute represents. The US demonstrated in 1978 (in response to the 1973 energy crisis) that the country could take a definitive stance in favor of non-utility power production and energy independence. Recent administrations have declined to act further on a national FIT, but state and local/municipal FITs have arisen in California, Florida, Hawaii, Maine, New York, Oregon, and Vermont. Meanwhile, North Carolina has opted not to adopt a feed-in-tariff at this time, exclusively net metering and subsidizing installation costs through tax breaks and abatements. Elsewhere, FITs have gained international celebrity with the remarkable success of Germany’s renewable energy revolution, the Energiewende. In 2013 German commercial solar energy had already reached grid-parity largely as a result of FIT policymaking. While opposition will always exist to such an aggressive energy policy, it is worth noting the resounding success of FITs as a potential model to be emulated in the future.

2.7 Local Efforts and Policies

“As of 2012, 87% of the state’s 550 cities and 79% of the state’s 100 counties have adopted zoning ordinances. Of these, only 24 cities and 18 counties have incorporated solar development ordinances into their codes; each on a case-by-case basis. This inconsistent approach to solar development regulation has created a patchwork of disparate and often undefined approaches, potentially creating unnecessary barriers to investment and development.”

Although federal and state level policies pose important incentives for solar energy as well as renewable energy, one must also look into useful policy and community efforts that happens at the city and county levels for motivators of its enactment. These efforts combined can determine the quality of the installation as well as help spread awareness and support. Local support for commercial properties on solar power installations in Orange County is imperative for this case study.

Orange County primarily consists of three cities Carrboro, Hillsborough and Chapel Hill. Within these cities the concept of solar power is not only emerging into popular topic of conversation but also being promoted by the county’s legislations, school system and local solar power installation companies. Awareness and spread of solar power information to facilitate the solarize movement therefore relies heavily on cooperation at the community level.

The Orange county development ordinance (adopted April 5, 2011) informs the population about the installation of solar power arrays by describing its guidelines and standard evaluation criteria. A positive one being that it allows non-residential businesses to transfer or sell excess power generated onsite back to the utility provider or other third party entity as well as receive credit from a local utility provider for the power generated onsite as a means to offset utility bills. This ordinance also outlines the necessary submittal requirements needed for approval of installation for both nonresidential and


48 Orange County Code of Ordinances, Article 5.9.6 Solar Array.
residential properties. This includes standards for ground and building mounted devices as well as general standards about capacity, volume and area limit.

The city of Carrboro WISE Homes and Buildings program is also helpful in providing helpful information on loans for small business owners to use for their installations in the town of Carrboro. This would allow commercial properties to get an extra help with the up front cost of solar array installment. It provides an Energy Efficiency Revolving Loan fund consisting of a 3% interest rate and 10 year payback with a minimum loan amount of $1500\textsuperscript{49}. The program works closely with Southern Energy management, one of Orange County’s local solar energy contractors, for financial assessment and installation. If your building can achieve a minimum of 15% projected energy savings from solar power arrays then it will be considered for installation and Southern Energy Management will send a complete detailed report to the Carrboro Energy Efficiency coordinator. It is then reviewed the EE coordinator and the Economic Sustainability Committee (ESC) before it is sent for final approval from the Board of Aldermen, which will either deny or approve the loan\textsuperscript{50}.

Additionally, the city of Chapel Hill’s Code of Ordinances under Building and Building regulations presents a section on energy conservation goals in building design. The code demands that any new or expanded building built by and for the town government are to employ the Leadership in Energy and Environmental Design (LEED) Green Building Rating System throughout their design, construction, and operation unless the town council determines that such certification is not in keeping with the use or purpose of the building or is otherwise inappropriate\textsuperscript{51}. LEED is a green building certification program that recognizes best-in-class building strategies and practices. To receive LEED certification, building projects satisfy prerequisites and earn points to achieve different levels of certification. Prerequisites and credits differ for each rating system, and teams choose the best fit for their project. The University of North Carolina has abided by this standard in the building of its Genomic Science Building in 2011. Attaining an overall LEED score of Gold.

\textsuperscript{49} Carborro Worthwhile Investments Save Energy \url{http://www.ci.carrboro.nc.us/DocumentCenter/View/162}
\textsuperscript{50} Ibid
\textsuperscript{51} Chapel Hill Code of Ordinances Ord. No. 2005-05-09/O-3, § 1 \url{http://www.townofchapelhill.org/home/showdocument?id=4954}
Two main local contractors of solar energy in Orange County are: Yes! Solar Solutions and Southern Energy Management. These contractors build a one-on-one relationship with their customers to help assess their business for installation. Yes! Solar Solutions provides free assessments for commercial and business areas. Assessment includes measurement of usable area, pricing, and their expertise in tax incentives, rebates, and energy programs. It is considered a certified Green Plus company that strategizes in finding the best energy conservation possible and includes community outreach efforts. The company works in junction with North Carolina Sustainable Energy Association, NC Green Power, the American Solar Energy Society, and the US Green Builders Council to provide our neighbors, our families and our world with a renewable source of clean energy.

Stew Miller is one of the co-founders and president of Yes! Solar Solutions and a man devoted towards a green future. He and his wife Katy Miller opened the company in 2009 after selling a previous education-based private preschool business (Primrose Schools of Cary). Opening a business can be an incredibly hard task; however, both founders had previous long corporate careers that made them experienced in all areas of business management, construction, and operation.

“My interest in solar started as a by-product of our restoration of several historic and older properties; Kathy and I realized that solar had great potential in reducing the operating costs of these structures, while at the same time, reducing their impact on climate change.”

Stew believes that North Carolina has a great head start on all of the other states in the Southeast with our installed solar capacity and potential. That Clean Energy industry will be the only opportunity the state has to participate in the future of energy revolution. For this to happen solar power has to not only be installed across residential and commercial properties but also adopted and supported by the community. Solarize

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53 Ibid
54 Personal communication: Stew Miller, Yes! Solar Solutions
movements and reception from all around the state is critical for the future of green energy.

“In my opinion, we have just barely started to realize the potential of solar energy and as newer technologies emerge, solar farms will produce more on less acreage. The solar energy generation will be integrated into most new home and commercial building constructions. Customer demand drives innovation and reduces cost, and installing technologies like solar to help reduce energy costs will not only allow citizens to be independent of utility companies but also allow them to invest in clean energy to help stop climate change.”

Although ordinances and loan programs are important for the implementation of solar power, education at the county level is a key element for a community change of practice. A social barrier to the implementation of solar power is the lack of awareness, acceptance, and education at the community level. Education on solar power not only allows people to familiarize with the idea of renewable energy but also to see it as feasible for installation. Solar Energy International is a non-profit educational organization that promotes the use of sustainable practices for the world, including the use of solar power. They offer a full spectrum of personal or online training workshops and courses for people interested, one of which is given at Durham Technical Community College in Hillsborough. These workshops vary in topics but include electric and thermal solar training. The significance this organization has is tremendous, for it can become a door for those interested in learning about and joining the solar power movement. Furthermore the organization also caters to the subjects of these workshops by teaching Spanish courses as well as financial assistance for those that can’t afford them.

Additionally, the Orange County school system has worked with the solarize campaigns to develop awareness and excite students on the topic of solar power and solar programs in the area. Yes! Solar Solutions works with the Orange County School department to implement information sessions for the students and their families on the topic of solar power. This year McDougle Middle school in Carrboro went solar. The students made a cooperative effort to make a video explaining why solar power is

55 Personal communication: Stew Miller, Yes! Solar Solutions
56 Solar Energy International http://www.solarenergy.org/
important for the school and sourced enough funds including a hefty donation from a non-profit organization called Next Climate. Yes! Solar Solutions was able to install a 1-kilowatt array with Enphase micro inverters and 4 REC 250 watt solar panels. Solarize programs have also worked with the Durham County Soil & Water Conservation District to install a small solar battery back-up system at the Southern School of Energy and Sustainability to help teach the students. East Chapel Hill High currently works in conjunction with the Solarize Orange County movement to raise enough funds to install solar array panels so as to help the school use less energy from non-renewable sources and to make it environmentally friendly and energy efficient. This installation will also help students gain an in-depth knowledge of how solar power works by allowing them to actively monitor the production of these panels.

These county efforts are not only seeking to reflect and shape the attitude of modern society standards but also stimulate the community to become a solar powered reliant entity. They signal public awareness of what needs to be addressed. These efforts can build movement within a county to make renewable energy an everyday reality. With their aid, Orange County steps towards a greener future.


3.0 FINANCIAL

3.1 Introduction

When considering solar PV system installations for commercial buildings, the main barrier experienced is finance. Solar installations come with large upfront costs and a long-term return on investment, which varies with each solar installation. Often, the commercial sector does not see the benefits of solar installations because financial models represent only the short term accounting costs to run a business. If the commercial business projects their energy costs on a long-term scale, then they can gauge the effectiveness of solar systems in reducing electricity expenses and increasing the property value of a commercial space.59

There are varying aspects to the quantitative piece of solar energy installations. Throughout this section, we will address the aspects of financing a solar installation such as costs, tax incentives, depreciation, which will lead to a predicted payback period for the investment in solar. In the beginning of this section, we aim to look at the price of standard electricity rates compared to the cost of solar energy over time in order to predict the economic future for energy production in a resource intensive market. The cost of solar energy is measured in cents per kWH of energy produced and includes the installed system expense. In analyzing the economic feasibility of commercial-scale solar installations, we will project three cash flow models based on a small-, medium-, and large-scale commercial installation. Finally, we will present financing options available to commercial business owners for solar installations.

3.2 Methodology

To compare standard electricity rates and solar energy rates, we used historical commercial rate prices provided by the US Environmental Information Administration (EIA). We analyzed the rates over the last ten years, and then used projected growth rates to look at possible electricity costs in the next ten years. Figure 2.1 shows the change in

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standard electricity rates over time. Solar energy rates are derived from the report “Levelized Cost of Solar in North Carolina”. Figure 2.2. Shows the levelized cost of energy of solar PV systems over time, with projections based on information from the research. The LCOE is calculated by dividing lifetime cost by lifetime energy production.60

To analyze the financial aspects of investing in commercial-scale solar energy, we utilized existing projects to create foundational estimates. From these estimates, we have projected cash flows for small- (30kWh), medium- (135kWh), and large-scale (470kWh) commercial installations. These cash flows utilize the federal and state tax incentives as well as Modified Accelerated Cost Recovery System (MACRS) depreciation to project an overall return on investment (ROI) for the installation.

We conducted interviews with non-bank entities that grant loans for solar energy projects. The information obtained from these interviews has been used to explain financing options for commercial business owners and to help project payments on the system in the cash flow models.

3.3 Overcoming Financial Barriers

3.3.1 Growing Rates of Standard Electricity vs. Decreasing Cost of Solar

One of the main barriers in adoption of solar energy is the associated cost with using a more expensive renewable energy source versus buying cheaper electricity from local utilities. Throughout the early 2000s, rates in southern US states stayed low and discouraged incentives to install solar energy.61 During this time, the cost of renewable energy, specifically solar power, was nowhere near grid parity. As illustrated in Figure 2.1. And Figure 2.2, in 2006, electricity cost 9.6 cents per kilowatt-hour (kWH) when the levelized cost of solar electricity was 45 cents/kWH to install on average in the United States.

However, as seen in Figure 2.1, average electricity rates in the United States and North Carolina specifically have increased over the last decade and are predicted to continue growing at a steady rate. In the last ten years, the national average of electricity rates has increased from 8.17 cents per kilowatt-hour (kWh) in 2004, to 10.63 cents/kWh in 2014. This 2.67% growth rate has also been recognized in North Carolina. In 2004, average rates in the state were 6.7 cents/kWh; whereas today, rates are 8.71 cents/kWh. Developers predict national rates to be at 12.10 in 2019, and 14.70 cents per kilowatt-hour by 2024. These numbers correlate with a 3.97% growth rate in electricity prices after the next five years and are similar to growth rates predicted by the EIA, as discussed in the next paragraph.

Increasing electricity rates have stemmed from a number of sources: higher resource extraction prices, maintaining aging infrastructure, combating environmental damage, and meeting the ever-increasing demand for reliable electric power. As the cost of electricity generation increases, utilities must find a way to fund grid power. Through either fixed rate price hikes, or increasing per kilowatt-hour charges, electricity providers can increase their income. The EIA predicts national increased retail prices for the commercial sector from 10.29 cents per kilowatt-hour to 10.70 cents/kWH in 2014 and 10.87 cents/kWH in 2015. The predicted rate increases are likely driven by projected increases in power generation fuel costs such as coal and natural gas from, 2.35 to 2.36 dollars per million Btu and 4.32 to 5.24 dollars per million Btu, respectively from 2013 to 2014.

The increasing electricity rates of North Carolina create a window of opportunity for electrical consumers to offset energy consumption and avoid higher electricity rates by installing clean energy systems. Over the past decade, North Carolina solar energy prices have decreased from extremely high rates recognized in the early 2000s; the rates are

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62 Note: Rates are averaged because actual rates vary in the summer and winter.
64 Ibid.
expected to continue decreasing in the future. Figure 2.2 shows the cost of solar PV systems greater than 10 kW and less than 500 kW, represented in cents per kilowatt-hour. The graph shows two scenarios: (1) the costs including federal and state tax incentives, (2) costs without federal and state tax incentives. The average system size for Orange County’s solar projects should rarely exceed 500 kW, while below 10 kW is considered residential capacity size.69

Based on a net-metering model, North Carolina solar systems have the capability to record their energy use against their electricity generation. If the system owner wants to sell all to the grid, Duke Energy will buy back excess solar energy generated to the grid at approximately 2-8 cents /kWh, dependent on the peak rate, length of contract, and the month of year, i.e. summer energy generation makes more money because demand is highest.70 Basically, Duke Energy buys back at a rate equivalent to the avoided cost of generating that amount of electricity from standard utility sources. Although generating more than monthly usage is rare for a commercial business, they will save money on their energy bills in due time and continue saving while standard electricity prices continue to climb. When comparing the decreasing cost of solar PV systems and the increasing solar-to-watt conversion efficiencies against the increasing traditional energy prices, NC is at an advantage to invest in solar now while the market is still favorable.

3.3.1.2 Graph of Rates of Standard Electricity Rates and Solar Energy Rates (2004 - 2024)

Figure 2.2 Annual Commercial Electricity Rates in the United States and North Carolina

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69 Miriam Makhyoun, Rich Crowley, and Paul Quinlan.
Data from EIA Historical and Predicted Rates.\textsuperscript{71,72}

Figure 2.2 Annual NC Average Cost of Commercial PV Systems 10kW-500kW

Data from NC-Sustainable Energy Association.\textsuperscript{73}

3.4 Cash Flow Models

\textsuperscript{71} Environmental Information Administration. \textit{Electricity Data Browser}. Created September 12, 2014. \url{http://goo.gl/D8eWdq}.


\textsuperscript{73} Miriam Makhyoun, Rich Crowley, and Paul Quinlan.
The following case studies represent three local commercial proposals for a small- (29kW), medium- (135kW), and large-scale (470kW) solar system. Potential consumers can utilize these cash flow models to evaluate how a certain sized installation may affect their energy projections, cash flows, and returns on investments.

3.4.1 Carrboro Animal Hospital - SEM Proposal

The first case study projects the return on investment for a small-scale commercial property. This study is based on an existing project in Carrboro, North Carolina led by Southern Energy Management of Raleigh, initiated in May 2014. Furthermore, the cash flows presented are based on the assumption that the system is paid for with cash.

In this particular example, the building is about 10,000 square feet with minimal shade. Due to a significant amount of air conditioning units on its rooftop, less than 50% of the rooftop is viable for solar; therefore, the property will not allow extremely efficient returns on power generated per square foot. The solar PV system size is estimated at 30.08 kW, which will generate about 39,189 kWh per year. Annual energy usage by this property is 114,211 kWh, or $12,161 per year. The following Figure 3.1 is a chart that incorporates the rising price of electricity per kilowatt-hour, and displays how much the owners of the building would pay for standard electricity cumulatively for 25 years. As you can see highlighted below, the total cumulative energy cost of grid electricity would be around $506,466 without solar photovoltaic.

Figure 3.1 - Carrboro Animal Hospital Grid Electricity

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74 David Churn.
As previously mentioned, the 1-year production of this small-scale installation would be 39,130 kWh with a lifetime production of 890,218 kWh over 25 years. The net-metered payback from the first year’s energy generation equals $4,045. As highlighted in Figure 3.2, the system actually appreciates in value, as the payback amount from solar increases with time. Over the life of the solar photovoltaic (PV) system it doubles in annual productivity. Moreover the chart expresses that cumulative solar energy savings for this property is estimated at $156,670, which is nearly 34% of its energy usage being offset by a renewable source.

![Figure 3.2 - Carrboro Animal Hospital Solar Savings](image)

Now it is important that we examine the solar PV system costs in order to compare them to its savings, and subsequently present a cash flow model. The total system cost including installation labor, the PV panels, mounts, and inverters, amounts to $155,954. Although by deducting the federal and state tax credit, along with the federal and state depreciation values, the net cost of this 30.08 kW system totals $18,145. Assuming the owner is this instance invests with cash, and not with the capital lease option, the results show that in 5 years the solar financement becomes cash positive at $1,836 (Figure 3.3).
With an internal rate of return, or a project rate of growth at 9.03% the system yields a total of $96,764 over 25 years of operation. Consequently, the red line labeled 'Grid Energy' represents the amount of money the property owners would pay in electricity cost had the system not been built. Essentially this is the opportunity cost of installing rooftop solar photovoltaic, which is equivalent to ($156,670).

Figure 3.3 - Cash Flows with Solar PV

With the government allowances that are currently available for commercial entities, a solar PV system such as this can significantly discount the cost of installing a renewable energy source. The net system cost was only 12% of the total value, where its returns are manifested within the first 5 years of operation through tax deductibles and depreciations. Following this period of generous concessions, the system continues to generate monetary value for the property as it lessens its dependency on a non-renewable energy source over time.

3.4.2 Yes! Solar Solutions Proposal

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Our team had the privilege during our research to speak with Stew Miller, the President of Yes! Solar Solutions, in order to learn more about solar PV system analysis and the financial returns of a larger scale installation. Based on a mock proposal given to us by Yes! Solar Solutions, we were able to present a second case study of a medium-scale commercial solar PV project. There has been no data given about the method of financing for this undertaking, so we will assume it was purchased with cash.

The proposed project includes a 135.2 kW DC net-metered system with an annual production of 189,910-kilowatt hours per year. This number is based on the average annual solar radiation amounts in North Carolina and the efficiency of a particular system, according to its DC rating and its DC to AC conversion factor. In our projections below, the solar data is gathered from National Renewables Energy Laboratory’s PV WATTS. Starting in January, this PV system produces almost ten and a half thousand kilowatt hours, then it gradually increases each month until June when it produces a monthly high of 20,238 kilowatt hours. From July to December it slowly falls again until it reaches about 9 thousand-kilowatt hours. In monetary values, June’s monthly high generates a value of $1,619.04 and December’s monthly low generates a value of only $746.00. The total yearly value of this 135.2 kW system would be equivalent to $14,110. This amount however should not be thought of as revenue but as savings, unless a property’s annual energy consumption is less than 189,910 kWh.

Based on the yearly net metered savings mention from above, which is estimated to increase by 3% year to year, a federal tax credit of 30%, a state tax credit of 35%, a federal MACRS depreciation and a state MACRS depreciation, a graph of cumulative cash flows for the investment is shown below from a starting system cost of $358,280 (Figure 3.4). The tax benefits acquired from the solar system only remain for 6 years but as you can observe, the investment becomes cash positive during year 5. From this point on the property is saving exactly what is being produced by its installed solar PV system.

Figure 3.4 135kW - Yes! Solar Solutions, Cumulative Cash Flow
Throughout the life of the 135.2 kW PV system, the total cumulative cash flow at year 25 is projected to be $416,246 if the net-metered rate is $0.074. The total return at this same rate is an estimated $774,526. There are no financial assumptions made in the case study; however, if the investment were paid for with loans or a type of leasing option the cash flows would not be as favorable. Regardless, the long-term benefits of a solar PV system such as this one are substantial both environmentally and financially.

3.4.3 SEC Proposal

The final case study presents financial returns for a large-scale commercial proposal. The cash flows are modeled from a solar installation in Charlotte, North Carolina, proposed by a solar design company for Starr Electric Company. For commercial PV projects in areas such as Chapel Hill and Carrboro, this case study represents the upper-end of the scale of solar system cash flows.

The total system size for this particular proposed solar PV system is 471.24 kW DC power and the estimated annual production is 681,531-kilowatt hours. In other words, 1,496 rooftop PV panels will produce approximately an average of 50,000-kilowatt hours per month. To get a sense of scale this is almost 350,611 square feet of roof mounts altogether. Moreover, where the facility’s utility usage without solar would be near 1,100

thousand kilowatt hours, the proposed solar system installed would produce about 62% of current usage or 682,000 kilowatt hours (Figure 3.5). Subsequently, the client's utility usage with solar falls to 418,000-kilowatt hours per year. These numbers build the case for huge financial savings on utility bills each year.

Figure 3.5 - SEC Proposal Solar Production

Furthermore, the cost breakdown of this large-scale system starts with an installer contract cost of $1,245,274. The total tax impact and federal tax credit amounts to $377,082, which deducts the net cost to $868,192 during the year of installation. In the five to six years to follow however, MACRS depreciation and the solar energy tax credit discounts of $444,563 and $31,500 respectively, reduce the overall net cost to $392,129. Figure 3.6 below incorporates these figures as well as the system’s net energy bill savings to calculate annual and cumulative cash flows. Net energy bill savings is measured by the yearly estimated production multiplied by rate by which solar energy is bought back from the utility provider.
As can be seen from the table above, the estimated payback period is 5-6 years in this proposal. It is important to note that the net energy bill savings increase from year to year as the solar system is expected to increase in value over time. Also included in Figure 3.6 are operational costs, maintenance costs, and inflation rates that slightly increase over the life of the 25-year solar system. At year 10 the cumulative cash flows equals $444,792, whereas at years 20 and 25 the cumulative cash flows increase significantly to $1,353,251 and $2,051,696. Lastly, Figure 3.7 projects both annual and cumulative cash flows providing a comprehensive view of the proposed system’s financial analysis.

For any business or property owner who is looking for a long-term financial asset that can generate substantial savings, it is hard to overlook a case such as this one that produces an average monthly utility savings of $8,981 over the life of its system. As the cost of standard electricity increases and the cost of solar decreases over time, it is extremely beneficial for commercial property owners to capitalize on the long-term in a rooftop solar PV systems.
3.5 Financing Options

The primary financing options for solar photovoltaic systems in Orange County: cash, solar loans, and solar leases.

3.5.1 Cash

The most financially simple way to pay for small commercial projects would be, if the business can provide cash upfront. There is no interest on cash payments and the system would be owned by the commercial small business, beginning their 5-year cash flow model without any setbacks from financing structures. The small projects may be afforded by the business involved or through a cooperative cash plan. Solarize Orange County has worked toward connecting individual residential homeowners and forming cooperatives that can afford to invest as a group. This model is not ideal for business owners who decide their bottom lines void of community involvement, solely responding to the business's investments.

3.5.2 Loans

Loans cushion the investor with a little financial help in the up front cost of the installation and provide a longer period of time to pay off the commercial solar system. NC has a program that keeps interest rates for these projects fixed at a maximum of 8%, with a term not exceeding 20 years. In August 2009, NC enacted legislation (HB 1389) that authorizes cities and counties to establish revolving loan programs to finance renewable energy and energy efficiency projects. The loan fund provides financing where the loan repayments and interest feed back into the fund to provide loans for more solar projects. 77

Orange County’s Self Help Credit Union provides personal loans. For small commercial projects, they expect the business to invest 20% of the cost of the PV system upfront and use a 7BA loan system, which uses the solar panels as collateral if the borrower stops paying on their loans. The value of the panels amounts to 10%, at most, of the loan

value. They look at credit score and income and apply underwriting policies that apply to all loans. The tweak that makes Solarize different is that when the borrower gets their tax credit, they can pay down the loan and Self Help Credit Union will recalculate the monthly payments based on the new loan balance.

3.5.3 Lease

The final option, for those who want $0 down and/or are unable or unwilling to use the Federal Investment Tax Credits (ITC) and state tax credit, comes in the form of a solar lease or power purchase agreement (PPA). The basis of a Solar Lease and PPA is to rent your commercial PV system space to another company, who would then own, maintain, and reap the tax benefits and rebates of the system. The business using the PV system would reap the benefits of reduced energy costs from the energy that the system generates, offsetting some of their utility costs. North Carolina currently only has a power purchase agreement for residential properties (Sunsense Residential PV Incentive Program). NC Green Power offers financial incentive to systems under 5 kW that have a PPA agreement with a North Carolina Utility. The following is a breakdown of the leasing options presented by Self Help Credit Union, available to Orange County residents and small businesses:

i. Commercial Capital Lease Option
   - $19,244 Cash Down Payment
   - $51,316 Short Term Lease (2 years)
   - $57,731 Capital Term Lease
   - $2,286 Short term payment (2 year)
   - $970 Capital Term Payment (6 year)

ii. Small Commercial Capital Lease
   - $19,244 Cash Down Payment
   - $109,047 Capital Term Lease
   - $1,843 Capital Term Payment (5 years)

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4.0 TECHNICAL

4.1 Introduction

The technical goal of this capstone was focused on the creation of two computer-based deliverables, one being a GIS layer identifying ideal candidates in Orange County to undertake commercial solar projects, and the other being a web platform showing the details of a virtual site assessment. The first output essentially entailed the formulation of a process model within ArcGIS to pull compiled property records, energy use data, and aerial imagery and impose on them specific criteria to get a final short-listing of properties to provide area solar contractors. The accumulation of the best available and most relevant data was determined by online research and subsequent communication with data-collection agencies to fit the Orange County area. Using ArcGIS allowed for the model to represent the data spatially in a way that the output of many variables could be easily understood by people unfamiliar with the data sets. The second output is intended to be a direct application of the policy and financial research that was done in this project, with the purpose of providing pertinent information to the potential commercial solar owners that would aid in making the decision to install. This platform will require some inputs from the person or company considering installing solar in order to better understand the property in question. The visual and computational capabilities we desire in our platform are based on comparative research to similar websites that contain this information for other areas within the US.

4.2 Identifying Viable Commercial Buildings for Solar Projects in Orange County

All data manipulation was done using ESRI ArcGIS software. All data (as shown in the appendix) was provided by Orange County\textsuperscript{79}, Town of Mebane\textsuperscript{80}, Town of Carrboro\textsuperscript{81} Town


\textsuperscript{80} Shapefile of Mebane land zoning (unknown date). Provided by Kyle Smith, Staff Engineer of Alley, Williams, Carmen & King, Inc. awck.com

\textsuperscript{81} Shapefiles of Carrboro building footprints (2010), land zoning (updated as needed). www.ci.carrboro.nc.us/145/Downlo
of Chapel Hill\textsuperscript{82}, or Town of Hillsborough\textsuperscript{83} governments. Because Chapel Hill (2014) and Carrboro (2010) each maintain polygon shapefiles of buildings within each municipality, which is more current than the shapefile, or format for storing the location and attribute information of geographic features, for the remainder of Orange County buildings (2008), we chose to join these files together in an effort to have the most temporally correct data for later analysis of buildings. See below for a flow chart of this model (Figure 4.1). Blue refers to data inputs, yellow to computed processes and data manipulation, and green to output datasets.

From the shapefile of all Orange County city boundaries, separate shapefiles of Chapel Hill, Carrboro, and the two towns together were created. The shapefile of buildings within Chapel Hill, from 2014, was clipped to only include structures within the city limit. The same was done for Carrboro. The resultant building shapefiles were joined in a union with a shapefile of the remaining Orange County buildings (itself created by excluding any buildings within Chapel Hill or Carrboro limits from a dataset of all 2008 Orange County structures).

From this dataset, zoning shapefiles from each town were used to exclude any residentially zoned buildings. A new shapefile of non-residential buildings was created for each town in this way, using selection and geographic clipping. Similarly to how the remainder of the county was selected in the previous paragraph, buildings that do not fall within any town zonings were put into a separate shapefile. Then, the non-residential buildings were selected from this area using a zoning shapefile of the entirety of Orange County.

The geographic union of these final five datasets of buildings was computed, and rooftop area was estimated for each polygon using ArcMap’s “Calculate Geometry” feature. This result was spatially joined to county tax parcels; each building was assigned to the property on which its center falls. The results were again spatially joined to a dataset of addresses to create the final shapefile of properties in Orange County with non-residential buildings. Figure 4.1 shows the process of data input and output; the blue refers to data inputs, yellow to computed processes and data manipulation, and green to output datasets.

\textsuperscript{82} Shapefiles of Chapel Hill building footprints (2014), land zoning (2008). gis.townofchapelhill.org/download
\textsuperscript{83} Shapefile of Hillsborough land zoning (2014). Provided by Town Planner Stephanie Trueblood.
Figure 4.1: Model flow chart
4.3 Creating a Web Platform to Provide a Virtual Solar Assessment

4.3.1 Web Platform Design

**Figure 4.2.** Web Platform Layout

The web design above (**Figure 4.2**) was created with Adobe Illustrator to match the current format of the Solarize Orange County website; the model has a home under the 'Virtual Assessment' tab. The features and input/output fields chosen to be displayed on the solar feasibility website are based on a comprehensive study and assessment of the plethora of such maps already in existence (note that the scope of our platform is a diversion from the typical city-based region, expanding the concept to an entire county which inherently may exclude some portions of cities). The five input boxes at the top of
the webpage include address, rooftop area, usable roof area, average utility rate, and average monthly bill. Some of the included features are fairly standardized across all, or many, of the maps while others we specifically picked or created as we thought they would be important to our study. The address is consistently the main locator input, from which a building on the map can be viewed. The user is asked for their rooftop area and percentage of available roof-space for solar PV placement, which can be gauged from the located building on the map, as well as utility rate and average monthly bill, as those will go into the generation potential and financial models. The useable rooftop area is represented with a sliding bar so that the user can easily adjust for roof space. One way in which we have deviated- for now- from existing platforms is in the lack of incorporation of solar energy potential data. Measures and presentation of best solar access points\(^8\) would be unavailable to the customer without this data.

Once the user has inputted all the necessary information, a pop-up box will appear at the building site on the map containing detailed information, including estimated costs, tax credits, carbon dioxide offset, and average annual savings, that may be helpful to the owner of the commercial property in the decision-making process. The design was built to be user friendly and easily accessible to commercial building owners and solar companies from the already existing Solarize Orange County website. The visual model will pull from the financial excel spreadsheet that will be updated with current costs and tax credits annually.

4.3.2 Solar Assessment Assumptions

The online solar viability model was developed with a set of assumptions. Many of the metrics used are based on case study calculations and assumptions - therefore this solar viability model could be greatly improved with more data points from a variety of different sources.

1. Total System Size (kW): Refers to the potential size (in terms of energy) of the solar project based on rooftop area and percent usable roof space.

\(^8\) Solar access points or Solar Access Index\(^*\) (SAI) is the photo-electric yield capacity of any given surface relative to the best possible yield within a given sample. SAI is a location-specific scale that ranges from zero (0) to the maximum possible, defined as one (1).
a. The model inputs rooftop area (measured in square footage) that the potential solar user provides. Additionally, the user is allowed to choose the percentage of their roof space that is usable, with a default value of 70%.\textsuperscript{85} By allowing the user to input the percent of their roof that is usable, it allows the model to take into consideration that not all of the roof can be used for solar.

b. Using a set of case studies (18 different solar projects) across the state of North Carolina provided by Duke Energy, a metric for the average number of kilowatts (kW) per square foot was produced.\textsuperscript{86} The details of each case study including the project’s name, location, system size (kW), annual generation of power (kWh), number of solar panels installed, and size can be found in Table 4.1 below. Based on the aforementioned metrics, the number of kWh of power generated per square foot and the number of kW of energy per square foot were calculated. The average value for number of kilowatts per square foot was calculated to be 0.00883 kW/sqft.

\textbf{Table 4.1} Solar projects commissioned by Duke Energy.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>System Size (kW)</th>
<th>Annual Generation (kWh)</th>
<th>No. of Panels</th>
<th>Size (sqft.)</th>
<th>Calculated kWh/sqft.</th>
<th>Calculated kW/sqft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA Learning Center</td>
<td>Durham</td>
<td>109.5</td>
<td>476</td>
<td>13,140</td>
<td>0.0</td>
<td>0.00833</td>
<td>0.00833</td>
</tr>
<tr>
<td>Maple View Ag. Center</td>
<td>Hillsborough</td>
<td>180.32</td>
<td>259,270</td>
<td>784</td>
<td>21,638</td>
<td>11.98</td>
<td>0.00833</td>
</tr>
<tr>
<td>Highwoods Properties</td>
<td>Greensboro</td>
<td>1,495</td>
<td>6,500</td>
<td>179,400</td>
<td>0.0</td>
<td>0.00833</td>
<td></td>
</tr>
<tr>
<td>Liberty Hardware</td>
<td>Winston Salem</td>
<td>312.24</td>
<td>406,833</td>
<td>1,358</td>
<td>37,481</td>
<td>10.85</td>
<td>0.00833</td>
</tr>
<tr>
<td>Thomas Built Buses</td>
<td>High Point</td>
<td>388.6</td>
<td>1,689</td>
<td>46,632</td>
<td>11.96</td>
<td>0.00833</td>
<td></td>
</tr>
<tr>
<td>Food Lion</td>
<td>Salisbury</td>
<td>1,090</td>
<td>4,746</td>
<td>130,800</td>
<td>0.0</td>
<td>0.00833</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{85} Interview: Stew Miller (YES! Solar Solutions)

<table>
<thead>
<tr>
<th>Location</th>
<th>City</th>
<th>System Price ($)</th>
<th>Installed Capacity (W)</th>
<th>Annual Energy (KWh)</th>
<th>O&amp;M Costs ($)</th>
<th>Efficiency (%)</th>
<th>Capacity Factor</th>
<th>LCOE ($)</th>
<th>LCOE ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freightliner</td>
<td>Cleveland</td>
<td>358.8</td>
<td>514,743</td>
<td>1,612</td>
<td>43,056</td>
<td>11.96</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marshall Steam Station</td>
<td>Terrell</td>
<td>950</td>
<td>1,577,171</td>
<td>3,535</td>
<td>114,000</td>
<td>13.83</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lincoln Charter Schools</td>
<td>Denver</td>
<td>161</td>
<td>211,892</td>
<td>700</td>
<td>19,320</td>
<td>10.97</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kimberly-Clark</td>
<td>Hendersonville</td>
<td>83</td>
<td>120,404</td>
<td>361</td>
<td>9,960</td>
<td>12.09</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>McAlpine</td>
<td>Pineville</td>
<td>50</td>
<td>71,892</td>
<td>18</td>
<td>6,000</td>
<td>11.98</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Gypsum</td>
<td>Mt. Holly</td>
<td>1,208</td>
<td>5,252</td>
<td>144,960</td>
<td>0.00</td>
<td>0.00833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaston County Schools</td>
<td>Gastonia</td>
<td>70.84</td>
<td>93,233</td>
<td>308</td>
<td>8,501</td>
<td>10.97</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childress Klein</td>
<td>Charlotte</td>
<td>2,171.20</td>
<td>2,860,546</td>
<td>9,440</td>
<td>260,544</td>
<td>10.98</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siemens</td>
<td>Charlotte</td>
<td>54.74</td>
<td>74,077</td>
<td>238</td>
<td>6,569</td>
<td>11.28</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childress Klein Properties</td>
<td>Charlotte</td>
<td>532</td>
<td>2,314</td>
<td>63,864</td>
<td>0.00</td>
<td>0.00833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier Center</td>
<td>Charlotte</td>
<td>528.08</td>
<td>695,007</td>
<td>2,296</td>
<td>63,370</td>
<td>10.97</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City of Charlotte</td>
<td>Charlotte</td>
<td>112.7</td>
<td>148,325</td>
<td>490</td>
<td>13,524</td>
<td>10.97</td>
<td>0.00833</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Costs and Revenues

a. System Price ($): Refers to the total installed system cost based on the average price per installed Watt. The average price per installed Watt is dependent on the total size of the system -- refer to Table 4.2 for specific values based on system size thresholds. The values in Table 4.2 were estimated by observing the cost per watt for three differently sized solar installation projects. Our first case study expressed that a 30kW installation would cost about $4.90 per Watt, although our other two system proposals of 135kW and 471kW similarly showed a cost of about $2.60 per Watt. This table is a rough estimate of $/Watt figures for different systems sizes, however depending on the characteristics of each particular solar site these numbers are subject to change.

Table 4.2 Average price per installed Watt based on total system size
b. Installation Incentives

i. Federal Tax Credit: 30% of total system cost

ii. Federal MACRS Depreciation: Any commercial entity that invests or purchases a qualified solar energy property may use the Modified Accelerated Cost Recovery System accelerated depreciation schedule for nearly 25.5% of the total installed cost. Year 1=20%, Year 2=30%, Year 3=19.20%, Year 4=11.52%, Year 5=11.52%, Year 6=5.76%.

iii. State Tax Credit: 35% of total system cost

   1. Federal Tax on State Tax Benefit: Beginning a year after installation, an estimated federal tax of 32% is applied to the yearly state tax credit of 35% on the solar system. This is a negative in cash flows within the financial model.

iv. State MACRS Depreciation: In North Carolina an additional Modified Cost Recovery System depreciation schedule can be applied to the state depreciation amount, which is about 2.36% of the initial investment. See the Federal MACRS Depreciation for details.

c. Net Cost ($): Refers to the total system cost taking into consideration the aforementioned installation incentives--Federal Tax Credit, Federal MACRS Depreciation, State Tax Credit, State MACRS Depreciation, and the Federal Tax on State Tax Benefit.

d. Average Savings Annually ($): Alludes to the average amount of money saved from installing a solar system on the particular building. The calculation takes into consideration the average cost of electricity purchased from utility of $0.074/kWh and the estimated annual
production of power per year. The estimated annual production of power per year is calculated using a metric of the estimated annual power production of 11.59 kWh/sqft and the percent usable roof space. The estimated annual power production metric was calculated from the Duke Energy solar project case studies by looking at Table 4.1.

e. Payback Period: In our model you can easily observe the amount of years in which it takes for cumulative cash flows to become positive. Cumulative cash flows incorporate the initial investment cost, tax benefits and depreciation values, as well as net-metered savings over time.

3. Environmental Benefits: The carbon emissions offset of the system and provide equivalences to better stand what these emissions amount to.

   a. Carbon Dioxide Offset: Refers to the amount of carbon dioxide emissions that would be offsetted by producing energy through the renewable energy system rather than conventional electricity provided by the utility. This calculation takes estimated annual power production based on squarefootage and usable roof space as inputs. The estimated annual power production based on squarefootage was calculated using the Duke Energy solar project case studies (refer to Table 1), and found to be 11.59 kWh/sqft. The Environmental Protection Agency has created a conversion factor from electricity use to carbon offset --6.89551*10^-4 metric tons carbon dioxide per kWh.88

   b. Carbon Capture: Refers to the amount of carbon dioxide being captured by trees, once again defined by the Environmental Protection Agency's Greenhouse Gas Equivalency Calculator-- 0.039

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87 Interview: Stew Miller; (YES! Solar Solutions)
metric tons carbon dioxide per urban tree planted. This value is another way to portray carbon dioxide offsets.

5.0 CONCLUSION

There are numerous barriers to commercial solar installation, many of which must be addressed by political action. Federal tax programs in conjunction with state and local efforts have worked to encourage installation and address some of these policy hurdles. The interaction and transaction costs of any policy implementation prove to be the dominant barrier to solar policy development. The interaction of cost and complexity (as well as a more general sense of consumer inertia) greatly increase the perceived threshold to solar investment. Simultaneously, however, policy must address market, technical, structural and social barriers in formatting a solution. A coherent system provides property owners with the information necessary to fully understand the complexity and functions involved in solar power installation and use, which is particularly important on the local level where awareness and education are spread throughout Orange County to make the community more receptive and proactive.

The main financial barriers of cost, return on investment, and financing have been addressed throughout the report. If standard electricity prices follow projection, solar energy will eventually reach grid parity. Even if standard electricity prices increase at a slower rate than predicted, increasing innovation in solar panels as well as federal and state tax incentives will continue making solar a competitive option to standard electricity. Cash flow models illustrate that the average return on investment falls within 25 years. Because commercial entities are much larger than residential solar installations, it is not likely that commercial-scale installations will offset all of a company's energy usage. Commercial businesses with viable roof space could save hundreds of thousands of dollars spent on grid electricity over the system’s lifetime by using solar energy. Finally, there are multiple options to help business owners finance a solar installation. While an all-cash option allows users to recognize returns sooner, many businesses do not have the large amounts of capital necessary to fund an installation. Loans are available through bank and

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89 Ibid.
non-bank entities to make a system more affordable over specified time periods of a loan. Capital leases spread the cost over a time period, like a loan, but do not require a down payment. Additionally, interest rates are negotiable between the lessee and the lessor, but usually range between 5 - 7%. Also like a loan, the tax benefits of ownership (investment tax credit, depreciation, and interest) stay with the lessee. Having addressed these three barriers, financial aspects of commercial-scale solar seem more viable.

The technical portion of this project synthesized available data to create a two part model to be used by commercial owners and solar installation partners. The model displays building rooftops in Orange County with varying rooftop space. The viability was determined based on building type and rooftop size. The second part of the model successfully shows how a virtual assessment could be incorporated into the existing Solarize Orange County website. The virtual assessment utilizes the financial data compiled throughout the report and gives a user-friendly output depicting net cost for the potential installer amongst other environmental offsets.

If policies continue on a trajectory in support of solar energy generation in the State, then commercial solar could greatly increase in Orange County. This report introduces reasons in favor of solar installations on commercial buildings, by providing a model that calculates avoided energy costs based on size of the building, energy usage and viability of solar rooftop space. The viability of commercial solar in Orange County has potential to overcome all variable barriers presented in this report.
6.0 FUTURE WORK

If policy incentives change, then the future of the commercial solar financial model will have to reflect the new tax credits or subsidies, or lack thereof. As the technology of solar equipment progresses and the cost per panel decreases to meet market demand, the cost of installation per Watt must be updated in this model as well. Moreover, to increase the accuracy of the commercial solar financial model present in this paper it would be most beneficial to further research the cost per Watt for a wide range of project sizes.

With respect to the technical output, while the model is able to locate all properties with viable buildings, further truncation of results is necessary. Because it is ideal to locate businesses that both own and operate a single building, a dataset of business licenses would be helpful to filter the data. It would be possible to check if the owner of each property (provided in our product) was the same as the owner of the business that operates from it. Such information may be available from the Orange County Chamber of Commerce or Tax Department. Alternatively, utilizing a simple data query within ArcGIS, a person could filter the current set of properties based on roof size in an attempt to locate a smaller subset of viable buildings for commercial-scale solar with a simple tool. Before doing this, however, it would be prudent to derive an optimal/ideal roof size threshold, based on guidance from commercial solar providers.

There are several improvements to be made to the second technical deliverable. The first and most important addition to make the model complete is a layer of solar irradiation data. During the initial data-mining period, we were unable to find processed lidar (Light Detection And Ranging) data for Orange County to the spatial resolution possessed by by major metropolitan cities like New York City\(^\text{90}\) and Washington D.C\(^\text{91}\). It was not until recently that we were able to recognize the potential to use existing lidar data in the form of LAS files and a program to process this data to output a high-resolution solar potential map\(^\text{92}\). In 2015, up-to-date lidar data of Orange County, and much of North Carolina, will be

\(^{90}\) http://nycsolarmap.org
\(^{91}\) http://www.mapdwell.com/en/dc
\(^{92}\) Interview with Tait Chandler (UNC student)
available from the North Carolina Geospatial & Technology Management Office. This data will have very accurate spatial resolution, allowing not only for all county buildings to be mapped but for each roof to be mapped in high detail. Feeding this data into our web model will help users better identify available solar access points for commercial projects in the future. The next set of improvements to be made are in the assumptions used in the calculations of outputs, that is, the information that was pulled to ultimately return quantitative estimates on system size, costs and revenues and environmental benefits. Numbers used to calculate figures like power generation and related savings are based on the limited case studies to which we had access, and are hence are either very specific to one type of solar panel, electricity rate, etc. or some sort of average of a few (look at section 4.3.2 for specifics). Inclusion of several options would make the model more robust and much more accurate for the specific user. Finally, usability studies can be done with small focus groups of our target audiences to assess which features on the web platform are the most helpful, and which can be clarified or changed.

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7.0 COMPARATIVE ANALYSIS

7.1 California Case Study

The state of California leads the nation in terms of solar power efficiency and installation. This is because of growing support from the state’s communities, financial incentives, and its impressive Renewable Portfolio Standard. California is a state committed to the use of solar power and the movement towards a green energy future. Its solar initiative program can and should be used as an excellent example for other renewable energy seeking areas of the United States to incite their solar movement.

Go Solar California! is California’s Solar Initiative campaign that encourages homeowners and businesses to switch to solar power by providing a “one stop shop” website that includes complete information not only on available solar incentives but also on installation programs across the state. The campaign is an effort from the California Energy Commission and the California Public Utilities Commission (CPUC). The campaign goal is to encourage Californians to install 3,000 megawatts of solar energy systems on homes and businesses by the end of 2016, making renewable energy an everyday reality. Action and promotion for this campaign started early in the 2000’s but was unveiled by Governor Schwarzenegger on Oct. 19th, 2006 at the Solar Power Conference and Expo in San Jose as part of his Million Solar Roofs Program. Schwarzenegger is a great advocate for renewable energy reform, as he believes it is the way of the future.

“Today, the brightest spot in California's economy is our green sector. One-third of U.S. clean tech venture capital flows into California. One in every four solar jobs in the U.S. is in California. A recent report showed that California’s solar industry has doubled over the past five years. California generates more solar power than either France or China.”

Table 1. Go Solar California Campaign by Program Components, 2007-2016

<table>
<thead>
<tr>
<th>Program</th>
<th>California Public Utilities</th>
<th>California Energy Commission</th>
<th>Publicly Owned</th>
<th>Total</th>
</tr>
</thead>
</table>

95 Ibid
<table>
<thead>
<tr>
<th>Authority</th>
<th>Commission</th>
<th>Utilities (POUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Name</td>
<td>California Solar Initiative (CSI) (including CSI-Thermal)</td>
<td>New Solar Homes Partnership</td>
</tr>
<tr>
<td>Budget</td>
<td>$2,167 million (Electric) $250 million (Gas)</td>
<td>$400 million</td>
</tr>
<tr>
<td>Solar Goals</td>
<td>1,940 MW (Electric) 585 million therms (Gas)</td>
<td>360 MW</td>
</tr>
<tr>
<td>Scope</td>
<td>All solar systems in large IOU areas except new homes</td>
<td>Solar systems on new homes in large IOU areas</td>
</tr>
</tbody>
</table>

Note: The electric budgets are for 2007-2016, and the gas budgets are for 2010-2017.
Source: [http://www.gosolarcalifornia.ca.gov/about/index.php](http://www.gosolarcalifornia.ca.gov/about/index.php)

Their Solar Incentive program is also designed to be responsive to the solar power market. That is, as the market grows, the installation costs will decrease. CPUC divided the overall megawatt goal for the incentive program into 10 programmatic incentive level steps, and assigned a target amount of capacity in each step to receive an incentive based on dollars per-watt or cents per-kilowatt-hour\(^97\). This provides the program some structure for the ten-year plan to efficiently use their $3.3 billion dollar budget.

Additionally, the Renewable Portfolio Standard for California wants the state’s utilities to achieve 33% of electricity production from renewable energy by 2020 with a sub goal of 25% by the end of 2016\(^98\). This goal number much higher than other states and is critically strong to encourage utilities and companies to implement greener energy uses. The penalty in California for not meeting the RPS standards is 5 cents per kWh, up to $25 million per year, per utility\(^99\).

Similar to our campaign case study, the Go Solar! California website includes information on financial incentives and state policies which supports the installation and

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\(^{97}\) About California Solar Initiative California Public Utilities Commission


http://www.solarpowerrocks.com/california

\(^{99}\) Ibid
use of solar power. It also includes information on where to find solar contractors and installers for one’s respective area. Go Solar California includes also includes a model called California Solar Statistics were participants that apply for incentives with the program, provide data about their residence or business and about the solar system they are installing. The model chooses among those many application data fields the items expected to be of greatest interest to the public. It then "cleans" the "Raw Data Set" which is now the "Working Data Set" and reports on data in the Working Data Set available on the website. This model works similarly to the one we developed as it aims to find the best available data concerning one’s space and efficiency in installation.

In terms of power cost comparison, Californians currently pay an average 17 cents/kWh for electricity, one of the highest rates in the nation. Not to exclude the fact that altogether electricity costs have been going up. In the nation overall, prices go up about 3.5% per year. Their cost is more than the 10.2 cents/kWh that North Carolina offer; however, it can also be a big factor in the decision to switch to solar power. The faster they switch the faster the returns for the investment will come.

The California Solar Initiative also enacted solar rebate programs through municipal utilities around the state on for either home or business. These rebates are meant for solar panel purchases to spur on investment and get rewarded for it by the state’s solar initiative. If one purchases the solar panel system themselves, they qualify for this free cash. It requires buying electricity from one of California’s three investor-owned utilities (IOUs - Pacific Gas and Electric, Southern California Edison, or San Diego Gas & Electric) and having a commercial property that has a roof or ground space that receives unobstructed sunlight from 11 a.m. to sunset year round. Once one qualifies then they are rewarded with cash back incentives through the California Solar Initiative.

The Go Solar! California campaign is already on its way to meet its goals for the year 2016. It has been able to penetrate into different parts of California to not only promote solar panel installation but also spread education and information on the gravity of green energy as the way of the future. Our Case Study is similar to the campaign although it is focused on a smaller regional level rather than the whole state. Both create a convincing

argument for making the installation of solar power for commercial properties a reality in their state/county.