Technical and Economic Analysis of Rooftop Solar PV

for

New Hanover County Public Schools and Green Power of North Carolina

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U.S. DOE Solar in Your Community Challenge

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Disclaimer

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Executive Summary

The purpose of this report is to assist New Hanover County Schools (NHCS) with the decision-making process for installing solar photovoltaic (PV) arrays on the rooftops of public school buildings in New Hanover County, North Carolina.

The Solar in Your Community (SIYC) Challenge is a U.S. Dept. of Energy initiative to support innovative and replicable community-based solar business models and programs that will bring solar to underserved communities (such as schools, non-profits and low income households). Through the SIYC Challenge the NC Clean Energy Technology Center has been contracted by Green Power of North Carolina (GPNC), a Greenville, NC solar installation company and SIYC team, to conduct a "Technical Analyses of North Carolina Solar PV Sites for Schools."

The analysis is composed of two parts:

Task 1: Developing a model of available roof area for solar photovoltaics (PV) for a representative sample of New Hanover County Schools rooftops and an estimate of renewable energy production for each site. Thirteen buildings were evaluated in this task based on input from New Hanover.

Task 2: Characterizing the current/projected energy cost, solar PV installation costs and net savings with available connections to grid (e.g. buy-all / sell-all, net metering, net billing),utilizing the $1.10 per watt lease to own price for non-profits offered through Green Power of North Carolina.

The objective is to provide useful analysis of the technical and financial feasibility for NHCS's interests in considering/pursuing rooftop solar PV. Additionally, the objective of the analysis is to provide a basis from which NHCS can consider next steps.

Task 1 Takeaways

- For all but one of the buildings evaluated (Eaton Elementary), the larger solar PV system capacity in kW did not exceed the maximum historical kW demand of the school.
- Each PV system would generate 3-70% of current electricity usage per building.
- In future, care should be taken to maximize roof space and solar access for solar PV.

In total, the thirteen buildings evaluated in Task 1 could support installation of 1,107 kW to 2,738 kW of rooftop solar PV and generate from 1,716,177 to 4,188,376 kWh annually. This is equivalent to 14-35% of the electricity presently consumed in all the buildings evaluated.

Task 2 Takeaways

- The analyses indicate that New Hanover will realize the most financial benefit from installing solar PV in a net-metering configuration.
- The solar rebate of $0.75 per W up to 100 kW proposed by Duke Energy Progress is a key incentive to optimizing PV economics for New Hanover.
- Simple paybacks range from 5.7 years to 6.1 years with the rebate under net metering.

Solar In Your Community - Solar PV Assessment

Summary and Purpose

New Hanover County Schools has 41 schools and seven administrative buildings in North Carolina that serve over 26,000 students.[1] As such, New Hanover is a large energy user and would potentially benefit from the installation of renewable solar PV systems on the rooftops of buildings located on these campuses.

The economics for solar PV installations in North Carolina has changed over the recent past; construction cost for solar has come down significantly, but so have incentives for the electricity generated by solar PV. However, new incentives have recently become available in North Carolina that make PV economics more attractive. Through this analysis, the authors intend to provide an assessment of solar PV for select rooftops at New Hanover, using up to date performance, cost and incentive information.

Solar in your Community (SIYC) is a U.S. Department of Energy sponsored $5 million prize competition that aims to expand solar electricity access to all Americans, especially underserved segments such as low- and moderate-income (LMI) households, state, local, and tribal governments, and nonprofit organizations, such as schools.

For eighteen months (through September 2018), the challenge is supporting teams across the country to develop projects and programs that expand solar access to underserved groups, while proving that these business models can be widely replicated and adopted by similar groups. In addition to teams, the challenge supports technical assistance providers (consultants and coaches) that assist teams by providing resources to develop their business models. The NC Clean Energy Technology Center (NCCETC) is a contracted consultant through the SIYC challenge and Green Power North Carolina is a registered team who has received cash vouchers to contract for technical assistance services through the SIYC Marketplace.

Green Power of North Carolina (GPNC) is a Greenville, NC solar installation company that is pioneering a dollar per watt rooftop solar initiative for non-profits. Nonprofits (such as schools and local government) can lease to own solar PV installed on their rooftops by GPNC for five years at a $1.00 per watt installed. After five years they have the option to purchase the PV panels for $.10 a watt. Currently GPNC has one local government, the Town of Apex NC, who is utilizing its $1.00 per watt for non-profits model. It is a 27kW array on a Town's Public Works Building.

[1] https://nces.ed.gov/ccd/districtsearch/district_detail.asp?start=0&ID2=3703330

Scope and Objectives: Task 1 and 2

New Hanover County Schools provided a list for assessment, based on criteria including roof age, roof type and area available for PV. Generally buildings with newer roofs that have a large unobstructed south facing expanse are preferred for solar PV. Based on the preferred criteria, thirteen schools were selected to conduct estimates of annual renewable energy production for task 1. The objective of task 1 was to provide a broad analysis of PV suitability for an assortment of buildings NHCS may consider for future solar PV. Based on the estimated resulting renewable energy production capability for each building selected, the most promising four buildings were selected for further financial analysis conducted in task 2.

The table below indicates the building sites, types, addresses, roof description and those selected for task 1 and task 2 analysis.

Table 1: New Hanover County Schools Evaluated for Solar PV

Site	Delivery Address	City	SIYC Task 1	SIYC Task 2	Roof Description
Anderson Elementary	455 Halyburton Memorial Pkwy	Wilmington	X	X	Membrane roof
Carolina Beach Elementary	400 South 4th Street	Carolina Beach	X		Membrane roofs with two small metal roofs
Codington Elementary	4321 Carolina Beach Road	Wilmington	X	X	Metal roof
Eaton Elementary	6701 Gordon Road	Wilmington	X		Metal roof
Holly Tree Elementary	3020 Webb Trace	Wilmington	X		Membrane roof
Parsley Elementary	3518 Masonboro Loop Rd	Wilmington	X	X	Metal Roof
Pine Valley Elementary	440 John S. Mosby Drive	Wilmington	X		Membrane roof
Snipes Elementary	2150 Chestnut St.	Wilmington	X		Membrane roof
Winter Park Elementary	204 S. MacMillan Avenue	Wilmington	X		Membrane roof
Wrightsboro Elementary	2716 Castle Hayne Road	Wilmington	X		Metal roofs on covered walkways
Holly Shelter Middle School	3921 Roger Haynes Drive	Castle Hayne	X		Metal roof
Hoggard High School	4305 Shipyard Boulevard	Wilmington	X		Membrane roof
Lake Forest Academy & Admin Bldgs	1806 South 15th St	Wilmington	X	X	Metal roof

Task 1 - Solar Rooftop PV Potential for New Hanover

Approach and Summary

The solar PV design and modeling software Helioscope[2] was used to develop layouts and designs for solar PV arrays on the rooftops of the thirteen buildings identified by the team as candidates. Sites were chosen based on the roof warranty data provided by NHCS which highlighted schools with newer roofs or building with metal roofs.

Two scenarios were considered for each building. The first scenario was for a PV installation that used all available roof area, which excludes areas with existing equipment, or that are shaded by trees or adjoining structures. The second scenario was for a 100 kW PV array, if the first scenario array was greater than 100 kW in size.

Of the schools evaluated, ten had potential for PV arrays greater than 100 kW. Hoggard High and Pine Valley Elementary both have new roof areas, so a scenario using only that roof area is presented.

The schools could accommodate PV arrays ranging from 30 kW $_{AC}$ to 410 kW $_{AC}$. The table below summarizes the results of the Helioscope analysis.

[2] Helioscope, a trademarked program of Folsom Labs; accessible at https://www.helioscope.com/.

Table 2: Task 1 Analysis of Solar PV Potential on Selected New Hanover County Schools

Site	2017 Utility Max (kW)	2017 Utility Usage (kWh)	Solar PV Size (kW AC)	Solar PV Energy (kWh)	% kWh from Solar PV
Anderson Elementary School	416	872,200	277.8	384,389	44.1%
			99.9	159,496	18.3%
Carolina Beach Elementary	490	496,400	93.5	143,197	28.8%
			6.2	9,485	1.9%
Codington Elementary School	264	621,760	230.2	337,371	54.3%
			100.3	150,815	24.3%
Eaton Elementary School	274	688,028	326.8	481,761	70.0%
			100.1	146,859	21.3%
Hoggard High School	469	2,933,568	(All Roofs) 383.6	621,036	21.2%
			(New Roof) 45.2	78,295	2.7%
Holly Shelter Elem & Middle School	698	1,226,600	409.8	606,578	49.5%
			99.9	159,642	13.0%
Holly Tree Elementary School	321	642,497	99.9	162,911	25.4%
Lake Forest Academy & Admin	195	468,300	160.4	259,281	55.4%
			100.3	170,630	36.4%
Parsley Elementary School	351	815,646	279.9	398,311	48.8%
			99.9	143,642	17.6%
Pine Valley Elementary School	388	1,003,662	(All Roofs) 148.8	237,517	23.7%
			(New Roof) 30.0	44,681	4.5%
Snipes Elementary School	414	902,634	166.5	293,069	32.5%
			99.9	152,387	16.9%
Winter Park Elementary School	239	536,271	38.1	65,931	12.2%
Wrightsboro Elementary School	150	730,812	122.7	197,024	27.0%
			100.1	154,528	21.1%
Totals - Maximum	**4,669**	**11,938,378**	**2,738**	**4,188,376**	**35%**
- Minimum			**1,107**	**1,716,177**	**14%**

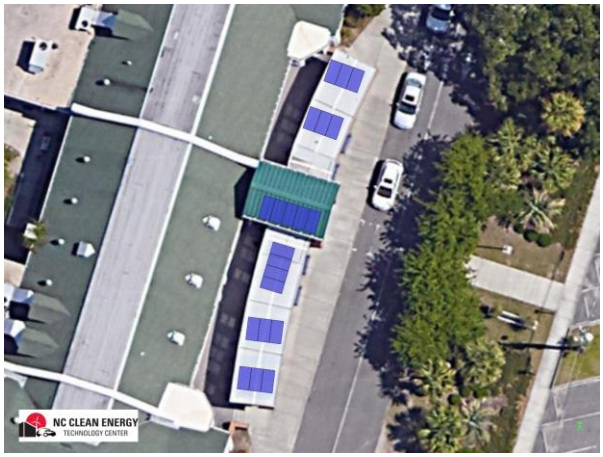
In the following section, renderings of each of the Helioscope designs are presented.

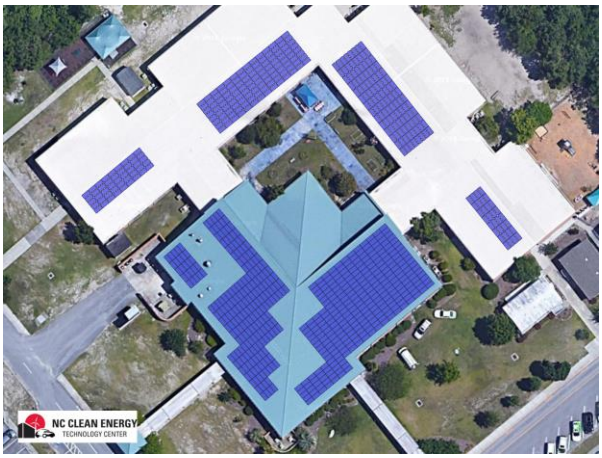
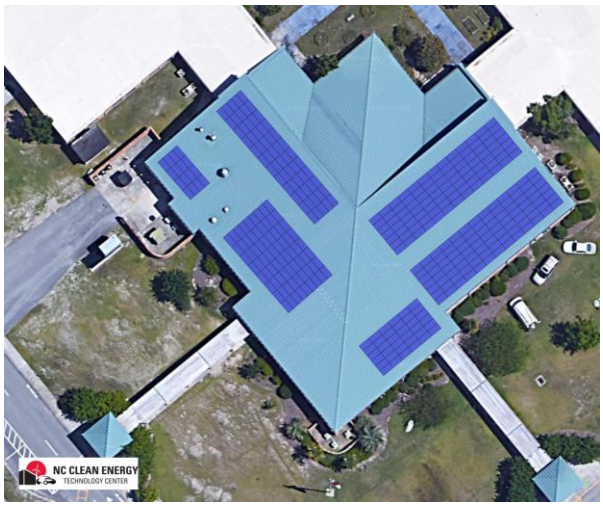
New Hanover County Schools Solar PV Renderings

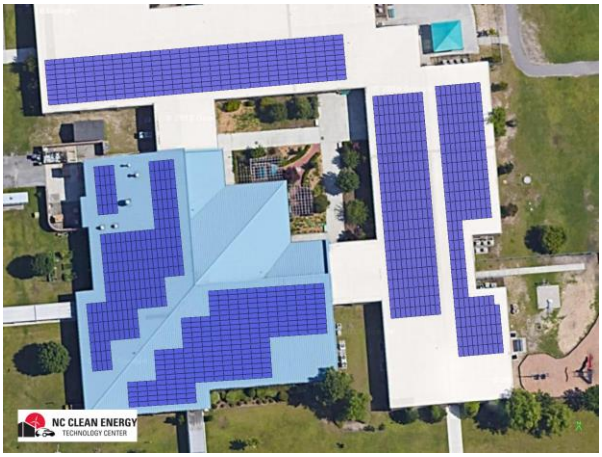
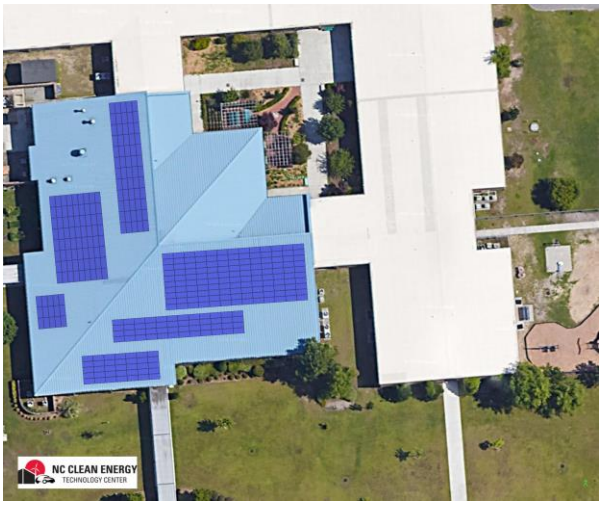
Note: All views show with North towards top of page. Not to scale. Buildings shown were chosen based on roof type (metal being most preferable for solar PV mounting) and age (expected lifetime of the roof near or exceeding the predicted life of solar PV panels).

Systems based on using 295 W solar PV modules, each with dimensions of approximately 78 inches tall by 40 inches wide. The arrays are mounted directly flush to the roof in the case of buildings with metal roofs. On buildings with a membrane/TPO roof, the modules are mounted at an angle of 10 degrees towards south on a structural aluminum frame which is ballasted to prevent uplift.

<table>
<tr><td colspan="2">Anderson Elementary</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>277.8 kW AC Solar PV Option</td><td>99.9 kW AC Solar PV Option</td></tr>
</table>

Carolina Beach Elementary	
	
93.5 kW AC Solar PV Option	6 kW AC Solar PV Option using only the walkway covering near the entrance

Codington Elementary School	
	
230.2 kW AC Solar PV Option	100.3 kW AC Solar PV Option

Eaton Elementary School	
	
326.8 kW AC Solar PV Option	100 kW AC Solar PV Option

Holly Tree Elementary	
	
130.1 kW AC Solar PV Option	99.9 kW AC Solar PV Option

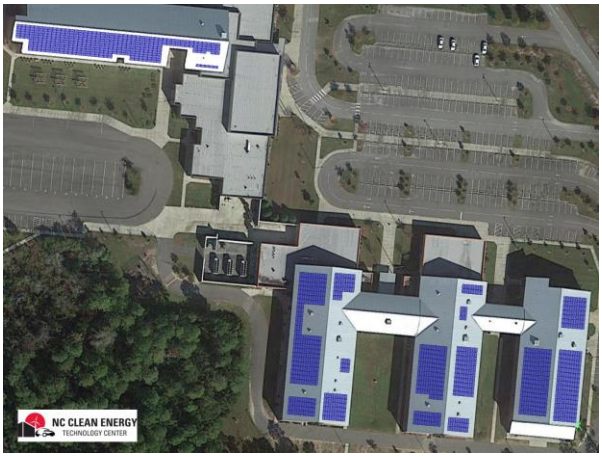
Parsley Elementary	
	
279.9 kW AC Solar PV Option	99.9 kW AC Solar PV Option

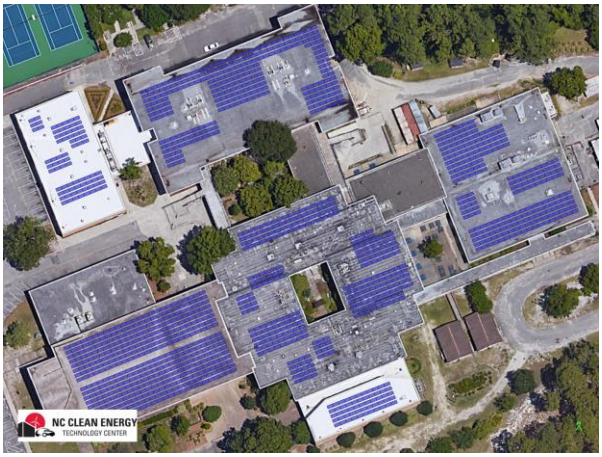
Pine Valley Elementary	
	
148.8 kW AC Solar PV Option Using all structure roofs	30 kW AC Solar PV Option Using only the new roof.

Snipes Elementary	
	
166.5 kW AC Solar PV Option Using all structure roofs	99.9 kW AC Solar PV Option.

Winter Park Elementary	
	
38.1 kW AC Solar PV Option Using all structure roofs	

Wrightsboro Elementary	
	
122.7 kW AC Solar PV Option Using all structure roofs	100 kW AC Solar PV Option.

Holly Shelter Middle and Castle Hayne Elementary	
	
409.8 kW AC Solar PV Option Using all structure roofs	100 kW AC Solar PV Option.

Hoggard High School	
	
383.6 kW AC Solar PV Option Using all structure roofs	45.2 kW AC Solar PV Option. Uses only the new roof area

Lake Forest Academy & Admin Bldg	
	
160.4 kW AC Solar PV Option Using main building and outbuilding roofs	100 kW AC Solar PV Option.

Solar-Ready Roof Potential

The purpose of this section is to emphasize the importance of considering solar PV during the design process of a building. Generally, we consider a solar-ready roof one that minimizes shading through nearby structures, roof geometry, or avoids roof installation of HVAC units, skylights. Ideally, the roof is medium to low slope standing seam metal facing due south, with options going up to due east/west losing ~15% of maximum solar generation. The following table illustrates the hypothetical scenario in which the roof available at the schools would be solar-ready. The process included measuring the roof area of each school, and assuming each panel occupies about 14.28 sq. ft. with a 20deg. tilt (actual panel surface area is 15.2 sq. ft.). Orientation and panel performance has not been assessed in this scenario.

Table 3: New Hanover County Schools roof area potential to maximize solar

School	Roof Area	Task 1 Max Solar Availability, kW	Task 1 Max Solar Availability, sq. ft.	Solar-ready Roof PV Potential, kW	Roof Area Covered by PV, sq. ft.
Anderson Elementary	72,532	277.8	15,760	1,201	72,532
Carolina Beach Elementary	48,994	93.5	5,304	811	48,994
Codington Elementary	77,663	230.2	13,059	1,285	77,663
Eaton Elementary	72,192	326.8	18,540	1,195	72,192
Holly Tree Elementary	59,652	130.1	7,381	987	59,652
Parsley Elementary	68,119	279.9	15,879	1,128	68,119
Pine Valley Elementary	41,490	148.8	8,442	687	41,490
Snipes Elementary	57,097	166.5	9,446	945	57,097
Winter Park Elementary	31,920	38.1	2,161	528	31,920
Wrightsboro Elementary	25,452	122.7	6,961	421	25,452
Holly Shelter Elem & Middle School	71,948	409.8	23,248	1,191	71,948
Hoggard High School	101,646	383.6	21,762	1,682	101,646
Lake Forest Academy	52,636	160.4	9,100	871	52,636

When considering new buildings or roof replacements, flat membrane roofs would have a 10 degree angle and require a 6 foot set back, while metal roofs facing south at a 25% degree slant would have a 4 foot set back. Therefore there is a better solar return from metal roofs, further solar installed on metal does not require any penetration of the roof as part of the installation. In addition, it is important to have solar breaker box, inverter and conduit as well as space outside by the meter for inverter disconnect. For monitoring purposes, it is important to have Ethernet cable going from router to inverter.

Applicable Solar PV Terms and General Utility Tariff Information

Buy-All, Sell-All

Sell-all agreements under Duke Energy allows generators up to 5 MW to sell all of their generated power under 2, 5, 10 or 15 year terms. This agreement requires a second meter to be installed on the facility that will monitor electricity generation provided to the grid. The generation owner will be compensated based on the energy they deliver (in kWh) and the capacity additions (in kW). Under this agreement, the owner is paid as a wholesaler of electricity, and will purchase power from the utility under standard rate structures.

Net-Metered

Duke Energy's net metering program applies to renewable electricity generators up to 1,000 kW on non-residential buildings (20kW on residential). This agreement requires the installation of a bi-directional meter on the facility. The installed solar array will generate electricity and offset the building's electricity consumption and electricity demands above the generation of the array will be provided by Duke Energy. The meter monitors consumption and production, and any excess electricity generation will be credited to the customer on a one-to-one ratio per kWh, and carried over to following months.

Zero Export

A zero export structure creates an isolated generation system. The PV array is used within a building or facility to offset internal use without returning any electricity to the electric grid. These systems use internal monitoring devices to balance the electricity generated with building demands and pull in electricity from the grid as needed.

Net Billing

Net billing systems are an alternative to net metering. Instead of a customer receiving a credit for excess generation on a per-unit basis, the customer receives monetary compensation for their excess generation at the wholesale rate. This difference is important, as net metering compensates the customer for excess generation at the retail rate and net billing compensates at the wholesale or "avoided cost" rates.

Applicable Electric Rate Schedules - Duke Energy Progress

Net Metering Rider

This rider only operates if the customer has a residential or general service schedule and operates a generating system such as solar, wind-power, etc. The systems rated generating capacity cannot exceed the customers estimated max annual kilowatt demand or 1000kW, whichever comes first. The rate is calculated by charging and crediting On-peak and Off-peak kWh separately, applying any remaining excess On-peak credit to Off-peak kWh. A customer will be credited according to their subscribed schedules On/Off-peak rate hours. Any excess credited energy will be carried over at the end of the month until May 31st of each year where the credit will be reset to 0 kWh.[3]

Purchased Power Schedule (Buy-all, Sell-all)

Duke Energy Progress offers a range compensation options depending on the customers on-peak time-of-use hours and type of interconnection. On/Off-peak generation rates for non-hydroelectric sources are defined in the table below:

		Interconnected to Distribution		Interconnected to Transmission	
Energy Credits Applicable to all Generation		Variable Rate	Fixed Long-Term Rate (10yrs)	Variable Rate	Fixed Long-Term Rate (10yrs)
Option A Energy Credit (¢/kWh)	On-peak kWh	3.54	3.66	3.48	3.59
	Off-peak kWh	3.25	3.36	3.22	3.32
Option B Energy Credit (¢/kWh)	On-peak kWh	3.63	3.67	3.55	3.59
	Off-peak kWh	3.28	3.41	3.24	3.37
Energy Credits Applicable to All But Hydroelectric Generation without Source					
Option A Energy Credit (¢/kWh)	On-peak kWh - On-peak Month	0.00	0.55	0.00	0.54
	Off-peak kWh - Off-peak Month	0.00	1.12	0.00	1.10
Option B Energy Credit (¢/kWh)	On-peak kWh - Summer	0.00	0.83	0.00	0.82

[3] https://www.duke-energy.com/_/media/pdfs/rates/rr3-nc-rider-nm-dep.pdf?la=en

	Off-peak kWh - Non-Summer	0.00	1.93	0.00	1.89

Duke Energy Progress Purchase Power Schedule (PP-3) Generation Rates for Non-Hydroelectric Systems[4]

Customers will also be charged with a monthly Seller Charge of $23.06 and an Interconnection Facilities Charge which is priced at 1.3% of the estimated installed cost of all facilities required for interconnection, the charge will be no less than $25/mo.[5]

A new solar rebate from Duke Energy presents a key opportunity for New Hanover to lower the cost of solar PV investments. Duke has proposed to offer rebates of $0.75/W to nonprofit and government entities for solar PV installations. This rebate program was mandated under House Bill 589 passed in 2017 by the NC General Assembly.

- The proposed rebate program is intended to provide a financial incentive for Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) residential, business, and nonprofit customers toward the upfront cost of installing solar at their premise.
- The rebate will be available as of January 1, 2018 for residential installations up to 10kW and non-res up to 100 kW.
- Represents 20 MW of installed capacity per year for the next five years for DEC and DEP combined. Each year, 5MW will be reserved for non-profit organizations, which can include schools, places of worship, and so on.

[4] https://www.duke-energy.com/_/media/pdfs/rates/c1ncschedulecspdep.pdf?la=en
[5] https://www.duke-energy.com/_/media/pdfs/rates/c2nctermsandconditionsdep.pdf?la=en

Task 2 - Economic Analysis of Solar PV Options for New Hanover

Of the thirteen structures selected for task 1 analysis, four schools were evaluated in task 2 for modeling using the National Renewable Energy Lab's economic analysis tool, System Adviser Module[6](SAM). The return on investment will be best with the potential Duke Energy rebate on systems up to 100kW. Further, the Helioscope configured arrays of the four schools selected for SAM analysis maximize the potential for solar electricity generation due to unobstructed south facing exposures.

An economic model was run to simulate the savings from the system over a 25-year lifetime, and determine the net present value (NPV) and simple payback of the systems. The results from SAM for each system are summarized below, and detailed reports are provided in Appendix 3. Note that while the system sizes are the same as in Task 1, the energy output in kWh varies slightly due to differences between Helioscope and SAM.

The SAM analysis utilized the total purchase price of $1.10 per watt offered through Green Power of North Carolina (GPNC) to non-profits. GPNC lease to own model requires upfront payment of $1.00 per watt and at the end of year five an additional $.10 per watt (10% of installation cost) payment to purchase the solar PV system at its fair market residual value. There is no penalty for prepayment of the $.10/watt. Conversely if NHCS no longer wants the solar PV system, they may opt out of the $.10 watt purchase and GPNC will remove the panels at no additional charge. The NCCETC does not warrant this pricing, nor reviewed the economic analysis upon which GPNC has based its pricing. The SAM analysis also takes into account Duke Energy's anticipated $.75 watt $_{AC}$ solar rebate for non-profits (up to a maximum of 75 watts $_{AC}$) when calculating payback period.

For each of the four buildings evaluated in Task 2, the 100 kW or smaller option was modeled in SAM. While all the buildings can accommodate PV systems larger than 100 kW, the proposed Duke Energy solar rebate would apply to only the first 100 kW. Therefore, the economic gains would be less as the system size increases above 100 kW.

The results from SAM for each system evaluated are summarized below, and detailed reports are provided in Appendix 3.

[6] System Adviser Module, a program developed maintained by the National Renewable Energy Laboratory for the U.S. Department of Energy; accessible at https://sam.nrel.gov/.

Anderson Elementary

455 Halyburton Memorial Pkwy, Wilmington, NC

PV System Specifications

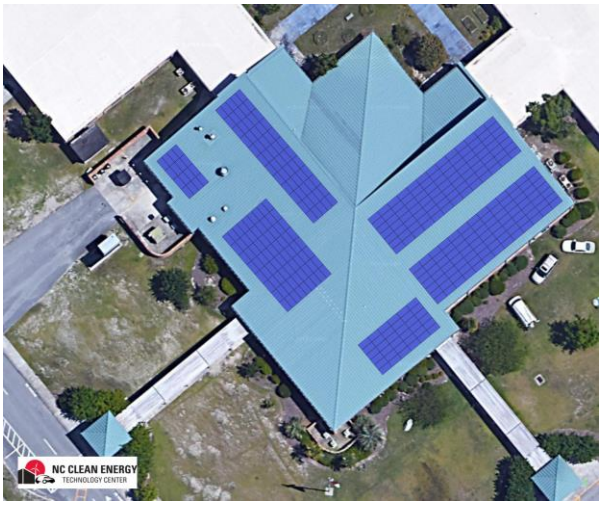
System Nameplate Size, kW_{DC}	Rated Inverter Size, kW_{AC}	1st Year generation, kWh	Installation cost, upfront	Buyout option cost, year 5	Potential DEP Rebate
116.5	100	154,000	$116,500	$11,650	$75,000

Economic Analysis Results Summary

Interconnection Type	1st Year utility cost savings	Nominal LCOE, cents/kWh	Net Present Value (25 year life)	Simple Payback Period, years
Net-metering	$8,951	3.5	$67,200	6.1
Buy All/Sell All - Option A	$6,066	3.5	$25,000	9.1
Buy All/Sell All - Option B	$6,315	3.5	$28,700	8.7

Codington Elementary

4321 Carolina Beach Road, Wilmington, NC



PV System Specifications

System Nameplate Size, kW_{DC}	Rated Inverter Size, kW_{AC}	1st Year generation, kWh	Installation cost, upfront	Buyout option cost, year 5	Potential DEP Rebate
113.57	100	154,000	$113,570	$11,357	$75,000

Economic Analysis Results Summary

Interconnection Type	1st Year utility cost savings	Nominal LCOE, cents/kWh	Net Present Value (25 year life)	Simple Payback Period, years
Net-metering	$8,815	3.3	$68,700	5.8
Buy All/Sell All - Option A	$6,056	3.3	$28,400	8.5
Buy All/Sell All - Option B	$6,313	3.3	$32,100	8.2

Lake Forest Academy

1806 South 15th S, Wilmington, NC

PV System Specifications

System Nameplate Size, kW_{DC}	Rated Inverter Size, kW_{AC}	1st Year generation, kWh	Installation cost, upfront	Buyout option cost, year 5	Potential DEP Rebate
115.9	100	168,087	$115,900	$11,590	$75,000

Economic Analysis Results Summary

Interconnection Type	1st Year utility cost savings	Nominal LCOE, cents/kWh	Net Present Value (25 year life)	Simple Payback Period, years
Net-metering	$9,444	3.2	$75,000	5.7
Buy All/Sell All - Option A	$6,642	3.2	$34,100	8.2
Buy All/Sell All - Option B	$6,933	3.2	$38,300	7.8

Parsley Elementary

3518 Masonboro Loop Rd, Wilmington, NC

PV System Specifications

System Nameplate Size, kW_{DC}	Rated Inverter Size, kW_{AC}	1st Year generation, kWh	Installation cost, upfront	Buyout option cost, year 5	Potential DEP Rebate
112.7	100	153,000	$112,700	$11,270	$75,000

Economic Analysis Results Summary

Interconnection Type	1st Year utility cost savings	Nominal LCOE, cents/kWh	Net Present Value (25 year life)	Simple Payback Period, years
Net-metering	$8,874	3.3	$70,600	5.7
Buy All/Sell All - Option A	$6,038	3.3	$29,200	8.4
Buy All/Sell All - Option B	$6,290	3.3	$32,800	8.1

Conclusions

New Hanover County Schools has opportunity to make investments in solar PV to further its sustainability and realize significant utility cost savings. Market conditions have been steadily improving due to lower solar PV equipment and installation costs.

Task 1 - Solar PV Potential - Key Takeaways

- For all but one of the buildings evaluated (Eaton Elementary), the larger solar PV system capacity in kW did not exceed the maximum historical kW demand of the school.
- Each PV system would generate from 3 to 70% of current electricity usage per building.
- In future, care should be taken to plan rooftops to maximize space and solar access for solar PV, both for new buildings and roof replacements.

In total, the thirteen buildings evaluated in Task 1 could support installation of 1,107 kW to 2,738 kW of rooftop solar PV and generate from 1,716,177 to 4,188,376 kWh annually. This is equivalent to 14-35% of the electricity presently consumed in all the buildings evaluated.

Task 2 - Economic Analysis - Key Takeaways

- The analyses indicate that New Hanover will realize the most financial benefit from installing solar PV in a net-metering configuration.
- The solar rebate of $0.75 per W up to 100 kW proposed by Duke Energy Progress is a key incentive to optimizing PV economics for New Hanover.
- Paybacks range from 5.7 years to 6.1 years with the rebate under net metering.

Next Steps

If New Hanover County Schools elects to procure the solar PV systems as identified, there are a number of ways to proceed. One way is to issue a request for proposals to solicit standardized proposals that require potential partners to respond to specific conditions and issues so that New Hanover can compare bids to understand which one provides the best value.

Resources

U.S. Department of Energy Better Buildings Initiatives Zero Energy Schools
https://betterbuildingsinitiative.energy.gov/accelerators/zero-energy-schools

NC Sustainable Energy Association - Proposed Duke Energy Solar Rebate Program Overview
https://energync.org/duke-energy-solar-rebates/

North Carolina Clean Energy Technology Center
https://nccleantech.ncsu.edu/technology/renewable-energy/

Appendix 1 - Inputs and Assumptions

Parameter Type	Parameter	Source
PV System Tilt	Equal to roof slope for metal roof, 10 degrees for flat roof	Based on installation considerations
DC to AC Ratio	1.0-1.4	Varies due to inverter size graduations
Panel degradation rate	0.5% per year	SAM default
System expected useful life	25 years	SAM default
Upfront cost	$1 / watt DC	Green Power of North Carolina
Buyout cost	$0.10 / watt DC	Green Power of North Carolina
Operations & maintenance costs	$0 per year	Green Power of North Carolina
Insurance cost	0.5% of installed cost per year	SAM default
Inflation rate (used for electricity cost escalation)	2.5 % per year	SAM default
Discount rate, real	4.0 % per year	Typical for local government

Appendix 2 - Preliminary Solar PV Designs - Helioscope Software

Total (25) Helioscope reports - 65 pages

Anderson Elementary School 100kW
Anderson Elementary School 278kW

Carolina Beach Elementary School 6kW
Carolina Beach Elementary School 94kW

Codington Elementary School 100kW
Codington Elementary School 230 kW

Eaton Elementary School 100kW
Eaton Elementary School 327kW

Hoggard High School 45kW
Hoggard High School 384kW

Holly Shelter Middle School 100kW
Holly Shelter Middle School 410kW

Holly Tree Elementary School 100kW
Holly Tree Elementary School 130kW

Lake Forest Academy 100kW
Lake Forest Academy 160kW

Parsley Elementary School 100kW
Parsley Elementary School 280kW

Pine Valley Elementary School 30kW (new roof only)
Pine Valley Elementary School 148kW

Snipes Elementary School 100kW
Snipes Elementary School 167kW

Winter Park Elementary School 38kW

Wrightsboro Elementary School 100kW
Wrightsboro Elementary School 123kW

Appendix 3 - Economic Analysis from System Adviser Module

(Four schools 37 pages)

Anderson Elementary- Net Metering,

Anderson Elementary- Buy-All Sell-All A

Anderson Elementary- Buy-All Sell-All B

Codington Elementary- Net Metering

Codington Elementary- Buy-All Sell-All A,

Codington Elementary- Buy-All Sell-All B

Lake Forest Academy & Admin -Net Metering,

Lake Forest Academy & Admin Buy-All Sell-All A

Lake Forest Academy & Admin Buy-All Sell-All

Parsley Elementary Net Metering,

Parsley Elementary Buy-All Sell-All A,

Parsley Elementary Buy-All Sell-All B