

Guide to Interconnecting Small PV Systems for Participation in NC Green Power



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Introduction

This guide outlines the steps to interconnecting small photovoltaic (PV) systems to the utility grid with the intention of selling electricity to the NC GreenPower Program. It is not a technical guide to the actual installation of a system, but it covers basic issues such as siting, system configuration, cost, financing, and working with your local utility. Included at the end is a summary checklist that presents the logical step-by-step process to installing a PV system that will suit your needs and meet the requirements of your utility and NC GreenPower. The NC GreenPower program strongly encourages both solar and wind resources and will pay a premium greater than that allowed for other resources if funding is available through the program.

Site Evaluation

To install a solar energy system properly, it is important to understand the siting and tilt requirements for solar collectors. Photovoltaic modules should be oriented and tilted to obtain maximum solar radiation and to avoid unwanted shading. A well-designed PV system needs clear and unobstructed access to the sun's rays around solar noon for about six hours a day throughout the year. You can make an initial assessment yourself, and if the location looks promising, your PV contractor has the tools to trace the sun's path at your location and determine whether your home or business can make use of a PV solar system.

Orientation and Sun Position

In North Carolina, the sun is always in the southern half of the sky and is higher in the summer and lower in the winter. A solar collector or photovoltaic (PV) module gathers the most sunlight when it is perpendicular to the sun. Ideally, your PV array should be tilted to follow the sun's change in elevation during the course of the year, and turn to follow the sun's apparent path from east to west during the day, called a tracking system. This daily east-west tracking can produce 20 to 40 percent more electricity, depending on the time of year. The use of tracking is only cost-effective if the value of the additional energy by the tracking system exceeds the cost of purchasing, installing, operating, and maintaining the tracker.

For a fixed, non-tracking system, solar collectors or photovoltaic modules are usually installed facing true south. This is the one fixed orientation by which they almost always intercept the greatest amount of solar radiation during the year. Local weather patterns, orientation of an existing building, or other factors relating to the building site, such as shading may dictate the orientation of a solar collector or module from true south. Deviating active solar or PV solar systems from true south by as much as 20° to 30° east or west will not significantly reduce the total solar radiation received. True south is not the same as magnetic south at most locations. This variance is called magnetic declination and is usually represented as the number of degrees that compass (magnetic) north varies from true north. For more information about how to determine true south from magnetic south, please consult the NC Solar Center factsheet "Siting of Active Solar Collectors and Photovoltaic Modules."

Tilt Angle

Again, a solar collector or photovoltaic module collects the maximum solar radiation when the sun's rays strike it at right angles. As the solar collector or module is tilted away from

perpendicular alignment to the sun, less solar energy is received. The optimal tilt angle for a solar energy system depends on both the site latitude and the application for which it is to be used. To maximize annual electricity production, solar collectors are usually tilted at an angle equal to the latitude of the site. This angle points the collectors and modules directly toward the sun in the spring and the fall when the sun is at its midpoint position in the sky. For example, in Raleigh, the collector or module is positioned so that a 36° angle is made between the collector or module and the horizontal. Similar to orientation, small deviations away from the ideal tilt will not affect energy output much, and may be preferable from an appearance or stability standpoint. If the PV array will be installed on an existing roof, it is recommended to mount it parallel with the existing roof pitch

Effects of Shading

While orientation and tilt angles are not critical, the installation site must be carefully analyzed to determine if obstructions to the south will prevent access to the sun during some or all of the year. While solar collectors and modules do not require guaranteed access to sunlight from sunrise to sunset, they should be shaded as little as possible between 9 AM and 3 PM solar time, when nearly 85 percent of the sun's energy reaches the earth. Shading affects the performance of photovoltaic modules more critically than it affects solar thermal collectors. It is important to note that even though the area where a system is mounted may be unshaded during one part of the year, it may be shaded during another. If this is the case, then this shading may substantially reduce the amount of electricity that your system will produce. A well designed PV system will be unshaded for the six hours around noon on March 21 and September 23.

Location of PV Modules

Usually, the best location for a PV system is mounted on an existing roof. For the most part, if your modules are oriented at slopes 45° or less (typical roof pitches) and oriented within 30° of south, your system will provide at least 90% of the optimal energy output. If a rooftop can't be used, your solar modules can also be placed on the ground, either on a fixed mount or a "tracking" mount that follows the sun to orient the PV modules for maximum performance. They can also be mounted to provide shade on window awnings or over patios.

The amount of space needed by a PV system is based on the physical size of the system you purchase. A starter 1 kW residential system will need about 100 ft². If your location limits the physical size of your system, you may want to install a system that uses more- efficient PV modules which use less surface area to convert sunlight into a given amount of electric power.

A PV system can be installed on any roof type, but some may be easier to work with than others. If your roof is older and needs to be replaced in the very near future, you may want to replace it at the time the PV system is installed to avoid the cost of removing and reinstalling your PV system. There is an increasing number of building integrated photovoltaic products such as shingles or raised-seam metal roof sections. One benefit of these systems is their ability to offset the cost of roof materials.

Overview of Hardware Basics

Photovoltaics

PV technology converts sunlight directly into electricity. It works any time the sun is shining, but more electricity will be produced when the light is more intense (a sunny day) and is directly over the PV modules. The basic building block of PV technology is the solar cell. PV cells are wired together to produce a PV module, the smallest PV component sold commercially, and these modules range in power output from about 10 watts to 300 watts. A PV array consists of one or more PV modules wired together. The array is connected to an inverter that converts the system's direct-current (DC) electricity to alternating current (AC). AC power is compatible with the utility grid and able to power common household devices such as lights, appliances, computers, and televisions. You may also include batteries in the system to provide back-up power. Most PV modules will come with 20-25 year warranties, but often the warranties on other components (batteries, controllers, inverters) will be much shorter.

PV System Configurations

PV systems are usually referred to as either utility tied or off-grid . Off-grid PV systems are not tied to the utility grid and therefore do not qualify to participate in the NC Green Power Program. A utility tie system can either have or not have battery backup power. If you have a grid-tied system with batteries, you will be able to supply loads in your home or business even when the utility power goes down. Battery based systems provide emergency power or supply uninterruptible power systems, but batteries will add to the cost of the system. The decision of whether to have battery backup power must be made initially because it will dictate the choices of other power conditioning equipment.

Sizing the PV System

There are several approaches to sizing a grid tied PV system. You may want a system that produces a certain percentage of your electricity needs. To figure out your electrical consumption, you can look at past utility bills or contact your utility. The size will most likely be limited by the amount of money you wish to spend or the roof or open area you have available.

PV modules come with a peak power rating (common residential modules will be 75 to 300 Watts DC). There are many assumptions required to calculate annual electricity production in kWh from the PV system. However, there are many useful tools to help do exactly this task. A free program from the National Renewable Energy Laboratory and Department of Energy is called PV Watts available at: <http://rredc.nrel.gov/solar/calculators/PVWATTS/> . Using this program, Table 1 summarizes the expected annual kWh output for a one kilowatt PV array for a fixed position (oriented due south and tilted at latitude with no shading), one axis tracking, and two axis tracking. The values presented are for ideal shaded conditions and may vary as much as 20 % per year, but should give a general idea of how much electricity you can expect per kilowatt. For these conditions on a fixed system, you can expect about 1300 kWh per year for each kW DC installed in North Carolina. A tracking system will boost production to 1600-1700 kWh per year.

Table 1: Expected kWh production from a one kilowatt DC PV array in North Carolina.

City	Fixed (kWh)	1-Axis Tracking (kWh)	2-Axis Tracking (kWh)
Asheville	1287	1615	1664
Cape Hatteras	1319	1684	1734
Charlotte	1314	1668	1718
Greensboro	1308	1669	1719
Raleigh	1297	1647	1695
Wilmington	1319	1684	1734

Economics: Cost and Incentives

The initial cost and savings for a PV system really needs to be considered on a case-by-case basis, but this section will help clarify what you might expect to pay.

PV System Cost

There is not necessarily a simple answer. Your system's price will depend on a number of factors, including whether the home is new construction, whether the PV is integrated into the roof or mounted on top of an existing roof, the system rating and configuration, manufacturer, retailer, and installer.

The size of your system is the most significant factor in any equation measuring your costs against your benefits. A 2-kilowatt grid tie system that will offset the needs of a very energy-efficient home may cost \$20,000 to \$24,000 installed, or \$10 to \$12 per watt. At the high end, a 5-kilowatt system that will completely offset the energy needs of many conventional homes may cost \$40,000 to \$50,000 installed, or \$8 to \$10 per watt. These prices, of course, are just rough estimates, and your costs will depend on your system's configuration. For example, battery based systems will be more expensive. These price estimates do not include the reduction due to NC State tax credits described in the next section.

As you size your system, you should consider the economics of scale that can decrease the cost per kilowatt-hour as you increase the size of the system. Many inverters are sized for systems up to 5 kilowatts, and if your PV array is smaller (say 3 kilowatts), you may still end up buying the same inverter. In addition, labor costs for a small system may be nearly as much as those for a larger system. Therefore, it may be more cost effective to install a 2 kilowatt system all at once, than to install a 1 kilowatt this year and another similar system next year because multiple orders and multiple site visits are more expensive.

Financing

Financing the cost of purchasing and installing a residential PV system is fairly straightforward. The best way to finance PV systems for homes is through a mortgage loan. Mortgage financing options include your primary mortgage, a second mortgage such as a U.S. Department of Housing and Urban Development (HUD) Title 1 loan, or a home-equity loan that

is secured by your property. You can also use a conventional bank loans, but the interest rate is often higher. PV systems purchased for business applications in North Carolina qualify for a low-interest loan program administered through the State Energy Office. Please contact Star Brown, starlette.brown@ncmail.net, 919-733-1897 or Cynthia Moseley, cynthia.moseley@ncmail.net, 919-733-1896. Because this is a new program, the operating procedure and rules are still under development. Businesses can also use Small Business Administration loans or conventional bank loans.

Renewable Energy Tax Credits

Since 2000, North Carolina has offered a 35% tax credit for a PV system. Cost of equipment, design, construction, and installation are all eligible for this tax credit. The amount eligible for the tax credit is reduced when the solar electric equipment serves multiple functions (building integrated PV) such as roofing or siding. The PV system must comply with all applicable state or local codes and inspections to qualify for the tax credit.

Residential

For a residential property, the income tax credit is 35% with a limit of \$10,500 per installation. The maximum allowance credit is 50% of the taxpayer's tax liability for the year reduced by the sum of all other credits. For a single family dwelling, the credit must be taken in the year in which the system is placed in service. For a multiple family dwelling, starting with the year of installation, the credit is taken over five years in equal installments.

Non-residential

For a non-residential property, the income tax credit is 35% with a limit of \$250,000 per installation. This credit is taken over five years in equal installments starting with the year the system is installed and completed. Commercial and industrial photovoltaic systems also qualify for a 10% federal corporate income tax credit. Federal law also allows a 5-year Modified Accelerated Cost Recovery System (MACRS) depreciation schedule for commercial and industrial photovoltaic systems

Finding a Contractor

North Carolina is fortunate to have many contractors with experience in installing PV systems. Check the North Carolina Solar Center's Directory of Renewable Energy Professional in North Carolina on the World Wide Web at: www-solar.mck.ncsu.edu/directory.htm.

You should try to find a contractor with experience installing grid-connected systems since they will have experience interacting with the local utility. However, grid-connected systems are still relatively uncommon in NC. Therefore, some PV contractors may not have this credential but they still will be familiar with all the other technical details on installing the system and are qualified to do the work.

PV systems should be installed by an appropriately licensed contractor. This means that either the contractor or subcontractor has an electrical contractor's license. The State Board of Examiners of Electrical Contractors, (919-733-9042) can tell you if a contracting firm has a valid license. The Board also has a Web site (www.ncbeec.org) where you can check to see if an electrical contracting firm holds a license. Local building departments also may require that the

installer have a general contractor's license. Consumers should call the city and county in which they live for additional information on licensing.

There is also a new national certification program for PV installers administered by the North American Board of Certified Energy Practitioners (NABCEP). While this is new and voluntary certification program, it is still recommended that you try to find someone who has passed the NABCEP exam.

Permits, Inspections, and Insurance

Under North Carolina State law, you have the legal right to install a solar system on your home. However, homeowner's associations can have covenants or restrictions on solar systems. If your homeowner's association forbids the installation of a solar system, please contact Steve Kalland at the NC Solar Center at steve_kalland@ncsu.edu or 919-515-1396. If you live in a community in which a neighborhood association requires approval for a solar system, you or your PV contractor may need to submit your plans. It is important to gain approval from your association before you begin installing your PV system.

You will need to obtain permits from your city or county building department. You will probably need a building permit, an electrical permit, or both before installing a PV system. Typically, your PV contractor will take care of this and the price of the permits will be included into the overall system price. However, in some cases, you may be responsible for "pulling" the permit. Therefore, you should be clear with your PV contractor whether this is included.

There may be some local code requirements for PV systems, but most requirements are based on the National Electrical Code (NEC). The section of the NEC that deals with PV systems is Article 690. Because most local requirements are based on the NEC, your building inspector is likely to rely on Article 690 for guidance in determining whether your PV system has been properly designed and installed. Inspectors will also look to Article 230-Services and Article 250-Grounding to confirm that the design and installation passes code. If you are among the first people in your community to install a grid-connected PV system, your local building department may not have approved one of these systems. If this is the case, you and your PV contractor can speed the process by working closely and cooperatively with your local building officials to help educate them about the technology and its characteristics. The NC Solar Center has additional resources on our webpage at www.ncsc.ncsu.edu to aid you in this education process.

There are national interconnection standards for utility interconnection of PV systems. These standards help insure that your inverter and power conditioning equipment is safely connected to the utility grid. The three major standards are:

- Institute of Electrical and Electronic Engineers, P929: Recommended Practice for Utility Interface of Photovoltaic Systems. Institute of Electrical and Electronic Engineers, Inc., New York, NY (1999)
- Institute of Electrical and Electronic Engineers, 1547: Standard for Interconnecting Distributed Resources With Electric Power Systems. Institute of Electrical and Electronic Engineers, Inc., New York, NY (2003).
- Underwriters Laboratories, UL Subject 1741: Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems. Underwriters Laboratories, Inc., Northbrook, IL (1999).

If you interconnect your PV system to the utility grid, your electric utility will require you to enter into an interconnection agreement, described more fully in the next section. Usually, these agreements set forth minimum insurance requirements. If you are buying a PV system for your

home, your standard homeowner's insurance policy is usually adequate to meet the utility's requirements

Working with Utilities

To connect your PV system to the utility grid, you will be required to enter into an interconnection agreement and a purchase and sale agreement. North Carolina Public Utilities Commission regulations and federal law require utilities to supply you with an interconnection agreement. There are three basic types of electrical utilities in NC: 1) Investor Owner Utilities, 2) Cooperative Utilities (Coops or EMCs), and 3) Municipal Electrical Utilities (Municipals). The Investor Owned Utilities in NC include Progress Energy, Duke Power, and Dominion North Carolina Power. These utilities all have at least one standard interconnection agreement for small photovoltaic systems. The interconnection agreement specifies the terms and conditions under which your system will be connected to the utility grid. These will include your obligation to obtain permits and insurance, maintain the system in good working order, and operate it safely. The purchase and sale agreement specifies the metering arrangements, the payment for any excess generation, and any other related issues. Under the federal Public Utility Regulatory Policies Act (PURPA), utilities must allow you to interconnect your PV system, and they must also buy any excess electricity you generate (beyond what you use in your home or business).

You may have heard of the term net metering. Net metering allows eligible customers with PV systems to connect to the grid with their existing single meter and customers are billed monthly for the "net" energy consumed. The meter spins forward when electricity is flowing from the utility into the building and spins backward when power is flowing from the building to the utility. The electricity is bought from and sold to the utility at the same rate reflecting the market value of the commodity at the point of delivery. Currently, North Carolina does not have a net metering law or ruling and therefore the Investor Owned Utilities will not offer you a net metering agreement. Some North Carolina EMCs and Municipals offer you a net metering agreement while others will not. Nonetheless, it is worth mentioning this option to your utility.

Included in Appendix A are the sample rate schedules from Progress Energy, Duke Power, and Dominion Power. In addition, the forms to apply for interconnection with Progress Energy and Duke Power are included in Appendix B. While some EMCs and Municipalities have developed simplified, standardized interconnection agreements for small scale PV systems, many may not have processed this type of request before. If you contact your local EMC or Municipal Utility and find there is no standard agreement yet, refer them to Appendix A and B. Since net metering is not available in most cases, the utility will only pay you a wholesale or "offset generation" rate for your excess electricity. If you are unclear about the details of these agreements, you should contact the utility or CC Maurer at ccmaurer@ncsu.edu, 919-515-9782 or Steve Kalland at steve_kalland@ncsu.edu, 919-513-1896 at the NC Solar Center.

Basically, there are three metering options for connecting our small renewable energy system to the grid and your configuration will depend both on your needs and your utilities options. As mentioned previously, to participate in NC Green Power Program, you can either have direct grid tie system without batteries or a grid tie system that can provide backup power from batteries.

Direct Grid Tie System

A direct grid tie system is the simplest configuration. All of the solar electricity you generate will be sent straight to the grid through a separate electric meter as shown in figure 1.

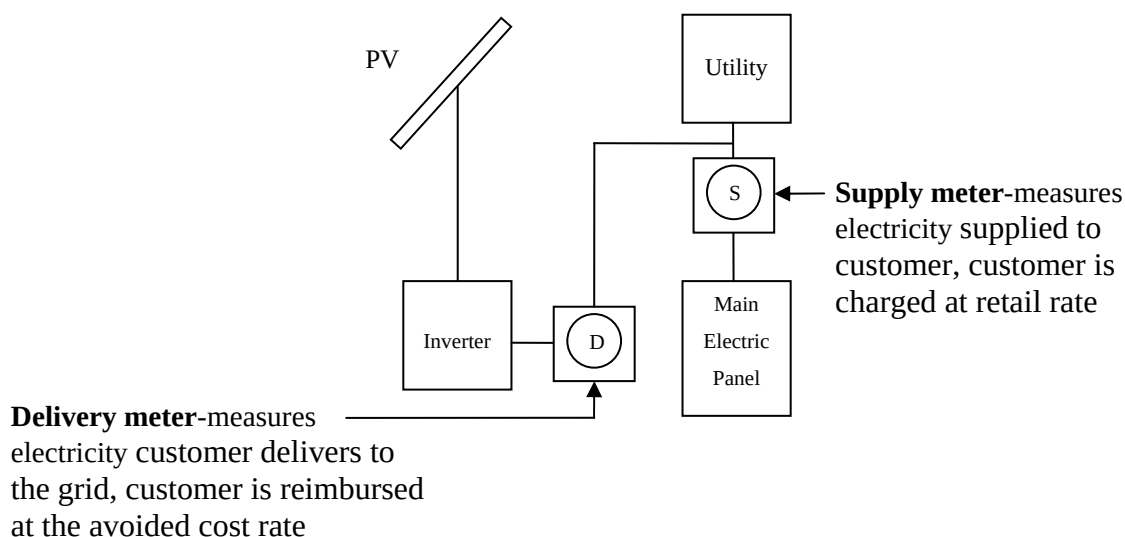


Figure 1: Line diagram for Direct Tie PV System

To meter your electricity with this option with the major investor owned utilities, you will be considered a small power producer. The three major utilities have the following rate schedules as of August 2004:

Utility	Schedule	Title
Progress Energy, Inc	CSP-21A	Cogeneration and Small Power Producer
Duke Power	PP-N (NC)	Non-Hydroelectric Qualifying Facilities Purchased Power
Dominion NC Power	19	Power Purchases from Cogeneration and Small Power Production Qualifying Facilities

Under these agreements, you will be paid an energy credit by your utility which varies depending on the season and time of day (whether the energy is generated on peak or off peak) and possibly by the duration of your contract with your utility. The energy credit varies based on the offset generation rate determined by your utility, but will be around \$0.02-0.035 per kWh. There is an additional capacity credit of about \$0.02 per kWh. You will also be charged an additional meter charge or fixed amount per month for your account. Again, if you are not in the district of one of the major utilities, your local electric provider may not have a standard rate schedule and interconnection agreement. Please use schedules provided in the Appendix A as a sample for your utility. These rate schedules are normally used for larger generation facilities than residential or commercial size PV systems. Note that currently Dominion Power requires a filing fee of \$10,000 for an interconnection feasibility study. The investor owned utilities in NC are currently working with the NC Utilities Commission to develop simplified interconnection process for PV systems less than 100 kW AC.

Becoming a Qualified Small Power Producer: FERC Form 556 and Rule R1-37

While the details of these rate schedules may vary, if you are interconnected as a small power producer, your PV system must be a Qualified Facility (QF) by Federal Energy Regulatory Commission (FERC). Becoming a Qualified Facility is fairly simple if you use the self-certification process. You must fill out FERC form 556 and provide some information about your generating facility (www.ferc.gov/docs-filing/hard-fil-elec.asp). A sample form with much of the required information is included in Appendix C. Fourteen copies of this form must be sent to the Secretary of FERC along with a notice stating that you are applying for self-certification as a qualifying facility. A copy of the FERC form must also be sent to the appropriate person at your utility and the NC Utilities Commission. If you have any additional questions about the available rate schedules or FERC form, please contact the NC Solar Center.

In addition, you must file a certificate of convenience and necessity with the NC Utilities Commission under Rule R1-37. The information required for this application is described in detail in R1-37(B) (available on the NCUC website at www.ncuc.commerce.state.nc.us), but is summarized with the form provided in Appendix D. The application should include a notarized Verification page. There is a \$25 filing fee and the check should be made out to the NC Department of Commerce/NC Utilities Commission. For systems greater than 10 kW AC, the application and 19 copies must be filed with the Chief Clerk of the Utilities Commission. In addition, the applicant for systems larger than 10 kW AC must advertise for four consecutive weeks in a daily newspaper in the county where the system will be installed. In August 2004, the Commission simplified this process for PV systems 10 kW AC or less. For systems 10kW AC or less, the application and 10 copies shall be filed with the Chief Clerk of the Utilities Commission and the applicant is exempt from the newspaper advertising rule.

Grid Tie with Battery Backup

Many people will install a PV system because it can provide backup power. For these systems, there are currently two ways to meter your electricity production. First, you can be connected similarly to the Direct Grid Tie System where normally, all the electricity you produce is fed directly onto the electric grid. You are also purchasing all your electric power from the utility. However, an extra transfer switch will be installed in your system so that if indeed the electricity grid fails, your house will automatically switch over to backup power mode. Then, your PV system is only being used to charge your batteries and power your emergency loads in your house (fridge, lights, etc.). When the utility fixes the problem with their service, then your PV system will automatically transfer to selling power back to the grid and you will purchase power from the grid. Under this configuration, you will use the same interconnection agreement as with a Direct Tie system (Small Power Producer) and will follow the same procedure outlined in the previous section.

PV Rider

The second way for the utility to meter a battery based system is shown in figure 2. The PV system is connected to the utility through your main electrical panel. In this case, only excess power is sold to the grid when it is not being used onsite. While this may not optimize the power sold to the NC Green Power Program, there is a simplified interconnection agreement called PV Rider for these systems under Progress Energy for residential customers and Duke Power for

both residential and non-residential customers. PV Rider was initiated in 1999-2000 to provide an easy way for residential PV systems 10 kW AC or less to interconnect. All the solar power cannot be sold directly to the grid, it must first go through your main electrical panel inside your house. For Progress Energy, Inc customers, there will be an additional meter charge of \$3.15 per month and then the utility will credit \$0.03708 per kWh delivered to the grid. For Duke Power residential customers, the additional facilities charge is \$1.10 while for Non-residential customers the facilities charge is \$2.75. For both residential and non-residential customers, the reimbursement credit is \$0.0254 per kWh. There is not seasonal or time variation in the credit for electricity generated under PV Rider

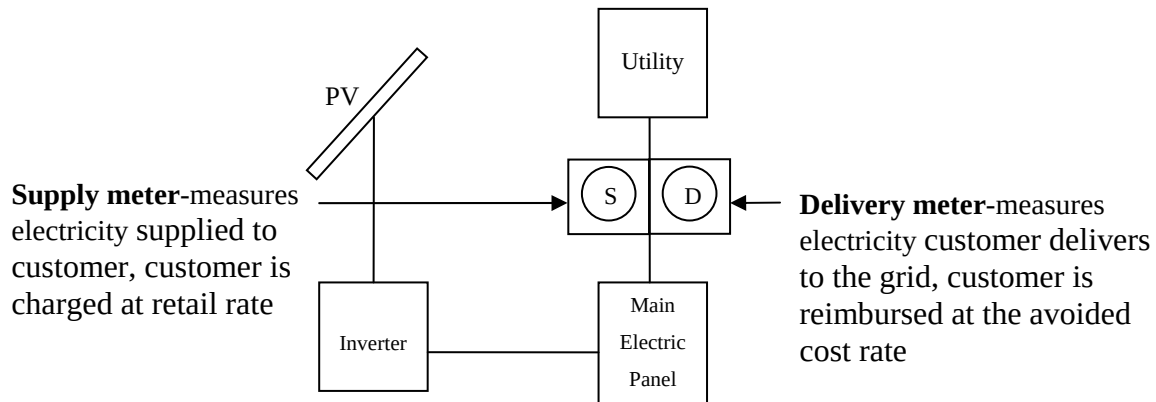


Figure 2: Line diagram for metering on PV System which sells only excess power

In this metering arrangement, there will be times when you are consuming your solar electricity onsite. Your utility and NC Green Power are not reimbursing you for this electricity. However, you do offset your electricity consumption, so you will be saving the retail rate for this electricity (about \$0.08 per kWh). This metering arrangement will work well if you minimize your electricity loads during peak PV production (generally between 9 and 3pm) or for a vacation home.

Dispute Resolution With Your Utility

In the case that you have problems working out an interconnection and rate agreement with your utility, there are some resources to help resolve disputes with the major utilities. The Consumer Services Division of the North Carolina Utilities Commission-Public Staff is responsible for assisting the public with complaints against regulated public utilities. After you have tried working out the problem directly with the utility, you can contact the Ben Turner, the Director of the Public Staff Electric Division at 919-733-1518 or Ben.Turner@ncmail.net. The North Carolina Utilities Commission does not have jurisdiction over municipal utilities or electric cooperatives.

The Public Staff at the Utilities Commission handles most individual consumer complaints, but the NC Attorney General is authorized to intervene on behalf of consumers in any Utilities Commission case. Usually, the Attorney General assists in cases with broad legal or policy implications, like rate cases or interconnection standards. Consumers can contact the NC Attorney General's Office, Consumer Protection Division at 919-716-6000.

Approval from NC Green Power

Compensation

The current level of premium being paid to solar producers by NC GreenPower (NCGP) is \$0.18/kWh and applies to systems up to and including 10 kW AC. This level of compensation could change in the future. Currently, NCGP is entering into five year contracts, which maintain the level of premium constant over the five years. To be considered for the program, the solar generator must supply NCGP with a proposed level of production in kWh per year. The Solar Center recommends using the free program mentioned in a previous section called PV Watts (<http://rredc.nrel.gov/solar/calculators/PVWATTS/>) to estimate the annual kWh production. In addition, you must inform NCGP of the time frame in which production will begin. When accepted as an NCGP provider, you will be sent a generation agreement. A sample generation agreement is provided in Appendix E.

Participation Limits

NCGP is a demand driven program, so participation as a generator is limited by the amount of electricity purchased by the customers of NCGP. The program plan includes targets for the resource mix in the third year of the program. The goal is to have solar and wind produce 15% of the electricity in the product intended for residential customers and 4% of the electricity in the product for large volume customers.

Billing to Advanced Energy

Once connected to the grid, your utility should send NCGP monthly billing data from the meter on your solar electric system. This data will show how much energy was generated that actually flowed onto the NC electric grid. In some cases, it may be easier for the owner of the system to send a copy of the bill directly to NCGP. Once NCGP verifies which portion of the electricity flowed onto the electric grid, they will issue a premium check. For any questions about NCGP, contact Bob Zickefoose at Advanced Energy, Inc at bzickefo@advancedenergy.org or 919-857-9027.

Calculating Savings from Your PV System

The total value of your PV system's electricity will depend on your system configuration. Using utility data from the NCSU Solar House as an example, the savings under the different interconnection agreements is compared as shown in Table 2. The columns on the left of the table show the utility data including the total solar electricity and the solar electricity exported to the utility. From this, the solar electricity consumed onsite is determined. The DC nameplate rating of the NCSU Solar House is 3 kW. Because the array is about 20 years old, the annual output of the array for this year is comparable to a new 1.8 kW DC array.

With the direct tie system, based on kWh production, you can estimate yearly savings through reimbursement from the NCGP Program and an average of how much your utility will pay you for your generated electricity. You must subtract out the additional meter charge, which will vary from utility to utility. The NCSU Solar House is connected to Progress Energy, Inc. With a direct tie photovoltaic system, it is required to connect under Cogeneration and Small Power Producer (CSP). Under this schedule, the utility charges the generator a monthly seller charge of \$7. The utility will charge the customer for any equipment required to interconnect

such as an electrical meter. It is assumed that the meter will cost \$150 and that the customer is charged at 2% of the initial cost each month (\$3/month). The total credit for on-peak generation is \$0.05959/kWh while it is \$0.04045 for off-peak generation. On and off peak hours and months are defined in the interconnection agreement. Based on the hours of PV production, it was assumed that around 65% all of the electricity generated between April 1 and September 30 was on-peak and that only 40% of the solar electricity generated between October 1 and March 31 qualifies for on-peak rates. These rates apply to all the solar electricity generated. Based on these assumptions, it is estimated that the annual savings from the PV system would be about \$350.

If you have a battery based system and only sell excess power under PV Rider (PVR), then the value of the electricity is harder to determine. A percentage of the electricity you produce will only be worth the rate you pay your utility; only the amount you export will qualify for the \$0.18 per kWh from NC Green Power and the offset generation rate from your utility. PV Rider provides a simpler interconnection agreement with a flat rate for exported electricity of \$0.03708/kWh under Progress Energy, Inc and a meter charge of \$3.15. For the year from July 2002-June 2003, the NCSU Solar House PV system produced just over 2100 kWh and exported about 500 kWh to the utility or about 24% of the total electricity produced. The savings from the PV electricity is reduced to around \$200/year.

Table 2: Projected savings for NCSU Solar House under the Small Power Producer (CSP) or PV Rider.

Usage Period	Total Solar Generated (kWh)	Export to Utility (kWh)	Solar Consumed on Site (kWh)	Savings under CSP	Savings under PV Rider
July-02	188	18	170	\$ 33	\$ 15
August-02	197	25	171	\$ 34	\$ 17
September-02	171	15	156	\$ 29	\$ 13
October-02	112	36	76	\$ 14	\$ 11
November-02	205	80	124	\$ 34	\$ 24
December-02	173	80	94	\$ 27	\$ 21
January-03	215	64	150	\$ 36	\$ 22
February-03	152	45	107	\$ 23	\$ 15
March-03	185	47	138	\$ 30	\$ 17
April-03	189	45	144	\$ 32	\$ 17
May-03	173	26	147	\$ 29	\$ 13
June-03	171	25	145	\$ 28	\$ 13
Total for Year	2129	507	1622	\$ 349	\$ 198

Summary of Steps to Interconnecting PV System

- 1) Evaluate site for solar access
- 2) Check with neighborhood association about rules governing solar equipment
- 3) Decide how large you want your system to be or how much you want to spend
- 4) Decide whether you want straight grid-tie system or battery backup system
- 5) Contact NC Green Power to participate in the program. Estimate annual kWh production and provide time frame for when system will be operating
- 6) Contact your local utility, Electric Coop, or Municipality to find out about interconnection agreements
 - o If you are under Progress Energy or Duke Power, you have two options:
 - Sell excess power only under PV Rider
 - Sell all energy produced under CSP or PP
 - o If you are under Dominion Power, you will connect under Schedule 19
 - o If you use EMC or Municipality you may need to show them previously mentioned interconnection agreements as a model
- 7) Find a local contractor to make a site visit and propose a system design
- 8) Make sure your contractor pulls all required permits
- 9) If connecting as Small Power Producer:
 - o Fill out FERC 556 form and file fourteen copies with notice to Office of the Secretary of FERC. Send copy to your utility and NC Utilities Commission. (Appendix C)
 - o Apply for Certificate of Necessity and Convenience with the NCUC (Appendix D). There is a \$25 filing fee.
 - For systems 10 kW AC or less, file the original application and verification page and 10 copies with the Office of the Clerk.
 - For systems greater than 10 kW AC, file the original application and verification page and 19 copies with the Office of the Clerk. You must also advertise this application in local daily newspaper
- 10) Apply for interconnection agreement (Appendix B) and have utility install meter at your house
- 11) File for NC State Tax Credit
- 12) Confirm agreement with NC Green Power (Appendix E). Arrange for your utility to send Bob Zickafoose at Advanced Energy an official copy of your meter reading to participate in NC Green Power.

Important Contact Information

NC Utilities

Progress Energy, Inc

Reese Dillard
Progress Energy / CP&L
Rate Services
412 S. Wilmington St.
Raleigh, NC, 27601

Duke Power

Phil Baker
Duke Power
PO Box 1090
Charlotte, NC 28201-1090
704-382-6090

Virginia Power and Light/

Dominion NC Power

One James River Plaza
701 E. Cary Street
Richmond, VA 23219-3932
888-667-3000

North Carolina Utilities Commission

NC Utilities Commission
4325 Mail Services Center
Raleigh, NC 27699-4325
Phone: 919-715-7057

General Interconnection Issues

Sam Watson, Attorney
919-715-7057

Application for Certificate of Public Necessity and Compliance

Geneva Thigpen, Chief Clerk
919-733-0840

Dispute Resolution

Ben Turner
919-733-1518
Electric Division
919-733-2267

Attorney General's Office

Leonard Green
NC Attorney General's Office
Consumer Protection Division
9001 Mail Service Center
Raleigh, NC 27699-9001
919-716-6000

Federal Energy Regulatory Commission

Filing FERC 556

Office of the Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

NC Solar Center

NC Solar Center
NCSU
Campus Box 7401
Raleigh, NC 27695-7401

Steve Kalland, 919-513-1896
CC Maurer, 919-515-9782

Advanced Energy

Advanced Energy, Inc
909 Capability Drive, Suite 2100
Raleigh NC 27606

Bob Zickafoose, 919-857-9027
Maggy Inman, 919-857-9000

References and Resources

Dominion Power

<http://www.dom.com>

Duke Power

<http://www.dukepower.com>

Federal Energy Regulatory Commission – Qualifying Facilities

<http://www.ferc.gov/industries/electric/gen-info/qual-fac.asp>

The North Carolina Consumer's Guide to Buying a Solar Electric System. (2002) NC Solar Center and U.S. Department of Energy.

Progress Energy

<http://www.progress-energy.com>

PV Watts:

<http://rredc.nrel.gov/solar/calculators/PVWATTS/>

Siting of Active Solar Collectors and Photovoltaic Modules. (2001) NC Solar Center.

Appendix A: Sample Rate Schedules

- 1) Progress Energy Carolinas, Inc: Cogeneration and Small Power Producer Schedule CSP-21A (4 pages)
- 2) Duke Power: Schedule PP-N (NC) Non Hydroelectric Qualifying Facilities (3 pages)
- 3) Dominion Power: Schedule 19: Power Purchases from Cogeneration and Small Power Production Qualifying Facilities (12 pages)
- 4) Progress Energy Carolina, Inc: Photovoltaic System (Experimental) Rider PV-4C (2 pages)
- 5) Duke Power: Rider PV (NC) Photovoltaic System Pilot (2 pages)

COGENERATION AND SMALL POWER PRODUCER
SCHEDULE CSP-21A

AVAILABILITY

Upon Seller's completion and Company's acceptance of an Application for Standard Contract, this Schedule is available for electrical energy and capacity supplied by Seller to Company if Seller is a Qualifying Facility as defined by the Federal Energy Regulatory Commission's (FERC) Order No. 70 under Docket No. RM79-54. This Schedule is not available for electric service supplied by Company to Seller or to Seller who has negotiated rate credits or conditions with Company which are different from those below. If Seller requires supplemental, standby, or interruptible services, Seller shall enter into a separate service agreement with Company in accordance with Company's applicable electric rates, riders, and Service Regulations on file with and authorized by the state regulatory agency having jurisdiction.

Qualifying Facilities Eligible for Capacity Credits

In order to receive Capacity Credits under this Schedule a Qualifying Facility must be classified as New Capacity in accordance with FERC Order No. 69 under Docket No. RM79-55. In addition, the eligibility for Capacity Credits is further limited to those Qualifying Facilities which meet the following conditions ("Eligible Qualifying Facilities"):

The 10- and 15-Year Fixed Long-Term Capacity Credits set forth below are only available to hydroelectric Qualifying Facilities with Contract Capacities of 5 MW or less and to Qualifying Facilities fueled by trash or methane derived from landfills, hog waste or poultry waste with Contract Capacities of 5 MW or less. The 5-Year Fixed Long-Term and Variable Capacity Credits set forth below are only available to: hydroelectric Qualifying Facilities with Contract Capacities of 5 MW or less; Qualifying Facilities fueled by trash or methane derived from landfills, hog waste or poultry waste with Contract Capacities of 5 MW or less; and Qualifying Facilities with Contract Capacities of 3 MW or less.

Sellers receiving Capacity Credits under this Schedule shall also receive corresponding Energy Credits of like term.

In order to receive the 10- or 15-year credits as specified in this Schedule, the Seller must renew the contract, at the Company's option, based on substantially the same terms and conditions as contained herein and at a rate either (1) mutually agreed upon by the parties negotiating in good faith and taking into consideration the Company's then avoided cost rate and other relevant factors or (2) set by arbitration.

Qualifying Facilities Not Eligible for Capacity Credits

Qualifying Facilities not eligible for the Fixed Long-Term and/or the Variable Capacity Credits of this schedule ("Non-Eligible Qualifying Facilities") may contract with Company to sell electricity to Company: (1) and receive the Variable Energy Credit as established and updated herein; (2) through negotiated purchase power agreements; or (3) if Company has a Commission-recognized active solicitation for additional capacity underway, by participating in such competitive bidding process.

All Qualifying Facilities

All Qualifying Facilities are eligible for the Variable Energy Credit. Such Variable Energy Credit shall constitute an "as available" avoided cost credit.

APPLICABILITY

This Schedule is applicable to all electric energy and capacity supplied by Seller to Company at one point of delivery through Company's metering facilities.

CONTRACT CAPACITY

The Contract Capacity shall be as specified in the Application For Standard Contract between Company and Seller.

MONTHLY RATE

Payment

Company shall pay Eligible Qualifying Facilities for energy and/or capacity furnished to Company the Credits set forth below as applicable. Company shall pay Non-Eligible Qualifying Facilities for energy furnished to Company the Variable Energy Credits set forth below as applicable. Such payments shall be reduced by both the Seller Charge and any applicable Interconnection Cost.

Energy Credits

Those Qualifying Facilities eligible for the Company's Fixed Long Term and/or Variable Energy Credits shall be paid an Energy Credit for all energy delivered to Company's System as registered or computed from Company's metering facilities. This Energy Credit will be in accordance with the length of rate term for energy sales so established in the Purchase Agreement.

For facilities whose deliveries do not enter Company's transmission system:

	<u>Variable Credit</u>	<u>Fixed Long-Term Credits</u>		
		<u>5-Year</u>	<u>10-Year</u>	<u>15-Year</u>
On-Peak kWh (¢/kWh)	3.650	3.492	3.486	3.631
Off-Peak kWh (¢/kWh)	2.106	2.142	2.244	2.368

For facilities whose deliveries enter Company's transmission system:

	<u>Variable Credit</u>	<u>Fixed Long-Term Credits</u>		
		<u>5-Year</u>	<u>10-Year</u>	<u>15-Year</u>
On-Peak kWh (¢/kWh)	3.565	3.411	3.405	3.547
Off-Peak kWh (¢/kWh)	2.076	2.111	2.212	2.334

Capacity Credits

Those Qualifying Facilities eligible for the Company's Fixed Long Term and/or Variable Capacity Credits shall be paid a Capacity Credit for all capacity delivered to Company's System as registered or computed from Company's metering facilities. This Capacity Credit will be in accordance with the length of rate term for capacity sales so established in the Purchase Agreement.

Company shall pay Seller a Capacity Credit based on the on-peak kWh supplied by Seller.

For hydroelectric facilities with no storage capability and no other type of generation whose deliveries do not enter Company's transmission system:

	Variable Credit	Fixed Long-Term Credits		
		5-Year	10-Year	15-Year
On-Peak kWh (¢/kWh)-Summer	3.849	3.981	4.189	4.375
On-Peak kWh (¢/kWh)-Non-summer	3.116	3.223	3.391	3.542

For all other facilities whose deliveries do not enter Company's transmission system:

	Variable Credit	Fixed Long-Term Credits		
		5-Year	10-Year	15-Year
On-Peak kWh (¢/kWh)-Summer	2.309	2.389	2.513	2.625
On-Peak kWh (¢/kWh)-Non-summer	1.869	1.934	2.035	2.125

For hydroelectric facilities with no storage capability and no other type of generation whose deliveries enter Company's transmission system:

	Variable Credit	Fixed Long-Term Credits		
		5-Year	10-Year	15-Year
On-Peak kWh (¢/kWh)-Summer	3.760	3.889	4.091	4.274
On-Peak kWh (¢/kWh)-Non-summer	3.044	3.148	3.312	3.460

For all other facilities whose deliveries enter Company's transmission system:

	Variable Credit	Fixed Long-Term Credits		
		5-Year	10-Year	15-Year
On-Peak kWh (¢/kWh)-Summer	2.256	2.334	2.455	2.564
On-Peak kWh (¢/kWh)-Non-summer	1.826	1.889	1.987	2.076

Summer months are defined as the calendar months of June through September. Non-summer months are defined as all other months.

Seller Charge

Seller shall pay to Company a Seller Charge outlined below in accordance with the Contract Capacity:

	Contract Capacity		
	0 to 100 kW	101 to 999 kW	1000 kW and above
Monthly Seller Charge	\$7	\$93	\$278

For Small Power Producers, as the term is defined in General Statute §62-3 (27a), with no storage capacity and no other type of generation whose deliveries do not enter Company's transmission system, the sum of: (1) the Seller Charge and (2) the Monthly Facilities Charge for those Interconnection Facilities installed before January 1, 2000 or replaced thereafter with equipment of equal capacity and kind, shall be \$100.00 per month; except that any Interconnection Facilities installed after January 1, 2000, other than replacement of existing equipment with equipment of equal capacity and kind, shall be subject to additional Monthly Facilities Charges. This provision applies only to a Small Power Producer who has completed an initial 15-year contract term under a Purchase Power Agreement with Company prior to January 1, 2000 or was selling electricity to Company on January 1, 2000.

RATE UPDATES

The Credits and Seller Charge of this Schedule will be updated every two years. Sellers who have contracted for the Fixed Long-Term Credits will not be affected by updates in the Energy and Capacity Credits until their rate term expires. For all Qualifying Facilities selling to Company pursuant to the Energy-only Variable Credits, such credits shall be updated and changed in accordance with the Commission's revisions to such credits in Company's biennial avoided cost proceedings.

DETERMINATION OF ON-PEAK AND OFF-PEAK HOURS

I. On-Peak Hours:

- A. Service used beginning at 12:00 midnight March 31 and ending at 12:00 midnight September 30:

The on-peak hours are defined as the hours between 10:00 a.m. and 10:00 p.m., Monday through Friday, excluding holidays considered as off-peak.

- B. Service used beginning at 12:00 midnight September 30 and ending at 12:00 midnight March 31:

The on-peak hours are defined as those hours between 6:00 a.m. and 1:00 p.m., plus 4:00 p.m. through 9:00 p.m., Monday through Friday, excluding holidays considered as off-peak.

II. Off-Peak Hours:

The off-peak hours in any month are defined as all hours not specified above as on-peak hours. All hours for the following holidays will be considered as off-peak: New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day. When one of the above holidays falls on a Saturday, the Friday before the holiday will be considered off-peak; when the holiday falls on a Sunday, the following Monday will be considered off-peak.

INTERCONNECTION COSTS

For Sellers with Contract Capacity of 5 MW or less, the installed costs for all facilities constructed or installed by Company to interconnect and safely operate in parallel with Seller's equipment shall be determined in accordance with Company's Terms and Conditions For The Purchase of Electric Power. For all other Sellers such interconnection costs shall be as determined under Company's Interconnection and Operation Agreement for Qualifying Facilities with Generating Capacity Greater Than 5 MW or similar provisions negotiated in lieu thereof.

Supersedes Schedule CSP-20D

Effective for Energy and Capacity rendered on and after November 28, 2003

NCUC Docket No. E-100, Sub 96

SCHEDULE PP-N (NC)
NON-HYDROELECTRIC QUALIFYING FACILITIES
PURCHASED POWER

AVAILABILITY (North Carolina only)

Available only to establishments located in the Company's North Carolina service territory which have non-hydroelectric qualifying facilities fueled by trash or methane derived from landfills, hog waste, or poultry waste contracting to sell generating capacity and energy not in excess of five (5) megawatts, or other non-hydroelectric generating facilities contracting to sell generating capacity and energy not in excess of three (3) megawatts, which are interconnected directly with the Company's system and which are qualifying facilities as defined by the Federal Energy Regulatory Commission pursuant to Section 210 of the Public Utility Regulatory Policies Act of 1978.

This Schedule is available only to Customers under contract with the Company on or before November 1, 2004, for delivery of power beginning on or before the earlier of thirty (30) months from the date of execution of the contract or May 1, 2007.

Notwithstanding the above, all qualifying facilities have the option to sell energy to the Company on an "as available" basis on or before November 1, 2004, and receive energy credits only calculated using the Variable Rates identified in this Schedule for the delivered energy.

This Schedule is not applicable to a qualifying facility owned by a Customer, or affiliate or partner of a Customer, who sells power to the Company from another facility within one-half mile.

Service necessary for the delivery of the Customer's Net Power into the Company's system under this Schedule shall be furnished solely to the individual contracting Customer in a single enterprise, located entirely on a single, contiguous premise. Service hereunder shall be restricted to the Net Capacity of the Customer's generating facilities which may be operated in parallel with the Company's system. Service necessary to supply the Customer's total load requirements other than Auxiliary Load, and service necessary to supply the Customer's Auxiliary Load when the Customer's generating facilities are not operating, shall be billed on the applicable schedule(s) of the Company. Net Power delivered to the Company under this Schedule shall not offset or be substituted for power contracted for or which may be contracted for under any other schedule of the Company, except at the option of the Company under special terms and conditions expressed in writing in the contract with the Customer.

The obligations of the Company in regard to service under this Schedule are dependent upon its securing and retaining all necessary rights-of-way, privileges, franchises and permits for such service and the Company shall not be liable to any customer or applicant for power in the event it is delayed in, or is prevented from purchasing power by its failure to secure and retain such rights-of-way, rights, privileges, franchises and permits.

TYPE OF SERVICE

Company will furnish 60 Hertz service through one metering point, at one delivery point, at one of the following approximate voltages, where available, upon mutual agreement:

- Single-phase, 120/240 volts; or
- 3-phase, 3-wire, 240, 480, 4160, 12470, or 24940 volts; or
- 3-phase voltages other than the foregoing, but only at the Company's option, and provided that the size of the Customer's contract warrants a substation solely to serve that Customer, and further provided that the Customer furnish suitable outdoor space on the premises to accommodate a ground-type transformer installation, or substation, or a transformer vault built in accordance with the Company's specifications.

The type of service under this Schedule shall be determined by the Company. Prospective customers shall ascertain the available voltage by written inquiry of the Company before purchasing equipment.

RATE (One of the following two Rate options shall apply):Option A

Interconnected to Distribution System:

	<u>Variable Rate</u>	<u>5 Years</u>	<u>Fixed Long-Term Rate (a)</u>	
			<u>10 Years (b)</u>	<u>15 Years (b)</u>
I. Capacity Credit				
a. All On-Peak Energy per On-Peak Month per kWh:	1.91¢	1.96¢	2.04¢	2.12¢
b. All On-Peak Energy per Off-Peak Month per kWh:	0.42¢	0.43¢	0.45¢	0.47¢
II. Energy Credit				
a. All On-Peak Energy per Month per kWh:	2.54¢	2.64¢	2.91¢	3.16¢
b. All Off-Peak Energy per Month per kWh:	1.96¢	2.00¢	2.16¢	2.37¢

Interconnected to Transmission System:

	<u>Variable Rate</u>	<u>5 Years</u>	<u>Fixed Long-Term Rate (a)</u>	
			<u>10 Years (b)</u>	<u>15 Years (b)</u>
I. Capacity Credit				
a. All On-Peak Energy per On-Peak Month per kWh:	1.83¢	1.88¢	1.96¢	2.04¢
b. All On-Peak Energy per Off-Peak Month per kWh:	0.41¢	0.42¢	0.44¢	0.45¢
II. Energy Credit				
a. All On-Peak Energy per Month per kWh:	2.44¢	2.54¢	2.79¢	3.04¢
b. All Off-Peak Energy per Month per kWh:	1.90¢	1.93¢	2.09¢	2.28¢

Option B

Interconnected to Distribution System:

	<u>Variable Rate</u>	<u>5 Years</u>	<u>Fixed Long-Term Rate (a)</u>	
			<u>10 Years (b)</u>	<u>15 Years (b)</u>
I. Capacity Credit				
a. All On-Peak Energy per On-Peak Month per kWh:	6.71¢	6.87¢	7.17¢	7.45¢
b. All On-Peak Energy per Off-Peak Month per kWh:	1.02¢	1.04¢	1.09¢	1.13¢
II. Energy Credit				
a. All On-Peak Energy per Month per kWh:	2.75¢	2.81¢	3.10¢	3.39¢
b. All Off-Peak Energy per Month per kWh:	2.11¢	2.18¢	2.37¢	2.60¢

Interconnected to Transmission System:

	<u>Variable Rate</u>	<u>5 Years</u>	<u>Fixed Long-Term Rate (a)</u>	
			<u>10 Years (b)</u>	<u>15 Years (b)</u>
I. Capacity Credit				
a. All On-Peak Energy per On-Peak Month per kWh:	6.44¢	6.60¢	6.89¢	7.15¢
b. All On-Peak Energy per Off-Peak Month per kWh:	0.98¢	1.00¢	1.05¢	1.09¢
II. Energy Credit				
a. All On-Peak Energy per Month per kWh:	2.64¢	2.70¢	2.98¢	3.25¢
b. All Off-Peak Energy per Month per kWh:	2.04¢	2.10¢	2.28¢	2.51¢

- Notes: (a) The 10-Year and 15-Year Fixed Long-Term Rates are applicable only to those qualifying facilities which are non-hydroelectric qualifying facilities fueled by trash or methane derived from landfills, hog waste, or poultry waste contracting to sell capacity and energy not in excess of five (5) megawatts.
- (b) Contracts for the 10-Year and 15-Year Fixed Long-Term Rates are subject to a provision making the contract renewable for subsequent term(s) at the option of the Company on substantially the same terms and provisions and at a rate either (1) mutually agreed upon by the parties negotiating in good faith and taking into consideration the Company's then avoided cost rates and other relevant factors, or (2) set by arbitration.

DEFINITIONS

Nameplate Capacity: The term "Nameplate Capacity" shall mean the maximum continuous electrical output capability of the generator(s) at any time at a power factor of ninety percent (90%).

Net Capacity: The term "Net Capacity" shall mean the Nameplate Capacity of the Customer's generating facilities, less the portion of that capacity needed to serve the generating facilities' Auxiliary Load.

Auxiliary Load: The term "Auxiliary Load" shall mean power used to operate auxiliary equipment in the facility necessary for power generation (such as pumps, blowers, fuel preparation machinery, and exciters).

Net Power: The term "Net Power" shall mean the total amount of electric power produced by the Customer's generating facilities less the portion of that power used to supply the generating facilities' Auxiliary Load.

Month: The term "Month" as used in this Schedule means the period intervening between meter readings for the purposes of monthly billing, such readings being taken once per month.

For Option A Rates, the On-Peak Months shall be the Months of June through September and December through March. The Off-Peak Months shall be the Months of April, May, October and November.

For Option B Rates, the Summer Months are the period from June 1 through September 30. The Non-Summer Months are the period from October 1 through May 31.

DETERMINATION OF ON-PEAK AND OFF-PEAK ENERGY

On-Peak Energy shall be energy, in kilowatt-hours, which is supplied to the Company during On-Peak Period Hours. Off-Peak Energy shall be energy, in kilowatt-hours, which is supplied to the Company during the Off-Peak Period Hours.

For Option A Rates, the On-Peak Period Hours shall be those hours, Monday through Friday, beginning at 7 A.M. and ending at 11 P.M. The Off-Peak Period Hours shall be all other weekday hours and all Saturday and Sunday hours.

For Option B Rates, the On-Peak Period Hours shall be those hours, Monday through Friday, beginning at 1 P.M. and ending at 9 P.M. during Summer Months, and beginning at 6 A.M. and ending at 1 P.M. during Non-Summer Months. The Off-Peak Period Hours shall be all other weekday hours and all Saturday and Sunday hours. All hours for the following holidays shall be considered as Off-Peak: New Year's Day, Memorial Day, Good Friday, Independence Day, Labor Day, Thanksgiving Day, Day after Thanksgiving, and Christmas Day.

INTERCONNECTION FACILITIES CHARGE

The Customer shall be responsible for providing suitable control and protective devices on his equipment to assure no disturbance to other customers of the Company or to the Company itself, and to protect the Customer's facilities from all loss or damage which could result from operation with the Company's system.

Schedule PP-N (NC) Continued

The Company will furnish, install, own, and maintain interconnection facilities necessary for service under this Schedule including: suitable control and protective devices installed on Company equipment to allow operation of the Customer's generating facilities; metering facilities equipped to prevent reverse registration for the measurement of service under this Schedule; and any other modifications to its system required to serve the Customer under this Schedule as determined by the Company.

All such facilities shall be subject to a monthly charge under the Extra Facilities provisions of the Company's Service Regulations. The Company reserves the right to install at any time facilities necessary for the appropriate measurement of service under this Schedule and to adjust the Interconnection Facilities Charge accordingly, solely at the option of the Company.

DETERMINATION OF CAPACITY CREDITS

Capacity Credits will be based on the energy, in kilowatt-hours, which is supplied to the Company during the On-Peak Period Hours of the Month and will be applied to the Customer's bill in the appropriate Month.

Capacity Credits are available only to qualifying facilities classified as "new capacity" in accordance with the Federal Energy Regulatory Commission's Order No. 69 in Docket No. RM79-55 and in accordance with the North Carolina Utilities Commission's Order dated September 21, 1981 in Docket No. E-100, Sub 41.

POWER FACTOR CORRECTION

When the average Monthly power factor of the power supplied by the Customer to the Company is less than 90 percent or greater than 97 percent, the Company may correct the energy, in kilowatt-hours, as appropriate. The Company reserves the right to install facilities necessary for the measurement of power factor and to adjust the Interconnection Facilities Charge accordingly, solely at the option of the Company.

PAYMENTS

Credit billings to the Customer shall be payable to the Customer within fifteen (15) days of the date of the bill.

Bills under this Schedule are due and payable on the date of the bill at the office of the Company. Bills are past due and delinquent on the fifteenth day after the date of the bill. If any bill is not so paid, the Company has the right to suspend service. In addition, all bills not paid by the twenty-fifth day after the date of the bill shall be subject to a one percent (1%) late payment charge on the unpaid amount. This late payment charge shall be rendered on the following month's bill and it shall become part of and be due and payable with the bill on which it is rendered.

CONTRACT PERIOD

Each Customer shall enter into a contract which shall specify the amount of capacity committed for delivery throughout the term of the contract and shall specify one of the following as the initial term and associated rate: variable rate for five (5) years or fixed long-term rate for five (5), ten (10) or fifteen (15) years. Following the initial term, the Variable Rate as from time to time amended by the North Carolina Utilities Commission shall apply to all power purchased by the Company until superseded by a new contract.

The Company reserves the right to terminate the Customer's contract under this Schedule at any time upon written notice to the Customer in the event that the Customer violates any of the terms or conditions of this Schedule or operates its generating facilities in a manner which is detrimental to the Company or any of its Customers or fails to deliver energy to the Company for six (6) consecutive Months. In the event of early termination of a contract under this Schedule, the Customer will be required to pay the Company for costs due to such early termination.

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

I. APPLICABILITY

This schedule is applicable to any qualifying Cogenerator or Small Power Producer (Qualifying Facility) which desires to deliver energy to the Company, and which has either (1) generating facilities designated as new capacity as defined by 18 C.F.R. 292.304(b)(1), or (2) hydroelectric generating facilities that meet the criteria of being owned or operated by a small power producer as defined in G.S. 62-3(27a).

Where the Qualifying Facility (QF) elects to be compensated for firm deliveries in accordance with this schedule, the amount of capacity under contract and the initial term of contract shall be limited as follows:

- A. Where the QF operates hydroelectric generating facilities that meet the criteria of being owned or operated by a small power producer as defined in G.S. 62-3(27a), or where the QF operates non-hydroelectric generating facilities fueled by trash or methane derived from landfills, hog waste or poultry waste, the amount of capacity subject to compensation shall be no greater than 5,000 kW, and the amount of energy purchased during a given hour at rates applicable to firm deliveries shall be no greater than 5,000 kWh. The initial term of contract for such a QF shall be for a period of 5, 10, or 15 years, at the option of the QF.
- B. Where the QF is not defined under I.A., the amount of capacity subject to compensation shall be no greater than 3,000 kW, and the amount of energy purchased during a given hour at rates applicable to firm deliveries shall be no greater than 3,000 kWh. The initial term of contract for such a QF shall be for a period of 5 years.

Where the QF elects to be compensated for firm or non-firm deliveries in accordance with this schedule, the QF must enter into a contract and begin deliveries to the Company on or before December 31, 2004. Where the QF elects an initial contract term of 10 or more years, such contract may be renewed for subsequent term(s), at the Company's option, based on substantially the same terms and provisions and at a rate either (1) mutually agreed upon by the parties negotiating in good faith and taking into consideration the Company's then avoided cost rates and other relevant factors or (2) set by arbitration.

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

I. APPLICABILITY (Continued)

This schedule is not applicable to a QF owned by a developer, or affiliate of a developer, who sells power to the Company from another facility located within one-half mile unless: 1) each facility provides thermal energy to different, unaffiliated hosts, or 2) each facility provides thermal energy to the same host, and the host has multiple operations with distinctly different or separate thermal needs, or 3) each facility utilizes a renewable resource which may be subject to geographic siting limitations, such as hydroelectric or wind power facilities.

II. MONTHLY BILLING TO THE QF

All sales to the QF will be in accordance with any applicable filed rate schedule. In addition, where the QF contracts for sales to the Company, the QF will be billed a monthly charge equal to one of the following to cover the cost of meter reading and processing:

<u>Metering required</u>	<u>Charge</u>
One non-time-differentiated meter	\$5.10
One time-differentiated meter	\$65.09
Two time-differentiated meters	\$102.62

III. DEFINITION OF ON- AND OFF-PEAK HOURS

As referenced in Paragraphs V.C., VI.A., VI.B., and VI.C., On-peak hours are defined as the hours between 7 a.m. and 10 p.m., Mondays through Fridays. Off-peak hours are all hours not defined as On-peak.

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

IV. CONTRACT OPTIONS FOR DESIGNATING MODE OF OPERATION

The QF shall designate under contract its Mode of Operation from the following options, each of which determines the Company's method of payment.

- A. The QF may contract for the delivery of energy to the Company without reimbursement, designated as the Non-reimbursement Mode of Operation; or,
- B. The QF may contract for the delivery of non-firm energy to the Company (no payment for capacity). This option includes QFs that elect to contract to deliver non-firm energy to the Company on an as-available basis. Where the QF's generation facilities have an aggregate nameplate rating of 100 kW or less the QF may designate the Non-firm, Non-time-differentiated Mode of Operation. Regardless of nameplate rating the QF may designate the Non-firm, Time-differentiated Mode of Operation.
- C. The QF may contract for the delivery of firm energy and capacity to the Company. The level of capacity which the QF contracts to sell to the Company shall not exceed 5,000 kW, where the QF is defined under Paragraph I.A., or 3,000 kW otherwise. This capacity level, in kW, shall be referred to as the Contracted Capacity. When the QF elects to sell firm energy and capacity, the QF shall designate the Firm Mode of Operation.

V. PAYMENT FOR COMPANY PURCHASES OF NON-FIRM ENERGY

The QF may contract to receive payment for non-firm energy at rates to be determined with each revision of this schedule. These rates will be based upon the QF's Mode of Operation as described below.

- A. Non-reimbursement Mode of Operation. Where the QF designates the Non-Reimbursement Mode of Operation, no payment will be made for energy delivered.

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

V. PAYMENT FOR COMPANY PURCHASES OF NON-FIRM ENERGY (Continued)

- B. Non-firm, Non-time-differentiated Mode of Operation. Where the QF's generation facilities have an aggregate nameplate rating of 100 kW or less and the QF designates the Non-firm, Non-time-differentiated Mode of Operation, the following rates in cents per kWh are applicable:

<u>2003</u>	<u>2004</u>
3.030	2.970

- C. Non-firm, Time-differentiated Mode of Operation. Where the QF designates the Non-firm, Time-differentiated Mode of Operation, the following On- and Off-peak rates in cents per kWh are applicable:

	<u>2003</u>	<u>2004</u>
On-peak	3.330	3.270
Off-peak	2.800	2.740

All energy purchase rates will be further increased by 2.8% to account for line losses avoided by the Company. This line loss percentage will be fixed for the initial term of the contract. In lieu of 2.8%, the QF may request that a site specific line loss percentage be determined with the QF bearing the cost of the study required.

VI. PAYMENT FOR COMPANY PURCHASES OF FIRM ENERGY

QFs designating the Firm Mode of Operation will be eligible to receive purchase payments for the delivery of firm energy by the QF to the Company. Where the QF operates generation facilities having an aggregate nameplate rating of 100 kW or less, the QF may contract to receive payments for firm energy based on A., B., or C., below. Otherwise, the QF may contract to receive payments for firm energy based on A. or B., below. Contract terms for 10 or 15 years are available only where the QF is defined under Paragraph I.A.

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VI. PAYMENT FOR COMPANY PURCHASES OF FIRM ENERGY (Continued)

Any energy delivered during an hour which exceeds the QF's Contracted Capacity will be priced at the rates provided in Paragraph V.C.

- A. The QF may contract to receive payment for firm energy at rates to be determined with each revision of this schedule. These rates in cents per kWh, which reflect the Company's estimated avoided energy cost for the year specified, are as follows:

	<u>2003</u>	<u>2004</u>
On-peak	3.797	3.678
Off-peak	2.640	2.914

- B. As an alternative to Paragraph VI.A., the QF may contract to receive energy purchase payments based on the Company's estimated resource plan used in support of this tariff. From this resource plan, an avoided energy mix will be derived for each year in the plan. These avoided energy mixes will then be levelized to create a mix that will be fixed for the initial term of the QF's contract. A QF contracting for this option will receive a levelized energy mix, as filed and approved in this Docket, that will correspond with the year the QF begins to deliver energy to the Company and the length of the contract between the QF and the Company. With each biennial avoided cost hearing, the Company will file with the North Carolina Utilities Commission its cost estimates for each fuel type, along with On- and Off-peak factors used to derive purchase prices, that will be applicable for the next two calendar years. Once accepted by the Commission, these yearly fuel costs will then be applied to the levelized energy mix in each QF contract to derive the applicable energy purchase prices, using the On- and Off-peak factors, for the next two years

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VI. PAYMENT FOR COMPANY PURCHASES OF FIRM ENERGY (Continued)

The 2003/2004 energy purchase prices, in cents per kWh, derived using levelized energy mixes for five, ten, and fifteen-year contract terms are as follows:

2003/2004 rates for operation beginning during 2003

Term:	<u>5 years</u>		<u>10 years</u>		<u>15 years</u>	
Year:	<u>2003</u>	<u>2004</u>	<u>2003</u>	<u>2004</u>	<u>2003</u>	<u>2004</u>
On-peak:	3.525	3.771	3.586	3.792	3.612	3.808
Off-peak:	2.620	2.802	2.665	2.818	2.684	2.830

2004 rates for operation beginning during 2004

Term:	<u>5 years</u>	<u>10 years</u>	<u>15 years</u>
On-peak:	3.729	3.790	3.798
Off-peak:	2.771	2.816	2.822

Attachments A1 and A2 of this schedule provide examples of how these rates are derived using the levelized energy mix.

- C. Where the QF operates generation facilities having an aggregate nameplate rating of 100 kW or less, the QF may contract to receive payments for the delivery of firm energy based upon levelized prices fixed for the initial term of the QF's contract, as shown below in cents per kWh:

<u>Initial Year of Operation</u>	<u>Contract Length in Years</u>		
	5	10	15
2003 On-Peak	3.577	3.631	3.680
Off-Peak	2.739	2.925	3.050
2004 On-Peak	3.554	3.649	3.693
Off-Peak	2.821	3.026	3.134

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VI. PAYMENT FOR COMPANY PURCHASES OF FIRM ENERGY (Continued)

All energy purchase rates will be further increased by 2.8% to account for line losses avoided by the Company. This line loss percentage will be fixed for the initial term of the contract. In lieu of 2.8%, the QF may request that a site specific line loss percentage be determined with the QF bearing the cost of the study required.

VII. PAYMENT FOR COMPANY PURCHASES OF CAPACITY

Company purchases of capacity are applicable only where the QF elects the Firm Mode of Operation. Such QFs shall receive capacity purchase payments based on the applicable levelized capacity purchase price below, in cents per kWh, corresponding to the contract length in years and the year in which the QF begins delivering Contracted Capacity to the Company on a firm basis. Contract terms for 10 or 15 years are available only where the QF is defined under Paragraph I.A.

Contract Length in Years	<u>Initial year of operation</u>	
	<u>2003</u>	<u>2004</u>
5	0.325	0.317
10	0.441	0.443
15	0.494	0.498

Payments will be made to the QF beginning in January, 2003, by applying the appropriate levelized capacity purchase price above to all kWh delivered to the Company during each hour, up to the Contracted Capacity. However, in any calendar year the total capacity purchase payments made to the QF shall not exceed the QF's Contracted Capacity, multiplied by 7,446 hours, and further multiplied by the applicable levelized capacity purchase price above. In the QF's beginning and ending year of its contract term, the 7,446 hours referenced above shall be prorated.

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VIII. PROVISIONS FOR COMPANY PURCHASE OF THE QF GENERATION

- A. The QF shall own and be fully responsible for the costs and performance of the QF's:
 - 1. Generating facility in accordance with all applicable laws and governmental agencies having jurisdiction;
 - 2. Control and protective devices as required by the Company on the QF's side of the meter.
- B. Upon request by the Company, the Cogenerator or Small Power Producer must demonstrate that the facility is a Qualifying Facility as defined by PURPA.
- C. Interconnection procedures for the QF's generation interconnection are provided through the Internet at the Company's website:

<http://www.dom.com/about/elec-transmission/gi-main.jsp>

(Continued)

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

IX. MODIFICATION OF RATES AND OTHER PROVISIONS HEREUNDER

The provisions of this schedule, including the rates for purchase of energy and Contracted Capacity by the Company, are subject to modification at any time in the manner prescribed by law, and when so modified, shall supersede the rates and provisions hereof. However, payments to QFs with contracts for a specified term at payments established at the time the obligation is incurred shall remain at the payment levels established in their contract.

If the QF terminates its contract to provide Contracted Capacity on a firm basis to the Company prior to the expiration of the contract term, the QF shall, in addition to other liabilities, be liable to the Company for excess capacity payments. Such excess payments will be calculated by taking the difference between (1) the total capacity payments already made by the Company to the QF and (2) capacity payments calculated based on the levelized capacity purchase price found in Paragraph VII corresponding to the highest term option completed by the QF. These excess payments shall also include interest, from the time such excess payments were made, compounded annually at the rate equal to the Company's most current issue of long-term debt at the time of the contract's effective date.

X. TERM OF CONTRACT

The term of contract shall be such as may be mutually agreed upon but for not less than one year.

(Continued)

ATTACHMENT A1
Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

FIRM MODE OF OPERATION
ENERGY PURCHASE PRICES FOR 2003
APPLICABLE TO QFs WITH FIVE YEAR LEVELIZED ENERGY MIX BEGINNING IN 2003

Fuel Type	(1) Displaced MWh	(2) Displaced Fuel Mix %	(3) Displaced Plants Heat Rate BTU/kWh	(4) Avoided Energy Costs \$/MBTU x (Col. 3) / 10,000
Fossil Steam:				
Coal	600,005	10.74	9,897	2.168¢/kWh = (2.191 \$/MBTU x 9,897)/10,000
Oil	204,871	3.67	11,866	3.411¢/kWh = (2.875 \$/MBTU x 11,866)/10,000
Natural Gas	1,303,402	23.33	7,452	3.031¢/kWh = (4.068 \$/MBTU x 7,452)/10,000
Comb. Turbine	35,406	0.63	11,467	4.707¢/kWh = (4.105 \$/MBTU x 11,467)/10,000
Pumped Storage	-338,301	-6.05		0.076¢/kWh
Purchase Power/Sale	3,357,174	60.08		3.330¢/kWh
Pumping	425,003	7.61		
150 MW Block	-5,587,560			

Weighted Average = Σ (Col. 2 x Col. 4) = 3.091¢/kWh

On-peak Energy Purchase Payment = 3.091 x 1.1405 (On-peak factor) = 3.525¢/kWh

Off-peak Energy Purchase Payment = 3.091 x 0.8475 (Off-peak factor) = 2.620¢/kWh

(Continued)

Filed 11-17-03
Electric-North Carolina

Superseding Filing Effective 01-01-01.
This Filing Effective for Usage on and After 01-01-03.

ATTACHMENT A2
Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

FIRM MODE OF OPERATION
ENERGY PURCHASE PRICES FOR 2004
APPLICABLE TO QFs WITH FIVE YEAR LEVELIZED ENERGY MIX BEGINNING IN 2003

Fuel Type	(1) Displaced MWh	(2) Displaced Fuel Mix %	(3) Displaced Plants Heat Rate BTU/kWh	(4) Avoided Energy Costs \$/MBTU x (Col. 3) / 10,000
Fossil Steam:				
Coal	600,005	10.74	9,897	2.029¢/kWh = (2.050 \$/MBTU x 9,897)/10,000
Oil	204,871	3.67	11,866	3.970¢/kWh = (3.346 \$/MBTU x 11,866)/10,000
Natural Gas	1,303,402	23.33	7,452	3.387¢/kWh = (4.545 \$/MBTU x 7,452)/10,000
Comb. Turbine	35,406	0.63	11,467	5.149¢/kWh = (4.490 \$/MBTU x 11,467)/10,000
Pumped Storage	-338,301	-6.05		0.078¢/kWh
Purchase Power/Sale	3,357,174	60.08		3.537¢/kWh
Pumping	425,003	7.61		
150 MW Block	-5,587,560			

Weighted Average = Σ (Col. 2 x Col. 4) = 3.307¢/kWh

On-peak Energy Purchase Payment = 3.307 x 1.1405 (On-peak factor) = 3.771¢/kWh
Off-peak Energy Purchase Payment = 3.307 x 0.8475 (Off-peak factor) = 2.802¢/kWh

ATTACHMENT A3
Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

FIRM MODE OF OPERATION
ENERGY PURCHASE PRICES FOR 2004
APPLICABLE TO QFs WITH FIVE YEAR LEVELIZED ENERGY MIX BEGINNING IN 2004

	(1)	(2)	(3)	(4)
Fuel Type	Displaced MWh	Displaced Fuel Mix %	Displaced Plants Heat Rate BTU/kWh	Avoided Energy Costs \$/MBTU x (Col. 3) / 10,000
Fossil Steam:				
Coal	571,821	10.23	9,903	2.030¢/kWh = (2.050 \$/MBTU x 9,903)/10,000
Oil	506,625	9.06	10,319	3.453¢/kWh = (3.346 \$/MBTU x 10,319)/10,000
Natural Gas	1,228,674	21.98	7,389	3.358¢/kWh = (4.545 \$/MBTU x 7,389)/10,000
Comb. Turbine	18,242	0.33	10,854	4.873¢/kWh = (4.490 \$/MBTU x 10,854)/10,000
Pumped Storage	-403,059	-7.21		0.078¢/kWh
Purchase Power/Sale	3,161,959	56.56		3.537¢/kWh
Pumping	506,358	9.06		
150 MW Block	-5,590,620			

Weighted Average = Σ (Col. 2 x Col. 4) = 3.269¢/kWh

On-peak Energy Purchase Payment = 3.269 x 1.1405 (On-peak factor) = 3.729¢/kWh

Off-peak Energy Purchase Payment = 3.269 x 0.8475 (Off-peak factor) = 2.771¢/kWh

PHOTOVOLTAIC SYSTEM
(EXPERIMENTAL)
RIDER PV-4C

AVAILABILITY

This Rider is available in conjunction with either of Company's Residential Service Schedules RES, R-TOUD, or R-TOUE or General Service Schedules on an experimental basis to Customer who operates a solar generating system located and used at Customer's primary, legal residence or business where a part or all of the electrical requirements of Customer can be supplied from the solar generating system. A solar generating system is defined as a photovoltaic system, with a rated capacity the lesser of 10 kilowatts or the estimated maximum 15-minute demand of Customer, that is connected in parallel operation with service from Company and located on Customer's premises. The solar generating system must be manufactured, installed and operated in accordance with governmental and industry standards and must conform with Company's "Interconnection Standards for Photovoltaic Generation Systems Rated 10 kW and Less."

The provisions of the Schedule with which this Rider is used are modified only as shown herein.

This Rider is available to a maximum of 25 customers on a first-come, first-served basis, except that no more than 12 customers can be nonresidential customers. This Rider shall be available for new applications until December 31, 2004, unless Company extends the availability.

TYPE OF SERVICE

The type of service to which this Rider is applicable is alternating current, 60 hertz, single-phase 3 wires, at Company's standard voltage of 120/240 volts.

MONTHLY RATE

In addition to all other charges stated in the Monthly Rate of the Schedule with which this Rider is used, the following charges and credits shall also apply:

1. Credit per kWh for energy delivered to Company's system as registered or computed from Company's metering facilities: 3.650 ¢/kWh¹
2. Seller Meter Charge: \$3.15
3. Standby Service Charges: Non-residential Customer receiving service under this Rider shall be subject to the applicable charges under Standby Service Rider No. SS, except Customer shall not be subject to the Monthly Rate II. A. Customer Charge per Meter installed at Customer's generation when Customer has no other generation operating in parallel with Company other than as covered under this Rider.

SALES TAX

To the above charges will be added any applicable North Carolina Sales Tax.

¹ The credit per kWh for energy delivered to Company's system is subject to change consistent with any change in the Energy Credits contained in Company's Cogeneration and Small Power Producer Schedule CSP.

SPECIAL CONDITIONS

1. A Service Agreement between Customer and Company will be required for service under this Rider. Company's "Interconnection Standards for Photovoltaic Systems 10 kW or Less" and "Application to Interconnect Photovoltaic System" shall be a part thereto.
2. Customer's service may be metered with a single, bi-directional meter, which records independently the flow of electricity in each direction through the meter, or two meters, at Company's option. If two meters are utilized, one meter will measure the energy delivered by Company to Customer and the other meter will measure the energy delivered to Company from the Customer that is generated by Customer's solar generating system.
3. In the event Company determines that it is necessary to install a dedicated transformer or other equipment to protect the safety and adequacy of electric service provided to other customers, Customer shall pay a Monthly Facilities Charge as specified in Company's Service Regulations for the additional estimated cost of the dedicated transformer or other equipment above the estimated cost which Company would otherwise have incurred, except that the minimum Monthly Facilities Charge can be less than \$25.00.
4. Customer grants Company the right to install, operate, and monitor special equipment to measure Customer's load, photovoltaic system output, or any part thereof and to obtain any other data necessary to determine the operating characteristics and effects of the installation. Customer also grants Company the right to utilize Customer's telephone line to transmit data from Company's meter and special equipment.

CONTRACT PERIOD

The Contract Period for service under this Rider shall be one (1) year and thereafter shall be renewed for successive one-year periods. After the initial period, Customer may terminate service under this Rider by giving at least sixty (60) days previous notice of such termination in writing to Company. Customer who is receiving service under this Rider will be permitted to remain on this Rider for a minimum of five (5) years subject to any and all subsequent modifications of this Rider approved by the North Carolina Utilities Commission at any time, provided that such Customer executes any necessary amendments to the Service Agreement to effectuate any modifications to this Rider.

Company reserves the right to terminate service under this Rider at any time upon written notice to Customer in the event that Customer violates any of the terms or conditions of this Rider, or operates the photovoltaic system in a manner which is detrimental to Company or any of its customers. In the event of termination of service under this Rider prior to the completion of the initial one (1) year period, Customer will be required to repay Company costs due to such early termination. Notwithstanding the above, Company reserves the right to terminate service under this Rider upon thirty (30) days prior notice if the retail supply of generation is deregulated.

GENERAL

Service rendered under this Rider is subject to the provisions of the Service Regulations of the Company on file with the state regulatory commission.

Supersedes Rider No. PV-4B
Effective for service rendered on and after November 28, 2003
NCUC Docket No. E-100, Sub 83

RIDER PV (NC)
Photovoltaic System
PilotAVAILABILITY

Available, at the Company's option, for up to 25 residential and nonresidential Customers receiving concurrent service from the Company where a solar photovoltaic (PV) source of energy designed to offset all or a portion of the electrical requirements normally provided by the Company, has been installed on the Customer's side of the meter, and where such photovoltaic system is interconnected with and operated in parallel with the Company's system. The Company reserves the right to limit the number of Customers allowed to interconnect photovoltaic systems on an individual electric circuit or substation. If the Customer is not the owner of the premises receiving electric service from the Company, the Company shall have the right to require that the owner of the premises give satisfactory written approval of the Customer's request for service under this Rider.

This Rider is available to Customers who install photovoltaic systems and contract with the Company for service under this Rider on or before December 31, 2004, subject to the following conditions:

1. Residential Customers

To qualify for service under this Rider, a residential Customer must be receiving service under Schedule RS, RE or RT, and may not be receiving service under Schedule WC. The Nameplate Rating of the photovoltaic system must not exceed the estimated maximum monthly kilowatt demand of the residence or 10 KW, whichever is less.

2. Nonresidential Customers

To qualify for service under this Rider, a nonresidential Customer must be receiving service under Schedule G, GA, I, or OPT and may not be receiving service under Rider IS or SG. The Nameplate Rating of the photovoltaic system must not exceed Customer's Contract Demand or 10 KW, whichever is less. The Contract Demand shall be the maximum demand to be delivered under normal conditions to the Customer excluding output from the photovoltaic system.

RATE:

- I. The applicable rate for energy delivered to the Customer, and demand if applicable, shall be the rate for which the Customer qualifies and / or selects from those listed for the Customer's class of service in the Availability paragraph Above.

- II. The following charges and credits will be added to the Customer's bill calculated under Paragraph I. above:

CHARGES

Supplemental Basic Facilities Charge per month

For customers on Schedules RS, RE or RT	\$1.10
For customers on Schedules G, GA, I or OPT	\$2.75

Standby Charge per month* \$1.03 per KW

CREDITS

The Customer will receive credits for all excess energy delivered by the Customer to the Company equal to the current Schedule PP-N (NC) Variable Rate Energy Credit for On-Peak Energy (Option A) (Interconnected to the Distribut System) as follows:

All kWh 2.54 cents per kWh

The monthly minimum bill for Customers receiving service under this Rider shall be no less than the Basic Facilities Charge contained in the Rate Schedule with which this Rider is used, plus the Supplemental Basic Facilities Charge, plus the Standby Charge, if applicable, less any credits for excess energy.

* For the purposes of this pilot, the Standby Charge will be waived for customers on Schedules RS, RE or RT.

METERING REQUIREMENTS

The Company will furnish, install, own and maintain metering to measure the kilowatt-hours delivered by the Company to the Customer, and if applicable, the kilowatt demand. The Company will also furnish, install, own and maintain additional metering equipment to measure the kilowatt-hours delivered from the Customer to the Company. The Customer's service may be metered with: (a) a single, bi-directional meter, which records independently the flow of electricity in each direction through the meter; or (b) at the Company's option, two meters, equipped to prevent reverse registration, one which will measure the energy delivered by the Company to the Customer, and the other which will measure the energy delivered by the Customer to the Company.

The Company shall have the right to install special metering and load research devices on the Customer's equipment and the right to use the Customer's telephone line for communication with the Company's and the Customer's equipment.

DETERMINATION OF STANDBY CHARGES

The Company will require each nonresidential Customer served under this Rider to contract for standby, auxiliary or breakdown service. For billing purposes, the Standby KW will be based on the Nameplate Rating, in kilowatts, of the Customer's photovoltaic system.

DEFINITION OF "NAMEPLATE RATING"

The term "Nameplate Rating" shall mean the maximum electrical output capability of the photovoltaic system at any time.

SAFETY, INTERCONNECTION AND INSPECTION REQUIREMENTS

This Rider is only applicable for photovoltaic systems with inverters that comply with the Duke Power Standard Requirements for Utility Interface of Photovoltaic Systems 10 KW or Less (Interconnection Standard), which include requirements for compliance with the following:

1. The Institute of Electrical and Electronics Engineers (IEEE) P929 – "Recommended Practice for Utility Interface of Photovoltaic Systems" (latest edition); and
2. Underwriters Laboratories (UL) 1741 – "Standard for Static Inverters and Charge Controllers for use in Photovoltaic Power Systems." (latest edition)
3. NFPA70 – National Electrical Code (NEC), and all applicable local codes (latest editions)

In order to ensure protection of the Company's system, the Company reserves the right, at its discretion, to inspect the Customer's photovoltaic system at any time upon reasonable notice to the Customer in an effort to ensure compliance with the Interconnection Standard. The Company reserves the right to disconnect electric service to any premises if the Company determines that the photovoltaic system is not in compliance with the Interconnection Standard and is being operated in parallel with the Company's system.

The Customer must submit an Application to Interconnect PV System (Application) which must be accepted by the Company.

The Customer must enter into a specific contract providing for interconnection to the Company's system whereby the Customer shall be responsible for providing suitable control and protective devices on its equipment to assure no disturbance to other customers of the Company or to the Company itself, and to protect the Customer's facilities and the Company's facilities from all loss or damage which could result from operation in parallel with the Company's system.

The Customer shall be responsible for any costs incurred by the Company pursuant to the Interconnection Standard. The Company reserves the right to require additional interconnection facilities, furnished, installed, owned and maintained by the Company, at the Customer's expense, if the Customer's photovoltaic system, despite compliance with the Interconnection Standard, causes safety, reliability or power quality problems.

The Customer shall obtain and retain, for as long as its photovoltaic system is interconnected with the Company's system, comprehensive general liability insurance with limits of at least \$500,000 per occurrence which protects the Customer from claims for bodily injury and / or property damage. This insurance shall be primary for all purposes. The Customer shall provide certificates evidencing this coverage as required by the Company. The Company reserves the right to refuse to establish, or continue the interconnection of the Customer's photovoltaic system with the Company's system, if such insurance is not in effect.

CONTRACT PERIOD

Each Customer shall enter into a contract for a minimum original term of one (1) year and thereafter for the remainder of the term of the pilot, except that either party may terminate the contract after one year by giving at least sixty (60) days previous notice of such termination in writing. The Company reserves the right to offer a contract for a longer original term of years as specified in the individual contract with the customer.

The Company reserves the right to terminate the Customer's contract under this Rider at any time upon written notice to the Customer in the event that the Customer violates any of the terms or conditions of this Rider, or operates the photovoltaic system in a manner which is detrimental to the Company or any of its customers. In the event of early termination of a contract under this Rider, the Customer will be required to pay the Company for the costs due to such early cancellation.

Appendix B:

Sample Interconnection Applications

Progress Energy Carolinas, Inc: Application to Interconnect PV

Duke Power: Application to Interconnect PV

Date: ____/____/____ (Application to Interconnect PV System)

TO: _____ (CP&L Representative Name and Address)

Permission to interconnect a Photovoltaic system with the CP&L source is requested as outlined in the "Carolina Power & Light Company Interconnection Standards for Photovoltaic Systems 10kW or Less" at the following location:

Customer Name: _____	Account Number: _____
Location Address: _____	_____
Phone Number: (____) _____ - _____	City _____ Zip Code _____
_____	E Mail Address: _____
Electrician Name: _____	_____
Electrician Address: _____	_____
Phone Number: (____) _____ - _____	City _____ Zip Code _____
_____	E Mail Address: _____

Site Information:

1. What is the proposed installation date of the PV system? ____/____/____
2. What is the peak demand (kW) from the Company for this facility? _____
3. Is the facility served from the Company with a self-contained meter? Yes ☐ No ☐
4. Is there an existing PV interconnection at this site? Yes ☐ No ☐

Inverter Information:

5. What is the Nameplate Rating (peak output) (kW) of the inverter? _____
6. Who is the manufacturer of the inverter? _____
7. What is model or Style number of the inverter? _____
8. What is the serial number of the inverter? _____
9. What is the manufacture date of the inverter? ____/____/____
10. Does the PV system and Inverter meet the requirements of the latest published edition of IEEE P929. Yes ☐ No ☐
11. Is the inverter listed per the latest published edition of UL 1741 Yes ☐ No ☐
(The inverter is required to have a UL listing. Any inverter that only has a CE mark is not acceptable.)
12. Note: Attach certificate of insurance evidencing the required coverage.

We certify the above described PV system will be installed as outlined in the "Carolina Power & Light Company Interconnection Standards for Photovoltaic Systems 10 kW or Less" and agree to the terms outlined in the standard and Carolina Power & Light Company's Service Regulations.

Customer signature: _____ Electrician signature: _____
Premise owners signature (if other than above)

Print Name: _____ Print Name: _____

<u>Company Use Only:</u>	Utility-Interface Disconnect Switch Required? Yes ☐ No ☐
Accepted By: _____	
Print Name: _____	
Date: _____	

Date: ____/____/____ (Application to Interconnect PV System)
 TO: _____ (Duke Power Representative Name and Address)

Permission to interconnect a Photovoltaic system with the Duke Power source is requested as outlined in the "Duke Power Standard Requirements for Utility Interface of Photovoltaic Systems 10kW or Less" at the following location:

Customer Name: _____	Account Number: _____
Location Address: _____	
Street	City
Phone Number: () - _____	E Mail Address: _____
Zip Code _____	
Electrician Name: _____	
Electrician Address: _____	
Street	City
Phone Number: () - _____	E Mail Address: _____
Zip Code _____	

Site Information:	
1. What is the proposed installation date of the PV system?	____/____/____
2. What is the <u>peak</u> demand (kW) from the Company for this facility?	_____
3. Is the facility served from the Company with a self-contained meter?	Yes ☐ No ☐
4. Is there an existing PV interconnection at this site?	Yes ☐ No ☐
5. Service Voltage (Ex. 120 / 240) _____ Phase (Ex. 1 or 3) _____ Number of Wires _____	
6. Where is service point of delivery on the premises? _____	

Inverter Information:	
7. What is the Nameplate Rating (peak output) (kW) of the inverter?	_____
8. Who is the manufacturer of the inverter?	_____
9. What is model or Style number of the inverter?	_____
10. What is the serial number of the inverter?	_____
11. What is the manufacture date of the inverter?	____/____/____
12. Does the PV system and Inverter meet the requirements of the latest published edition of IEEE P929.	Yes ☐ No ☐
13. Is the inverter listed per the latest published edition of UL 1741 <i>(The inverter is required to have a UL listing. Any inverter that only has a CE mark is not acceptable.)</i>	Yes ☐ No ☐
14. Note: Attach certificate of insurance evidencing the required coverage.	

We certify the above described PV system will be installed as outlined in the "Duke Power Interconnection Standards for Photovoltaic Systems 10 kW or Less" and agree to the terms outlined in the standard.

Customer signature: _____ Premise owners signature (if other than above)	Electrician signature: _____
Print Name: _____	Print Name: _____

<u>Company Use Only:</u>	
Utility-Interface Disconnect Switch Required?	Accepted By: _____
Yes ☐ No ☐	Print Name: _____
	Date: _____

Appendix C:
Sample FERC 556 Filing from NC Solar Center

October 5, 2004

Office of the Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Dear Secretary of the Commission:

This filing is a notice of self-certification of a qualifying facility (QF) under the Public Utilities Regulatory Policy Act (PURPA). This filing includes an original and fourteen copies of FERC [Form No. 556](#). A copy of this notice and completed Form 556 has been provided to Progress Energy, Inc and the North Carolina Utilities Commission.

Sincerely,

Shawn Fitzpatrick
Program Manager, PV and Wind

CC: Reese Dillard, Progress Energy, Inc
Sam Watson, NC Utilities Commission

PART A:

1a. Full Name of Applicant: North Carolina Solar Center
Purpose of Filing: Self-Certification

1b. Full Address of Applicant:
NC Solar Center
NCSU
Campus Box 7401
Raleigh, NC 27695-7401

1c. Owner of Facility:
North Carolina Solar Center
North Carolina State University

1d. Signature of authorized individual evidencing accuracy and authenticity of information provided by applicant

2. Person to whom communications regarding the filed information can be addressed:

Name: Shawn Fitzpatrick
Title: Program Manager, PV and Wind
Telephone Number: (919) 515-7147
Mailing Address: NC Solar Center
NCSU
Campus Box 7401
Raleigh, NC 27695-7401

3a. Location of facility to be certified:

State: North Carolina
County: Wake
City or Town: Raleigh
Street Address: 1101 Gorman Street
Raleigh, NC 27606

3b. Utility interconnecting with facility, purchasing useful output, and providing supplementary power:

Progress Energy

4a. Principal Components Description:

Two 3 kW (DC) Photovoltaic (PV) Arrays
One 4 kW Inverter
One 2.5 KW Inverter

One 1 kW (DC) Wind Turbine

4b. Maximum Gross and Maximum Net Electric Power Production Capacity, Show Derivation:

Photovoltaic modules are rated for their DC power output at Standard Testing Conditions (STC). STC are defined as a solar radiation of 1000 W/m^2 and module temperature of 25°C . To estimate peak AC power of a PV system, corrections are made for system losses including DC to AC power conversion losses, array mismatch losses, wiring losses, and manufacturer power specification tolerances. The assumption is made that the AC power rating of the array is 79% of the DC power rating.¹ Therefore, the maximum power capacity of the two PV systems at the NCSU Solar House is 4.74 kW.

The maximum DC capacity of the wind turbine is 1.0 kW. Based on manufacturer specifications on the inverter DC to AC conversion efficiency and estimating wiring losses, the AC maximum power rating for the system will be about 85% of the DC rating of the turbine, or 0.85 kW.

4c. Actual or Expected Installation and Operation Dates of the Facility:

One photovoltaic system was installed in 1992 and interconnected to the utility. In the future, the photovoltaic modules will be replaced with more modern technology. Installation of the second PV system and the wind turbine was completed in 2004. The expected life of these systems is twenty years.

4d. Primary Energy Input:

Solar: Photovoltaic Modules

5. Average annual hourly energy input for the following fossil fuels (BTU):

Natural Gas: 0

Oil: 0

Coal: 0

6. Discuss any characteristic of the facility which the cogenerator or small power producer believes might bear on its qualifying status:

None

7. There is no fossil fuel input

8. There is no non-eligible facility located within one mile of the instant facility owned by the North Carolina Solar Center or their affiliates.

1-National Renewable Energy Laboratory. (2004) PV Watts Version 1. Accessed August 2004 from <http://redc.nrel.gov/solar/calculators/PVWATTS/>

Appendix D:
**Sample Application for Certificate of Public
Convenience and Necessity from NC Solar Center**

September 15, 2004

Chief Clerk
North Carolina Utilities Commission
4325 Mail Services Center
Raleigh, NC 27699-4325

To Whom It May Concern:

This filing is an application for a certificate of public convenience and necessity according to Rule R1-37. This application is for a photovoltaic system less than 10 kW and therefore is exempt from the procedural requirements of R1-37(c) and includes the original and ten copies of the application. A copy of this application has also been provided to Progress Energy, Inc.

Sincerely,

Shawn Fitzpatrick

CC: Reese Dillard, Progress Energy, Inc

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. (Docket Number)

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of Application of	)	
(Company Name)	)	
for a Certificate of Public Convenience and)	VERIFICATION	
Necessity for (facility)	)	

I, (Name), (title), of (Company), verify that the contents of the application for a Certificate of Public Convenience and Necessity by (Company Name) filed in this docket are true to the best of my knowledge. I am duly authorized to act on behalf of (Company Name.)

(Signature of applicant)
(Name)

Sworn to and subscribed before me,
this is the _____ day of _____, 2004.

(Signature of Notary)
Notary Public

my Commission expires:_____

Application for Certificate of Public Necessity and Convenience

1. Full Name, Business Address, and Business Telephone Number of Applicant:

NC Solar Center
North Carolina State University
Campus Box 7401
Raleigh, NC 27695-7401
Attn: Shawn Fitzpatrick
Phone: 919-515-7147

2. Individual

3. Nature of the generating facility, including the type and source of its power or fuel.

The generating facility consists of two 3-kW solar photovoltaic arrays and one 1 kW wind turbine. The source of its power is solar and wind.

4. Address or location of generating facility set forth in terms of local highways, streets, river, streams, or other generally known landmarks together with a map such as a county road map with the location indicated on the map

NC Solar Center, NCSU Solar House
1101 Gorman St
Raleigh, NC 27606

5. Owner of site, if the owner is not the applicant, and the owner's interest in the site or relation to application

Owner is Applicant

6. A description of the buildings, structures and equipment comprising the generating facility and the manner of their operation

One PV system is located on the NCSU Solar House. It has battery backup to provide emergency power when the grid goes down. The wind turbine is connected to this battery bank also. The second PV system is located on the Alternative Fuels Garage at the NC Solar Center and is direct grid tie with no batteries.

7. The projected maximum dependable capacity of facility in megawatts

Photovoltaic modules are rated for their DC power output at Standard Testing Conditions (STC). STC are defined as a solar radiation of 1000 W/m² and module temperature of 25°C. To estimate peak AC power of a PV system,

corrections are made for system losses including DC to AC power conversion losses, array mismatch losses, wiring losses, and manufacturer power specification tolerances. The assumption is made that the AC power rating of the array is 79% of the DC power rating.¹ Therefore, the maximum power capacity of the two PV systems at the NCSU Solar House is 4.74 kW (0.00474 MW). The maximum DC capacity of the wind turbine is 1.0 kW. Based on manufacturer specifications on the inverter DC to AC conversion efficiency and estimating wiring losses, the AC maximum power rating for the system will be about 85% of the DC rating of the turbine, or 0.85 kW ((0.00085 MW). Since both wind and solar are intermittent energy sources, the maximum dependable capacity is 0 MW.

8. The projected cost of the facility

The projected cost is \$67,500.

9. The projected date on which the facility will come on line;

The facility is currently online.

10. The applicant's general plan for sale of the electricity to be generated, including the utility to which the applicant plans to sell the electricity, any provisions for wheeling of the electricity, arrangements for firm, non-firm or emergency generation, the service life of the project, and the projected annual sales in kilowatt hours

The applicant plans to sell the electricity to Progress Energy, Inc under the Cogeneration and Small Power Producer Schedule and will receive additional premiums for the energy delivered to the grid from the NC Green Power Program. The projected lifetime of the equipment is twenty years and there are plans to make upgrades and modifications as needed to keep equipment up-to date. The projected annual sales in kWh is 6500 kWh.

11. A complete list of all federal and state licenses, permits and exemptions required for construction and operation of the generating facility and a statement of whether each has been obtained or applied for. A copy of those that have been obtained should be filed with the application; a copy of those that have not been obtained at the time of the application should be filed with the Commission as soon as they are obtained.

The applicant has filed for self-certification as a Qualifying Facility under the Federal Energy Regulatory Commission. The FERC case number is QF04-164-000.

Appendix E:
Sample Agreement with NC Green Power from NC
Solar Center

NC GreenPower and NC Solar House Generation Agreement

Mr. Shawn Fitzpatrick
NC Solar Center
Campus Box 7401, NCSU
Raleigh, NC 27695-7401

Dear Mr. Fitzpatrick

We are pleased to inform you that your facility has been selected to participate as an energy supplier to the NC GreenPower program.

As a result of this participation in the program, NC GreenPower agrees to provide a premium of \$0.18/kWh for energy generated and supplied to the electric grid by means of solar photovoltaic cells.

NC GreenPower agrees to provide this premium for up to 2100 kWh per year (175 kWh per month).

This agreement will begin upon commencement of generation. It is expected that this generation will commence within six months of the signing of this agreement. The period of this agreement shall be for five years from its commencement.

The premium shall be paid by NC GreenPower within thirty (30) days of the receipt by NC GreenPower of official generation records supplied by the electric utility with which you have a current power purchase agreement.

As a result of participation in the NC GreenPower program, you will relinquish all rights to the ownership of any environmental attributes associated with the generation for which NC GreenPower pays a premium. NC GreenPower will assume ownership of these environmental attributes upon payment of the NC GreenPower premium for your generation.

During the period of this agreement, it is possible that NC GreenPower will request more generation from your installation, if available, than the amount stated above for the purpose of fulfilling program requirements.

Payments can vary based on the fluctuating level of contributions we receive from participants and governmental regulation of the NC GreenPower program and therefore we reserve the right to adjust and or cancel the premium at any time.

In the event of any changes in the NC GreenPower program, we may terminate this agreement at any time without notice and without any liability to you. IN ALL EVENTS, NC GREENPOWER'S AGGREGATE LIABILITY TO YOU FOR ALL CAUSES OF ACTION RELATED TO OR RESULTING FROM THIS AGREEMENT WILL NOT EXCEED THE AMOUNT OWED TO YOU BY NC GREENPOWER FOR ENERGY THAT YOU HAVE PROVIDED PURSUANT TO THE TERMS AND CONDITIONS OF THIS AGREEMENT.

All official notices shall be delivered (i) personally, (ii) by registered or certified mail, postage prepaid, or (iii) by overnight courier service to the following address for NC GreenPower:

NC GreenPower Corporation
909 Capability Drive, Suite 2100
Raleigh, NC 27606-3870
Attn: Maggy Inman

In case any one or more of the provisions of this Agreement should be invalid, illegal or unenforceable in any respect, the validity, legality and enforceability of the remaining provisions contained herein shall not in any way be affected or impaired thereby.

This Agreement constitutes the entire agreement between the parties concerning the subject matter hereof and supersedes all written or oral prior agreements or understandings with respect thereto. No course of dealing or usage of trade shall be used to modify the terms hereof.

This Agreement may be executed in one or more counterparts, each of which shall for all purposes be deemed to be an original and all of which shall constitute the same instrument.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their duly authorized officers as of the day and year first written below.

NC GreenPower Corporation

By: _____

Printed Name: Margaret A. Inman
Title: Vice President

Date: _____

North Carolina Solar House

By: _____

Printed Name: _____
Title: _____

Date: _____