Growing Solar in North Carolina:

Solar Power's Role in a Clean Energy Future

ENVIRONMENT NORTH CAROLINA
RESEARCH & POLICY CENTER

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Cover photo: Solar panels on a home in North Carolina
Photo by: Alternative Energy Concepts, Inc.

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Executive Summary

Solar power is a real energy option for North Carolina, blessed with sunlight on nearly 250 days per year. North Carolina could replace at least 22 percent of its current electricity use with solar power by installing solar panels and solar hot water heaters on residential and commercial rooftops and by building utility-scale solar installations on barren land.

North Carolinians have already started tapping into the state's solar energy reserves with new solar farms like the one in Cary, new solar panels on the roofs of homes and businesses across the state, and the world's largest solar heating and cooling installation in Fletcher. In 2008, North Carolina's installed solar capacity grew more than six fold, from 0.7 to 4.7 megawatts (MW).

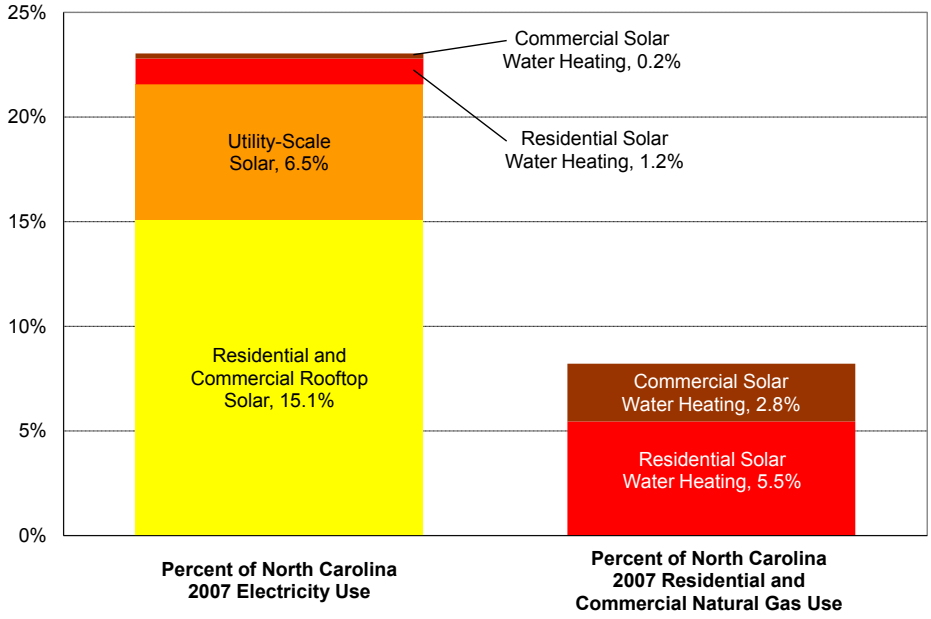
Solar energy can become a major source of electricity for North Carolina in the next two decades. Based on the rate of growth in solar installations achieved in other states and countries, North Carolina can install enough solar power to supply 2 percent of the state's electricity by 2020 and 14 percent by 2030.

Using more solar power would reduce North Carolina's contribution to global warming and make the state's air cleaner. More solar power would also create jobs and boost manufacturing in North Carolina. Putting policies in place to support solar power will allow North Carolina to start reaping these benefits today.

North Carolina has the technical potential to install at least 22 gigawatts (GW) of solar power, which would supply 21.6 percent of its current electricity use.

- Installing photovoltaic panels on all rooftop suitable space on residential and commercial buildings would yield 15 GW of solar power capacity, producing enough electricity to supply 15.1 percent of the state's electricity.
- Rooftop solar potential will increase over time along with construction of additional buildings and improvement in solar panel technology.
- Building utility-scale solar installations on all barren land, excluding

Figure 1. The percent of North Carolina's 2007 electricity and natural gas use that could be replaced by solar power.



protected land, could result in 6.5 GW of installed solar power, producing enough electricity to supply 6.5 percent of North Carolina's needs.

- North Carolina has additional potential for solar power on the roofs of industrial and public buildings, parking lots, brownfields, highway medians, and other available land.

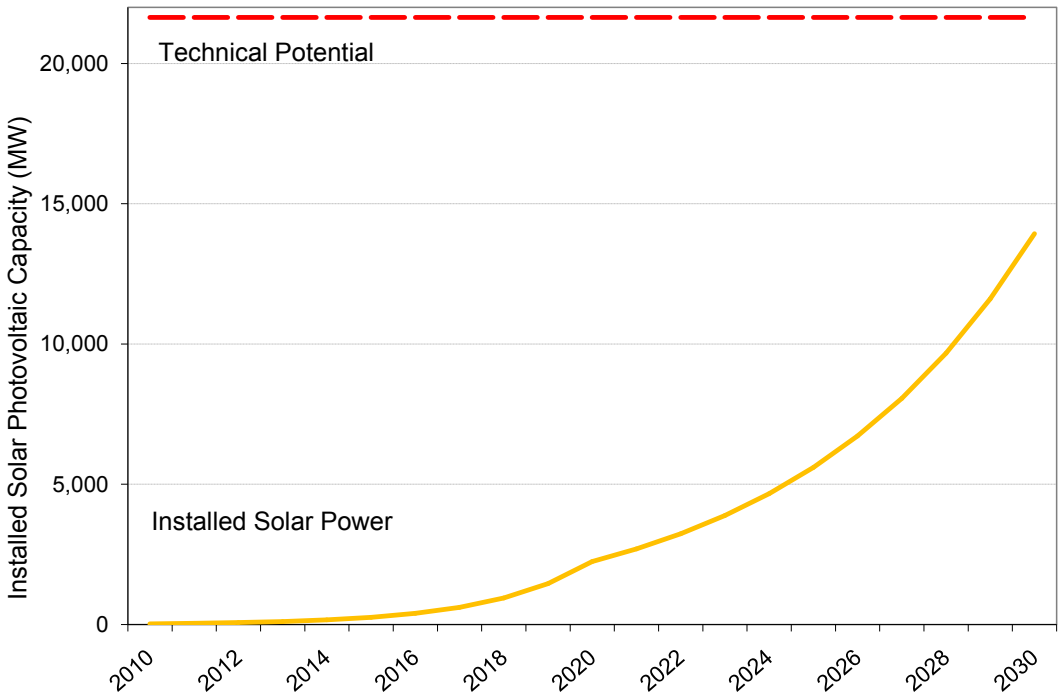
Solar hot water systems could reduce North Carolina's residential and commercial natural gas consumption by 8.2 percent and total electricity use in the state by 1.5 percent.

- Installing solar hot water systems on 40 percent of residential rooftops and 60 percent of commercial buildings would save about 1.9 million MWh of electricity and 8.6 billion cubic feet of natural gas.
- Combining electricity generated from solar panels and electricity saved from solar hot water systems, North Carolina has the potential to replace 22.0 percent of the state's current electricity use with solar power.

By 2020, North Carolina could install enough solar power to supply more than 2 percent of the state's projected electricity use, rising to 14 percent by 2030.

- If all currently announced solar projects are completed, North Carolina's solar power capacity could increase from 4.7 MW to more than 30 MW by the end of 2010.

Figure 2. North Carolina's minimum technical solar potential in 2007, and potential growth in solar electricity production through 2030.

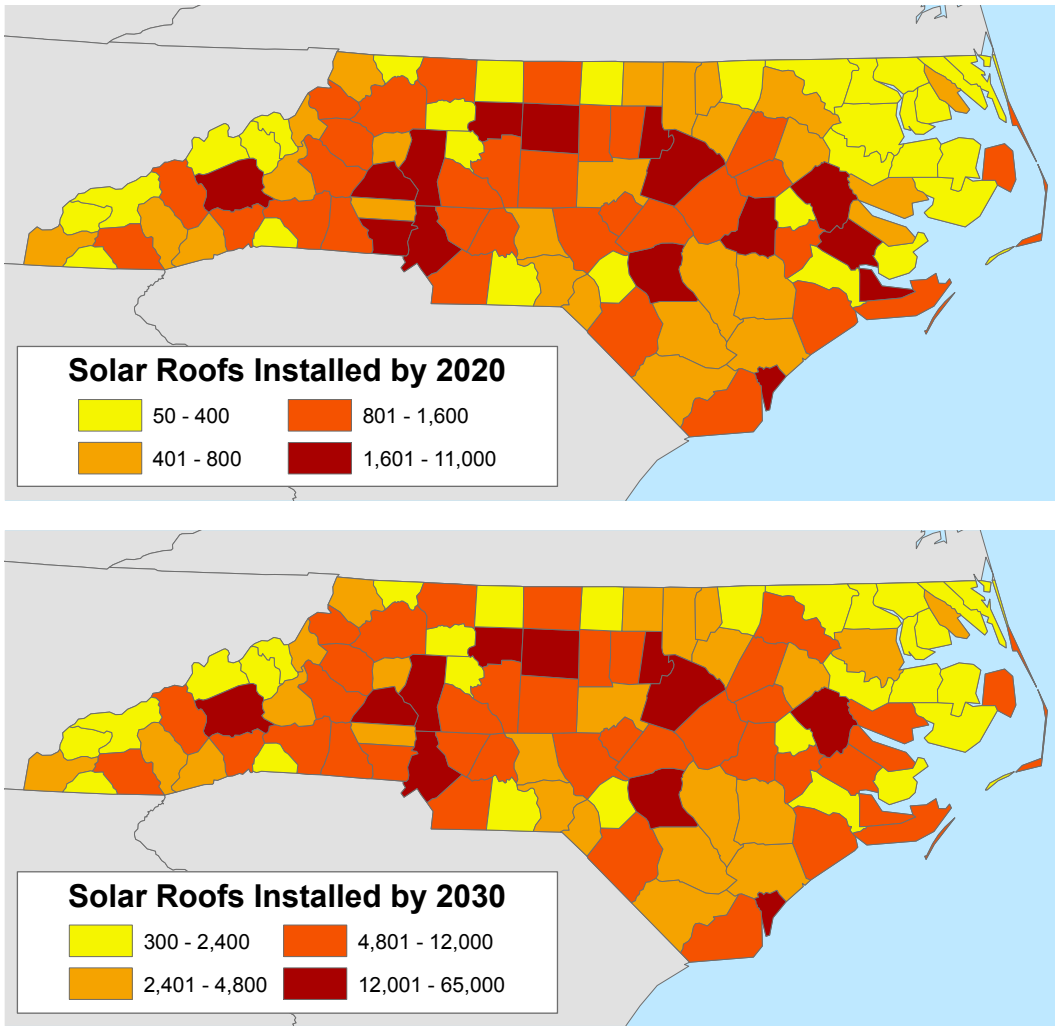


- After 2010, if North Carolina's solar market grows at the same rate that California's has for the past decade, increasing 54 percent a year, solar power would supply over 2 percent of the state's projected electricity use by 2020.
- Even if the growth in installed solar power in North Carolina slowed down significantly after 2020 to a 20 percent yearly increase, solar power would supply over 14 percent of the state's projected electricity use by 2030.
- At these rates, North Carolina could install more than 100,000 solar roofs by 2020 and 700,000 by 2030, assuming that at least 50 percent of the installed solar power is on rooftops.

Solar power is good for the environment and is an increasingly practical way to meet North Carolina's energy needs.

- Solar power produces no global warming emissions. Getting a significant portion of its electricity from solar power would drastically reduce North Carolina's contribution to global warming.
- Solar power produces no air pollution. Using more solar power will help clean up North Carolina's air and reduce emergency room visits, childhood asthma, and deaths from lung disease.
- The cost of solar power has dropped 80 percent since 1980, and is expected to be cost competi-

Figure 3. The number of solar roofs that could be installed in each North Carolina county by 2020 and 2030, with the right policies in place.



tive with other sources of electricity by 2015.

Increasing the market for solar power in North Carolina could make the state a leader in the regional solar power industry, creating jobs and boosting the state economy.

- Installing one megawatt of solar power creates nine times as many jobs as installing one megawatt of coal or gas power.
- North Carolina has the technological and intellectual resources to lead on solar, with our public and private universities employing some of the nation's leading innovators and experts on solar technology, and a number of existing and emerging technological hubs such as Research Triangle Park.

- North Carolina already has a budding solar industry. Last year, the state was among the top 10 states in the country for new solar energy installations. And there are already over 45 solar installers, dealers, and project developers in North Carolina.
- Solar companies nurtured in North Carolina's technological hubs, and encouraged by the growing industry, are already emerging and creating jobs in the state. Sencera, for example, plans to build a plant in Charlotte to manufacture the thin film solar panels it has been developing. This plant will employ 65 workers in Mecklenburg County. And Semprius, headquartered near Research Triangle Park in Durham, is developing new semiconductor technology to make solar panels more efficient and inexpensive.

North Carolina should enact policies that allow the state to realize its solar potential. These policies should:

- Help businesses and individuals finance solar power installations by enabling buyers to pay for their investment over time in property tax assessments.
- Allow solar companies to lease solar power systems to home and business owners, enabling them to use solar power without paying the upfront costs.
- Bring net metering policies up to standard and ensure that home and business owners with solar panels are fairly compensated for the electricity they produce.
- Adopt feed-in rates that set fair and predictable prices for solar electricity produced.
- Require solar power to be included or provided as an option on new houses.
- Require all of the solar power that counts towards North Carolina's renewable energy standard to be produced in state.
- Reinstate the renewable energy manufacturing tax credit.

Introduction

It's becoming clearer every year that North Carolina's current sources of energy are not sustainable. The energy that powers our lives is also causing global warming and making us sick.

North Carolina is already feeling the effects of global warming. In 2007, the weather station in Raleigh recorded 83 days where the temperature hit at least 90°F – 45 days more than the historic average.[1] Storms with heavy rainfall are now 16 percent more frequent in North Carolina than they were 60 years ago.[2] Hurricanes have become more intense.[3] Scientists are becoming increasingly concerned that critical thresholds are a matter of years or a few decades away – beyond which lie dramatic and irreversible changes to our world and our way of life.[4]

To avoid the most catastrophic impacts of global warming, North Carolina and the world must dramatically reduce emissions of global warming pollution. In North Carolina, reducing the use of coal for electricity generation holds the potential for significant progress. Coal-fired power plants are responsible for almost half of the state's total global warming pollution.[5]

Coal also pollutes the state's air, leading to increased emergency room visits and deaths due to lung disease.[6] Mining the coal to supply North Carolina's power plants is destroying the Appalachians, leaving gaping holes in the landscape and poisoning the air and water in surrounding communities.[7] The plants themselves present direct risks to North Carolinians. The U.S. Environmental Protection Agency lists 12 "high hazard" coal ash dumps in North Carolina – more than in any other state – where a spill like the 2008 disaster in Tennessee could cause significant harm to people and property in surrounding communities.[8]

Luckily, North Carolina is not stuck indefinitely with its current energy portfolio. There are multiple clean and safe alternatives that can reduce the use of coal.

Solar power is one option that provides North Carolina with an enormous energy resource right at its fingertips. Over half

…using even a few types of rooftops and land for solar power could supply a large amount of North Carolina's electricity needs.

of the state's daylight hours are sunny every year, turning any surface that sunlight hits into a potential electricity generator – from rooftops to abandoned industrial sites to mall parking lots.[9]

As this report shows, using even a few types of rooftops and land for solar power could supply a large amount of the state's electricity needs. Taking advantage of this potential will help stabilize the climate, clean up the state's air, and make North Carolina's citizens safer and healthier.

Solar Power Is a Real Option for North Carolina

North Carolina's sunshine is a massive energy resource. The average annual solar energy intensity in North Carolina is more than 80 percent as strong as in Florida – the Sunshine State.[10] Converting even a small portion of this energy to electricity could power the entire state.

The amount of solar energy North Carolina could generate is limited by the amount of space in the state where solar panels could reasonably be installed. Yet even with this limitation, solar energy could provide at least 22 percent of North Carolina's electricity.

Solar Electricity

The energy in North Carolina sunlight can be captured and transformed into electricity using solar photovoltaic (PV) panels.

The simplicity of photovoltaic panels makes them easy to install on residential and commercial rooftops in a city, or in concentrated, utility-scale solar farms. Solar PV panels are the only electric generators without moving parts, and they require no fuel supply.

Rooftop Solar

The availability of solar panels turns North Carolina's rooftops into a vast untapped energy resource. A homeowner can supply as much electricity as his or her house will use in a year with a 3 to 5 kilowatt (kW) solar PV system, and, depending on its size, a business can be powered by a solar PV system anywhere from 5 to more than 100 kW in size. A building with a solar PV system installed will usually be tied to the electric grid, which supplements the solar panels during cloudy weather or at night and absorbs extra electricity when the panels produce more than the building uses.

Solar panels can be installed on almost any roof, but they produce the most power when they face south and are not

shaded by trees or other objects for most of the day. North Carolina's potential for rooftop PV is the amount of solar power that could be produced by installing solar panels on all rooftop space that is oriented correctly and not shaded.

In a 2008 study conducted for the National Renewable Energy Laboratory, Navigant Consulting found that installing solar panels on all suitable residential and commercial rooftop space in North Carolina would result in 15,144 MW of solar power.[11]

One MW of solar power installed in different states will result in different amounts of electricity produced, depending on the average cloud cover of the area. In North Carolina, a one MW solar farm will produce an average of 0.15 MWh of electricity per hour; in other words, North Carolina's solar capacity factor is 15 percent. For reference, the capacity factor in the sunniest part of Florida is 16 percent, and the capacity factor in Germany, one of the leading countries in installed solar power, is about 9 percent.[12]

Taking capacity factor into consideration, 15,144 MW of solar panels on North Carolina's rooftops would generate about 20 million MWh of electricity every year, or 15 percent of the electricity North Carolina used in 2007.[13] (See Appendix for county-level numbers.)

Utility-Scale Solar

Utility-scale solar installations are arrays of solar panels installed with the purpose of producing power for the electric grid, rather than just one building or facility. These installations can be any size. Some are under 1 MW, or are collections of smaller arrays. For example, a utility could install solar panels at all of its electric substations, and together they might add up to a few hundred kW of installed solar power. Others are larger, like the planned 21.5 MW installation in Davidson County, which will

Utility-Scale Solar in North Carolina

2008 was a big year for North Carolina's solar industry, with a number of large installations going on line, and plans announced for others. Following is a selection of utility-scale solar arrays already built or planned for North Carolina:

A closed landfill in Haywood County will be the site of a 1 MW solar array. The landfill is owned by Evergreen Packaging, a paper production company, and will be leased to FLS Energy for 20 years while the solar power plant is in operation. Progress Energy is already contracted to buy the electricity from the installation, which will cover about 7 acres of land.[16]

SAS, a software company with world headquarters in Cary, built a 1 MW solar array on five acres of its campus. The panels at this plant are designed to change their tilt as the sun moves in order to maximize their energy production. SunPower Corporation designed the installation, and Progress Energy is buying the electricity.[17] The plant went live in December 2008, and SAS now plans to add another 1.2 MW installation, to be completed in March 2010.[18]

SunEdison has plans to build a 20 MW solar array in Davidson County. This will be the largest solar PV installation in the United States when it is built.[19] The installation is scheduled to be completed by December 2010, and Duke Energy is contracted to buy the electricity. It will produce enough energy to power more than 2,600 homes, and building it will create up to 80 construction jobs.[20]

be the largest solar PV installation in the United States upon completion.[14] Large installations can benefit from economies of scale, making electricity from them cheaper. As the solar industry takes off, the maximum size of utility-scale solar installations will increase dramatically – internationally, several 100 MW systems are being planned, which would produce the same amount of power as a smaller coal-fired power plant.

Utility-scale solar arrays can be built on most types of land, and can be a very good use of certain types of land which may otherwise have limited uses. A planned 1 MW solar farm in Haywood County is being built on a former landfill, and many are built on brownfields or unused industrial lands.[15] Other non-sensitive lands that would be well suited to having solar panels installed on them include parking lots, abandoned strip mines and barren lands.

North Carolina has enough barren land to install at least 6.5 gigawatts (GW) of solar panels. This amount of installed solar power would produce 8.5 million MWh of electricity, or 6.5 percent of the electricity North Carolina used in 2007.[21]

This number is almost certainly an underestimate of the amount of land North Carolina could reasonably use for solar farms. Barren land is only one of many types of land that are suited to solar power, although others are more difficult to quantify. These lands include parking lots, retired landfills, abandoned industrial sites, and highway medians.

North Carolina's acres of parking lots and miles of highways could double as solar power plants, like these in an employee parking lot at a California company and along an interchange on Interstate 5 in Oregon. *Photos: Envision Solar and Gary Weber, Oregon Department of Transportation photo/video services.*

Solar Water Heating

Solar water heating systems, which use roof-mounted solar energy collectors to pre-heat water, can reduce electricity or fossil fuel use for water heating by about two-thirds.[23] Solar heating systems do not take up as much space as solar photovoltaic panels, and the requirements for orientation are less strict, so more homes could replace or augment their water heater with a solar hot water system.[24]

If 40 percent of the households in North Carolina had solar hot water heaters, the state would save about 1.6 million MWh of electricity and 5,700

Concentrating Solar Power

Concentrating solar power (CSP) is another technology that converts sunlight to usable energy. In the United States today, CSP is typically used in the Southwest, where large tracts of open space and intense sunlight are available; however, as the technology improves and evolves, CSP could play a role in electricity production in states like North Carolina as well.

Just as a magnifying glass can focus the sun's hot rays to ignite a scrap of paper, CSP focuses and collects the thermal energy of sunlight. In typical CSP plants, mirrors reflect sunbeams to heat a liquid (typically water, oil or molten salts) to about 400° Celsius. This extreme heat is used to generate steam to drive large, conventional turbines or to power heat engines. Unlike electricity, which is currently costly and difficult to store, heat can be stored easily and cost-effectively, making CSP a unique solar technology that can provide electricity even during cloudy weather and after sunset.[22]

million cubic feet of natural gas a year.[25] This assumes that electricity or natural gas used to heat water in a home with a solar hot water system is reduced by 60 percent.[26] (See the Appendix for an estimate of residential solar hot water potential by county.)

Commercial buildings tend to be taller and less shaded than houses, meaning that a larger percentage of commercial buildings could install solar hot water systems.[27] If 60 percent of North Carolina's commercial buildings had solar hot water systems, the state would save 320,000 MWh of electricity and 2,900 million cubic feet of natural gas a year.[28] As with residential buildings, this estimate assumes electricity or natural gas used to heat water in a building with a solar hot water system is reduced by 60 percent.[29]

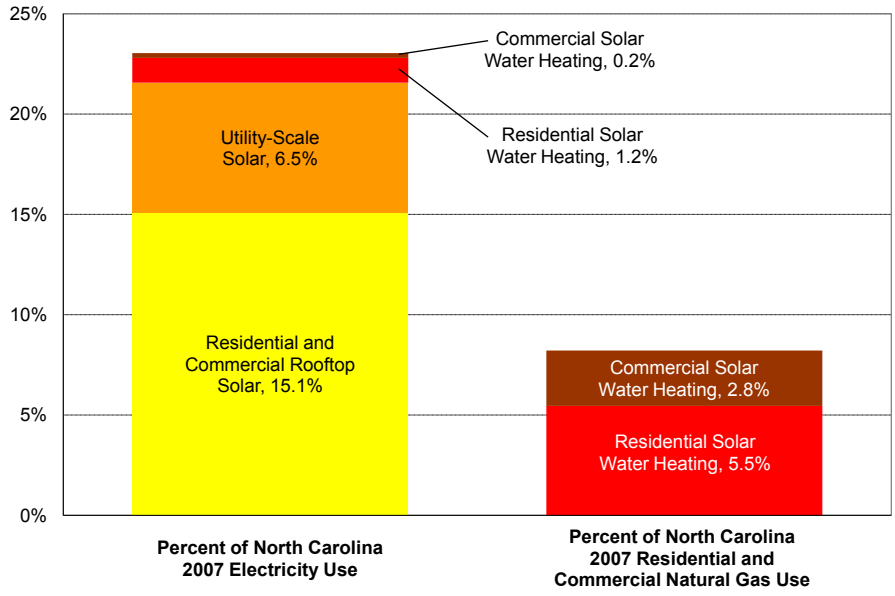
All together, the energy that could be saved in North Carolina through solar hot water heating adds up to 1.9 million MWh of electricity and 8,500 million cubic feet of natural gas. This is the equivalent of 1.5 percent of North Carolina's electricity consumption in 2007, and 8.2 percent of the natural gas used in North Carolina's residential and commercial sectors in 2007.[30] Additional energy could be saved by using solar hot water in North Carolina's industrial sector.

Putting it all Together

Combining electricity generated from solar PV and electricity saved from solar hot water panels results in the potential to replace **22.0 percent** of the state's current electricity use with solar power. This accounts for the reduction in rooftop space available for solar photovoltaics that would result from realizing the full potential for solar hot water.[31] In addition, natural gas saved from solar water heating could replace 8.2 percent of the natural gas used in North Carolina's residential and commercial sectors in 2007.

This is still an underestimate of North Carolina's technical solar potential. A number of types of land and other spaces that would be good places for solar PV

Figure 4. The percent of North Carolina's electricity and residential and commercial natural gas use that could be replaced by solar power.[32]



installations are not included, such as parking lots, highway medians, and public buildings. And less-common uses for solar power beyond the scope of this report have huge potential for saving money, especially in heating and cooling. Solar hot water can be used to heat buildings, and new technologies allow solar power to be used to cool buildings as well. The Fletcher Business Park has the largest solar heating and cooling installation in the world, with solar power providing space heating and air conditioning for offices and a warehouse.[33]

In addition, the efficiency of solar panels has been increasing, so that

North Carolina's Growing Solar Potential

North Carolina's technical solar potential will increase over time. Recent technological advances have led to solar panels that convert a larger percentage of the sun's energy into electricity. Efficiency is expected to continue to increase, so that a typical solar panel 10 years from now will produce more power per square foot than today's solar panels do. The amount of rooftop space will also grow over time.

By 2015, Navigant Consulting predicts that installing solar panels on all suitable residential and commercial rooftop space would result in 25,175 MW of solar power, enough to supply 25 percent of North Carolina's 2007 electricity use.[35] Solar farm potential will likely grow to 7.3 GW by 2020, enough to produce 7.3 percent of the state's 2007 electricity use.[36]

more electricity can be produced from a solar panel of the same size. As efficiency continues to increase, North Carolina's solar potential will grow even if the amount of rooftop and land area available for solar power stays the same (see "North Carolina's Growing Solar Potential).[34]

With about 5 MW of solar PV currently installed, North Carolina's solar potential is an enormous untapped resource.

Passive Solar Heating

In addition to producing electricity for the grid and replacing traditional hot water heaters, the sun's energy can be harnessed to reduce the amount of energy that would otherwise be used for space heating. This is done through building design, and is usually paired with techniques that allow buildings to avoid the sun's energy during hot months.

Buildings can be designed so that the heat from the sun is blocked in the summer and maximized in the winter, lowering heating and cooling costs. This can be as simple as maximizing south-facing windows as well as designing roof overhangs so that the high summer sun is blocked and the low winter sun can penetrate. But design changes can also go much farther. Dark masonry surfaces that store heat can be incorporated into surfaces such as walls or floors in places where they can absorb heat from the sun during cold parts of the year, warming rooms at night by radiating the heat as the building cools.[37]

Quantifying the potential for energy savings from passive solar heating is difficult since energy use varies widely from building to building depending on how aggressive the design is and other factors. However, it is clear that taking advantage of the sun's energy for heating could replace significant amounts of natural gas and electricity use, especially in a sunny state like North Carolina. The U.S. Department of Energy estimates that new office buildings using a combination of passive solar design and energy-efficient technologies can reduce energy costs by 30 to 50 percent versus the national average.[38] With the help of these design techniques and solar power, some homes have been built that use almost no energy for heating.[39]

North Carolina Can Develop its Solar Energy Resources Now

Realizing North Carolina's Solar Potential

Knowing that North Carolina could be getting much more of its energy from solar power, the next question is how quickly solar power could be installed in the state. The limit to the speed of installation for solar power is not technical – rather, it depends on the policies that are in place and what effect they can have on increasing solar installations.

A number of countries and states have recognized that solar energy could be one of the more powerful tools for reducing greenhouse gas emissions and other pollution, reducing dependence on imported fuels, as well as being a source of economic growth, and an opportunity for job creation. To reap these benefits, their governments have put policies in place to encourage solar installation and build their solar industries. These places – including countries such as Germany, Japan and Spain, and states such as New Jersey and California – have seen their solar power market skyrocket over the past decade. In 2008, more than 75 percent of the solar power installed in the world was in Germany, Spain, and Japan, because of their policies favorable towards the installation of solar power.[40]

The rates of growth in solar installation in these countries, combined with projects already being planned for North Carolina, can provide a sense of what is possible for the state's solar industry.

Today, North Carolina has 4.7 MW of solar PV installed – a six-fold increase from 2007.[41] With the projects that are currently in the works and more solar roofs being installed every day, North Carolina could reasonably have 30 MW of solar PV by 2010 – another six-fold increase.

The 1 MW solar array at SAS's headquarters in Cary went live in December 2008, contributing to the six-fold increase in North Carolina's installed solar power in 2008. Many projects like this one are scheduled to go online in the next two years, including another 1.2 MW installation at SAS.[42]
Photo: David Horne Photography

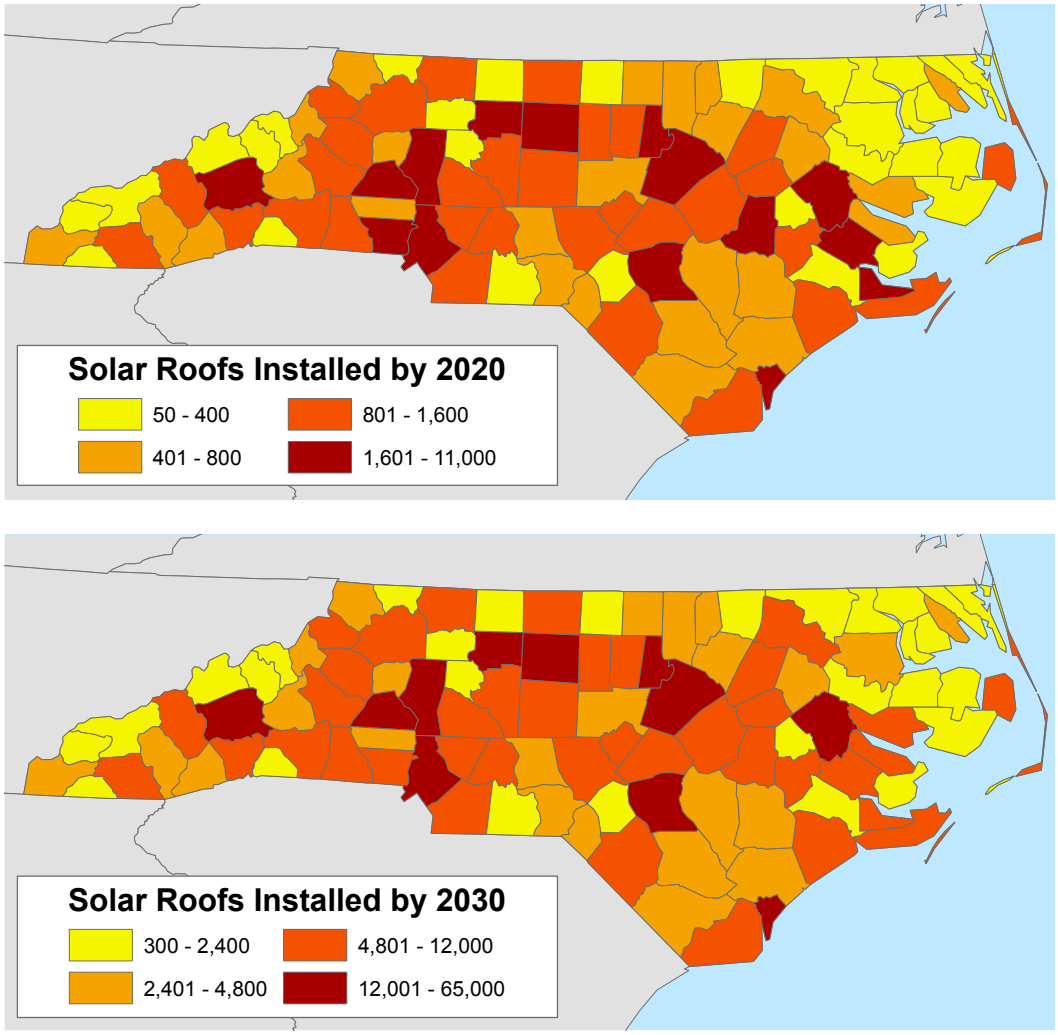
Annual growth in solar installations of 500 percent is not sustainable over the long term. But other U.S. states and other countries have been able to maintain strong annual growth rates over time through consistent public policy support.

Today, North Carolina has 4.7 MW of solar power installed – a six-fold increase from 2007.

If North Carolina's installed solar power grew at California's rate of growth from 2010 to 2020 – installed MW increasing by 54 percent annually – solar power would supply 2.2 percent of the state's projected electricity use by 2020.[43] This rate of growth or higher rates have also been experienced by other places that encouraged solar power, such as New Jersey and Germany.[44]

Even if the market for solar power slowed considerably after 2020, North Carolina's production of solar electricity could increase dramatically. An annual growth rate of 20 percent – two-thirds of the entire world's annual growth rate in solar power over the past 10 years – would result in solar panels providing 14 percent of North Carolina's projected electricity use in 2030.[45]

Figure 5. The number of solar roofs that could be installed in each North Carolina county by 2020 and 2030, with the right policies in place.

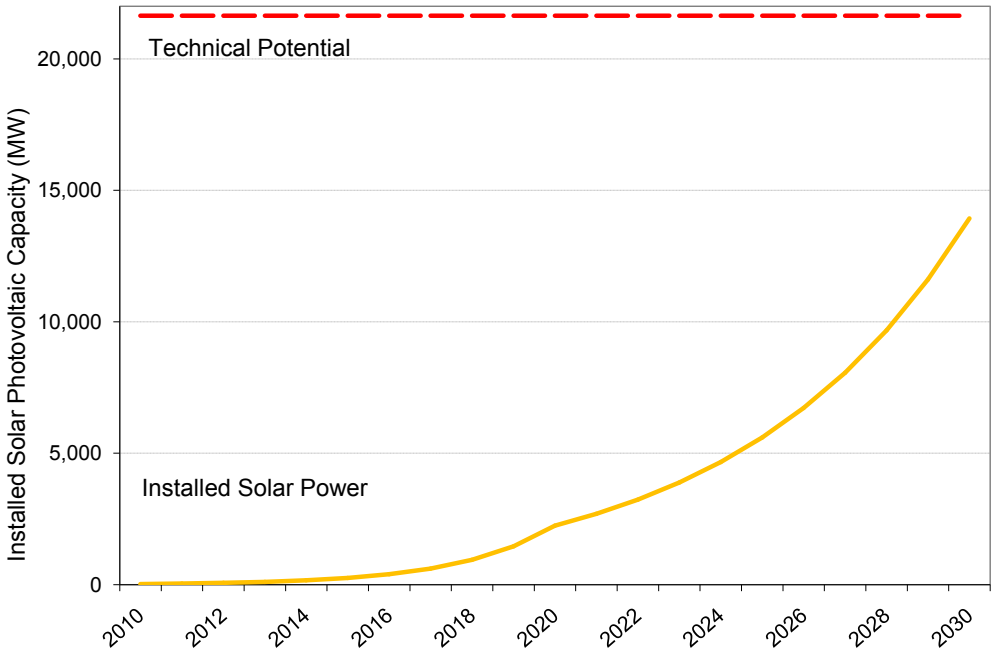


Assuming that at least 50 percent of the installed solar power was in rooftop systems, this translates into more than 100,000 solar roofs installed in North Carolina by 2020, and nearly 700,000 by 2030. (See Figure 5 and appendix for county level estimates.)

Again, this projection is an underestimate. Solar power is expected to be competitive with other electricity sources in terms of cost per kWh by 2015, at which point there will be few limits to the amount of solar power installed.[46]

With more than 4 million housing units in North Carolina today, reaching 700,000 residential and commercial solar roofs by 2030 would likely remain below market saturation. With the right policies in place, and the expected drop in the price of solar power, new houses could come with solar panels installed, and solar arrays could become a standard feature on malls, schools and office buildings.

Figure 6. North Carolina's technical solar potential in 2007, and potential growth in solar electricity production through 2030.



Solar Power Will Benefit North Carolina's Environment and Economy

North Carolina has the potential to become a leader in solar power. Besides supplying energy for the state, realizing this potential would help North Carolina reduce its global warming emissions, clean up its air and water, and otherwise improve the environment. Building out solar power would also create jobs in the state and stimulate the local economy.

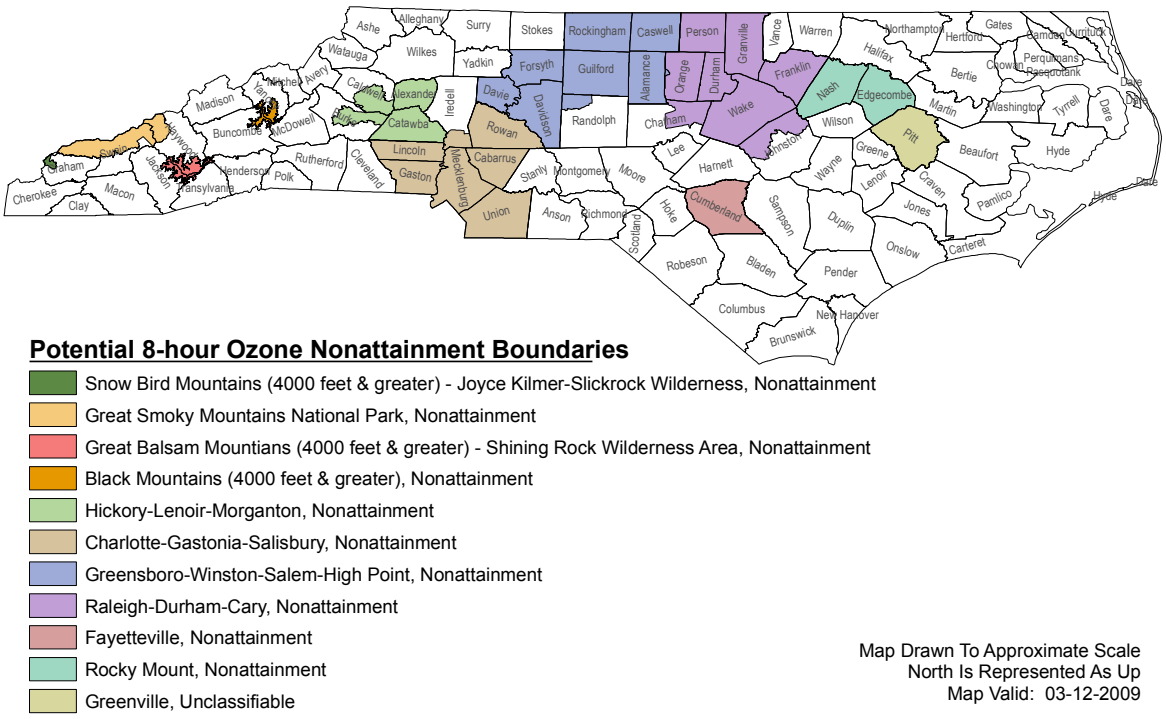
Solar Power Is Cleaner and Safer Than Other Energy Sources

Investing in solar power can reduce global warming pollution and help to create a cleaner, healthier future for North Carolina. By displacing electricity generated from fossil fuels, solar power can cut emissions of carbon dioxide, the leading cause of global warming, as well as speed progress in reducing soot, smog and mercury pollution, which damage public health. At the same time, solar power can help to conserve North Carolina's supplies of fresh water, reducing the amount of water that would otherwise be consumed in steam-driven power plants.

Preventing Global Warming Pollution

On average, a household in North Carolina produces about 18,000 pounds of carbon dioxide in a year, the leading pollutant driving global warming.[47] This is about the same amount of carbon dioxide produced by the average car in a year and a half.[48] A disproportionate amount of carbon dioxide is produced during the hours of the day when energy demand is highest – at these times, emissions are 60 percent higher than average.[49] In contrast, solar power produces zero global

Figure 7. North Carolina counties that the state has recommended to be federally classified as "non-attainment areas," which do not meet federal air quality standards for smog (ozone).[54]



warming pollution (outside of any fossil fuels used during manufacture or installation of the system), and would replace the most fossil fuels during peak hours, when sunlight is the strongest.

Replacing coal and other fossil fuels with solar power would help North Carolina do its fair share to mitigate the worst effects of global warming. According to climate scientists, the world as a whole must reduce carbon dioxide pollution 50 percent or more by 2050. The United States must do more, as one of the leading emitters of global warming pollution – cutting pollution by at least 35 percent by 2020 and 80 percent by mid-century.[50] Solar power is one important tool to make reaching this target possible.

Preventing Soot and Smog Pollution

Solar power can help clean North Carolina's air and improve public health. By displacing dirtier power sources, solar power can help prevent emissions of pollutants that damage our lungs and cause asthma, bronchitis, lung cancer and heart attacks.[51]

For every megawatt-hour of electricity generated during hours of peak demand, the average North Carolina power plant emits 3 pounds of smog-forming nitrogen oxides, and 12 pounds of soot-forming sulfur oxides.[52] Partially because of this pollution, 24 counties and parts of 17 others in North Carolina do not meet federal health standards for smog.[53]

Preventing Mercury Pollution

Mercury emissions from coal-fired power plants and other industrial sources are making the fish in North Carolinas' bays, lakes, rivers and streams unsafe to eat. Burning coal releases mercury into the air that eventually contaminates rivers and lakes, where bacteria convert it to a highly toxic form that bioaccumulates in fish.[55]

Mercury is a neurotoxin that is particularly damaging to the developing brain. In early 2004, EPA scientists estimated that one in six women of childbearing age in the U.S. had levels of mercury in her blood that are sufficiently high to put her baby at risk of learning disabilities, developmental delays and problems with fine motor coordination, among other health impacts.[56]

In 2005, North Carolinas' coal-fired power plants emitted 3,510 pounds of mercury.[57] This has contributed to the need for the fish consumption advisories North Carolina has issued for many types of fish caught in the state's waters and for a number of inland lakes.[58]

Reducing Mining

Extraction of coal is also increasingly destructive. Although there is no coal mining in North Carolina currently, mountaintop removal methods have scarred other parts of the Appalachians with mines, some as big as the island of Manhattan, and afflicted the area's communities with polluted air and poisoned water. Mines using mountaintop removal supply coal to 13 North Carolina power plants.[59]

When North Carolina is using enough solar power to displace significant amounts of coal power, the pressure to mine for coal will be reduced.

Reducing Water Usage

Solar power has the additional benefit of conserving water.

Traditional power plants depend heavily on a constant supply of water to produce steam and provide cooling.[60] North Carolina's electric utilities are responsible for over 80 percent of the water withdrawals in the state.[61] Electricity production in North Carolina contributed to water shortages during the recent drought.

In contrast, solar photovoltaic systems generate electricity using very little water. For example, a homeowner might periodically wash dust off of his or her solar panels. Replacing traditional electric production with solar power will relieve some of the stress on the state's water supplies.

Investments in Solar Power Benefit North Carolina's Economy

North Carolina's progress toward clean energy can benefit the state's economy. Solar power helps to replace energy expenditures for fuel or materials produced out of state with labor and materials produced at home. This keeps more of North Carolina's energy dollars in the local economy. As a result, solar power can create jobs and expand economic activity in all areas of the state.

Manufacturing

North Carolina's extensive network of universities, experts, and innovators make it an ideal site for developing and manufacturing solar energy technology. Hubs of research and innovation like the state's world class universities, Research Triangle Park, and the North Carolina Solar Center can make the state a leader in solar technology development. Companies that develop from these innovations will bring manufacturing jobs to North Carolina.

Building a photovoltaic system requires creating cells from silicon and glass, installing wires and other electrical components, and assembling them into a unit. According to a 2002 analysis by University of California-Berkeley Professor Daniel Kammen, manufacturing a megawatt of solar photovoltaic panels requires approximately six full-time employees working for a year.[62]

North Carolina is home to a variety of solar energy companies. Sencera, for example, plans to build a plant in Charlotte to manufacture the thin film solar panels it has been developing. This plant will employ 65 workers in Mecklenburg County.[63] And Semprius, headquartered near Research Triangle Park in Durham, is developing a new semiconductor technology to make solar panels more efficient and inexpensive.[64]

By increasing local demand for solar energy systems, North Carolina could create and enhance the opportunity for new companies to locate facilities in the state while bolstering the state's existing clean energy businesses. For example, the Spanish wind turbine manufacturing company Gamesa located its U.S. headquarters in Pennsylvania in part because of the state's commitment to renewable energy, as well as its strategic location.[65]

Building Trades, Construction and Installation

Installation of energy efficiency measures and renewable energy facilities typically involves local construction firms and general contractors, boosting local economies. There are more than 45 solar installers, dealers, and project developers in North Carolina.[66] These companies help homeowners and businesses plan solar projects, then do the work of rewiring houses for solar power and installing the solar panels. The more solar panels that are being installed, the more local work there will be for these sorts of companies, as well as electricians and other workers.

Spillover Effects

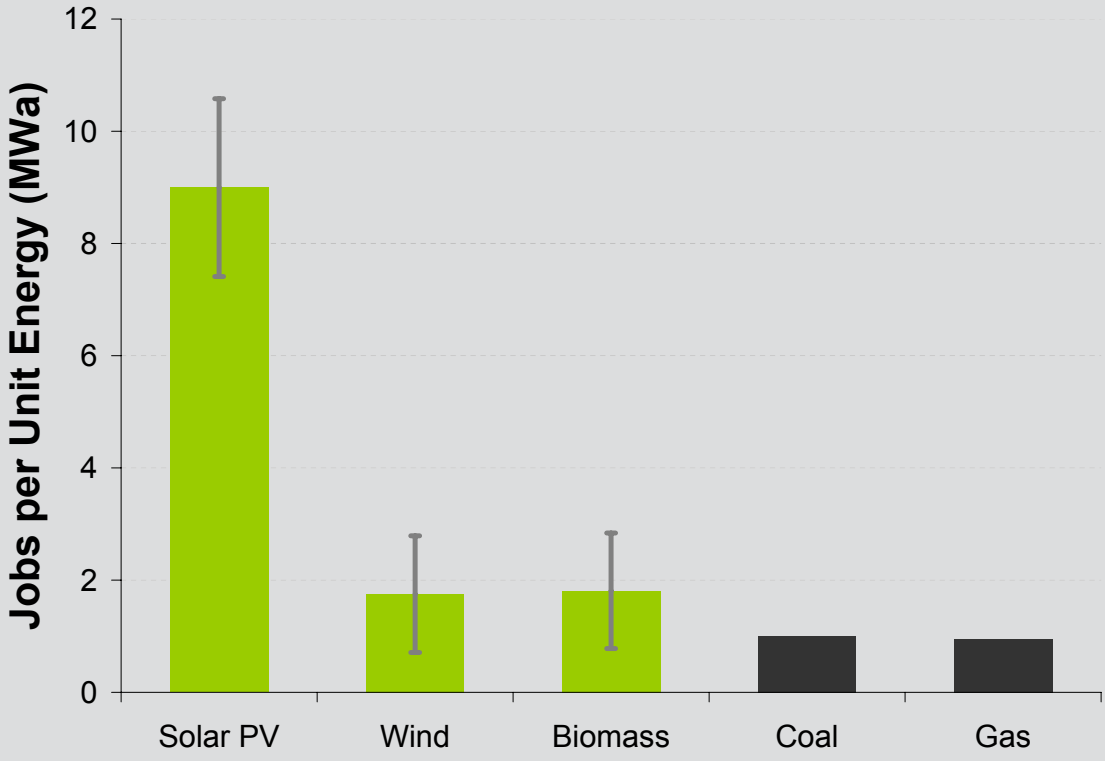
Each dollar spent on solar energy creates impacts that ripple outward through the local economy, extending far beyond the direct creation of jobs.

For example, workers at a manufacturing plant need raw materials and equipment. Their work in assembling solar systems supports jobs in equipment manufacturing and component supply. Contractors at a construction site need equipment and food, and their work supports additional jobs supplying these needs. In addition to these indirect jobs, workers spend much of their wages in the local economy, purchasing goods and services like groceries and housing and supporting additional workers.

Solar Energy Facilities Have Larger Direct Economic Impact Than Coal or Gas-Fired Power Plants

Solar power and other forms of renewable energy generate more total jobs per unit energy produced than fossil-fuel technologies.[67] Compared to coal- and gas-fired power, solar energy creates on the order of 9 times as many jobs, and wind and biomass create on the order of 75 percent more jobs.

Figure 8. Jobs per Unit of Energy from Renewable and Fossil Technologies, U.S.[68]



Policies That Will Help North Carolina to Achieve its Solar Potential

Getting more energy from solar power would have clear benefits for the state, and with so much at stake it is critical that North Carolina start the process of ramping up its solar power today. However, there are a number of barriers that are preventing the state from taking advantage of its huge solar potential. State and local governments have a role to play in eliminating these barriers and helping solar power play a larger role in North Carolina's energy economy.

For North Carolinians considering installing solar panels on their homes or businesses, one of the largest barriers is the cost of solar panels. The upfront cost of solar photovoltaic panels is prohibitive to many homeowners, and, with North Carolina's relatively low electricity rates, the avoided electricity costs do not yet generally repay the cost over the lifetime of the system.

The cost of solar power is dropping, however, and will continue to decline as production ramps up. Prices have fallen by more than 80 percent since 1980.[69] Analysts at the U.S. Department of Energy forecast that if solar production continues to increase, the installed cost of solar PV systems will fall by 50 percent or more by 2015, making solar electricity price competitive with other sources of electricity – even in states with relatively low-cost electricity like North Carolina.[70]

There are additional barriers to installing solar power on homes and small businesses, from fees imposed by utilities to the daunting prospect of an installation project. By helping homeowners and small businesses finance solar power, and removing the other barriers to installing rooftop solar systems, North Carolina can ensure that small solar is on a level playing field with other sources of electricity.

North Carolina recently extended the 35 percent investment tax credit for installation of renewable energy technologies, including solar panels.[71] While this was an important step, there are many more policies the state can put in place

to ensure the growth of solar power in North Carolina.

Provide New Solar Financing Options for Homeowners and Businesses

Eleven states have recently adopted a policy that would allow local governments to use their borrowing power to help businesses and individuals finance solar power installations. Participants would pay the loan back through increased property tax assessments; the increase would be tied to the property, rather than to the owner.[72] North Carolina should follow these states' lead and create a similar program to make it easier for homeowners and businesses to install solar power.

Even once solar power is cheaper over the lifetime of a system than buying the same power from the grid, paying for the equivalent of 20 years of electricity bills at once is difficult for most families and small businesses. Spreading the costs of a solar power system over its entire lifetime allows solar power to compete fairly with other sources of electricity. Integrating the loan into property taxes means that homeowners who plan to move in the next 20 years or businesses that expect to change buildings before the loan is paid off will not be deterred from installing solar power. By providing this financing option, North Carolina can remove one of the most significant barriers to the growth of solar power without any additional cost to the state or to local governments.

North Carolina took the first step towards making this sort of financing possible for residents in 2009. The state should take the final steps to put this policy in place.

Allow Building Owners to Lease Solar Panels

Some companies specialize in installing solar panels on roofs for the buildings' owners for free, especially those of large businesses, then charge the owners for the power they use from the system through an agreement called a "power purchase agreement," or PPA, which establishes a fixed price for the electricity for a decade or longer. These agreements allow businesses and homeowners to use solar power without the hassle of purchasing a system, and protect them against electricity price increases.

Currently, however, only utilities can establish this sort of agreement with building owners in North Carolina – if a solar company wants to establish a PPA program, state law requires that it be regulated as a utility, effectively prohibiting this type of financing in North Carolina by non-utilities. Laws requiring utility regulation were created before companies started using PPAs, however, and PPAs do not create the risks that utility regulation guards against. This type of financing has the potential to speed up solar power installation in North Carolina. State law should exempt renewable energy PPA programs from utility regulation.

Make Net Metering Work for Home and Business Owners

Net metering laws allow solar panel owners to be fairly compensated for the electricity they are supplying to the utilities. North Carolina has improved its net metering laws significantly over the past year, but the rules still have some provisions that act as disincentives for home and business owners to install solar panels. In particular, standby charges for certain system sizes and complicated

rules that limit the benefit solar power system owners can gain from their systems make it more costly for many home and business owners to install solar panels.

North Carolina law allows utilities to bill the owners of solar panels for "standby charges." Residential systems under 20 kW and commercial systems under 100 kW are exempt, but above this, systems up to 500 kW can face steep charges each month for having their system connected to the grid.[73]

Commercial installations between 100 and 500 kW are not uncommon – California has more than 40 solar installations in this category.[74] These standby charges are limiting the size of solar PV systems in North Carolina, and should be eliminated.

People who produce renewable electricity are entitled to "renewable energy credits," or RECs. These credits are in high demand from utilities seeking to comply with renewable electricity standards and companies who purchase them to boost their "green" credibility, and the proceeds can help solar panel owners finance their systems. However, North Carolina's net metering laws give utilities the right to claim RECs for any solar panels their customers connect to the grid.

The only way that home and business owners with solar panels in North Carolina can avoid surrendering their RECs to the utilities is to agree to a complicated "time-of-use" net metering system. Under this system, electricity produced by a solar panel during peak hours – generally during weekday daylight and evening hours – can only count against electricity used during peak hours, and the same for off-peak hours. A homeowner with solar panels using this system can keep his or her RECs, but will likely have higher utility bills, since electricity production and use won't necessarily fall during peak and off-peak hours in the same proportions.

This net metering system is unfair to the owners of small solar power systems, and adds unnecessary complication and cost to solar panel ownership. North Carolina should bring its net metering practices up to the highest standards to ensure that solar panel owners are fairly compensated for the electricity they produce.

Allow Regulators to Set a Fair and Predictable Price for Solar Power Produced

In order to truly integrate distributed solar generation into North Carolina's energy portfolio, solar providers must be paid a fair and predictable rate for the electricity they generate. This policy, known as a "feed-in rate," has catapulted solar power production in Germany and Japan; North Carolina should follow suit.

A homeowner who installs a solar panel on his or her roof in North Carolina today can use any electricity produced over the course of the year to offset annual utility bills, through net metering. However, if the solar panels produce more electricity than the house uses in a year, the utility gets the extra power for free. This limits the growth of installed solar power in the state, with rooftop solar power systems rarely larger than the size that will supply the electricity for an individual building.

In addition, consumers who invest in solar power actually *save money* for other electricity consumers. With more solar power in the system, utilities may invest less in transmission lines and expensive "peaking" power plants that only run

when demand for electricity is very high. And the pollution that is avoided by installing solar panels also has economic value in the form of reduced public health impacts from air pollution and less danger from global warming. Fair payment for solar power would compensate consumers for these benefits.

With a "feed-in rate," small businesses and homeowners are instead paid a fair rate for every kW of electricity they produce. This rate is guaranteed for a long enough period of time, 15-25 years, to allow those considering installing solar panels to be sure what the lifetime net cost will be for the panels.[75] Regulators can set the price at whatever level they determine will stimulate the growth of solar power in the state.

Feed-in rates encourage solar installations by setting competitive prices for solar electricity produced, and providing an incentive for home and business owners to build rooftop solar PV systems that are as large as possible, rather than just large enough to supply electricity for their own buildings. With feed-in rates, homeowners and businesses that install solar panels will not only eliminate their monthly electricity bill, but receive payments for the power they are producing.

Gainesville, Florida recently approved a feed-in rate policy for solar power, which is designed to give those who install solar panels on their building a 5 percent return on investment after taxes with a 20-year contract. The city has already reached its cap on solar installations covered under the program for this year and next, which is set at 4 MW installed per year.[76]

Establishing a feed-in rate in North Carolina would enlarge the market for solar power, increasing the growth rate of installed solar power and boosting the solar industry.

Require Solar Panels in New Home Design and Construction

One of the most efficient ways to increase the amount of solar power is to require new homes to come with solar panels, or with the option of installing solar panels. By planning solar power into new homes, builders can ensure that homes are oriented properly with un-shaded roof space for the panels. Including solar panels in new homes also costs about 25-33 percent less than retrofitting an existing home for solar.[77] And building in solar panels while the house is under construction makes it easier for homeowners to choose and finance solar power – solar panels become a standard option, like granite countertops, in a project already underway.

A growing number of states have solar requirements for new homes. New Jersey requires builders to offer solar panels in new developments of more than 25 homes. New homes in New Mexico must be wired for solar power.[78]

North Carolina should require home builders to include solar panels as a standard feature in new homes. At the least, solar power should be an option on all new homes built. This would ensure a growing amount of solar power in North Carolina, help the state's growing solar industry, and make it easier for homeowners to power their homes with solar power.

Ensure That North Carolina's Renewable Energy Standard Stays Strong

The North Carolina Utilities Commission (NCUC) recently ruled that 25 percent of the solar requirement in the state's renewable energy standard (RES)

can come from other states. North Carolina will see the most benefit from its RES if it is used to encourage the state's own solar industry, not the solar industry in other states. The NCUC should reverse this decision.

Reinstate the Renewable Energy Manufacturing Tax Credit

North Carolina's renewable energy manufacturing tax credit expired in 2006. North Carolina should reinstate the tax credit to build the state's solar industry.

The solar industry has been growing in North Carolina over the past decade, and the state should be encouraging this trend. Companies like Sencera, a solar technology developer and manufacturer in Charlotte, have plans to grow and expand production in the coming years.[79]

Building the solar manufacturing industry will help lower the cost of solar power as well. The cost of solar panels is directly related to the level of production – the more panels produced, the cheaper they are. Accelerating the growth of North Carolina's growing solar industry, combined with the growing solar industry across the United States and the world, will bring solar technology to widespread mass production more quickly, making it cheaper to produce and more attractive for utilities installing new electric generation or homeowners considering installing solar panels on their roofs.

Methodology

Solar Roofs

For the total amount of solar photovoltaic power that could be installed on residential and commercial rooftops in North Carolina, we used an estimate that Navigant Consulting computed for the National Renewable Energy Laboratory. Navigant found that installing solar panels on all suitable residential and commercial rooftop space in North Carolina would result in 15,144 MW of solar power. Navigant also estimated total solar roof potential for 2015, based on their assumptions about the increasing efficiency of solar PV and the increasing rooftop space in North Carolina.[80]

In calculating this number, Navigant took into account factors such as tree and other shading on residential and larger buildings, roof tilt and orientation, and the room needed on roofs between solar panels and taken up by other objects such as chimneys and fan systems.[81] Navigant estimated that 22 percent of residential roof space and 65 percent of commercial roof space could be used for solar panels.[82]

We estimated solar rooftop potential on the county level by apportioning Navigant's state total to counties. We apportioned the state's solar potential to groups of counties by the percent of developed land in each area of North Carolina, representing groups of counties, in 2007.[83] Developed land area was apportioned to each county in the county groups according to the percentage of residential units and employees in each county in 2007 and 2006 respectively, averaged.[84] For example, if a county had 10 percent of the employees and 8 percent of the residents in the county group, we assumed that it had 9 percent of the solar potential in that county group.

To estimate number of solar roofs, we assumed the average rooftop system size – including both residential and commercial installations – would be10 kW. This is a rough but conservative guess based on information about the average

size of solar roofs in California, the only place for which this sort of information is easily available. In California, commercial and residential solar roofs have been an average of 13 kW through the California Solar Initiative, but this average was higher than expected because of the large size and number of commercial installations, and would likely be smaller in other states.[85]

Utility-Scale Solar

We estimated potential for utility-scale solar power using the amount of barren land in North Carolina. Our estimate for barren land is based on data from the North Carolina Gap Analysis Project (NC-GAP), which used geographic information system (GIS) data to analyze the land cover in North Carolina and classified land based on its protection status.

We included three types of barren land: "quarries, strip mining, and gravel pits," "bare rock and sand," and "sand." "Sand" does not include coastal areas, which are classified in their own categories. Only half of the land in "quarries, strip mining, and gravel pits," was included, to account for land currently in use. Land was classified into four levels of protection status; only the lowest level, land entirely not protected or under consideration for protection, was included. A total of 65,000 acres was included.[86] We assumed 1 MW of solar power for every 10 acres, based on the assumptions Navigant Consulting used in an estimate of utility-scale solar potential for Florida.[87]

We calculated 2020 utility-scale solar potential based on the percentage increase in MW/million square feet by 2020 that Navigant assumed when estimating Florida's solar potential.[88]

Solar Water Heating

We computed residential potential for solar hot water systems based on the total number of households in North Carolina and in each county in 2007, the average natural gas and electricity used to heat water per household in the South Atlantic, and the percent of residences in the South Atlantic that use electricity and natural gas to heat water, respectively.[89] We used the National Renewable Energy Laboratory estimates that 40 percent of residential buildings in the South Atlantic could install solar hot water systems, and that each system could replace 60 percent of the energy a household uses to heat water in North Carolina.[90]

Total residential potential does not equal the sum of county potentials because the American Community Survey, the source for the number of households, only reports county-level data for counties with over 20,000 people.

We computed commercial potential for hot water systems based on the number of commercial buildings in North Carolina, the average amount of natural gas or electricity used to heat water in commercial buildings in the South Atlantic, and the percentage of buildings that use natural gas or electricity in the South Atlantic.[91] We used the National Renewable Energy Laboratory estimate that 60 percent of commercial buildings in the South Atlantic could install solar hot water systems, and that each system could replace 60 percent of the energy a household uses to heat water in North Carolina.[92]

The number of commercial buildings in North Carolina was estimated using the total number of commercial establishments in North Carolina and the number of establishments per non-mall commercial building in the

South Atlantic.[93] The number of establishments per commercial building was listed as ranges in the Commercial Buildings Energy Consumption Survey – for example, two to five establishments per building. In order to be conservative in estimating the number of buildings, the highest number in the range was assumed when converting number of establishments to number of buildings.

In computing the potential for rooftop solar hot water systems on residential and commercial buildings, we used the National Renewable Energy Laboratory estimate that 40 percent of residential buildings and 60 percent of commercial buildings in the South Atlantic could install solar hot water systems.[94]

Putting it All Together

We estimated that installing the full potential for solar hot water on residential and commercial rooftops would reduce photovoltaic solar potential to 20.5 percent of North Carolina's 2007 electricity. We calculated this by computing the total rooftop area used for residential and commercial solar hot water systems, converting that area to MW of solar PV, and subtracting that number from our estimate of total MW of rooftop solar PV potential.

We computed rooftop area used in residential solar hot water based on the typical size of a residential system, combined with information used when computing total solar hot water potential. Rooftop area used for residential solar hot water assumes an average of two 32 square foot collectors per residence.[95]

We computed rooftop area used in commercial solar hot water based on the system size necessary to supply 60 percent of the average energy used to heat water in commercial buildings in North Carolina. This assumed 900 British thermal units (Btus) delivered per square foot of collector on a clear day, and that 60 percent of daylight hours are clear in North Carolina.[96] Average energy used to heat water in a commercial building in North Carolina was based on information used to compute total commercial solar hot water potential.

Rooftop area was converted to MW of solar PV based on factors used by Navigant Consulting in their estimate of total rooftop solar PV potential in North Carolina.[97]

Realizing North Carolina's Solar Potential

Our projection for the rate of growth in installed solar power that favorable policies could achieve is based on current projects planned, the rates of growth seen in countries and states with favorable policies, and the worldwide rate of growth in installed solar power.

Projects planned for North Carolina through 2010 include a 21.5 MW solar farm and a number of smaller solar farms under 2 MW.[98]

Over the past 10 years, California's installed solar power has increased by an average of 54 percent a year, and Germany's has increased by an average of 60 percent a year.[99] In the past few years, New Jersey has seen similar rates of solar installation, with installed solar power growing 75 percent in 2007 and 47 percent in 2008.[100] And installed solar power in the entire world has increased by an average of 31 percent a year from 1998-2008.[101]

Appendix

Residential and commercial rooftop solar photovoltaic potential in North Carolina, by county. Total potential for MW of installed solar power, total potential for solar roofs, and the number of solar roofs that could be installed by 2020 and 2030 with the right policies in place, assuming that 50 percent of installed solar power will be on rooftops.[102]

County	Total Potential, MW	Total Potential, Roofs	Solar Roofs Installed by 2020	Solar Roofs Installed by 2030
North Carolina Statewide	**15,144**	**1,514,400**	**112,538**	**696,804**
Alamance County	183	18,277	1,358	8,410
Alexander County	59	5,947	442	2,736
Alleghany County	29	2,852	212	1,312
Anson County	40	3,985	296	1,834
Ashe County	61	6,081	452	2,798
Avery County	59	5,863	436	2,698
Beaufort County	107	10,700	795	4,923
Bertie County	54	5,352	398	2,462
Bladen County	74	7,361	547	3,387
Brunswick County	187	18,710	1,390	8,609
Buncombe County	361	36,089	2,682	16,605
Burke County	171	17,143	1,274	7,888
Cabarrus County	190	18,996	1,412	8,741
Caldwell County	156	15,644	1,163	7,198
Camden County	11	1,119	83	515
Carteret County	173	17,337	1,288	7,977
Caswell County	29	2,869	213	1,320
Catawba County	413	41,315	3,070	19,010
Chatham County	65	6,497	483	2,989
Cherokee County	71	7,066	525	3,251
Chowan County	34	3,373	251	1,552
Clay County	24	2,391	178	1,100
Cleveland County	196	19,558	1,453	8,999
Columbus County	81	8,149	606	3,749
Craven County	217	21,743	1,616	10,004
Cumberland County	436	43,646	3,243	20,082
Currituck County	49	4,853	361	2,233
Dare County	129	12,930	961	5,949
Davidson County	168	16,829	1,251	7,743
Davie County	42	4,193	312	1,929
Duplin County	92	9,168	681	4,218
Durham County	471	47,056	3,497	21,651
Edgecombe County	96	9,622	715	4,427
Forsyth County	515	51,465	3,824	23,680
Franklin County	56	5,635	419	2,593

County	Total Potential, MW	Total Potential, Roofs	Solar Roofs Installed by 2020	Solar Roofs Installed by 2030
Gaston County	229	22,914	1,703	10,543
Gates County	14	1,394	104	642
Graham County	22	2,237	166	1,029
Granville County	94	9,378	697	4,315
Greene County	23	2,309	172	1,062
Guilford County	734	73,397	5,454	33,771
Halifax County	105	10,461	777	4,813
Harnett County	120	12,041	895	5,540
Haywood County	143	14,285	1,062	6,573
Henderson County	140	13,975	1,039	6,430
Hertford County	51	5,140	382	2,365
Hoke County	38	3,830	285	1,762
Hyde County	11	1,078	80	496
Iredell County	344	34,416	2,558	15,836
Jackson County	100	10,003	743	4,603
Johnston County	161	16,145	1,200	7,429
Jones County	14	1,442	107	664
Lee County	136	13,618	1,012	6,266
Lenoir County	157	15,654	1,163	7,203
Lincoln County	76	7,614	566	3,503
Macon County	116	11,581	861	5,328
Madison County	36	3,581	266	1,648
Martin County	36	3,588	267	1,651
McDowell County	73	7,296	542	3,357
Mecklenburg County	1,379	137,880	10,246	63,441
Mitchell County	40	4,001	297	1,841
Montgomery County	61	6,055	450	2,786
Moore County	184	18,398	1,367	8,465
Nash County	169	16,910	1,257	7,781
New Hanover County	415	41,528	3,086	19,108
Northampton County	40	3,957	294	1,821
Onslow County	201	20,065	1,491	9,232
Orange County	159	15,893	1,181	7,313
Pamlico County	22	2,247	167	1,034
Pasquotank County	81	8,096	602	3,725
Pender County	64	6,410	476	2,949
Perquimans County	21	2,088	155	961
Person County	71	7,056	524	3,247
Pitt County	281	28,111	2,089	12,934
Polk County	43	4,270	317	1,965
Randolph County	160	15,981	1,188	7,353

County	Total Potential, MW	Total Potential, Roofs	Solar Roofs Installed by 2020	Solar Roofs Installed by 2030
Richmond County	91	9,062	673	4,170
Robeson County	166	16,573	1,232	7,626
Rockingham County	177	17,701	1,315	8,145
Rowan County	157	15,686	1,166	7,217
Rutherford County	151	15,060	1,119	6,930
Sampson County	102	10,241	761	4,712
Scotland County	75	7,512	558	3,457
Stanly County	116	11,650	866	5,360
Stokes County	40	4,030	299	1,854
Surry County	178	17,792	1,322	8,186
Swain County	47	4,655	346	2,142
Transylvania County	73	7,291	542	3,355
Tyrrell County	6	631	47	290
Union County	176	17,609	1,309	8,102
Vance County	87	8,727	649	4,015
Wake County	1,171	117,140	8,705	53,898
Warren County	32	3,227	240	1,485
Washington County	27	2,747	204	1,264
Watauga County	139	13,950	1,037	6,419
Wayne County	238	23,839	1,771	10,969
Wilkes County	169	16,906	1,256	7,779
Wilson County	185	18,525	1,377	8,524
Yadkin County	38	3,812	283	1,754
Yancey County	39	3,895	289	1,792

Solar hot water potential on residential rooftops in North Carolina, by county.[103]

County	Residential Solar Hot Water Systems	Natural Gas Saved (million cubic feet)	Electricity Saved (MWh)
North Carolina Statewide	**1,349,035**	**5,502**	**1,576,335**
Alamance County	22,643	92	26,458
Alexander County	5,210	21	6,088
Anson County	3,423	14	4,000
Ashe County	4,458	18	5,209
Beaufort County	7,563	31	8,838
Bladen County	5,109	21	5,970
Brunswick County	16,926	69	19,778
Buncombe County	37,621	153	43,960
Burke County	13,637	56	15,935
Cabarrus County	23,906	97	27,934
Caldwell County	12,413	51	14,504
Carteret County	10,911	44	12,749
Caswell County	3,429	14	4,007
Catawba County	23,519	96	27,481
Chatham County	9,000	37	10,516
Cherokee County	4,408	18	5,150
Cleveland County	14,882	61	17,390
Columbus County	8,450	34	9,873
Craven County	15,545	63	18,164
Cumberland County	47,007	192	54,927
Currituck County	3,681	15	4,301
Dare County	6,227	25	7,276
Davidson County	24,411	100	28,524
Davie County	6,100	25	7,127
Duplin County	7,055	29	8,244
Durham County	40,332	164	47,128
Edgecombe County	8,525	35	9,962
Forsyth County	53,560	218	62,584
Franklin County	8,130	33	9,499
Gaston County	30,248	123	35,344
Granville County	7,566	31	8,841
Greene County	2,576	11	3,010
Guilford County	73,743	301	86,168
Halifax County	8,556	35	9,998
Harnett County	15,212	62	17,775
Haywood County	9,936	41	11,610
Henderson County	16,882	69	19,726
Hertford County	3,391	14	3,963
Hoke County	5,345	22	6,246
Iredell County	22,280	91	26,034

County	Residential Solar Hot Water Systems	Natural Gas Saved (million cubic feet)	Electricity Saved (MWh)
Jackson County	5,908	24	6,903
Johnston County	21,878	89	25,564
Lee County	8,404	34	9,820
Lenoir County	9,912	40	11,582
Lincoln County	10,876	44	12,709
McDowell County	6,739	27	7,875
Macon County	5,868	24	6,857
Madison County	3,208	13	3,749
Martin County	3,912	16	4,572
Mecklenburg County	135,080	551	157,840
Montgomery County	4,018	16	4,695
Moore County	12,127	49	14,170
Nash County	14,304	58	16,714
New Hanover County	32,606	133	38,099
Northampton County	3,182	13	3,718
Onslow County	21,704	89	25,360
Orange County	19,573	80	22,871
Pasquotank County	5,711	23	6,673
Pender County	7,643	31	8,931
Person County	5,915	24	6,912
Pitt County	24,629	100	28,779
Randolph County	21,334	87	24,928
Richmond County	7,230	29	8,448
Robeson County	17,404	71	20,336
Rockingham County	14,951	61	17,470
Rowan County	20,811	85	24,317
Rutherford County	10,370	42	12,118
Sampson County	8,971	37	10,482
Scotland County	5,187	21	6,061
Stanly County	8,784	36	10,264
Stokes County	6,991	29	8,169
Surry County	11,278	46	13,178
Transylvania County	4,999	20	5,842
Union County	24,111	98	28,173
Vance County	6,575	27	7,683
Wake County	119,835	489	140,026
Watauga County	7,340	30	8,577
Wayne County	17,646	72	20,620
Wilkes County	10,482	43	12,248
Wilson County	11,834	48	13,828
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