North Carolina Economic Developer's Guide to the Renewable Energy Industries

Volume 5
Spring 2013

Solar PV: Changing the Landscape

Growing Pains of a Global Industry

EDITOR'S NOTE

In the five years since enactment of North Carolina's Renewable Energy & Energy Efficiency Portfolio Standard (REPS) a lot has changed. Duke Energy is now the largest electric utility in the country, and one of the largest owners of renewable energy projects as well. More than $1 billion has been invested in renewable energy projects located in this state, and at least as much again invested in clean energy-related manufacturing and production facilities. North Carolina broke into the top 5 state PV markets with nearly 132 MW installed during 2012, and is poised to continue its rise during 2013. Accompanying that success, are some of the country's top solar energy companies such as Asheville-based FLS Energy, Durham-based Semprius, and Shelby-based Schletter.

Many firsts have also occurred in North Carolina in recent years. The largest solar thermal facility was installed by FLS Energy and allows St. Pauls-based turkey processor Prestage Foods to save hundreds of thousands of dollars in energy costs every year. Apple, Inc.'s data center - now one of many in the state - stands out for its 20-MW solar farm and the world's largest fuel cell power plant. Chemtex is developing the U.S.'s first commercial scale cellulosic ethanol production facility in the southeastern part of the state, in no small part due to the commpany's collaboration with the Biofuels Center of North Carolina and the biotechnology expertise of Novozymes AS.

While industry developments are far too numerous to cover comprehensively in this publication, others, like the federal offshore wind lease, are playing out as I write this and proffer the promise of continued growth in the renewable energy industries. Whatever the future, one trend is abundantly clear from these past five years - North Carolina's renewable energy industries are successfully connecting the high-tech with the traditional, knowledge with application, and urban with rural. The long-sought promise of the renewable energy industries is being realized, right here, right now, and every North Carolinian is better off for it as a result.

Jason W. Hoyle, Editor

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On the Cover: Silicon crystalline solar cell. Image Credit Dennis Schroeder / NREL

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About

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BY THE NUMBERS

$1.04 billion

Invested in NC renewable energy projects between 2007 and 2012
Source: RTI International

$1.5 billion

Projected cumulative savings through 2020 in NC's state-owned buildings from the State Energy Office-run Utility Savings Initiative
Source: Utility Savings Initiative 2012 Report

611,000,000

Estimated number of gallons of biofuels needed to be produced annually within North Carolina to achieve state goal of providing 10% of its own liquid transportation fuel by 2017
Source: Biofuels Center of North Carolina

745%

Percentage growth in PV generating capacity under contract with utilities in North Carolina from 2008 and 2012
Source: North Carolina Public Utility Commission filings

53.8%

Utility segment's market share of U.S. PV capacity installations in 2012 - the highest utility share ever
Source: Solar Energy Industries Association

56%

Renewable energy's share of new electric generating capacity installed nationwide during 2012
Source: Energy Information Administration

42%

Wind power's share of new electric generating capacity installed nationwide during 2012 - the largest share of any source
Source: Energy Information Administration

5th

Rank of North Carolina's PV market among state markets in 2012 when nearly 132 MW was installed
Source: SEIA and GTM

6th

Rank of North Carolina among states for cumulative PV capacity installed, estimated at 229 MW by the end of 2012
Source: SEIA and GTM

14th

Charlotte, NC's 2012 ranking among all U.S. cities for the most ENERGY STAR-certified buildings
Source: ENERGY STAR

17.2 mill.

Square feet of floor space certified as ENERGY STAR in Charlotte during 2012
Source: ENERGY STAR

44.8 mill.

Cumulative LEED™-certified square footage in North Carolina at the end of 2012
Source: U.S. Green Building Council Project Database

THE COUNTRY'S LARGEST UTILITY

Duke Energy is, for any practical purpose at least, "The Utility" in North Carolina – a regulated monopoly, indeed. On July 2, 2012, Charlotte, NC became home to the nation's largest electric utility with the closing of the merger between Duke Energy and Progress Energy. The combined company employs nearly 28,000 people, provides electricity service to 7.2 million retail customers located in six states, and owns and operates 62,772 MW of electricity generating capacity in the U.S. and Latin America.

An impressive industrial giant by any standard of measure, Duke Energy's generation fleet remains coal-intensive and largely focused on centralized generation plants. However, over the past five years, the company has quietly been working on a new facet to its energy business – a clean and renewable facet. Duke Energy Renewables was started as a division of the company's unregulated commercial business in 2007, and in the years since has invested more than $2.5 billion in renewable energy generation, resulting in nearly 1,800 MW of wind and solar capacity and a project pipeline in excess of 5,000 MW.

In 2012 alone, Duke Energy added more than 650 MW of wind and solar capacity across the U.S. – an increase of more than 50% from 2011. The company is actively engaged in advancing energy technology as well, and has plans to invest as much as a billion dollars in smart grid technologies to improve the efficiency of its distribution and transmission infrastructure.

Duke Energy Renewables was started with the acquisition of Texas-based Tierra Energy in 2007, and was expanded with the purchase of Vermont-based Catamount Energy a few years later. In November 2012, the company acquired Outland Energy Services, a Minnesota-based provider of operations and maintenance services for wind farms.

The company has done more than simply purchase and develop projects, though. With a growing wind portfolio, Duke recognized the need to optimize turbine output and subsequently developed the Renewable Energy Monitoring Center (REMC) which provides 24-hour operational monitoring and coordination 365 days per year. An even stronger indicator of Duke's firm footing and strategic interest in renewables is the company's recent decision to expand its renewables business and offer the services of both Outland and the REMC to renewable energy project operators outside the Duke enclave.

The company's expertise has also extended to innovation in integrating renewables into the grid. Late 2012 saw the completion of one of the largest battery-energy storage systems in the world at Duke's 153-MW Notrees wind farm in Texas; the system can provide as much as 24 MW-hours of electricity to help smooth the weather-related variations in output from wind farms. Duke was also recognized in 2012 with a Project of the Year award by POWERGRID Magazine for a PV-integrated battery system used to smooth out minute-by-minute fluctuations in output from a 1.2-MW project located near the Rankin Substation in Gaston County, NC. The company has other renewable storage and integration projects, including the storage capability integrated with the 1-MW PV array installed at the Marshall Steam Station in Catawba County, testing of battery systems at small-scale distributed PV generation sites, and has plans to roll out a program to re-purpose used Chevy Volt batteries for grid storage in 2013.

Most recently, Duke announced the company would be filing for a new rate schedule sometime during the summer of 2013. The new rate schedule has been described by the company as a clean energy rate that will be available to industrial customers. Creation of this schedule was partially the result of a collaborative effort with Google, and was made public in conjunction with Google's announcement that its Lenoir data center will be expanded.

Duke Energy's air emissions between 2008 and 2012...

17.7% decline in CO_2 emissions

19% decline in total CO_2 emissions intensity

68.2% decline in SO_2 emissions

48.5% decline in NO_x emissions

Image Credit: Duke Energy Renewables

World Record PV Cell Efficiency

Semprius, a 29-employee Durham-based company focused on high-concentration photovoltaic modules, announced plans to locate an $89.7-million manufacturing facility – the company's first – in the Vance County town of Henderson in mid-2011. The facility is expected to create 256 high-technology manufacturing jobs paying an average of $45,565 – more than 50% higher than the average wage in Vance County. According to the News & Observer, the company was offered incentives worth $15.5 million from Virginia, but opted to locate the facility in North Carolina after state and local officials offered an incentive package totaling nearly $18.3 million, including a $3-million grant from Commerce's JDIG fund, $10.3 million in tax credits and exemptions, nearly $2 million in grants from the GoldenLEAF Foundation and the NC Rural Center, and $2.6 million from Vance County.

The facility is expected to initially have a production capacity of about 5 MW per year (about 67,000 PV modules) and has the potential to expand production capacity to as much as 150 MW per year (about 2 million PV modules). Currently, the company outsources its semiconductor processing to Research Triangle Park-based RTI International, but will begin in-house processing once construction of its new facility is complete.

Semprius's solar modules focus sunlight through lenses onto small photovoltaic cells to produce electricity.
Image Credit: Semprius

Accompanying the manufacturing facility announcement in mid-2011 was the closing of a $20-million funding round led by Siemens Venture Capital. In early 2012, Semprius announced it had secured an additional $3-million in financing. This latest round of investment included the first investment by Morgan Creek Capital Management and additional funds from In-Q-Tel, the Central Intelligence Agency's investment arm.

Semprius's business, founded in 2006, uses a technology developed by three professors at the University of Illinois at Urbana-Champaign that, through a patented process called micro-transfer printing, allows the substrate on which the semiconductor crystals grow to be reused. The solar modules use only a tiny amount of highly efficient semiconductor material, unlike more-traditional technologies which use large areas of semiconductor material.

Semprius's modules have glass lenses that focus light in order to magnify the intensity of sunlight by about 1,100 times and have been measured at 34% efficiency – more than twice the efficiency of current photovoltaic technology. The company's triple-junction gallium arsenide cells are intended to be installed on rotating mounts that track the sun across the sky to further increase their output, and are currently in prototype testing at various locations across the Southeast. The company's technology was recognized by MIT's Technology Review as one of the top 10 emerging technologies in 2012 as an "Ultra-Efficient Solar" panel.

Wind & Wood: Renewables at N.C. Ports

Serving renewable energy markets has been an increasingly lucrative activity for the Port of Morehead City, as the facility begins positioning itself to take advantage of developments in the wind turbine market, particularly offshore wind projects. The Morehead City facility has received several shipments of wind turbine blades and other components in recent years. One wind turbine shipment originating from India and bound for California, included turbine nacelles, crates with balance-of-component parts, turbine blades as long as 85 feet, and had a combined weight of more than 80 tons. The turbine shipments that have been received are typically loaded onto trucks for transport to their final destination in a same-day expedited process that has been praised by several logistics companies who have overseen the shipments.

Renewable energy business at the ports features more than inbound cargo, however. Port facilities were upgraded in 2011 to improve wood-chip handling capabilities with the goal of processing and exporting 40,000 tons of wood chips over a two-month period for new client Co-

Unloading California-bound Wind Turbine Components at the Port of Morehead City

NC Ports' shore crane unloads Palm Springs, CA-bound wind turbines shipped on the M/V PAC ADARA from India.

Top: Wind turbine nacelles, which were stowed below deck during the voyage, are discharged directly from ship to truck at the Port of Morehead City.

Bottom: Four wind turbine blades being transported in a specialized blade-cage system are discharged from their above-deck stowage and offloaded by NC Ports shore crane.

Image Credit: North Carolina Ports

gent Fibre. In November 2012, the Port Authority's Board of Directors voted to invest $5 million to design storage and loading docks to handle wood pellets. The impact of the ports extends beyond mere import-export business.

Enviva LP currently operates a Hertford County-based wood pellet plant, and with the new wood-pellet handling capabilities at the Port of Morehead will be expanding its operations with an even larger facility in Northampton County. Also, in early January 2013, International WoodFuels LLC announced a 300,000 metric ton-per-year wood pellet processing facility in Wilson County that will create 32 full-time jobs and invest more than $60 million over the next three years. The company will produce wood-pellet fuel for export to Europe where electric utilities will use the fuel to displace coal burned in power plants. Company President Steve Mueller told the Department of Commerce that the Wilson, NC location was selected based on the support the company received from local and state agencies saying, "The combination of plentiful fiber supply, a strong rail network and two exceptional port facilities in North Carolina offers WoodFuels reliable, cost-efficient and long-term resources suited to a multi-decade export business."

Geology Drives Electric Vehicle Niche

North Carolina is home to a highly unique mix of minerals (highlighted in the last volume of this publication), including a variety of rare earth elements and the nation's largest reserves of lithium. Continued rapid expansion of the market for hybrid and electric vehicles – major consumers of lithium – continues to pay economic dividends on the state's geological resources.

Lithium carbonate, Li_2CO_3 an inorganic compund used in the manufacture of cathodes used in lithium-ion batteries.
Image Credit: Wikipedia Commons

Rockwood Lithium (formerly known as Chemetall Foote Corp.) held the grand-opening ceremony for its Kings Mountain-based lithium processing facility in early Summer 2012. The facility is already the largest lithium processing plant in the U.S., and the $75-million expansion will increase employment by as many as 100 jobs, expand production capacity by 5,000 metric tons per year, and includes a new technology development center focused on research and development related to lithium battery technology for electric vehicles.

Also located in Gaston County is the sprawling 900-acre lithium processing facility of FMC Lithium, where U.S. Senator Kay Hagan was on hand for a late-2011 expansion announcement. The Bessemer City facility announced a $50-million expansion expected to add as many as 25 new jobs to the existing 215-employee plant. The company also launched a new lithium metal purification process targeting next-generation energy storage applications that will enable North Carolina to further capitalize on the state's dominance in domestic lithium-based battery technology.

On the other side of Charlotte from Gaston County's growing lithium processing expertise, is Concord, NC's expanding stake in producing key components in lithium batteries. Also in mid-2011, Charlotte-based Celgard LLC announced plans for $105-million expansion of its existing facility that is expected to add 250 new employees to the 600 current workers. The Concord facility mostly serves the electric vehicle market and specializes in producing the membranes found within batteries that facilitate the electrolytic reaction.

Growth in electric-platform vehicles also spurred expansion of Hitachi Metals North Carolina, Ltd.'s rare earth permanent-magnet processing facility in China Grove. The $60-million investment is expected to create 65 new jobs paying 20% more than the average county wage, doubling employment at the plant over the next few years. The expanded facility will produce neodymium magnets engineered for use in hybrid-electric and electric vehicles.

A Rising Star

Wake Forest, NC-based Power Secure Inc. is a rapidly growing manufacturer and energy services provider. After more than 30 years in business, the company found itself in search of a revival in 2009 when layoffs pared its workforce to 179 people. Since 2009, the company's workforce has nearly more than tripled, due in part to a hiring binge that extended from early 2011 through 2012 and saw the company adding an average of about 15 new employees per month.

Image Credit: PowerSecure

This extraordinary pace of hiring has been driven by rapid growth with the company's traditional business of providing back-up generator services to grocery stores expanding into new markets such as data centers, hospitals and other facilities where energy reliability is highly valued. Bolstering the growth in its traditional markets, the company also has been acquiring portions of existing energy service providers such as Lime Energy and Southern Energy Management with a focus on assuming the contracts with these companies' largest customers.

Partly due to these newly acquired business portfolios as well as continued strong growth of its traditional businesses, the company announced a record backlog of $206 million in its first quarter results in early May 2013 – a backlog worth $32 million more than the company's trailing 12-month revenues. In its first-quarter 2013 investor presentation, the company projected continued rapid

growth would sustain at compound annual rate of 26% over the period from 2010 through 2015 with its utility infrastructure and distributed generation divisions leading the way.

Several new business lines driving this rapid growth were recently added. On the energy services side, these include energy performance contracts and solar installations. The company has also branched out into developing and manufacturing highly efficient LED lighting solutions at three Morrisville locations. The company's LED products include refrigerator case lights, shelf lights, street lights, and parking lot lights.

Manufacturing Competitiveness from Renewable Energy & Energy Efficiency

The economic development benefits that accrue from producing and selling renewable energy and energy efficient equipment are reasonably straightforward. However, a new trend is emerging across the spectrum of North Carolina's more traditional stalwart industries – using renewable energy and energy efficiency technology to reduce costs and increase competitiveness.

Raleigh-based Kyma Technologies, Inc. is a manufacturer of gallium nitride-, aluminum nitride-, and aluminum gallium nitride-based semiconductor materials and products that may bring to mind some high-tech solar device. While the company may well supply the solar market, its news of the day is the 35% overall reduction in utility bills the company realized following installation of a 30-ton geothermal HVAC system and a 20-ton energy-efficient chiller, which is thought to be the largest geothermal air-handling HVAC system for a cleanroom in the state.

Advanced materials are not the only technology industry taking advantage of the cost savings and improved performance of green energy. Pfizer recently completed a $7.9-million combined heat and power biomass boiler that generates electricity, heat, and steam using wood chips instead of natural gas or oil. The Sanford, NC facility currently produces vaccine components for the company's pneumococcal bacteria vaccine and will become Pfizer's primary site for launching new vaccines in the late and early clinical stages. The biomass boiler, which costs less to operate than fossil fuel-based alternatives according to a company spokesperson, provides 20,700 pounds of steam per hour from wood chips that are moved to the boiler along a conveyor from an 85-foot storage silo where a three-day fuel supply is kept.

Field of FLS Energy's solar thermal panels providing 100,000 gallons of hot water to Prestage Foods per day since Feb. 2012.
Image Credit: FLS Energy

Another facility in a well-established industry has also put renewable energy to work as a means to reduce energy bills by about 35%. Prestage Foods operates one of the state's largest turkey processing plants in St. Pauls, NC, and saves more than $200,000 per year by purchasing hot water from the world's second-largest solar water-heating installation. Another North Carolina company, Asheville-based FLS Energy, owns and operates the more than 2,100 water heating panels located adjacent to the Prestage facility. These panels soak up the sun's rays heating as many as 100,000 gallons of water per day to temperatures as high as 180 degrees. Hot water is then stored in heavily insulated 25,000-gallon tanks and eventually sold to the processing plant at a price well-below that of the fossil fuel upon which they formerly relied.

Beyond Oil – Fuel from the Fields

Novozymes AS, a Danish enzyme producer with its North American headquarters in Franklinton, introduced the first commercial enzyme for turning biomass pulp into the fermentable sugars necessary for the production of ethanol in 2010. While biofuel-related sales only account for about 16% of Novozymes nearly $2 billion in annual revenue, the company's new CEO, Peder Holk Nielsen, sees a future where 90% of the company's revenue may come from biofuel producers within two decades.

The company's enzymes turn inedible crops, waste by-products such as corn stover and forestry debris, and even municipal solid waste into sugary liquids which can then be turned into fuel. The company estimates that in places with sufficiently abundant biomass resources, the cost of producing ethanol using its technology is around $2 per gallon. To-date, Novozymes is just about the only ethanol success story to emerge from North Carolina.

Ethanol production and North Carolina have a decades-long history – one notable for the many misguided attempts at using corn to produce ethanol and one marked by numerous bankruptcies, lawsuits and other undesirable outcomes. The latest failure in this saga was the bankruptcy and auction of Clean Burn Fuels $100-million production facility located near Fayetteville in August 2011.

Where many have failed, Clean Burn Fuels attempted to succeed by leveraging economies of scale from what was intended to be the nation's largest corn-based ethanol production facility. After less than a year of operating in North Carolina – a state with comparatively high natural gas prices, whose animal feeding operations already create a substantial net deficit of corn, and with practically no capacity to blend ethanol into gasoline – the company and

its investors learned one business lesson the hard way: if it costs more to produce a gallon of ethanol than you get from selling it, producing world-record volumes will only yield world-record losses.

However, given the state's abundance of biomass resources, the state's substantial land-based rural economy, the prevalence and expertise of its biotechnology cluster, and the state policy to source 10% of its liquid transportation fuel from in-state resources by 2020, the pursuit of an ethanol production industry is a long way from over in North Carolina. Almost a year to the date from the auction of the Clean Burn Fuels facility, the U.S. Department of Agriculture announced a $99-million loan guarantee and partnership with Italy-based Chemtex International to develop a cellulosic ethanol plant in Sampson County.

The $170-million plant intends to begin production in 2014 and use grasses and crop stalks from as many as 30,000 acres as feedstock to produce about 20-million gallons of ethanol per year. It is expected to employ about 65 people directly at an average wage of more than $48,000 per year and support an additional 250 jobs in the nearby area providing a total economic gain of between $15- and $20-million annually.

It is no accident that the Chemtex facility is slated for North Carolina - the state has an abundant resource of cellulosic feedstock material, world-leading clusters of biotechnology and chemical companies, and an unparalleled research capacity. Based on these factors, the presence of Novozymes (whose enzymes will be used at the plant), the Chemtex facility in Wilmington (where the technology to grind and prepare raw feedstock for enzymatic treatment was developed), and the Biofuels Center of North Carolina's networking, research, and policy support, it appears that the first-of-its-kind domestic commercial-scale corn-free ethanol production facility would be hard pressed to find a location offering a greater chance of successful commercialization.

Apple Keeping the Pollution Away

Cupertino, CA-based Apple, Inc.'s billion-dollar data center in Maiden, NC is perhaps the most environmentally friendly facility of its kind in the world. First, the 2011-commissioned facility was built to the highest green building standard - LEED™ Platinum. In addition to using 14% recycled materials, diverting 93% of construction waste from landfills, and sourcing 41% of construction materials from within 500 miles of the facility, it has many high-efficiency design features, including:

- chilled water storage to allow the transfer of 10,400 kWh of electricity consumption to off-peak hours and outside air cooling to further reduce electricity use; and,

- precision-managed power use with self-contained cooling pods, motion sensor-activated LED lighting, and a white cool-roof to maximize solar reflectivity.

The design features however impressive, are just the tip of the iceburg where this facility's innovative approach to energy is concerned. The 11.5-acre data center in Maiden is also home to two firsts. Apple's 100-acre 20-MW_{ac} PV generating plant is the largest solar power facility ever built in North Carolina. The solar plant, which features a North-South single-axis tracking mount - is expected to generate 42 million kWh (42,000 MWh) of renewable electricity annually.

While impressive, the accomplishemnt of the solar power plant pales in comparison to the company's fuel cell installation. Apple has also installed a Bloom Box fuel cell generator that will use hydrogen from natural gas to generate as many as 80 million kWh of baseload electricity. The 10-MW fuel cell system is the largest installation of fuel cell technology in the country.

Although the fuel cell system is fueled with natural gas, a fossil fuel, the power it generates will still be considered renewable energy because the company is offsetting its purchase of fossil-based natural gas by using "directed biogas" that it purchases from a landfill (see NC Utilities Commission Docket No. SP-100, Sub 29 for more information on "directed biogas"). Basically, refined landfill gas will be delivered to a natural gas pipeline and Apple will purchase the renewable attributes of the refined landfill gas - much like Duke Energy purchases the renewable attributes from renewable electricity projects - and by doing so claim use of a renewable fuel to power its fuel cells. Overall, there are many lessons to be learned from Apple's Maiden facility. The company found ways to reduce its overall energy use as well as optimize the timing of its electricity purchases from the power grid.

ABB Expands Into NC Energy Hub

ABB, Inc. opened its $90-million very-high-voltage cable manufacturing plant in Huntersville, NC with a formal ribbon cutting in September 2012. The 240,000 ft^2-facility will employ about 105 people at an average salary of $64,000 to produce power lines to meet growing demand for new transmission lines in the U.S.

This facility is just the latest investment by the company in North Carolina whose North American headquarters moved to Cary, NC in 2010. Over the past three years ABB has doubled its operations in the state, and today has about 2,000 employees in North Carolina. ABB's Chief Executive Enrique Santacana attributes this growth to the state's established leadership role in the U.S. energy industry, citing the power generation cluster in Charlotte and the smart grid hub in Raleigh.

BIOFUELS INDUSTRY DEVELOPMENT

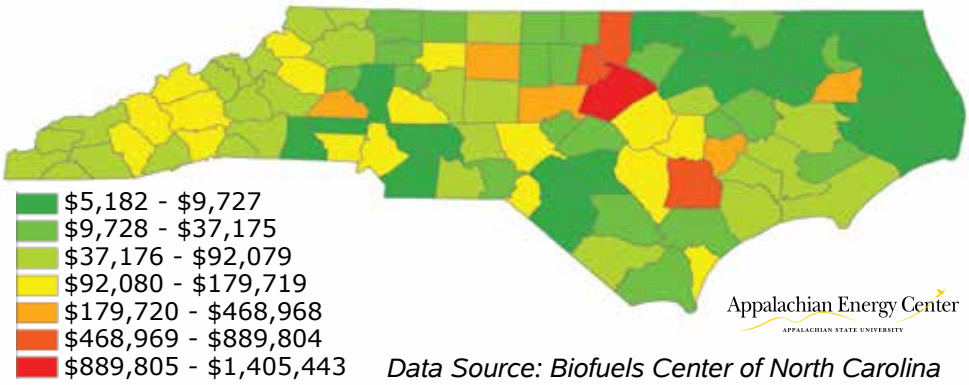
Top: The Biofuels Center of North Carolina provides funding for a wide variety of projects that are both located in and impact all counties of the state for the purpose of meeting the state's goal of 10% of liquid transportation fuels produced within North Carolina using local feedstocks by 2017. Much of the Center's work has been focused on the development of new feedstock crops, including cellulosic biomass such as switchgrass and other perennial grasses than can be grown on marginal crop land without adversely impacting other farming interests.

As a result of this NC-centric approach, a large number of the Center's funded activities have been focused on research at N.C. State University and in the farming-intensive eastern portion of the state. The notable exception is a large multi-stakeholder collaboration in Western North Carolina, organized by the AdvantageWest Regional Partnership, that was recently funded with TVA Settlement money.

Bottom: The Biofuels Center funds a variety of project types, as shown in the map below. Projects targeting development of new feedstocks and scientific research have impacted nearly every county in the state, while biofuels production and distribution funding has largely been concentrated in areas with existing biofuel producers.

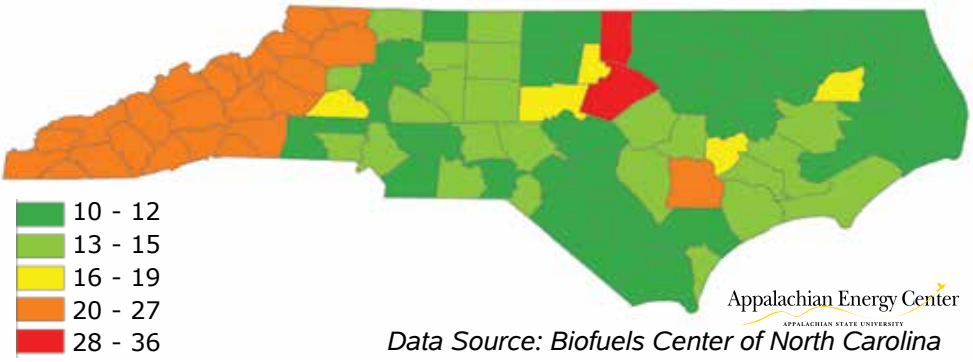
For more information about the Biofuels Center of North Carolina, see their website at www.biofuelscenter.org

Total Amount of Biofuels Awards Impacting County, $



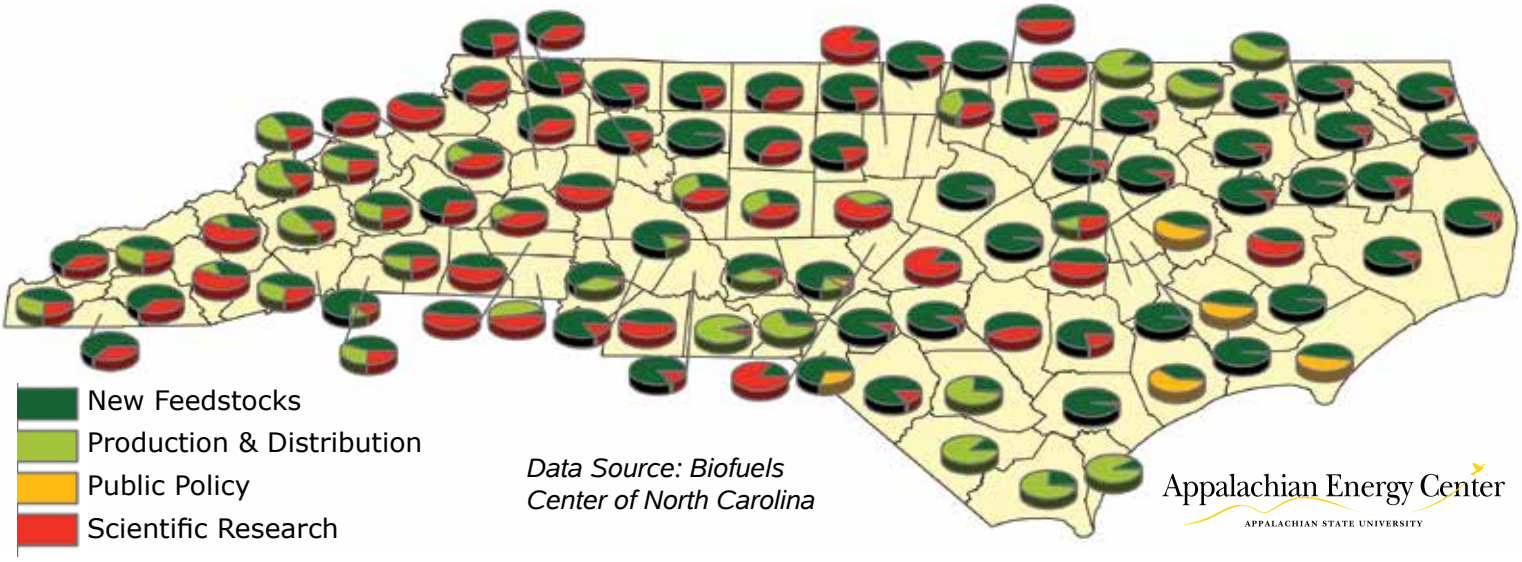
Data Source: Biofuels Center of North Carolina

Total Number of Biofuels Awards Impacting County, $



Data Source: Biofuels Center of North Carolina

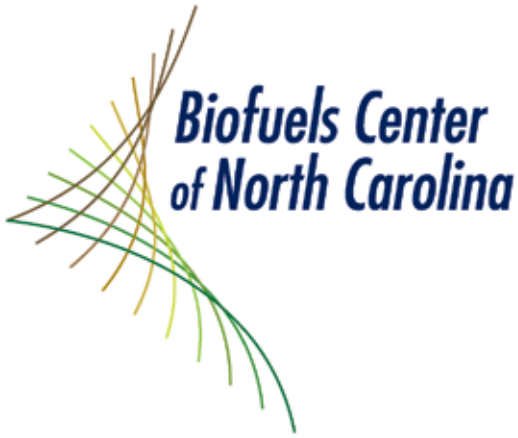
Share of Awards Impacting County by Biofuels Topic



Data Source: Biofuels Center of North Carolina

BIOFUELS CENTER'S VISION FOR A FUT

Ten percent of the state's transportation fuels by 2017, possibly totaling 600 mi
waste from a proximal surrounding regional growing zone. Different technologi
necessarily dot the landscape. Not exact, the map conveys the sort of developm

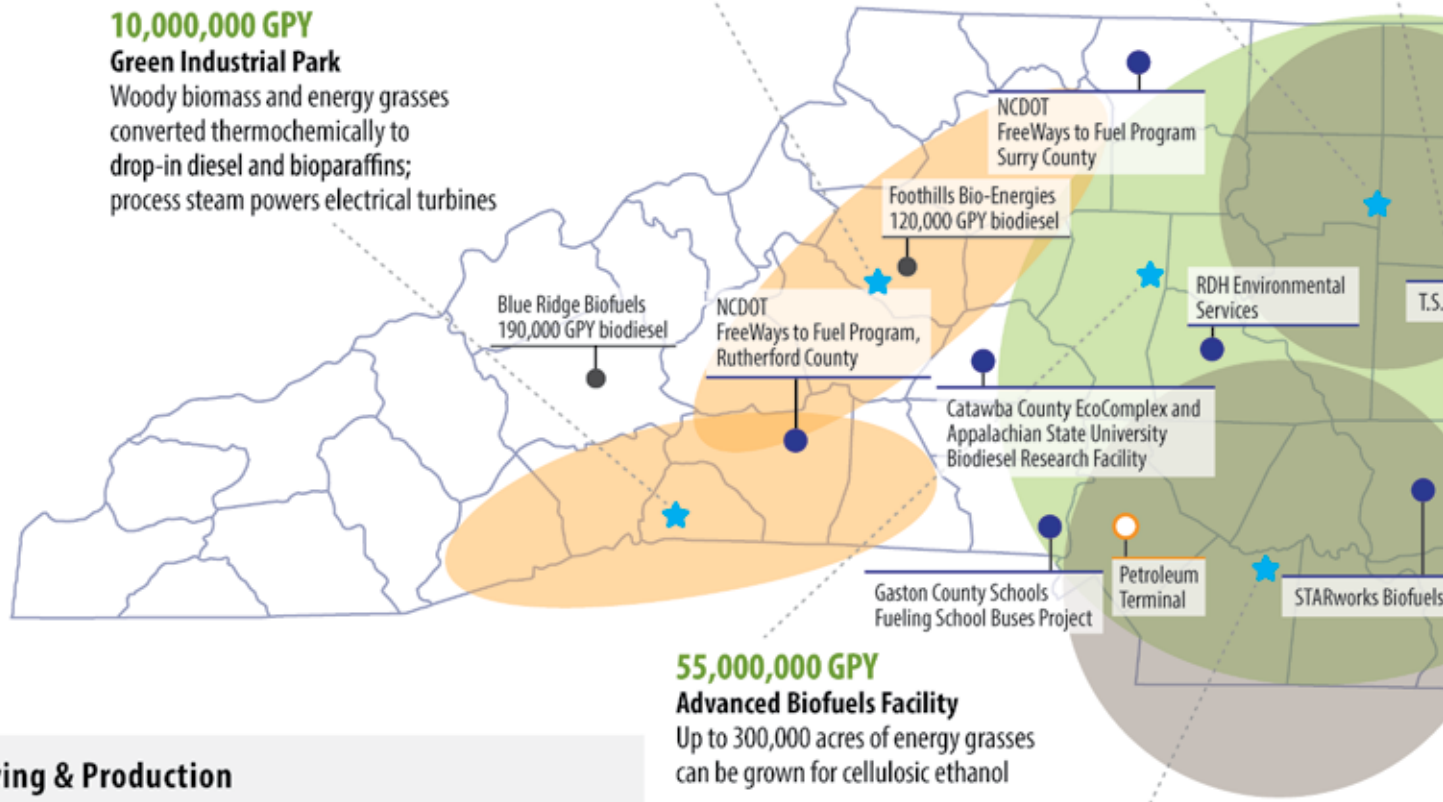


55,000,000 GPY
Thermochemical Plant
Woody biomass grown for making advanced fuels and drop-in diesel through a thermochemical process

50,000,000 GPY
Thermochemical Plant
Woody biomass and energy grasses grown for making advanced fuels and drop-in diesel through a thermochemical process

55,000,000 GPY
Advanced Biofuels Fa
Energy grasses can be g
of cellulosic ethanol

10,000,000 GPY
Green Industrial Park
Woody biomass and energy grasses converted thermochemically to drop-in diesel and bioparaffins; process steam powers electrical turbines



55,000,000 GPY
Advanced Biofuels Facility
Up to 300,000 acres of energy grasses can be grown for cellulosic ethanol

50,000,000 GPY
Thermochemical Plant
Woody biomass grown for making advanced fuels and drop-in diesel through a thermochemical process

55,0
Adva
Many
can b

Growing & Production

- Current biodiesel production facilities
  GPY: Gallons Per Year (GPY) is estimated based on 2011 output
- Hypothetical new production facility within growing zone
- Possible mixed woody biomass and energy grasses growing zones
- Possible woody biomass growing zones
- Possible energy grasses growing zones
- Municipal solid waste: possible biomass source and facility
- Algae: possible biomass source and facility
- Civic and small-scale production: 17 current projects
- Current petroleum terminals
  Biofuels blending and distribution

May 21, 2012-r7

URE BIOFUELS INDUSTRY LANDSCAPE

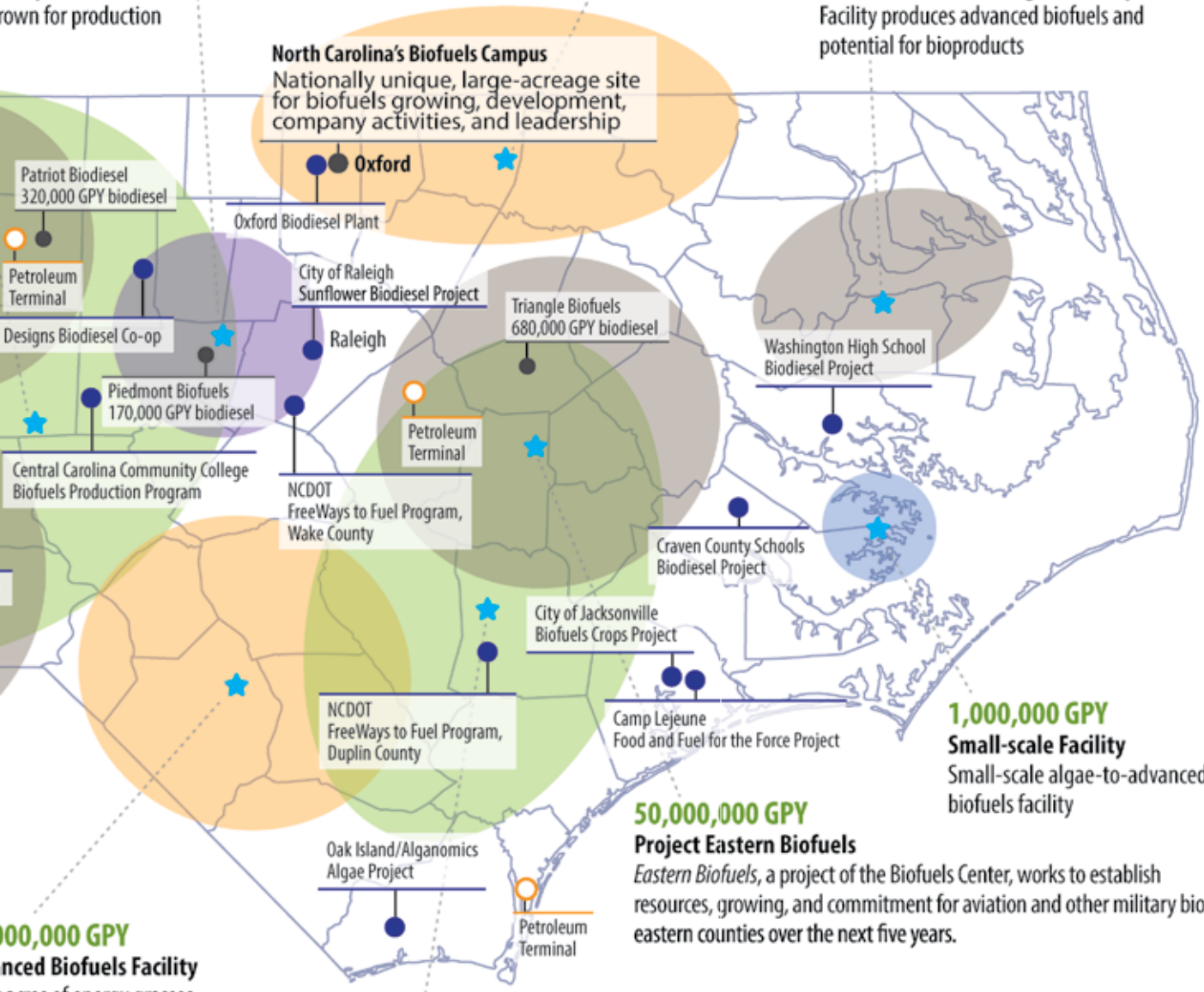
llion gallons, will require a range of production facilities. Each will draw on different feedstocks, biomass, or municipal ies will be required to convert different materials to fuel. Large commercial-scale and smaller facilities will in time ent likely to be seen in coming years. The noted Gallons Per Year (GPY) totals 611,000,000.

,000,000 GPY
unicipal Solid Waste Plant
nt uses solid waste for fuel, reducing lumes and landfill requirements

10,000,000 GPY
Green Industrial Park
Woody biomass and energy grasses converted thermochemically to drop-in diesel and bioparaffins; process steam powers electrical turbines

50,000,000 GPY
Advanced Wood-to-Sugars Facility
Facility produces advanced biofuels and potential for bioproducts

cility
rown for production



1,000,000 GPY
Small-scale Facility
Small-scale algae-to-advanced biofuels facility

50,000,000 GPY
Project Eastern Biofuels
Eastern Biofuels, a project of the Biofuels Center, works to establish resources, growing, and commitment for aviation and other military biofuels in eastern counties over the next five years.

00,000 GPY
nced Biofuels Facility
acres of energy grasses e grown for cellulosic ethanol

160,000,000 GPY
Up to 200,000 acres of hog lagoon sprayfields
Energy grasses on these sprayfields growing 15+ tons/acre can produce more than 160,000,000 GPY of advanced biofuels. A 20,000,000 GPY commercial project will likely be soon announced in Sampson County. The Biofuels Center, with partners, is verifying the total feedstock and production potential from this land.

Image Source: Biofuels Center of North Carolina, May 2012

Growing Pains of a Global Industry

By: Jason W. Hoyle, Editor

Trade complaints over protectionist policies and unfair trade practices in the renewable energy sector that began as a slow simmer a couple of years ago are quickly approaching a rolling boil. Currently, there are almost a dozen ongoing solar power trade disputes, and half as many other renewable energy-related trade disputes. The wellspring of trade disputes is somewhat unsurprising considering the phenomenal growth in these industries during the past decade.

In 2002, the global market for solar power was estimated by Clean Edge research to be worth about $3.5 billion and was projected to grow to $27.5 billion by 2012 – an impressive projected growth rate, but one that fell far short of the actual mark. The global solar market actually exceeded the 2002 projection in 2008 when it reached $29.6 billion, and by 2012 Clean Edge research reported a global solar market worth nearly $80 billion.

As countries sought to support solar power generation within their borders via tax incentives, premium payments for solar electricity through feed-in-tariffs and other programs, and portfolio standards that require increasing amounts of solar power generation, the solar market ballooned. Accompanying these efforts to increase the rate of solar technology adoption were often parallel efforts to capture the economic benefits from solar manufacturing, particularly jobs.

The result on one side was a rapid influx of new entrants to the solar manufacturing sector, and on the other was the proliferation of national and provincial policies that sought to leverage incentives and other support mechanisms for the deployment of solar power technology as a tool to drive local solar manufacturing. Therein lay the source of the current trade dispute proliferation.

Policies in which incentives for generating electricity with solar technology are linked to domestic content requirements are considered discriminatory under international trade rules. Likewise, national and other government support and subsidization for manufacturers also violates international trade rules. The incentives, which are the basis for most of the current trade disputes, take a variety of forms, including: local content requirements, direct support of domestic manufacturers, tax bonuses, guaranteed loans, and national policies of support for state-owned producers.

Solar Trade Disputes

U.S.-China Solar Trade Case

At the head of the pack of renewable energy trade disputes is the imposition by the U.S. International Trade Commission (ITC) of antidumping (AD) and countervailing duties (CVD) on crystalline-silicon (c-Si) solar cells originating from China. These duties were imposed in late 2012, and range from a combined 22.5% to 255.4%. At issue in this case was government subsidization of solar cell manufacturers by the Chinese government deemed to constitute an unfair trade practice that injured U.S.-based solar manufacturers.

EU-China Solar Trade Case

Following on the heels of the decision by the U.S. ITC, the European Commission's more-than-year-long case against China gained momentum, and in early May 2013 the Commission recommended duties on Chinese solar panels of between 37.3% and 47.6%, as reported by the Wall Street Journal. The formal release of the Commission's preliminary antidumping decision, expected in June 2013, will be followed by a preliminary antisubsidies ruling in August, with both determinations expected to be finalized by December 2013. Expanding on the solar panel case is an additional complaint which spurred an antidumping and antisubsidy investigation into imports of solar glass from China, independent of the solar panel matter.

China Polysilicon Dumping Probe

In response to the U.S. and EU cases, China initiated its own antidumping probe against the U.S., EU, and South Korea. At issue in China's investigation is whether the respondent countries are illegally dumping polysilicon – a raw material used in manufacturing silicon-based solar cells – and whether retroactive duties should be imposed. According to Bloomberg News, China announced its probe in November 2012, shortly after the ITC formalized U.S. AD/CVD tariffs and the EU affirmed its own investigations.

China-EU (Italy, Greece)

In early November 2012, China initiated a WTO complaint against the EU and member states Italy and Greece regarding the local content requirements of various feed-in-tariff programs in EU member states.

Ontario, Canada's Feed-In-Tariff

On December 19, 2012 the World Trade Organization's (WTO) Dispute Settlement body approved a report on Ontario's Feed-In-Tariff (FIT) green energy program, holding that the local content provisions of the program violate two WTO provisions. The ruling was appealed by Canada on February 5, 2013. The case was brought to the WTO by Japan and the EU in mid-2010 and mid-2011, respectively.

Ontario's FIT pays above-market rates to generators when at least 60% of the cost of goods and labor for a solar project are sourced from Ontario (25% for wind energy projects), pursuant to the province's Green Energy Act which, in part, aims to end coal-fired electricity generation in the province by 2014. The WTO panel report determined that this practice undermines competition by favoring domestic suppliers, or, in other words, discriminating against foreign suppliers.

U.S.-India Local Content Dispute

In February 2013, following three years of discussion, the U.S. requested dispute settlement by the WTO with the government of India concerning local content provisions in India's national solar policy, called the Jawaharlal Nehru National Solar Mission (JNNSM). The JNNSM policy is a multi-part effort under which Batch 1 of the first Phase requires developers of solar photovoltaic projects using crystalline silicon technology to use modules manufactured in India. The second portion of the first Phase expands the policy from only requiring India-made modules to also requiring that India-made crystalline solar cells be used in the modules.

Perhaps most disturbing to U.S. interests is the proposed modification to Phase 2. In draft form, the second phase of the JNNSM is exploring the expansion of the local content requirements to include thin-film technologies, which represent the bulk of U.S. solar exports to India. Under the JNNSM, the Indian government is offering participating solar power developers guarantees to purchase a certain amount of solar power at highly subsidized tariff rates, but only if the developers use India-made solar equipment rather than imports.

Final U.S. Antidumping (AD) & Countervailing Duty (CVD) Tariffs on Imported Chinese Solar Equipment

Trina Solar: 23.75% Total, includes 7.78% AD + 15.97% CVD

Suntech: 35.97% Total, includes 21.19% AD + 14.78% CVD

Separate Rate: 30.66% Total, includes 15.42% AD + 15.24% CVD

All Others: 254.66% Total, includes 239.42% AD + 15.24% CVD

India-U.S., Malaysia, China, and Chinese Taipei Antidumping Investigation

The Ministry of Commerce & Industry of the Government of India initiated an antidumping investigation into solar cells, modules, and panels imported from the U.S., Malaysia, and China in November 2012. The investigation was initiated in response to a complaint from the Solar Manufacturer's Association that alleged domestic producers had been injured by the dumping of solar photovoltaic products at below factory costs into the Indian market. Duties on imports of products originating or exported from the named respondent countries are being sought, as are retroactive duties.

Other Green Energy Disputes

While solar technology has received the bulk of attention in global green energy trade disputes, trade in other green energy technologies has not been forgotten. These other complaints span from trade in biodiesel to rare earths to wind turbine components.

As of December 2012, wind turbine towers imported into the U.S. from China and Vietnam are subject to duties of up to 71% as a result of the U.S. Department of Commerce investigation into turbine tower dumping and illegal subsidies by these countries.

The EU and member state Spain is the subject of a WTO complaint initiated in August 2012 by Argentina over the Spanish Ministerial Order regulating allocation of biodiesel quantities required to meet the mandatory renewable energy target (WTO Dispute DS443).

China is the subject of a WTO complaint initiated by the U.S. in March 2012 and joined by 18 third parties over China's export of rare earths, tungsten and molybdenum. The complaint addresses the imposition and administration of export restrictions by China, including: export duties, export quotas, minimum export price requirements, export licensing requirements, and other activities related to quantitative restrictions. (WTO Dispute DS431, DS432, DS433)

The United States initiated a WTO complaint against China in December 2010 over alleged Chinese domestic content requirements for suppliers of various wind turbine components. The complaint alleges Chinese support in the form of grants, funds, or awards to wind power equipment manufacturing enterprises in China that were contingent upon the use of Chinese domestic goods over imported goods.

Gaining Some Perspective

Solar photovoltaic technology is largely commoditized and while there remains some competition between differing solar technology platforms (e.g., thin-film and crystalline silicon) most solar systems use crystalline silicon and compete in the global marketplace based on price. As has been the case for years, solar manufacturing is dominated by Chinese companies which represented 7 of the top 10 manufacturers in 2012. However, output from the 10 largest solar suppliers supported less than half of global demand in 2012, an indication of the intense degree of competition in the global market.

On the opposite end of the spectrum is the highly consolidated market for photovoltaic technology. According to NPD Solarbuzz, 86% of global demand was located in the top 10 PV markets during 2012. Europe, led by Germany, accounted for about 46% of global

Renewable Energy-Related World Trade Organization Disputes

Details and more at http://www.wto.org/english/tratop_e/dispu_e/dispu_e.htm

DS443 European Union and a Member State - Certain Measures Concerning the Importation of Biodiesels (Argentina, Complainant | European Union and Spain, Respondent)

DS431 Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum (United States, Complainant | China, Respondent)

DS452 European Union and Member States - Certain Measures Affecting the Renewable Energy Generation Sector (China, Complainant | European Union, Italy, Greece, Respondent)

DS456 India - Certain Measures Relating to Solar Cells and Solar Modules (United States, Complainant | India, Respondent)

DS437 United States - Countervailing Duty Measures on Certain Products from China (China, Complainant | United States, Respondent)

DS449 United States - Countervailing and Anti-dumping Measures on Certain Products from China (China, Complainant | United States, Respondent)

DS419 China - Measures Concerning Certain Wind Power Equipment (United States, Complainant | China, Respondent)

DS426 Canada - Measures Relating to the Feed-In-Tariff Program (European Union, Complainant | Canada, Respondent)

DS412 Canada - Certain Measures Affecting the Renewable Energy Generation Sector (Japan, Complainant | Canada, Respondent)

demand, followed by China with 16% and North America with 12%, during 2012.

So, with hundreds of manufacturers competing on price to gain share in a very limited number of markets, the natural result is price competition. Declining prices coupled with a global industry shakeout has resulted in solar manufacturers being propped up by government loans or seeking bankruptcy protection. This industry consolidation has been evidenced in the U.S. with several high-profile bankruptcy cases and the recent bankruptcy filings and loan repayment troubles of some of the largest solar manufacturers in China during the past year. A representative of the China Photovoltaic Industry Alliance, according to China Daily, reported that the number of manufacturers in China fell from 262 in 2011 to 112 during 2012 – and the immediate outlook remains bleak.

At first glance, claims of dumping solar cells and modules at prices below factory cost appear to have some merit given the number of solar manufacturers going bankrupt, which is the expected result from selling products for less than they cost to produce. Likewise, distressed solar companies being propped up by stakeholder governments seeking to maintain employment within their territory also appear to support some claims of unfair trade practices.

However, much of these results may be completely market driven. Consider that the rapid growth of the industry naturally would attract new suppliers. This growth in suppliers results in an overly large production capacity relative to the market demand, and so selling any solar panels at all requires highly competitive pricing. This pricing strategy then undermines the fiscal health of the business and, in turn, results in subsidies and other unfair trade practices by stakeholder governments seeking to maintain employment in a growing industry.

One view is that this cycle is little more than the result of natural market forces at work in an emerging high technology industry, and that over time the supply and demand would balance as ever more producers fall away from the market until those remaining achieve the necessary scale to operate profitably on a sustainable basis. Whether that would be the eventual outcome we may never know.

Chinese companies represented 7 of the world's top 10 solar manufacturers in 2012

An Occluded Future

The trade disputes and their eventual outcomes have the potential to drastically alter the solar manufacturing value chain and could have deleterious effects in the global marketplace. Some possible outcomes include:

A downward spiral triggered by tariffs artificially increasing prices at every step of the value chain, starting with potential Chinese-imposed tariffs increasing the cost of raw polysilicon imports that would flow through as higher costs for Chinese-produced silicon wafers and cells, the costs of which would in turn be raised again via import duties when exported to a major market like the EU or U.S., thus raising the costs of cell or module production in those markets. The end result of this possible series of layered compounding tariffs could well be tariff costs multiplying through the value chain and causing rapid contraction in solar demand, which would then further shrink the market and result in continued production overcapacity, and so on.

Another potentially harmful effect could play out as tariffs stifle the transhipment of silicon wafers, cells, and modules back and forth across the globe. Domestic manufacturers in countries with protectionist tariffs could well suffer from the unavailability of competitively price intermediary solar materials as tariffs effectively halted the common practice of rebranding modules or assembling solar cells into modules locally, thereby undermining the viability of the very domestic companies for whom protection was originally being sought.

Likewise, there could be a dramatic shift in the market leadership in solar as the world divides itself into China-supplied and non-China supplied portions. This result would create significant supply/demand distortions as the China-supplied portion of the global market would inevitably be oversupplied for years as demand grew, while the non-China supplied portion would be woefully undersupplied, especially given the current dominance of Chinese solar manufacturers.

Basically, the commonality among virtually all possible futures in a global market constrained by artificial protectionist tariffs is higher-priced solar generating equipment. Given the strong desire for many countries to support increased adoption of solar technology, the only possible response would be for those countries to correspondingly increase incentives to offset the tariff-driven increase in price, if solar were to maintain its current level of competitiveness and those countries were to avoid the loss of tens or hundreds of thousands of solar industry jobs that support installation, project development, and balance of system component manufacturing.

Alternatively, there is the possibility of some sort of global solar trade accord, similar to the resolution of semiconductor trade disputes that arose at the start of the information age. Regardless of the eventual outcome of these disputes, it seems as if the nature of free-market competition in the global solar market will be forever changed.

SOLAR PV: Changing the Landscape

By: Jason W. Hoyle, Editor

Pictured here: Duke Energy's 1-MW Martins Creek Solar Project is located on the property of the Martins Creek Elementary School in Cherokee County, NC. The site's 4,400 ground-mounted panels supply electricity to the Tennessee Valley Authority through Blue Ridge Mountain EMC under a 10-year power purchase agreement. As part of the power purchase agreement, the school receives annual revenue from the system that is roughly equivalent to the cost of two full-time teachers.

Photos Courtesy of ESA Renewables and Duke Energy

Five short years ago, North Carolina and the Southeast were described as a backwater for the solar industry. As of the end of 2012, North Carolina ranked 6th among states for total installed solar photovoltaic generating capacity with 229 MW installed, according to a recent report from the Solar Energy Industries Association (SEIA) and GTM. Last year alone, 131.9 MW of solar was installed in the state, making North Carolina the 5th largest state market for solar during 2012, and projections indicate that 2013 will see North Carolina continue its meteoric climb to become the 4th largest solar market in the U.S.

As recently as 2006, reports filed with the North Carolina Public Utilities Commission (NCUC) by the state's investor-owned utilities indicated about 10 solar power projects under contract with a total capacity of about 37 kW. Two years later these same three utilities reported more than 15,854 kW of solar projects under contract to sell their output – the state's solar market grew by 2.5 orders of magnitude in a two-year period between 2006 and 2008. By early 2013, the utilities had more than 134,000 kW of NC-based solar power under contract – about 750% more than in 2008.

During the period from 2007 through 2012, approximately $1.04 billion was invested in 1,620 new renewable energy generation facilities across North Carolina, according to a recent North Carolina Sustainable Energy Association-commissioned report prepared by RTI International. Combined, these facilities generated more than 5.7 million MWh of renewable electricity between 2007 and 2012. Solar photovoltaic projects represented more than 71.5% of the total investment in new renewable energy facilities, accounting for $743 million – more than all other technologies combined.

However, installations and project investment are only half the story in our state's emerging solar industry. Innovative businesses and technology development have also taken hold and are bringing manufacturing jobs and other benefits to communities across the state. Three of the most notable solar manufacturing business successes in the state are Asheville-based FLS Energy, Durham-based Semprius, and Shelby-based Schletter. Together these three sector-leading manufacturers represent more than 630 jobs and more than $300 million worth of investment.

As a solar market, North Carolina is somewhat of a surprising national leader. The leading solar state is California where power reliability, air quality, and other environmental issues made it the first mover in renewable energy and where a variety of innovative incentives programs are available to support continued development of renewable energy. Second to California is the sunniest state, Arizona, where the greatest solar resource in the continental U.S. makes it a natural leader in solar power and fourth on the list is Nevada, which also has a significant solar resource. Sandwiched between Nevada and Arizona, ranked as the third largest solar state is New Jersey where aggressive incentives and a dedication to supportive policy have firmly established the industry.

So, how then does a state such as North Carolina that is more than 80% powered by very low-cost coal and nuclear gain a leadership spot in the solar industry? North Carolina doesn't have competitive wholesale markets, tightly constrained peak power capacity and infrastructure, extreme air quality restrictions, or a solar resource even close to that of states located in the desert Southwest. There is no single answer, or one specific factor to which our state's leadership in solar can be attributed; rather, it is a combination of policies, incentives, interest, and regulations developed over many years by dedicated people and organizations that created a tinderbox-like market environment and in 2007 the spark was provided via enactment of the Southeast's first Renewable Energy & Energy Efficiency Portfolio Standard, or REPS for short.

From Spark to Flame

The REPS was indisputably the catalyst for the phenomenal growth in solar installations North Carolina has experienced since 2007, in part due to the specific solar set-aside in the standard which requires power providers to use solar energy to meet a small portion of their retail sales – currently, 0.2% by 2018. In order to meet this obligation, utilities purchase Renewable Energy Certificates (RECs) from solar project owners providing a premium payment in addition to what the utility pays for the electricity itself. However, the amount of solar installed since the 2007 enactment of the REPS requirements far exceeds the set-aside minimum and is indicative of a market environment that is driven by far more than a policy requirement.

The groundwork for North Carolina's current solar industry leadership position was built over several decades, starting with corporate and personal investment tax credits. Although these credits were first established in 1977, they were little-used until the last five years. The tax credit is equal to 35% of the cost of the renewable energy system and is claimed in equal installments over five years, and is one of the highest-value credits of its type in the nation, exceeding even the 30% federal investment tax credit.

According to reports from the N.C. Department of Revenue, about $58,700 in tax credits for solar electric systems were claimed in 2006 by 26 non-business projects with an investment value in that year of $187,476. One year later, in 2007, solar electric projects rose from a 4.4% share of renewable energy credits claimed to nearly 16% of renewable energy credits claimed with more than $174,000 in credits claimed on projects valued at almost $600,000. This trend of rapidly rising use of the tax credit continues through the present.

In 2008, 74 taxpayers claimed more than $544,000 in state tax credits on investments worth nearly $1.8 million. In 2009, $3.67 million in tax credits were claimed on projects valued at $11.4 mil-

lion, and solar tax credits represented 37% of all renewable energy tax credits. Solar continued to dominate renewable energy investments with credits of nearly $5.5 million generated by projects valued at almost $16.3 million in 2010, and in 2011 solar represented 44% of renewable energy tax credits claimed with more than $18.4 million in credits generated from projects valued at over $53.4 million.

Tax credits, while a major contributor to the financial viability of solar technology in the state, are not the whole story by any stretch. Equally important and far more critical to the physical feasibility of solar projects are the policies enabling the physical solar power installation and interconnection with the grid. Accompanying the REPS bill in 2007, the legislature also passed a statewide solar access law which, according to the N.C. Solar Center's Database of State Incentives for Renewable Energy website, generally prohibits cities or counties from adopting ordinances that prohibits the installation of solar equipment on residential property.

Prior to the solar access law, residential projects' main benefit came from net metering regulations that were established in 2005. Net metering is a billing arrangement under which an electric utility customer installs a renewable energy system and the power it produces in excess of what is being used on-site is credited against the utility customer's electricity purchases. So, under net metering, a utility customer could generate electricity during the day which would be netted against electricity they consumed at night. Also, for small renewable energy system owners, starting in 2003, the North Carolina Green Power program allowed utility customers to voluntarily purchase blocks of renewable energy at a 4¢/kWh premium with the bulk of the premium payment passing directly to the renewable energy producer.

North Carolina also has interconnection standards that apply to the state's investor-owned utilities. These standards prescribe the process and requirements for independent generators of certain sizes to connect their projects to the grid – a basic prerequisite to selling renewable electricity. The North Carolina Public Utilities Commission also requires standard-offer purchase rates for renewable energy generators be determined every two years and published by each investor-owned utility; these rates establish the price that utilities pay for electricity generated by a renewable energy project that has 5 MW or less of capacity.

The standard-offer power purchase rates, called avoided cost rates, are an essential planning tool relied upon by project developers in determining whether or not to go forward with investments. The published standard-offer rates are available for a variety of term lengths, ranging from the variable rate which changes biennially with each new avoided cost proceeding before the Commission to a fixed rate over a 15-year term. The contracts, called power purchase agreements, through which utilities are required to purchase power from small producers like solar projects are reported as non-utility generators to the N.C. Public Utilities Commission.

Duke Energy's latest Commission filing detailing the company's contracts with non-utility generators shows nearly 123 MW of capacity under contract, 81.6 MW of which is from solar photovoltaic projects. Of the 30 MW of PV under contract with Duke Energy that had finished construction and were delivering power at the time of the report, nearly 2/3 had opted for a rate term of five years or less, meaning that the price those project owners receive for their power generation will change either every two or five years.

There is a clear trend in small power producers' choice of rate term – small-scale residential projects tend to opt for the short-term contracts under which the price they are paid for their output changes every two-to-five years, while large-scale projects, like many of those included in the nearly 52 MW under contract, but not operational at the time of the report's filing, almost universally opt for long-term fixed rates, typically 15-year terms or negotiated rates over similar or longer periods.

For more information on local, state, and federal incentives, see www.dsireusa.org

REC Markets Available to NC Solar Projects

NC Green Power is a voluntary program that allows electricity consumers in North Carolina to purchase green power from renewable energy generators. As of early 2013, the program supported 616 small-scale PV generators with a combined generation capacity of 2.84 MW and annual output of about 4,000 MWh/yr. See www.ncgreenpower.org

The NC-RETS registry maintains accounts for renewable generators in the state to track and sell their RECs. As of early 2013, the registry held records for 234 solar PV projects with more than 144 MW of generating capacity. The avgerage solar project size was 616.8 kW, and the median size was 159 kW. The registry also had 39 projects of with 1 MW or more of capacity, which together represent about 16% of registered projects but account for more than 70% of registered capacity. See www.nc-rets.org

North Carolina project owners interested in selling their solar RECs to buyers located in the Northeast where higher renewable portfolio standards may mean higher prices, register their project in the PJM GATS registry. As of early 2013, the PJM-GATS registry held 86 solar PV projects located in North Carolina with a combined capacity of 1.77 MW. These projects had an averge size of 2 kW and between November 2008 and May 2013 had been issued 20,182 RECs, 7,568 of which had been traded, and 13,504 were retired. PJM-GATS prices for NC-based projects ranged from 26.4¢/kWh to 36.2¢/kWh during 2012.

Solar Value Proposition

The avoided cost rate that solar generators are paid for their electricity output is the primary means through which a project earns revenue. Larger, multi-million-dollar projects typically have more complex financing structures that may include a mix of tax equity, secured or unsecured debt, and investor equity within a variety of corporate ownership structures. These sophisticated projects tend to select long-term rates to lock in a price and reduce financial risk from unanticipated future price movement. While some projects are far more complex than others, the basic value proposition is essentially the same.

Solar systems earn revenue by selling electricity into the power grid and by selling the environmental attributes of the renewably generated electricity in the form of assets called solar-RECs. In addition, project owners can claim tax credits equal to 35% of eligible expenditures against state tax liability and 30% against federal tax liability; after accounting for federal taxes on the state credit and discounting the state credit to the present day the combined value of these tax credits can equal 50% or more of a project's cost.

With the tax credit value and the price paid by utilities for electricity basically fixed to a limited number of options, the largest wildcard in determining a solar project is the value of the RECs. The renewable or environmental attributes represented by the RECs are sold separately from the underlying electricity, and need not be sold as a bundle with the electricity. In North Carolina there are several main options for selling RECs, including:

> N.C. Green Power purchases RECs at a standard tariff rate, currently 8¢/kWh, to supply the program's voluntary market demand, but this rate is only available to PV projects with less than 5 kW of capacity; larger projects are required to submit bids and compete with other projects using any eligible renewable energy resource including landfill gas, biomass, and small hydroelectric, among others.

> Retail power providers purchase RECs in order to comply with North Carolina's portfolio standard law which requires a minimum percentage of renewable energy in the utility's power supply. RECs that are sold to utilities for compliance with the REPS law are registered in the NC Renewable Energy Tracking System (NC-RETS) and when sold are transferred to the utility's account where they are retired once submitted, or claimed, by the utility for compliance.

> RECs generated by projects in North Carolina can also be sold to buyers in other states. Some buyers make voluntary purchases in order to claim they use renewable energy or green power, while others may purchase RECs for compliance with their own state's renewable portfolio standard. Aside from the NC-RETS registry, solar power producers may also register with the PJM Generation Attribute Tracking System (GATS), which functions much like the NC-RETS but is used by utilities located in the PJM regional transmission organization wholesale market.

The View Forward

Although North Carolina's policies and regulations set the stage for the rapid rise of the solar industry within the state, some acknowledgement must be made of the contribution provided by broader trends in the global solar value chain. In particular, the rapid reduction in the cost of solar panels has been a fundamental driver of increased market growth. Between the end of 2011 and the end of 2012 the price of solar modules declined by more than 40% from $1.15/Watt to $0.68/Watt, according to a recent report by the Solar Energy Industries Association. The reduction in module cost helped reduce the overall cost of a PV system during 2012 to $5.04/Watt in the residential market, $4.27/Watt in the non-residential sector and $2.27/Watt in the utility segment.

However, even at these lower costs, a PV system remains expensive. For example, a 100 kW non-residential system would cost $427,000 at these average prices. This hypothetical system could generate a federal tax credit worth $128,100, and a state tax credit (net of federal tax) worth a nominal $107,604 – a combined tax credit value of $235,704, about 55% of the project's cost, leaving $191,296 in overnight cost to be recovered by the system owner just to break even. If power produced by this 100 kW system was purchased by a utility at a nominal average rate of $0.08/kWh over a 20-year period annual sales of 119,560 kWh would be necessary to recover the remaining portion of the system's cost. This level of generation implies that the system would operate with an average effective capacity factor of 13.65%.

While the above scenario is not completely unrealistic in terms of system performance, it is a bit optimistic. Furthermore, the performance of a typical system degrades slightly from year to year, and the inverter and possibly other electronic components would likely need to be replaced at some point. Add to these expenses the cost of capital, the time value of money, and soft costs such as legal and accounting fees and insurance, and the financial viability of even a heavily incentivized PV system is eroded rapidly. Plus, a nominal $0.08/kWh is a higher price than a system installed in North Carolina could expect to receive over a 20-year period after adjusting for inflation, so when these factors are considered, the value of non-electric assets like the RECs takes on a very important role in establishing and supporting the market for solar.

Yet, in many states, North Carolina included, the requirements of the renewable portfolio standard policies that have driven demand for RECs and renewable energy in general have largely been met. For example, Duke Energy already has enough renewable energy under contract to generally remain in compliance through the end of this decade, and the company recently announced that it will rebate residential customers some of the few cents it charged per month to pay for the costs of meeting the portfolio stan-

dard. While utilities achieving compliance with the portfolio standard years in advance and at a much-lower-than-expected cost is surely a success for the technology, the potential sudden drop-off in demand for RECs could rapidly undermine renewable energy as an economic growth driver.

One option to avoid the disruption from demand for new renewable projects selected by policy makers in many states where portfolio standards were rapidly met was simply to increase the requirements, or alter the timing. Although North Carolina's utilities have already contracted more than enough solar projects to meet their obligation under the state's portfolio standard for the next 5 years, there are indications that renewable technology, and solar in particular, continues to have unmet, pent-up demand that exists independently of the portfolio standard.

One source of demand is corporations, particularly data centers. Duke Energy and Google announced plans for an industrial clean energy electricity rate, the proposal for which is expected to be filed in mid 2013. Also, many states are increasingly recognizing the restrictive nature of a largely tax-based incentive structure that eliminates many potential solar power generators or investors from participating in the market. Since tax incentives are only useful to individuals or businesses that have both a sufficient amount and the proper type of tax liability non-profit businesses, local governments, schools, hospitals, and many other potential market entrants are essentially penalized by being unable to take advantage of tax-based incentives. In addition to finding creative ways around the tax-based incentive limitation, policies are also being developed to remove other barriers such as lack of space or lack of sunshine on available space.

Expanding the Opportunity

Whether due to limits imposed by financing, access to solar resources, or electricity industry/market regulations, there remains a number of potential participants in the solar market who are unable to meaningfully engage. These and other barriers are being reduced and eliminated in a variety of ways through inovative policy approaches.

71.5% of the $1.04 billion invested in NC renewable energy projects since 2007 was invested in solar PV

Third-party Sales

Electricity remains a heavily regulated industry, and in most states electric utilities are granted monopoly rights as part of a retail franchise, meaning that only the utility may sell electricity to a retail user. The concept of third-party solar electricity sales enables a developer to install, own, and operate a solar system on a customer's property and directly sell that customer the electricity output from the system.

House Bill 657 was recently introduced in Georgia, whose electricity market is structured similar to North Carolina's, to allow just such an arrangement. The bill cites the public interest in encouraging broader participation in the deployment of solar electric generation and obstacles such as: lack of property rights or solar resource, inability to bear the up-front costs, difficulty in meeting contiguous real property requirements to operate shared solar generation facilities, and the lack of opportunities to own or purchase output from solar generation facilities. The proposed solution is a solar utility through which Georgia residents could purchase electricity from a solar facility located remotely and reduce their electric bill by the equivalent amount of solar generation.

Solar REIT

Another approach to increasing access to the solar market is to expand the access to finance for solar projects. The first Real Estate Investment Trust (REIT) for solar energy had its initial public offering on the New York Stock Exchange in April 2013 (Hannon Armstrong Sustainable Infrastructure Capital, NYSE:HASI), signalling that the IRS had provided a private letter ruling allowing the use of this structure for a renewable energy project for the first time. Using the REIT structure allows practically any investor to participate in a renewable energy project by buying shares of the REIT much like shares in a publicly held company.

Summary

North Carolina has become a national leader in the solar energy space, and as a result has reaped nearly a billion dollars in investment, attracted dozens of companies, and redefined the nature of competitiveness in renewable energy. The state's success is attributable to strong support from incentives, but also by ensuring fair and equitable access to markets, and enabling competition among electricity generation sources to occur.

Some may say the state's market is saturated and facing stagnation. Others, though, may point to recent news announcing 75 MW solar projects and increasing involvement of the state's utilities in the industry as a harbinger of continued movement toward greater market competition, support for innovation, and greater access to the marketplace. These trends could usher in a new era of solar energy competitiveness if individuals, businesses and other organizations are freed from artificial barriers, given the freedom to act according to their desires, and empowered to choose.

INDUSTRIES UPDATE: *SOLAR, BIOFUELS, EFFICIENCY & WIND*

Duke Energy's North Allegheny Windpower Project is located in Blair and Cambria counties, Pennsylvania – approximately 95 miles east of Pittsburgh. North Allegheny's 35 Gamesa wind turbines are capable of producing 70 megawatts of electricity, enough to power roughly 21,000 average-sized homes. All of the clean, renewable energy generated at North Allegheny is delivered to FirstEnergy under the terms of a long-term power purchase agreement.

Image Credit: Duke Energy Renewables

BIO-BASED FUEL

The past several years have seen biofuels markets become larger than ever and, in the case of ethanol, equally as ubiquitous as invisible. Nearly every gallon of gasoline sold in the U.S. today contains ethanol, often as much as 10% of the biofuel. Where the adoption of biofuels is concerned, the issue is no longer a question of "Will we use biofuels?" but instead a question of the extent to which biofuels production technology may reduce the cost of gasoline and diesel and function as a hedge against future price increasesd and oil market volatility and supply instability.

Ethanol

Year-over-year domestic ethanol production declined in 2012 by an estimated 4.6% from 2011's record levels to an estimated 13.3 billion gallons – the first such decline since 1996. With average annual production growth of about 37% per year during the past decade, ethanol has become a mainstay in the domestic fuel supply and most gasoline sold today contains about 10% ethanol, or E10.

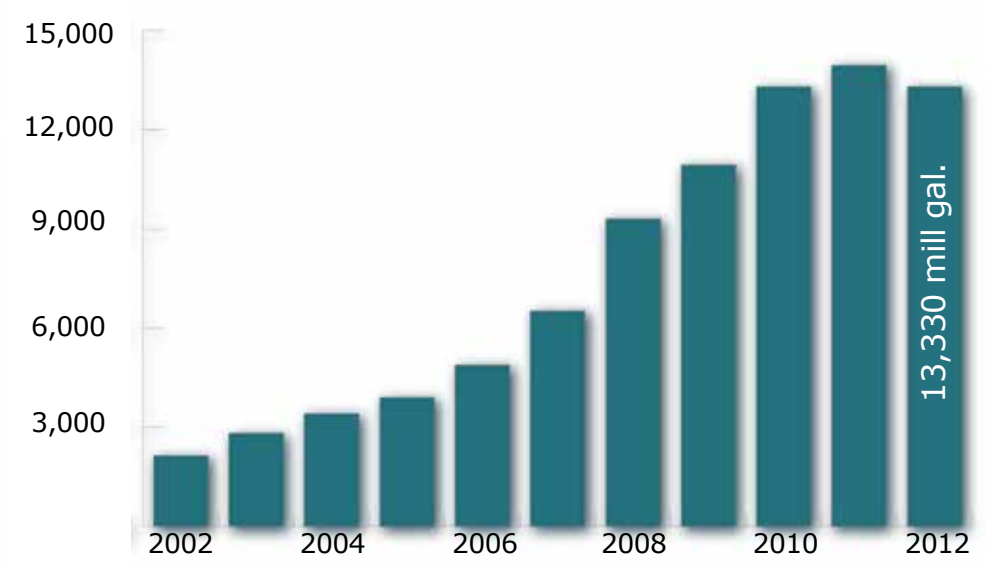
Overall, at the end of 2012 there were 211 ethanol production plants located in 28 states with the capacity to produce as much as 14.7 billion gallons per year, according to the Renewable Fuels Association. The ethanol market in 2012 is estimated to be worth about $30 billion – a 50% increase over 2009's market value, and about 2.5 times the 2006 value.

Top right: Ethanol production held steady in 2012 at more than 13.3 billion gallons in spite of adverse weather and market conditions, largely due to record-level corn planting. An economic impact study commissioned by the Renewable Fuels Association estimated the ethanol industry spent nearly $39.2 billion dollars, or about $2.95 per gallon, in production expenses during 2012 - more than 84.4% of which was for corn, the primary ethanol feedstock. The ethanol industry accounted for an estimated $43.4 billion of GDP during 2012, employing nearly 87,300 people directly and supporting almost 296,000 additional jobs which provided an estimated $30.25 billion in personal income.

Bottom right: The Renewable Fuels Standard (RFS) establishes targets for the blending of fuel produced from non-petroleum, renewable sources for major fuel distributors. Since its introduction in 2008, the standard has largely focused on more-traditional ethanol and biodiesel, but in the coming years the RFS increases the target level for next-generation advanced biofuels, such as ethanol made from cellulosic material and other non-food fedstock sources. Fuel suppliers either purchase renewable fuel directly, or buy renewable fuel credits called RINs which are submitted for compliance.

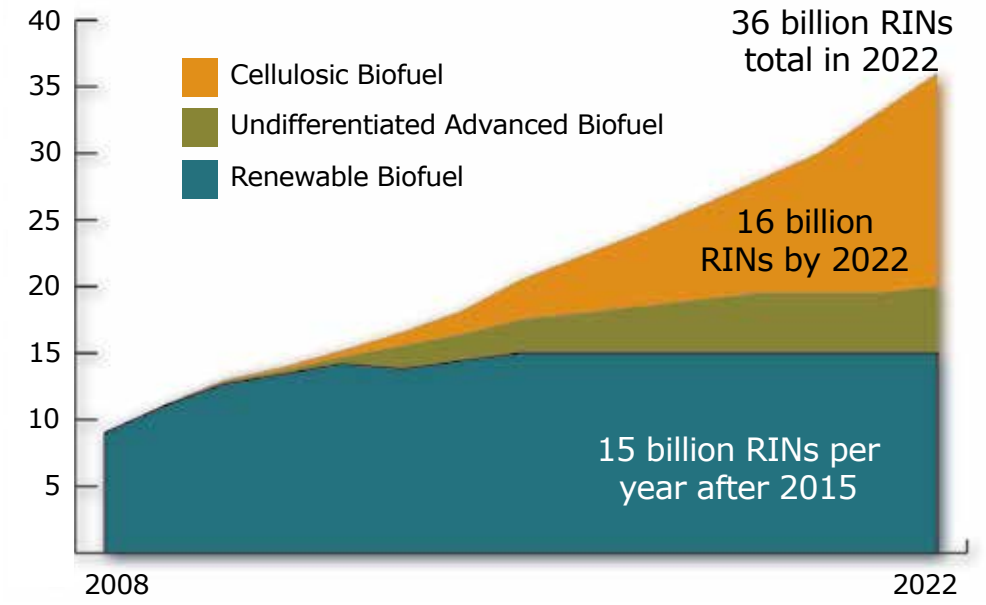
Annual US Ethanol Production, million gall. per year

Data Source: Renewable Fuels Association, 2013 Ethanol Industry Outlook



Renewable Fuel Standard (RFS), billion RINs per year

Data Source: Energy Independence and Security Act of 2007, RFS Schedule



The slight decline in ethanol production in 2012 is attributable to the combined effects of a variety of forces – economic-, technological-, and weather-related. Severe drought in the Midwest reduced corn yields by about 16%, and although the drought's effects were partly offset by the largest corn crop planted in half a century the decline in corn yields resulted in higher prices for ethanol's corn feedstock. Also, industry growth is beginning to bump against the E10 blend wall constraint, and until the 10% blend constraint is overcome changes in ethanol consumption will be highly correlated with gasoline demand that are, in turn, driven largely by economic output and oil prices.

Possibly the largest influence on the domestic ethanol industry's outlook for the current year will be the wildly volatile corn market. Last year's drought – the worst since the 1930s according to Bloomberg – drove corn prices to an all-time high and saw a handful of ethanol distilleries shuttered. However, market indications during the first few months of 2013 appear positive for ethanol producers.

The U.S. Department of Agriculture anticipates this year will see corn acreage increase from last year's record level to the most acres in 77 years. This increase in domestic production is being mirrored globally, with the result being declining U.S. exports as evidenced by the drop in the U.S.'s share of the global market from 33% a year ago to less than 25% currently. The increased supply of available corn in the domestic market has driven prices down from their 2012 high in excess of $8 per bushel to less than $6.50 per bushel as of early April 2013 and futures contracts indicate prices could continue to decline by as much as another dollar per bushel before the year's end.

Production and profits in the ethanol industry are highly sensitive to the price of corn, which in 2012 represented almost 85% of production costs. With abundant feedstock available at prices in line with the 2011 level and continued low natural gas prices (the second highest-cost production input), the ethanol industry could see another record setting year in 2013.

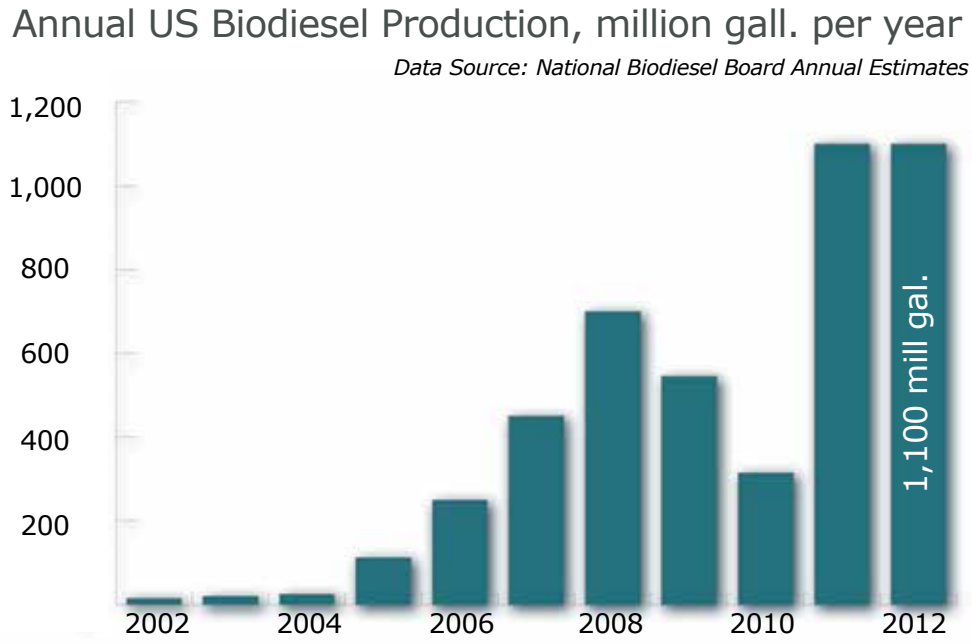
In the coming years the industry will benefit from increased feedstock diversification that should further reduce feedstock [and production] costs and somewhat insulate the industry from commodities market volatility.

Clockwise from top:
The biodiesel process line inside Appalachian State University Energy Center's Biodiesel Research Facility located at the Catawba County Eco-Complex. Process line components include the methoxide tank, reactor, wash, settling tanks, and feedstock pump and plumbing fixtures.

Oilseed presses and hopper pressing Canola crop in Catawba County's new feedstock processing station.

Outside view of the newly constructed feedstock processing station. The station is designed to produce as much as 50,000 gallons of feedstock oil per year, and currently has 2 of a possible 16 oilseed presses installed for a capacity to process 1 ton per day of oilseed.
Image Credit: Biodiesel Research Facility

Biodiesel production reached a milestone in recent years, exceeding one billion gallons. Current levels of production is far in excess of the Renewable Fuel Standard's 800-million-gallon target.
A recent National Biodiesel Board-commissioned study found that production of a billion gallons of biodiesel supports more than 39,000 jobs across the country and more than $2.1 billion in household income. According to the study, continued industry growth and the extension of the biodiesel production tax incentive could support creation of nearly 11,700 additional jobs by the end of 2013.



The most immediate opportunity on the horizon for traditional ethanol producers is the proposed Sugar to Ethanol Rule, under review by the White House as of early April 2013, which would allow excess sugar to be purchased by the federal government and resold to biofuel manufacturers under the Feedstock Flexibility Program for Bioenergy Producers.

Biodiesel

Much like the ethanol industry, biodiesel production remained comparatively flat from 2011 into 2012 at 967 million gallons and 969 million gallons, respectively. As of January 2013, the 110 U.S.-based biodiesel producers had a combined production capacity of 2.1 billion gallons per year. One notable shift in the biodiesel industry was the increase in sales of 100% biodiesel, called B100 – in 2011 B100 sales accounted for about 2/3 of the biodiesel market, and in 2012 that share increased to about 78% of biodiesel sales.

Biodiesel is made by reforming natural fats and oils using catalyst materials. Over 70% of biodiesel is produced from raw vegetable oils – in 2012 more than 4 billion pounds of soybean oil was used as feedstock for biodiesel production and represented 55% of all biodiesel feedstock by weight. More than 1 billion pounds of animal fat, representing 13% of feedstock by weight, was used to produce biodiesel in 2012, as was about 900 million pounds of recycled cooking oil.

While the ethanol industry is highly centralized and increasingly integrated as a component of mainstream gasoline – nearly all gasoline sold today has some ethanol – the biodiesel industry is much more amenable to a distributed model featuring local feedstock sources, local producers and local sellers. As of early 2013, the National Biodiesel Board reported that North Carolina was home to 43 retail biodiesel locations that serve the public.

Many of these stations offer biodiesel as a result of local community-oriented biodiesel businesses and sell biodiesel that is produced locally. According to the Energy Information Administration, North Carolina is home to 4 biodiesel producers with a combined production capacity of 10 million gallons per year; however, industry sources report 5 producers in the state with a combined production capacity of about 20 million gallons per year.

Notably, the state's only BQ-9000 certified producer, Piedmont Biofuels, is also a major supplier of equipment, education, and research that supports the industry's continued growth throughout the state. Among its many innovative activities, Piedmont Biofuels has developed an enzymatic biodiesel production process that both enables continuous processing (rather than currently used batch processing) and offers production cost reductions by using enzymes to replace caustic acids used in more traditional esterification methods.

Piedmont Biofuels: A Small Business with Big Innovations

Piedmont Biofuels is a small Pittsboro-based company that produces biodiesel using mostly waste cooking oil and grease. The company does much, much more.

Piedmont has taken a unique approach to the idea of business, producing equipment such as The Cavitator (pictured at right), seed presses, and the enzymatic FAeSTER reactor (developed as part of a collaborative research effort with Novozymes AS, pictured below) that is supplied to other small-scale biodiesel producers.

Piedmont also does research, education, and is at the core of the state's growing and well-organized community-scale biodiesel industry.

Piedmont is also a B-Corporation (see www.bcorporation.net), which is a type of corporate classification denoting a business' goal of addressing social and environmental problems via their business activities.

With Piedmont's expansive scope of activities and its relentless pursuit of supporting the industry's growth in communities across the state, saying that Piedmont Biofuels produces biodiesel is a gross understatement - Piedmont Biofuels is really producing a biodiesel industry.

Learn more at www.biofuels.coop

ENERGY EFFICIENCY & GREEN BUILDING

In the abstract, energy efficiency is easy to define – it is simply using less energy to accomplish the same amount of work or perform the same function. In practical terms however, energy efficiency includes the subset of all energy-using devices, facilities, and equipment that are more productive per unit of energy consumed than their peers.

The State of North Carolina's comprehensive, lead-by-example efficiency program, called the Utility Savings Initiative (USI), was begun in fiscal year 2002-2003. The program, as directed by statute, has a target of reducing energy consumption per gross square foot in all state buildings by 30% below the 2002-2003 fiscal year level by 2015.

At the end of 2012, a decade into the program, the $12 million investment of state appropriated funds have leveraged nearly $161 million in private investment to produce total savings of about $553 million – roughly $3.20 in savings per dollar of total investment. In fiscal year 2011-2012 alone, estimated energy savings were more than $105 million.

Energy efficiency improvements not only reduce energy costs, but efficiency also acts as a hedge against rising prices. When the USI program began, the cost of energy in state buildings was $12.57 per million metric Btu (mmbtu) but by the end of fiscal year 2011-2012 the cost of energy has risen 47% to $18.43/mmbtu. Over the same period, the USI program reduced energy consumption by 27%, from 164,147 Btu per square foot in fiscal year 2002-2003 to 119,822 Btu per square foot in fiscal year 2011-2012. Through the year 2020, the USI program is expected to save a cumulative $1.5 billion of tax dollars spent on energy at state facilities.

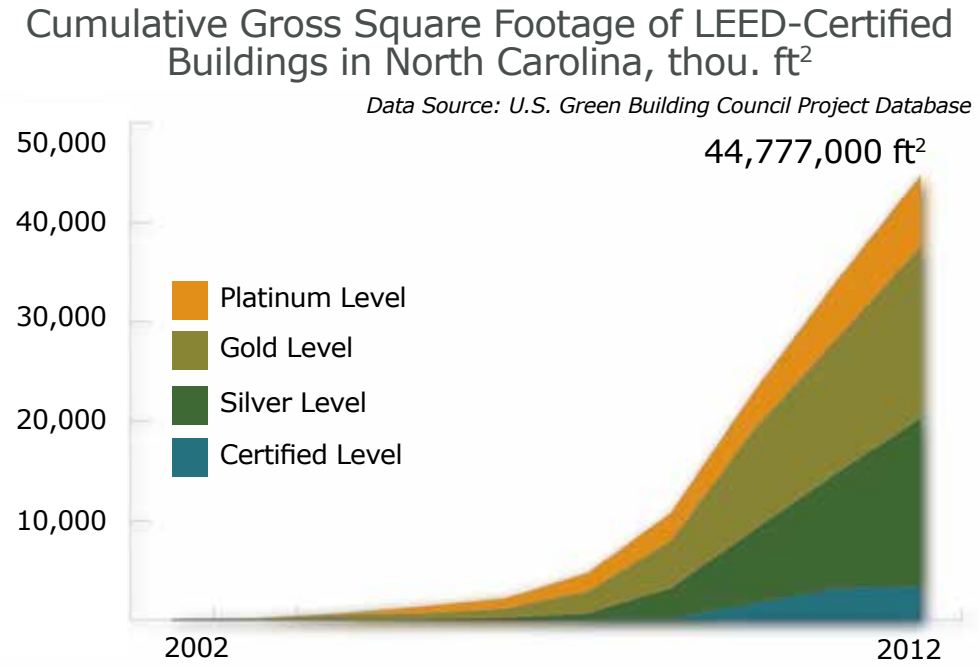
These savings are substantial, but the fact that they are relatively easy to obtain and so large in comparison to the level of investment highlights the abundance of inefficiency in the way we use energy. Had the buildings, equipment, and facilities that are the subject of efforts under the USI program been initially designed as high-efficiency or high-performance structures at the time they were constructed, then these savings would have been realized continuously throughout the life of the building. Several programs (e.g., ENERGY STAR and L.E.E.D.) that have emerged over the past couple of decades strive to ensure efficiency is a design feature rather than a retrofit.

Leadership in Energy & Environmental Design (LEED™)

The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) rating system is a building performance evaluation system to promote and recognize the use of high-performance green building practices in the design and construction of new buildings. The system includes required prerequisites and optional elements called credits across six dimensions which a building must meet, and based on the extent of achievement in meeting these standards, as determined by a third-party independent review, a building is awarded a LEED™ rating ranging from the minimum achievement of Certified to the maximum achievement of Platinum.

The six dimensions of LEED™ certification are: strategies related to site selection and design called Sustainable Sites, use of strategies to reduce indoor and landscaping water usage called Water Efficiency, use of energy efficiency and renewable energy called Energy & Atmosphere, measure of the use of recycled or renewable materials called Materials & Resources, and a weighted measure of the contribution to reduced greenhouse gas emissions called LEED GHG Index.

As of March 2013, the U.S. Green Building Council recognized 77 Chapters, 30,000 individual members; nearly 200,000 LEED™ credentialed professionals; almost 185,000 projects; and 10.6 billion square feet of projects. The program has also begun to be adopted internationally, with 22 associated international groups, ongoing discussion



By the end of 2012, nearly 44.8 million ft² of building space in North Carolina had achieved some level of LEED™ certification. The cumulative certified square feet in the state has doubled annually during 7 of the past 10 years. Among certification-level achievement, Silver and Gold are basically tied for the lead market share with 38.5% and 37.5% respectively, while the top-tier certification level of Platinum held 7.8% of the cumulative square footage certified despite the fact that the state's first Platinum-certified facility was a 21,000 ft² project certified only 5 years ago in 2007.

with 42 counties about development of green building councils, and member councils in 28 countries. North Carolina is home to three regional chapters of the U.S. Green Building Council: Piedmont Triad North Carolina Chapter, North Carolina Triangle Chapter, and the Charlotte Regional Chapter.

As of early 2013, the 451 projects in North Carolina that had achieved a LEED™ credential since 2002 had a combined area of nearly 47.2 million square feet – about 77% of which were certified either LEED™ Gold or Silver. Market indicators demonstrate a strong near-term future for the high-performance green building industry in North Carolina with the LEED™ program database showing more than twice as many projects and square feet in the pipeline as have been credentialed during the past decade.

ENERGY STAR

Unlike the more comprehensive LEED™ program, the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® certification is more narrowly focused on energy usage. Last year marked the 20th anniversary for the ENERGY STAR® program; the program initially labeled computers and monitors, expanded to include residential housing in 1996, and today includes tens of thousands of products ranging from major appliances and office equipment to new homes and commercial/industrial facilities and plants.

The North Carolina Energy Efficiency Alliance is a collective of organizations and businesses working to stimulate the market for energy efficient construction throughout the state.

North Carolina Energy Efficiency Alliance

The Alliance is dedicated to educating stakeholders in the home building industry about the benefits of ENERGY STAR homes. For more information on the NCEEA, visit www.ncenergystar.org

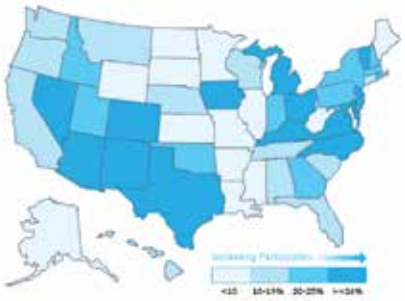
According to the latest awareness survey, more than 80% of Americans recognize the ENERGY STAR® label. The program has been widely touted as quite possibly one of the most successful governmental campaigns in history, and in 2012 alone claimed to have delivered energy and cost savings worth $24 billion to the U.S. economy. The program's impact is increasingly apparent as evidenced by the milestone achieved in 2010 when 25% of all single-family homes built in the U.S. earned the ENERGY STAR® label.

Charlotte, N.C. was recently recognized by the EPA as one of the Top 25 Cities for ENERGY STAR® buildings, ranking #14 out of all U.S. cities with 133 buildings occupying 17.2 million square feet of floorspace certified in 2012. These certified buildings are projected to realize annual cost savings of more than $15 million, and prevent the emissions equivalent to 10,800 homes' electric use.

North Carolina also ranked 11th among states with the highest share of new homes receiving the ENERGY STAR® Homes label, with 29% of new homes constructed during 2011 receiving the label. As of early 2013, the EPA reports a cumulative total of 42,711 ENERGY STAR-certified homes in North Carolina – 35% of which were

ENERGY STAR % Homes 2011 by state

Source: ENERGY STAR, U.S. EPA



North Carolina is among the top states for the portion of new homes built to the ENERGY STAR standard, and is far and away the leader in the Southeast region.

Cree's Reinvented Light Bulb

The Durham-based N.C. State-spinoff announced its $10 LED light bulb in early 2013. The glass-domed bulb looks similar to the traditional 60W incandescent bulb it is intended to replace, but unlike traditional bulbs, Cree's comes with a 10-year warranty, has an expected lifetime of 25,000 hours, and uses about 85% less energy than an incandescent bulb.

Cree's new bulb is considered the first affordable LED lamp, and is expected to drive the consumer transition from incandescent bulbs to high-efficiency LED lamps over the next decade.

The company has already hired about 200 people to manufacture the new bulb in Durham, increasing its workforce of 2,335 by about 8.5%.

built in 2011 or later. In the non-residential building sector, North Carolina is homes to 1,114 ENERGY STAR-certified buildings – nearly 44% of which have been certified since 2011.

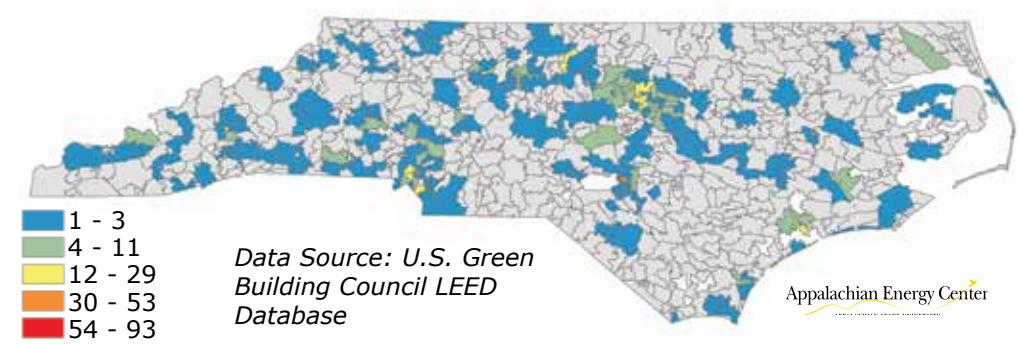
Green Building Geography

The LEED™ certification program has been most readily adopted in the commercial building sector, including corporate offices and government buildings. As a result, most zip codes in the state have no LEED™-credentialed buildings, as evidenced by the grey-colored zip code areas in the maps below.

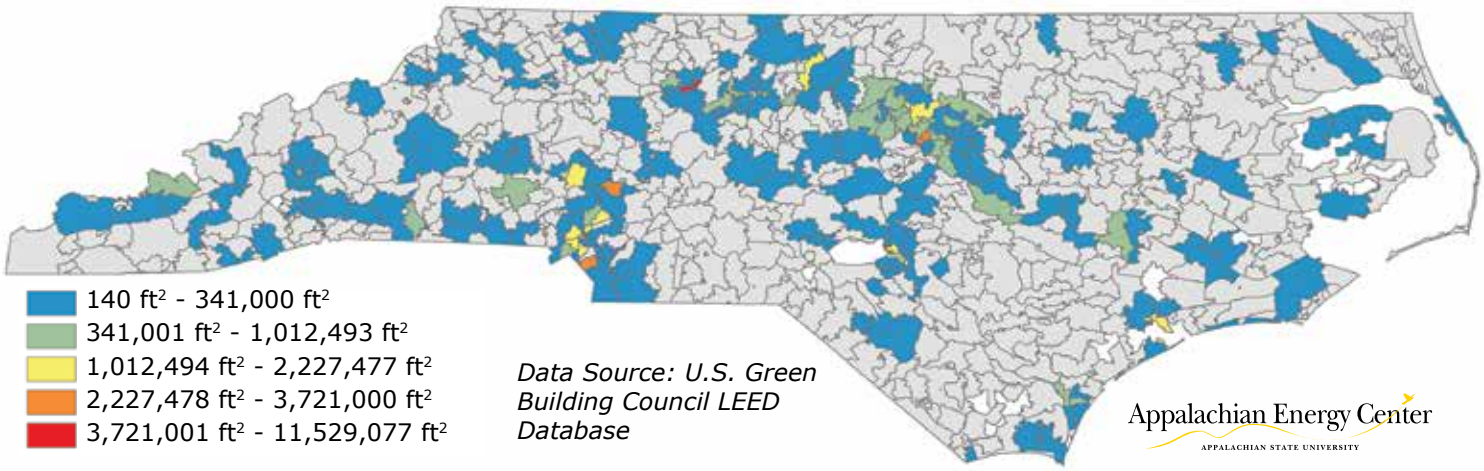
The isolated pockets of the state where there are a substantial number of credentialed buildings and the most credentialed gross square footage tend to be in either a major urban area such as Charlotte, the Triangle, or the Triad; or in an area with a concentration of government facilities such as the Great Smoky Mountains National Park, Ft. Bragg, and Camp Lejeune.

As demonstrated by the zip code maps, the highest concentrations of credentialed buildings tend to be in zip codes so small that they are almost not noticeable in a state-wide map, but these zip codes typically represent high density developed areas.

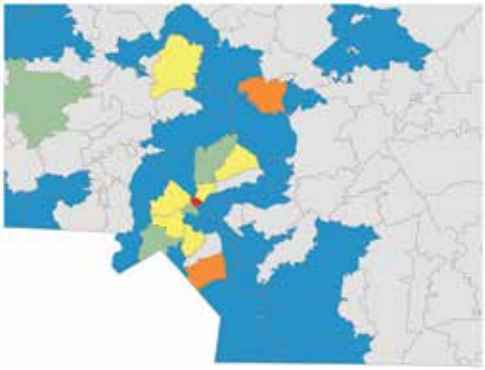
Number of LEED-certified Buildings by Zip Code



Gross Square Footage of LEED-certified Buildings by Zip Code



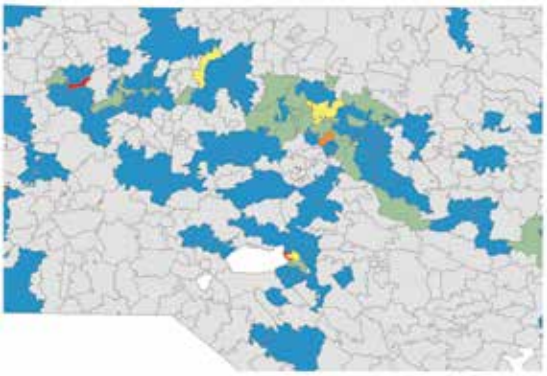
Charlotte Area



Left: The center city zip code in Charlotte is among the top three zip codes in the state for LEED™-credentialed gross square footage. Surrounding zip codes also have large amounts of credentialed square footage.

Right: In the central part of the state, zip codes in Winston-Salem and Ft. Bragg are two of the three zip codes with the most LEED™-credentialed gross square footage.

Central/South-Central NC



PHOTOVOLTAIC CELLS

Solar energy is the fastest growing energy source in the U.S. bar none. In fact, according to a recent report from the Solar Energy Industries Association (SEIA), the industry has set a record for annual installations every single year for more than a decade. A reported 3,313 MW_{dc} of photovoltaic (PV) capacity was installed in 2012, bringing cumulative installed PV capacity to nearly 7.3 GW.

The $11.5 billion solar market is slowing down, relatively speaking, with year-over-year growth declining to 76% above 2011 installations in 2012. While the industry is expected to continue setting new installation records in coming years, the compound annual growth rate (CAGR) is projected to decline substantially from the 82% CAGR experienced during the 2009-2012 period to a more modest and sustainable 28% CAGR for the 2013-2016 period. That is, however, hardly a concern for solar proponents and industry stakeholders as new installations in 2015 are projected by SEIA to equal the current cumulative installed capacity of about 7,000 MW.

Growth in the solar PV market is being largely driven by utility installations which accounted for almost 54% of 2012 installations with 1,781 MW, and realized year-over-year growth of 134% to surpass installations in the commercial market segment for the first time. Not surprisingly, large-scale utility projects featured installations with the lowest cost rate with the average utility project reaching an installed cost of $2.27/$W_{dc}$ by the fourth quarter of 2012 – nearly 30% lower than the installed cost at the end of 2011.

Overall, the low cost and large price decline driven by utility projects drove the U.S. average price down by 26.6% from $4.10/$W_{dc}$ in 2011 to $3.01/$W_{dc}$ by the end of 2012. Prices in the residential market segment fell by about 18% to $5.04/$W_{dc}$, and by 13.5% in the commercial segment to $4.27/$W_{dc}$ during 2012. Quite possibly the most startling price drop was the 41% decline in module prices which fell from $1.15/$W_{dc}$ in 2011 to $0.68/$W_{dc}$ in 2012, due to intense global competition and the persistent global oversupply of polysilicon.

Manufacturing & Trade

While there are a variety of different technologies that fall under the heading photovoltaic, crystalline silicon forms of PV have dominated the market to such an extent that PV cells have become practically commoditized. This intense price-based competition has led to substantial supply-side turmoil in the industry with numerous bankruptcies and plant closings as well as mergers and acquisitions announced during 2012 – all within a global trade context where tariffs and international trade organization complaints seem to have become as commonplace as, well, sunshine.

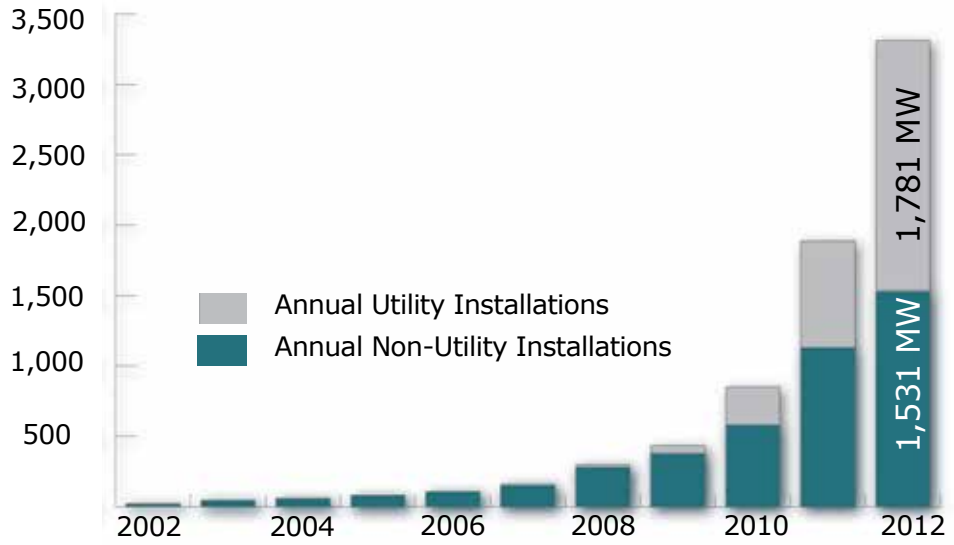
Upstream solar manufacturing – from raw polysilicon to wafers and cells – is very capital intensive and highly automated, meaning that it can occur virtually anywhere. Chinese companies, however, represented about 1/5 of global PV cell production capacity in 2010, according to a report from the Congressional Research Service (CRS).

Domestic manufacturing activities in the PV industry included about two dozen facilities involved in upstream production of raw materials or wafers (precursors to PV cells) in 2011, according to data from the Solar Energy Industries Association. Since then about 10 production facilities have announced closures, while about the same number of new facilities have announced plans to open, according to the CRS report. The overall outcome is an import-dominated industry, with the U.S. importing almost $5.1 billion worth of PV cells and modules in 2012 and exporting only about $468 million that same year, according to the latest data from the U.S. International Trade Commission.

Solar power capacity continues to grow at a breakneck pace in the U.S. and North Carolina. Spurring the industry's exponential growth experienced during the past three years is the rise of installations attributable to the utility market segment. The chart at right shows annual capacity installations of PV systems in the U.S. over the past decade, divided between installations by the utility segment and non-utility segments (i.e., residential and commercial). Although utilities have been increasingly active in the solar market over the past three-to-four years, last year was the first time in the industry's history that electric utilities represented more than half the market for solar PV.

U.S. Annual Solar PV Capacity Installations, MW

Data Source: GTM and Solar Energy Industries Association



Within the PV manufacturing value chain, the most common domestic activity is the relatively labor-intensive module assembly, for which facilities existed in about 25 states during 2011. Also, commonly sourced domestically are balance-of-system and -plant components such as wiring, inverters, and mounting equipment. Trade assessment data reported by the CRS indicated that the amount of U.S.-sourced content in inverters was about 45% in 2010, mounting structures were about 94% U.S.-sourced, and miscellaneous electrical components were almost 60% domestically sourced in 2010.

Production of these balance-of-system and -plant components as well as module assembly operations support many of The Solar Foundation-estimated 25,000 manufacturing jobs in the PV sector.

National Solar Jobs Census, Jobs by State

Source: The Solar Foundation

Solar energy is the fastest growing source of new electricity generating capacity in the U.S. - a fact that is well reflected in the industry's employment figures. As of Fall 2012, The Solar Foundation's National Solar Jobs Census reported more than 119,000 solar jobs nationwide - a 13% increase from 2011 figures. For purposes of the census, a solar job is one where solar-related work represents at least 50% of the employee's time.

The Solar Jobs Census reported the industry was expected to grow employment by 17%, adding as many as 20,000 jobs during 2013, bringing the total to nearly 140,000 solar jobs nationwide - the vast majority of which represent new positions rather than the addition of solar responsibilities to existing positions. The majority of employers require some solar work experience at least a 4-year college degree for new hires.

Asheville-based FLS Energy's owned-and-maintained Evergreen Solar Farm located in Canton, NC. This 550-kW project has 2,340 solar panels and has been in operation since December 2009.

A close look at the base of the solar panel mounts reveals an unusual style of ground mount. Ballasted mounts are typically used for rooftop installations where penetrating the roof isn't an option, but in this case the solar farm is constructed atop a closed landfill and regulations prohibit the mounting footers from penetrating the landfill cap.

Image Credit: FLS Energy

FLS Energy Named #1 Top-100 NC Companies by INC. Magazine and #7 Top 100 Energy Companies

FLS Energy was recognized by Inc. magazine in 2011 as the 46th fastest growing company in the U.S., and in 2012 was ranked 109th on the Inc. 5000 list based on the company's 3-year growth 2,727%. The company, which mostly builds, owns, and operates solar thermal systems at industrial, agricultural, and commercial facilities and then sells the heat output to the company to displace purchases of fossil fuels. The company has also been recognized as #7 of Inc.'s Top 100 Energy Companies and #1 of the Top 100 North Carolina Companies in 2012.

Leading Solar PV Mounting Equipment Manufacturer Locates Facility in Shelby, NC

In August 2012, Schletter, Inc. announced a new production and distribution facility to be located in Shelby, NC. The $27-million facility is expected to employ 305 people by 2016 at nearly 25% more than the average county wage, and serve as the hub of the company's east coast operations. Schletter is a leading producer of solar mounting equipment and produces about one-quarter of all domestically produced and sold solar mounting systems at its Arizona facility.

Wake Forest University Nanotech Center Solar Spinoff

Camel City Solar was spun off from Wake Forest University's Center for Nanotechnology and Molecular Materials and has plans to commercialize a three-dimensional solar cell design thought to yield as much as three times the power of more traditional solar cell designs.

WIND TURBINES

With a record-setting 13,131 MW of new wind power capacity installed in 2012, cumulative wind capacity in the U.S. grew nearly 28% year-over-year, and surpassed the 60 GW mark. Wind markets remained relatively unchanged in 2012, with Texas remaining firmly entrenched as the top wind power state with 12.2 GW of wind capacity installed, and followed by California, Iowa, Illinois, and Oregon – these top 5 states combined represent almost half of installed capacity in the U.S.

However, the outlook for the industry in 2013 – possibly even well into 2014 – is far bleaker. After experiencing several years with a fairly certain policy environment, expiration of the industry's primary incentive – the Production Tax Credit (PTC) – loomed on the horizon throughout 2012. The PTC was only renewed in early January 2013, and then only through the end of this year, albeit with a "begin construction" safe harbor rather than the typical placed-in-service requirement.

Nonetheless, policy uncertainty driven by the on-and-off-again PTC has confounded an industry that saw more than $25 billion in private capital invested to construct new wind projects during 2012, bringing new wind project construction to a virtual halt during the last half of 2012. As a result of this policy instability, the 25,500 manufacturing-related jobs at 559 facilities in 44 states which are supported by the wind industry were placed in jeopardy. The last-minute renewal of the PTC appears to have staved off the most devastating effects as new projects have entered the pipeline and orders are being placed – at least until the next round of PTC-related uncertainty rears its head later this year.

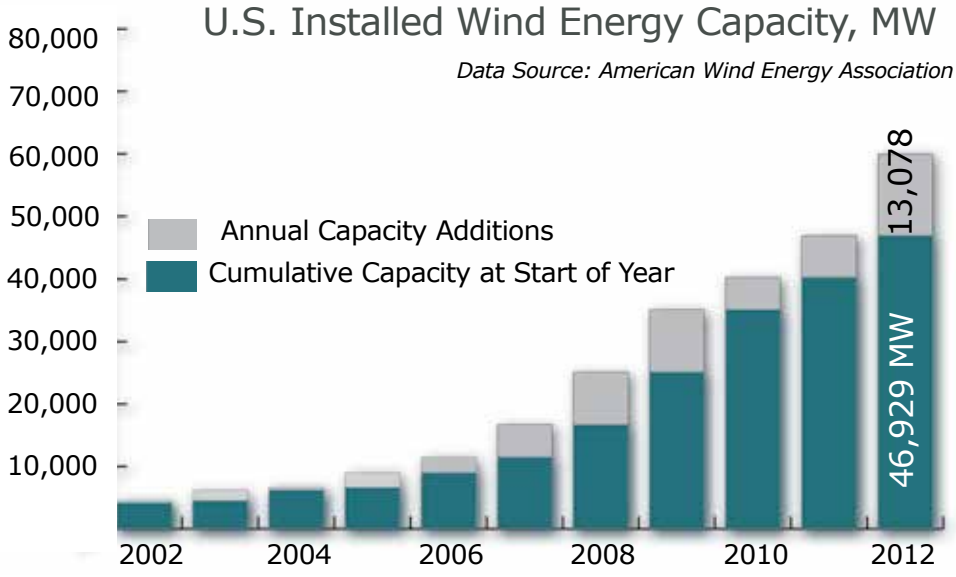
Technology & Performance

Wind technology has continued to climb into the sky, literally, with the average hub height exceeding 80 meters and 1,071 turbines installed during 2012 resting on 100 meter towers. These and other technological improvements have contributed to ever-increasing output; both Iowa and South Dakota now produce more than 20% of their electricity from wind, and 10% of the electricity on the Texas grid is from wind.

Wind has also shown itself to be a least-cost resource. A subsidiary of American Electric Power, a top coal-burning utility nationally, began purchasing 359 MW of wind power from projects located in Texas, Oklahoma, and Kansas to supply retail demand in Louisiana. As a result, the utility's customers will experience an average decrease in cost of 0.1¢ per kilowatt-hour over the next decade.

Wind Energy Project Installations by completion date and project size

Source: American Wind Energy Association



Project Installations (top right): Wind turbines continued to be installed at a record pace across the U.S. during 2012, with projects ranging in size from hundreds of kilowatts to hundreds of megawatts. While the Southeast has only 3 wind installations, one of which is Appalachian State University's 100-kW turbine, other areas such as west Texas, Idaho and Wyoming have strong project pipelines that are constrained by limited transmission capacity and awaiting planned transmission construction. Installed Capacity (right): A record-setting 13,100 MW of wind was installed in the U.S. in 2012, bringing the cumulative total to about 60 GW of installed wind capacity.

Manufacturing

Turbines from more than 59 manufacturers have been installed in the U.S. to-date. General Electric is by far the leader, cumulatively having provided more than 24 GW – 40% – of wind turbines in the U.S. market. Vestas holds the second largest cumulative market share of the U.S. market with 11.4 GW of turbines installed, and Siemens is ranked third with about 8.5 GW of turbines installed, as of the end of 2012; combined these top three manufacturers represent more than 73% of cumulatively installed domestic wind turbine capacity.

Perhaps, an even more encouraging signal for the American economy is that the domestic content of installed wind turbines reached about 67% in 2011, according to the U.S. International Trade Commission and the U.S. Department of Energy. This represents a rapid expansion of manufacturing capacity which saw the domestic content of wind turbines at only 25% as recently as 2005. Today, the wind turbine supply chain has an American Wind Energy Association-estimated 13 utility-scale blade facilities, a dozen facilities to produce wind turbine towers, and a dozen turbine nacelle assembly facilities located across 18 states. Downstream and specialized component production occurs in 44 states.

Wind Energy Manufacturing Facilities

Source: American Wind Energy Association

During 2012, 44 states hosted at least one of the 559-plus manufacturing facilities actively serving the U.S. wind turbine production supply chain. Production facilities in 18 states provided key subassemblies, including 12 nacelle assembly sites, 12 tower facilities, and 13 utility-scale blade plants. Today, all 50 states have either a wind project, a related manufacturing facility, or both.

Offshore Wind for the Mid-Atlantic Region

The first offshore backbone electricity transmission system proposed in the U.S. will start with development of the New Jersey Energy Link. The project is being developed by a consortium of industry that includes Trans-Elect, one of the country's first independent transmission companies, Good Energies, Google, and Marubeni Corporation.

When complete, the AWC backbone is expected to connect 7,000 MW of offshore wind power using High Voltage Direct Current (HVDC) technology, and could result in as many as 43,000 permanent operations and maintenance jobs according to an AWC-cited Department of Energy study.

Following a Dept. of Interior determination in May 2012, AWC announced the NJ Energy Link as the first phase and selected Bechtel and Alstom to provide engineering and construction support in January 2013.

Atlantic Wind Connection Schematic

Source: Atlantic Wind Connection

For more information and project updates, visit www.AtlanticWindConnection.com

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