

# SEA POWER

## South Carolina's Offshore and Nearshore Wind Resource Coincidence with Electrical Demand Load



Offshore and nearshore wind resources can provide energy at high-demand peak periods.

Electric utilities in the southeast usually experience high-demand peak electrical demand during the summertime. To supply power at peak demand, utilities may rely on more expensive power plants, like combustion natural gas turbines. However, a natural phenomenon in coastal and offshore areas may help supplant these higher cost peaking power plants. The Sea Breeze Effect occurs when cool ocean air rushes inland where warmer air is rising; this effect is prominent on hot summer afternoons when utility load demands are high.

South Carolina's offshore wind resources would be able to provide high value, and high demand energy when it is needed the most: hot summer afternoons. Based on this research, South Carolina's Sea Breeze Effect is positively correlated with a state utility's hourly electrical demand during summertime. Therefore, offshore wind energy resources have good coincidence with electrical demand load.

### Findings

South Carolina's offshore and nearshore wind resources are positively correlated with utility demand during the peak-demand energy months of June, July and August.

As electrical demand increases in the summer afternoons, offshore and nearshore wind resources generally increase.

Offshore and nearshore wind farms may be able to offset more expensive peaking power stations by providing valuable peak power.

Offshore and nearshore wind capacity factors are highest during the winter months of December, January and February.

## Wind energy has rarely been viewed as a peaking generation resource.

Wind energy is playing a more predominant role in electricity generation around the world and especially in the United States. Despite the surge in wind energy development, common misconceptions about this resource still remain. One of these misconceptions is that the wind does not blow (and thus, cannot create electricity) when electric power utilities require that electricity the most. To the contrary, wind farms in nearshore and offshore areas are likely to have good coincidence with electrical demand load; especially with electric utilities in the southeast due to the Sea Breeze Effect. The Sea Breeze Effect is the process whereby winds move inward from the ocean to the land, and back again, due to temperature differences between the landmass and ocean. To test this premise, electrical generation data from three theoretical offshore wind farms off South Carolina's coast were compared against an hourly demand load profile of a major electric utility in South Carolina.

## The Sea Breeze Effect may put a different spin on that point of view.

The Sea Breeze Effect occurs in coastal areas. As the ocean and landmasses warm and cool in a cyclical fashion throughout the days and nights, the two bodies lose and gain heat at different rates. Water radiates and absorbs heat from the sun at a slower rate than land. During hot summer afternoons, as the land absorbs heat at a faster rate than the ocean, the hot air mass above the land rises creating a vacuum. That vacuum is then filled by the cooler air mass above the ocean. From the shore, an observer should feel a sea breeze coming from the ocean in the late afternoons on hot summer days. This effect can occur at anytime of year. During the winter, for example, an opposite sea breeze can be felt early in the mornings when the colder land air mass is rushing over the shore to fill the void left by the warmer ocean air rising.<sup>1</sup> If nearshore or offshore wind farms can capture sea breezes, those wind farms will be well positioned to supply the real-time needs of a utility.

### Graphical Representation of Sea Breeze Effect (afternoon)



Temperature differences between a landmass and a body of water drive the Sea Breeze Effect. Landmasses heat up quicker than bodies of water. As the landmass air warms, it begins to rise. With the rising air, a vacuum is created and the relatively cooler air over a body of water (which is heavier and closer to ground level) begins to fill the vacuum – creating a summer afternoon's breeze offshore and nearshore.

## Peak-Power is High Value Power.

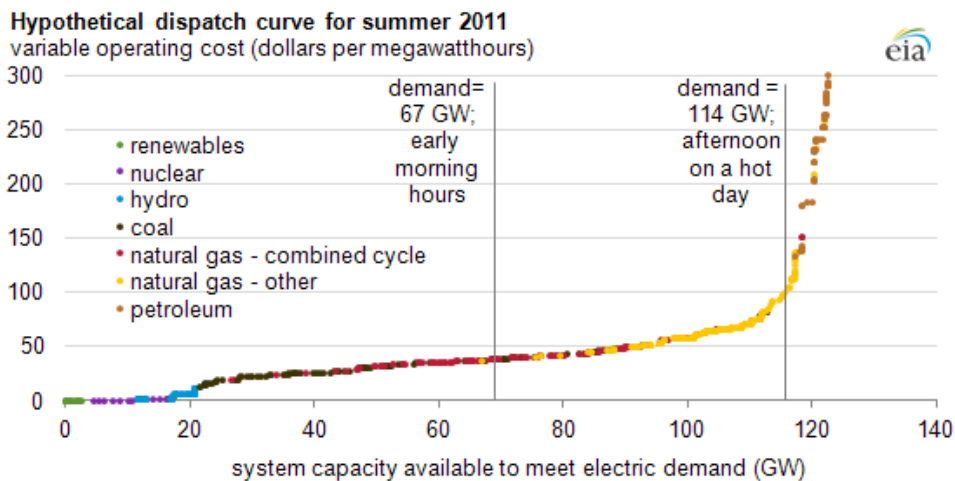
Peaking generation power plants are used minimally, but are required to quickly generate electricity and rapidly ramp up to meet the required electrical load. Peaking generation power plants can use diesel, petroleum, or more commonly, natural gas as a fuel source.<sup>5</sup> The power plant's minimal use, rapid and inefficient response as well as the use of fuels that are subject to price volatility make peaking generation an expensive generation resource. Nevertheless, peaking generation provides vital electrical resources when utilities need it most to prevent brownouts and blackouts. As such, utilities will pay more for peaking generation to ensure electrical reliability.

If offshore wind farms are capable of supplying peak power, utilities would not have to rely on more expensive peaking generation units.

## Sea Breeze Effect Occurs Offshore and Nearshore.

In 2007, an American offshore wind development firm published a report on offshore wind energy's capability of matching a utility's summer demand.<sup>2</sup> The Cape Wind project off the coast of Massachusetts has a tower constructed several miles offshore that collects wind speed data. The data show that if that project were constructed, the electricity it would produce would coincide with summertime peak electrical generating demand. Cape Wind provides anecdotal evidence for the Sea Breeze Effect's implications for offshore wind development.

Similar evidence suggests the Sea Breeze Effect also occurs in nearshore areas. In 2011, on a hot afternoon in Texas, numerous natural gas power plants and at least one coal-fired power plant suddenly went offline due to excessive heat.<sup>3</sup> Newly built coastal wind farms provided power when the Texas grid manager needed the electricity most due in part to the sea breeze effect.<sup>4</sup> Therefore, the Sea Breeze Effect is not only a phenomenon for offshore, but also nearshore areas.



Note: The dispatch curve above is for a hypothetical collection of generators and does not represent an actual electric power system or model results. The capacity mix (of available generators) differs across the country; for example, the Pacific Northwest has significant hydroelectric capacity, and the Northeast has low levels of coal capacity. This dispatch curve does not show all costs associated with electric generation, such as capital costs.

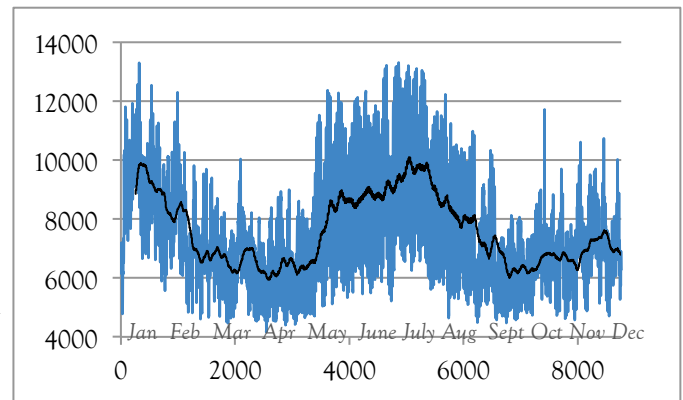
## South Carolina's Power Demands are Highest in the Summer.

Progress Carolinas was the fourth largest electric utility in South Carolina until it recently merged with Duke Energy.<sup>7</sup> The hour-by-hour electrical demand load profile of Progress Carolinas is available through the Federal Energy Regulatory Commission Form 714, along with Progress' hourly generation cost (system lambda) for 2007.<sup>8</sup>

Progress Carolinas' electrical demand tends to peak in the summer months from late May to early September (represented approximately by hours 3,500 – 5,500). During the wintertime, peak electrical demand also occurs from January to February (represented approximately by hours 0-500), albeit at a lesser intensity relative to the summer months. Of the top 10% of electrical demand hours, the vast majority of them occur in June, July and August (see Chart 3).

Another way to determine the importance of electrical generation is to evaluate at the cost of electricity at a particular hour. The higher the electrical cost, presumably the more important electrical generation becomes at that particular time. One way to determine these costs is by evaluating a utility's cost to generate the next megawatt-hour (MWh) of electricity, also called the "system lambda".<sup>9</sup> For Progress Carolinas, the 2007 top 10% of system lambda costs ranged from about \$74 per MWh to about \$237 per MWh. Unlike the top 10% of electrical demand hours, most of the top 10% system lambda costs in 2007 occurred during the winter months of January and February (see Chart 4). This result seems inconsistent with trend where high demand periods occur during the summertime. The inconsistency may be due to the availability of only a single year of data. System lambda costs tend to increase as a utility's ability to serve peak demand decreases; thus forcing the utility to buy electricity on an open market that may also be full of other utilities bidding for that same peak power.

**Chart 2: Progress Carolinas Annual Electrical Demand 2011 (MW, by hour)**



Source: Progress Carolinas, FERC Form 714. Rolling average indicated by black line.  
Hour 0 = 12AM, January 1, 2011

**Chart 3: Top 10% Avg. Hourly Demand Load Occurrences (Average 2006-2008)**

January	10
February	5
May	11
June	195
July	271
August	313
September	67
December	4

Source: Progress Carolinas, FERC Form 714.

**Chart 4: Top 10% System Lambda Cost Occurrences (2007)**

January	238
February	207
March	102
April	105
May	5
June	4
August	74
September	36
October	45
November	4
December	56

Source: Progress Carolinas, FERC Form 714.

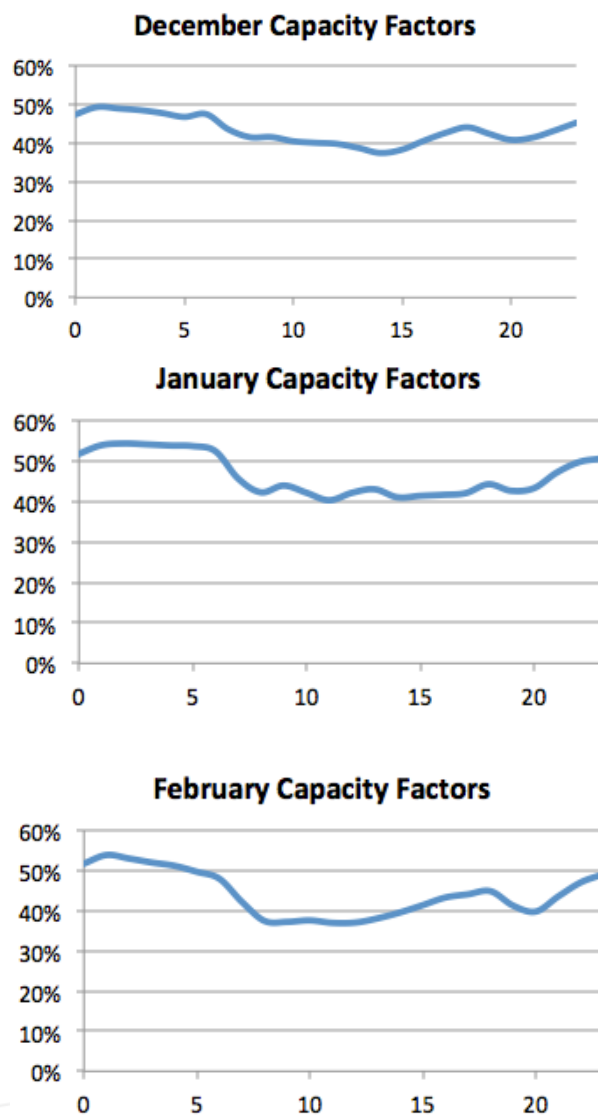
## South Carolina's Sea Breeze Effect is Strongest in the Summer.

A report completed in 2011 by AWS Truepower estimated offshore wind energy output for three potential offshore wind farms off South Carolina's northeastern coast.<sup>10</sup> For each of the three potential wind farms, 10-minute scale wind speed data files were created based on historical data from January 1, 1999 to December 31, 2008. For the purposes of this report, the data files were aggregated from 2006-2008 (to match data available from Progress Carolinas) and narrowed down to the wintertime and summertime periods.

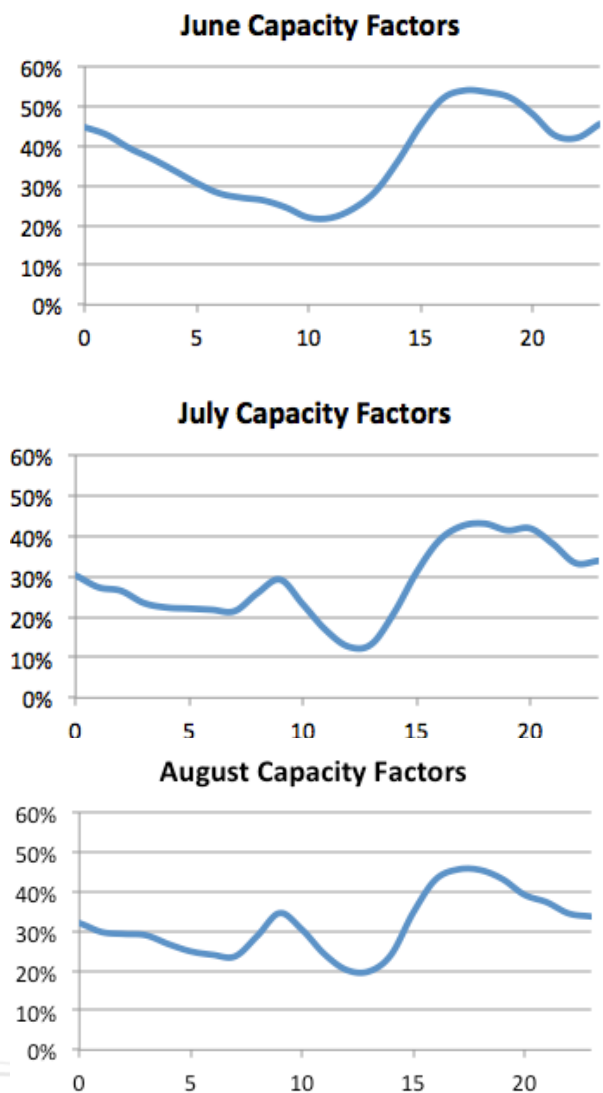
As can be seen by Chart 5, the Sea Breeze Effect during the summer months is most pronounced in the afternoon (especially around 5PM and 6PM). The wintertime Sea Breeze Effects are less pronounced but can generally be seen in the morning and afternoon (peaking around 6AM) and the lesser effect occurring in the evening (peaking around 6PM).

**Chart 5: Seasonal Offshore Wind Energy Output by Hour**

### South Carolina Wintertime Output



### South Carolina Summertime Output





## South Carolina Sea Breeze Effect Matches Peak Demand.

Modeled offshore wind generation off of South Carolina's coast continually increases from 1PM to 6PM particularly during the summertime. Of Progress Carolinas' top 10% load hours (top 876 hours in a year), South Carolina's offshore wind resource is readily available. During Progress Carolinas' average top 10% load hours from 2006-2008, the average capacity factor for modeled offshore wind resources was approximately 39%. Modeled offshore wind resources match Progress Energy's top 10% system lambda hourly costs (top 876 hours in a year) better than top load hours. During Progress Carolinas' top 10% system lambda hourly costs in 2007, the average capacity factor for South Carolina's offshore wind resources was approximately 41%. The vast majority of both the peak loads and number of peak load hours occurs in the months of June, July and August.

Wintertime offshore wind energy generation resources are generally more abundant than the summertime resources. Since most of the peak system lambda costs occurred in the winter months of January and February, wintertime offshore wind resources are potentially extremely valuable to South Carolina utilities. Additionally, wintertime offshore wind resources obtain higher capacity factors and fluctuate less than the summertime resources.

The summertime tends to contain the highest peak loads and the highest number of peak load hours. As such, summertime is a particularly important timeframe for offshore wind resources to correlate to electrical demand. On an annual basis, South Carolina's offshore wind energy resources have a slightly negative correlation\* (-0.19), meaning that as electrical demand increases, offshore wind output decreases slightly and vice versa. However, during the months of June, July and August, South Carolina's offshore wind resource shows a moderately positive correlation with electrical demand (>0.46), meaning as demand increases or decreases, offshore wind tends to follow those trends. Offshore wind resources during the winter months have a moderately negative correlation with electrical demand load to a greater degree than the annual correlation, but capacity factors are higher than the annual average. However, daylight (6AM-7PM) correlation is positive for both summertime and wintertime seasons.

\*Correlation identifies a statistical relationship between two variables. A +1 correlation shows a perfect relationship, a -1 correlation shows a perfectly opposed relationship and a 0 correlation

### By the Numbers

# 39%

Average Capacity Factor during  
Top 10% Avg. Load Hours  
(2006-2008)

# 41%

Average Capacity Factor during  
Top 10% System Lambda Hourly  
Costs (2007)

# 40%

Average Annual Capacity Factor  
(2006-2008)

# +0.54

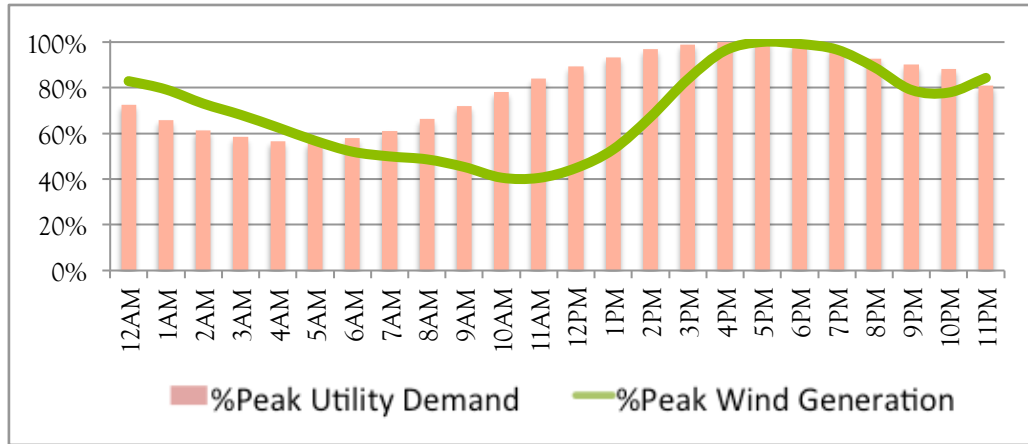
August Offshore Wind Positively  
Correlated with Electric Demand

**Chart 6: Offshore Wind  
Correlation with Electric Demand**

	Correlation	
	24-hr	Daylight
<b>June</b>	0.51	0.74
<b>July</b>	0.47	0.42
<b>August</b>	0.54	0.48
<b>December</b>	-0.39	0.09
<b>January</b>	-0.46	0.73
<b>February</b>	-0.48	0.47
<b>Annual</b>	-0.19	0.39

**Chart 7: Hourly offshore wind output (percentage of peak generation) and hourly Progress Energy demand load curve (percentage of peak load) by month (2006-2008)**

June



38%

Avg. Capacity Factor

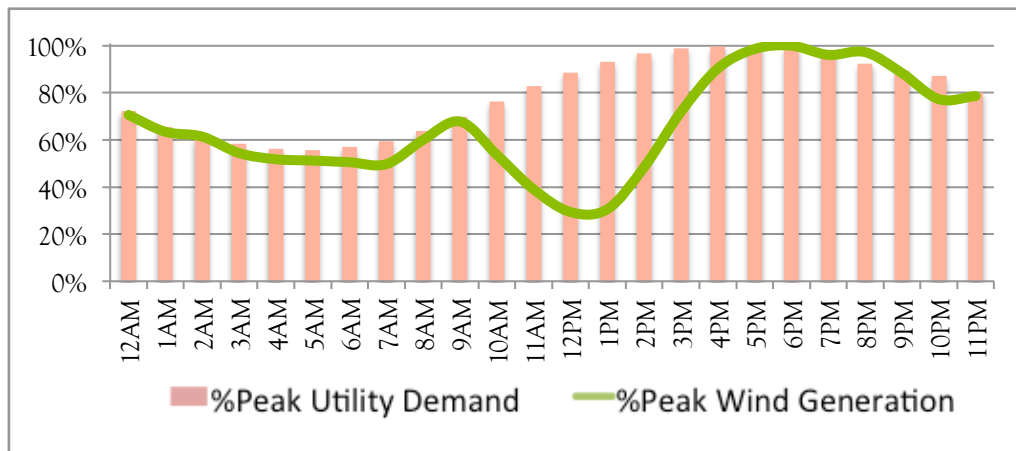
0.51

Hourly Correlation

0.74

Daylight Correlation  
(6AM-7PM)

July



28%

Avg. Capacity Factor

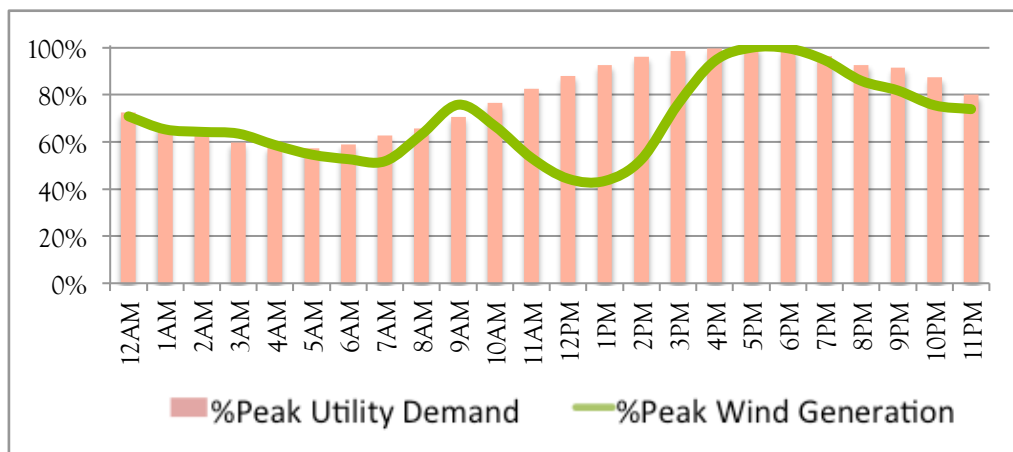
0.47

Hourly Correlation

0.42

Daylight Correlation  
(6AM-7PM)

August



32%

Avg. Capacity Factor

0.54

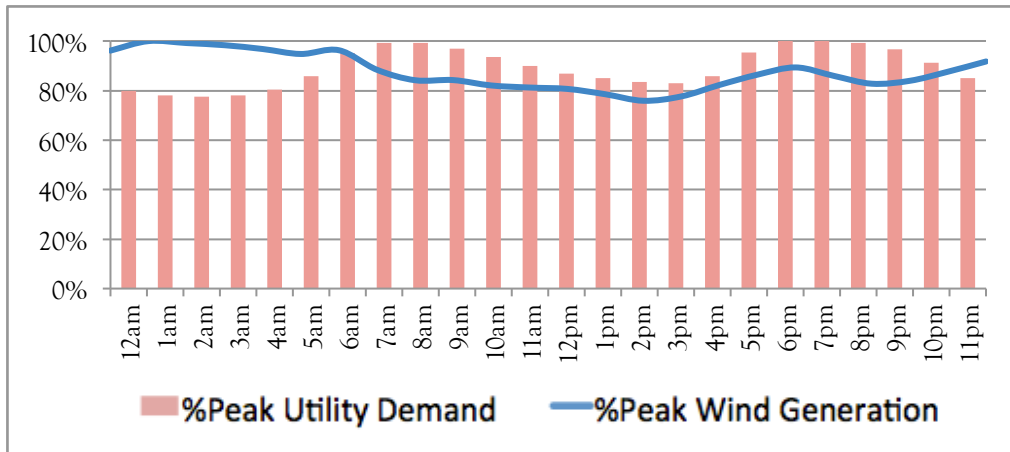
Hourly Correlation

0.48

Daylight Correlation  
(6AM-7PM)

**Chart 8: Hourly offshore wind output (percentage of peak generation) and hourly Progress Energy demand load curve (percentage of peak load) by month (2006-2008)**

December



43%

Avg. Capacity Factor

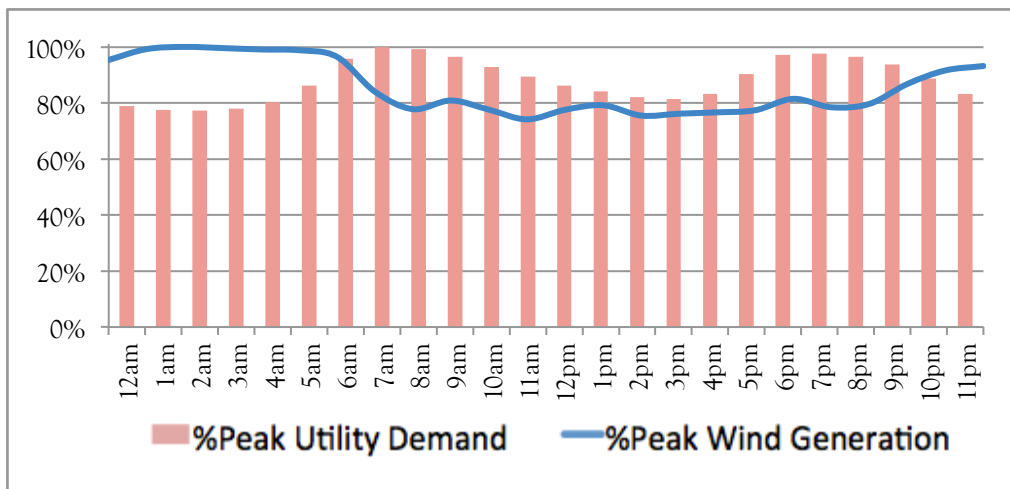
-0.39

Hourly Correlation

0.73

Daylight Correlation  
(6AM-7PM)

January



47%

Avg. Capacity Factor

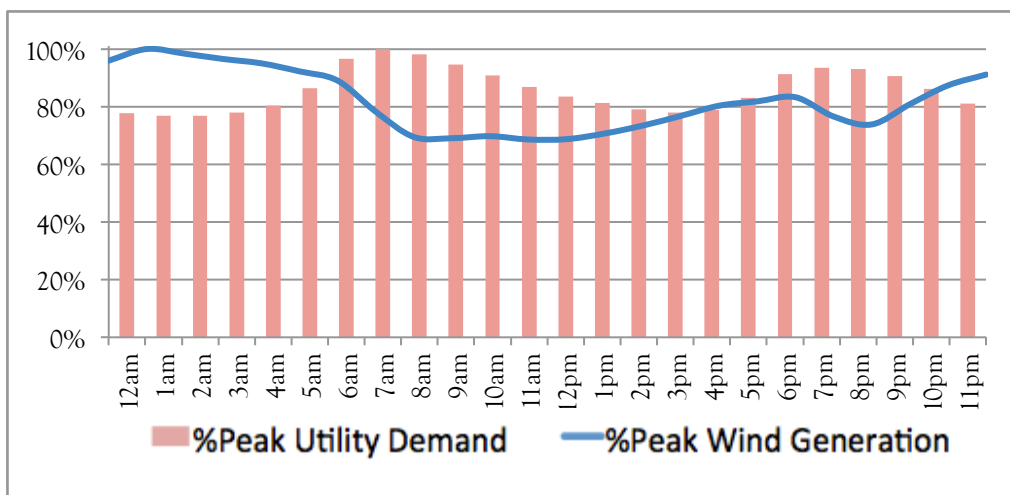
-0.46

Hourly Correlation

0.07

Daylight Correlation  
(6AM-7PM)

February



44%

Avg. Capacity Factor

-0.48

Hourly Correlation

0.09

Daylight Correlation  
(6AM-7PM)



## Conclusions

Currently, no offshore wind farms have been built off the United States. Bureaucratic red tape and hesitation to adopt new technology has thus far hampered this multi-billion dollar opportunity here. Abroad and especially in Europe offshore wind farms have been operational for over two decades. As the United States waits to develop this opportunity, it is becoming increasingly clear that offshore and nearshore wind farms can benefit from a unique natural phenomenon that occurs along coastlines. The Sea Breeze Effect occurs in coastal areas offshore and nearshore where a temperature differential between the land and sea causes a change in the wind. This phenomenon warrants a different evaluation of the value of offshore and nearshore wind farm development.

Offshore wind resources tend to be available when load demands are high. South Carolina's electricity demands tend to peak in the summertime. During summertime, the state's offshore winds are positively correlated with Progress Carolina's hourly electrical demand. Electricity demand tends to be higher during daylight hours when people are most active. Between the hours of 6AM and 7PM (inclusive), correlation between offshore wind resources and utility demand tend to be moderately positive during the summertime but strongly positive during the wintertime.

Offshore and nearshore wind energy would provide high value power. One common misconception is that wind energy should be compared against base load electric generation (e.g., coal or nuclear power); however, this research shows offshore wind and nearshore wind resources act more like peaking generation resources. Traditional peaking power plants, like natural gas combustion turbines, are usually a utility's highest cost power resource and are readily called upon during high load demands in the hot summer afternoons. Like solar power, offshore and nearshore wind resources naturally provide peak power generation during the summertime afternoons. These findings highlight the beneficial value of offshore and nearshore wind resources.

## Methodology

Hourly demand loads for Progress Carolinas were collected from the Federal Energy Regulatory Commission Form 714, Part 3, Schedule 2, Respondent ID 233, EIA Code 3046. Hourly loads for 2006, 2007 and 2008 were averaged together on an hourly, and monthly basis.<sup>11</sup> February 29<sup>th</sup>, 2008 was removed from the dataset as it was the only leap year day.

Wind output data were provided by AWS Truepower in association with development of the report, *Building an Infrastructure for Ocean Based Renewable Energy in the Southeast U.S.: Phase 2B Southeast Mesoscale Study*, April 4, 2011.<sup>12</sup> According to AWS Truepower,

“Using a mesoscale numerical weather prediction model at 20 km resolution, AWST modeled 10 years of wind resource at locations most suitable for offshore wind farm development identified in a previous phase of the project. Model wind speeds were validated by measurements from offshore moored stations in the region. Gross and net power output was calculated for each wind farm location, taking into account losses and turbine availability associated with typical offshore wind farms. Capacity factors were calculated for each site using 8 MW/km the maximum carrying capacity of each wind farm development area. Capacity factors were found to be consistent to those in previous offshore wind studies. Monthly average gross and net capacity factors.”

Wind output data were provided on a ten-minute scale from 1999-2008. Gross power output for Study Block 4, 5 and 6 (study blocks closest to South Carolina) were aggregated on an hourly, and monthly basis for 2006, 2007 and 2008. Total potential capacity for the three blocks added together is 3,315 megawatts. Data were made available in Greenwich Mean Time (GMT) and were subsequently altered to Eastern Standard Time (GMT-5) or Eastern Daylight Time (GMT-4) depending on the season. February 29<sup>th</sup>, 2008 was removed from the datasets.

### Establishing Percentage of Peak Generation and Peak Demand

In order to better compare utility demand to offshore wind generation, hourly demand load data and wind output data were converted in percentages.

Percentage of Peak Generation = Wind Hourly Capacity Factor / Wind Hourly Highest Capacity Factor

Percentage of Peak Demand = Hourly Demand / Highest Hourly Demand

Offshore wind generation was converted into hourly capacity factors (output divided by total potential capacity). The highest achieved average capacity factors for each evaluated month (January, February, June, July, August and December) was noted as peak generation. For each month, the average hourly capacity factors were divided by the peak generation (that month's highest average capacity factor) to create a percentage of peak generation. For utility demand load, the average hourly output (in megawatts) was plotted for each evaluated month. The highest achieved average hourly output was noted as peak demand. For each month, the average hourly outputs were divided by the peak demand. Pearson correlation coefficient tests were run on the percentage of peak generation and percentage of peak demand datasets to establish correlation and direction.

**Summertime Datasets for Wind Generation and Power Demand (2006-2008, average)**

<u>June</u>			<u>July</u>			<u>August</u>		
Time	Wind Output (MW)	South Carolina Power Load (MW)	Time	Wind Output (MW)	South Carolina Power Load (MW)	Time	Wind Output (MW)	South Carolina Power Load (MW)
12am	1485.2	7581.5	12am	1007.3	7982.2	12am	1068.6	8335.4
1am	1417.6	6866.7	1am	906.0	7232.4	1am	986.7	7666.3
2am	1307.0	6405.2	2am	876.8	6754.9	2am	970.6	7193.7
3am	1219.7	6104.0	3am	777.1	6432.5	3am	959.3	6859.7
4am	1120.1	5914.0	4am	739.6	6218.2	4am	885.8	6648.2
5am	1016.0	5861.6	5am	731.4	6150.5	5am	824.9	6582.0
6am	930.6	6038.2	6am	721.5	6305.3	6am	795.7	6772.4
7am	893.7	6378.8	7am	710.1	6568.5	7am	782.6	7200.4
8am	870.5	6920.1	8am	857.2	7042.6	8am	955.1	7554.9
9am	811.0	7520.5	9am	968.2	7695.2	9am	1144.9	8114.2
10am	727.1	8155.0	10am	766.1	8425.9	10am	1007.9	8797.7
11am	725.0	8778.1	11am	556.6	9156.9	11am	803.6	9502.1
12pm	802.5	9317.6	12pm	419.4	9778.3	12pm	669.9	10134.1
1pm	948.8	9746.8	1pm	436.5	10280.4	1pm	656.0	10647.8
2pm	1201.8	10107.9	2pm	691.9	10681.3	2pm	794.0	11070.0
3pm	1497.3	10326.5	3pm	1027.1	10910.4	3pm	1148.5	11333.7
4pm	1722.7	10442.2	4pm	1289.9	11016.3	4pm	1425.1	11462.5
5pm	1790.4	10469.9	5pm	1407.9	11041.2	5pm	1510.3	11499.5
6pm	1774.9	10359.7	6pm	1427.7	10927.0	6pm	1506.7	11384.5
7pm	1730.4	10105.8	7pm	1371.9	10664.1	7pm	1431.7	11088.4
8pm	1593.1	9688.1	8pm	1388.8	10204.8	8pm	1298.5	10664.8
9pm	1414.4	9398.1	9pm	1261.9	9874.1	9pm	1236.1	10514.0
10pm	1393.8	9200.7	10pm	1103.8	9613.7	10pm	1141.2	10042.1
11pm	1508.9	8455.9	11pm	1122.5	8856.7	11pm	1116.5	9211.7

**Wintertime Datasets for Wind Generation and Power Demand (2006-2008, average)**

<u>January</u>			<u>February</u>			<u>December</u>		
Time	Wind Output (MW)	South Carolina Power Load (MW)	Time	Wind Output (MW)	South Carolina Power Load (MW)	Time	Wind Output (MW)	South Carolina Power Load (MW)
12am	1717.8	6917.3	12am	1713.7	6990.6	12am	1572.4	6566.6
1am	1786.6	6805	1am	1785.7	6900.1	1am	1633.6	6413.2
2am	1800.6	6788.2	2am	1756.4	6910.7	2am	1620.8	6372.5
3am	1793.0	6845.6	3am	1723.8	6993.2	3am	1606.4	6420
4am	1784.0	7048.9	4am	1696.8	7226.9	4am	1581.3	6596.3
5am	1779.2	7551.9	5am	1647.2	7770.7	5am	1548.6	7053.8
6am	1737.2	8395.2	6am	1589.6	8674.6	6am	1573.3	7805.9
7am	1512.8	8771.6	7am	1397.4	8983.8	7am	1444.2	8154.2
8am	1400.3	8696.2	8am	1240.7	8817.3	8am	1375.4	8154.3
9am	1456.0	8453	9am	1233.2	8495.3	9am	1376.2	7954.3
10am	1396.9	8151.2	10am	1245.7	8152.3	10am	1340.8	7676.9
11am	1335.0	7842.9	11am	1225.1	7801.4	11am	1327.1	7388.3
12pm	1396.5	7569	12pm	1227.1	7503.6	12pm	1317.9	7141.8
1pm	1425.5	7379.7	1pm	1262.1	7305.2	1pm	1282.8	6990.7
2pm	1359.2	7201.1	2pm	1311.3	7109.1	2pm	1239.8	6858.7
3pm	1371.4	7141.8	3pm	1371.4	7009.2	3pm	1268.8	6822.5
4pm	1380.0	7299.1	4pm	1434.4	7091.5	4pm	1344.4	7041.2
5pm	1393.5	7917.5	5pm	1461.1	7456	5pm	1412.3	7839.1
6pm	1466.8	8518.1	6pm	1487.0	8205.7	6pm	1459.8	8213
7pm	1412.6	8557.1	7pm	1367.6	8397.8	7pm	1404.1	8215
8pm	1434.2	8470.3	8pm	1318.3	8351.4	8pm	1352.3	8155.7
9pm	1562.3	8220	9pm	1443.4	8143.2	9pm	1371.7	7932.4
10pm	1649.3	7789.9	10pm	1559.9	7734.6	10pm	1431.8	7496.7
11pm	1677.6	7304.1	11pm	1627.2	7276.5	11pm	1499.1	6977.6

## References

<sup>1</sup> McGregor, Kent, PhD. University of North Texas.

[[geography.unt.edu/~mcgregor/Earth\\_Science/Pressure.Land\\_Sea\\_Breeze.Forces.pdf](http://geography.unt.edu/~mcgregor/Earth_Science/Pressure.Land_Sea_Breeze.Forces.pdf)]

<sup>2</sup> Cape Wind (2007, July 2). "Comparison of Cape Wind Scientific Data Tower Wind Speed Data with ISO New England List of Top Ten Electric Demand Days." [<http://www.capewind.org/downloads/CWReport.pdf>]

<sup>3</sup> Souder, Elizabeth (2011, August 2). "Texas Power Grid Operate Issues Emergency Alert, Calls for Conservation," Dallas Morning News. [<http://energyandenvironmentblog.dallasnews.com/archives/2011/08/texas-power-grid-operator-issu.html>]

<sup>4</sup> Bode, Denise (2011, August 10). "Wind Power Lessons from the Texas Heat Wave," AOL Energy. [<http://energy.aol.com/2011/08/10/wind-power-lessons-from-the-texas-heat-wave/>]

<sup>5</sup> Energy Information Administration (2012, August 17). "Electric generator dispatch depends on system demand and the relative cost of operation." [<http://www.eia.gov/todayinenergy/detail.cfm?id=7590>]

<sup>6</sup> Energy Information Administration (2012, August 17). "Electric generator dispatch depends on system demand and the relative cost of operation." [<http://www.eia.gov/todayinenergy/detail.cfm?id=7590>]

<sup>7</sup> Duke Energy. [<https://www.duke-energy.com/corporate-merger/>]

<sup>8</sup> Federal Energy Regulatory Commission (2013, March 13). Form No. 714 - Annual Electric Balancing Authority Area and Planning Area Report. [<http://www.ferc.gov/docs-filing/forms/form-714/data.asp>]

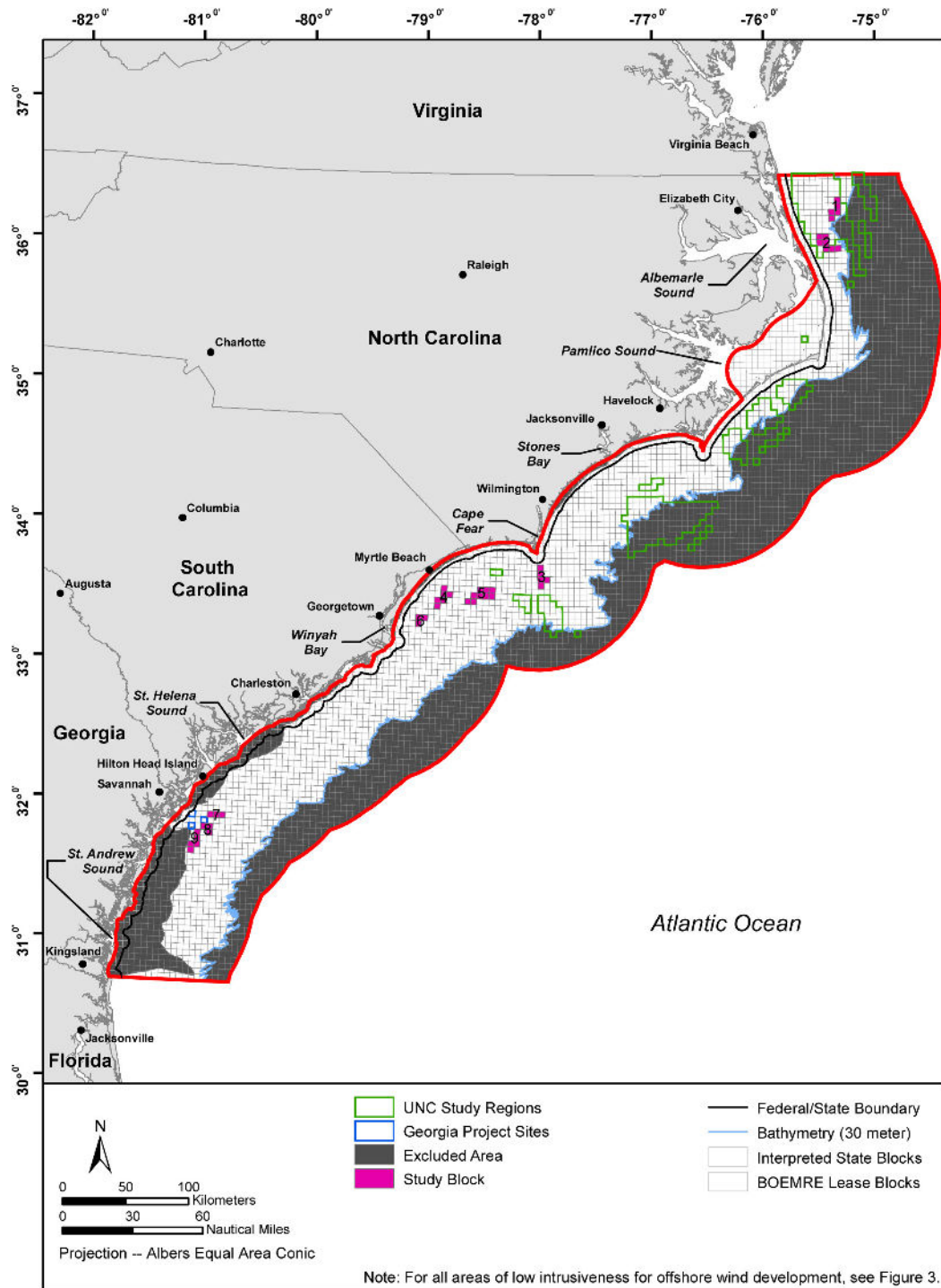
<sup>9</sup> Celebi, Metin; Hanser, Philip (2010). Marginal Cost Analysis in Evolving Power Markets, The Brattle Group. [[http://www.brattle.com/\\_documents/uploadlibrary/upload868.pdf](http://www.brattle.com/_documents/uploadlibrary/upload868.pdf)]

<sup>10</sup> AWS Truepower (2011, April 4). Building an Infrastructure for Ocean Based Renewable Energy in the Southeast U.S.: Phase 2B-Southeast Mesoscale Study. [<https://sites.google.com/site/sobreip/home/completed-reports>]

<sup>11</sup> Federal Energy Regulatory Commission (2013, March 13). Form No. 714 - Annual Electric Balancing Authority Area and Planning Area Report. [<http://www.ferc.gov/docs-filing/forms/form-714/data.asp>]

<sup>12</sup> Wind energy output reports and datasets are available online: <https://sites.google.com/site/sobreip/>

### Siting Analysis for Potential Near-Term Offshore Wind Farm Development: Georgia, South Carolina, and North Carolina (Geo-Marine, 2011)



Study Blocks 1, 2, 3 were used for the North Carolina analysis; Study Blocks 4, 5, 6 were used for the South Carolina analysis; Study Blocks 7, 8, 9 were used for the Georgia analysis.



## A leading voice for energy policy in the South.

The Southern Alliance for Clean Energy has been a leading voice for energy policy to protect the quality of life and treasured places in the Southeast since 1985. Our dedicated and diverse staff is poised to tackle our region's energy challenges and harness the economic opportunities presented by clean renewable energy. SACE advocates for federal, state and local climate policy solutions, energy efficiency programs and policies, and renewable energy such as solar, wind, and sustainable bioenergy. We promote clean fuels and vehicles, oppose nuclear and coal-fired power plant expansion, and encourage the retirement of old, dirty inefficient coal-fired power plants in our region.

For over 25 years, SACE has worked as a strong defender of the environment, challenging the status quo and working to minimize the impact of the energy sector on our region's communities, natural resources and economies. We are committed to ensuring that communities throughout the Southeast never have to choose between a healthy environment and a stable economy.



Southern Alliance for Clean Energy

For More Information, Contact:  
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