

The Impact of Renewables on the Transmission Grid – Planning and Operations

Presented by:
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The Impact of Renewables on the Transmission Grid – Planning and Operations

Topics

- **How do we plan the system today?**
- **What types of renewables do we need to consider?**
- **Focus on wind. What impact could wind resources have?**
- **National and local studies of potential wind scenarios**
- **How will renewables affect system operation?**
- **Where do we go from here?**

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How do we plan the system today?

The planning of the future power system is heavily regulated:

- The Federal Energy Regulatory Commission (FERC) governs rules for wholesale access and prices of services, as well as overall responsibility for reliability.
- The North American Electric Reliability Corporation (NERC) has responsibility for development and enforcement of operating and planning standards.
- The Southeast Electric Reliability Corporation (SERC) is an arm of NERC that deals with utilities in the southeast region, conducting audits and establishing fines, if necessary.
- The North Carolina Utilities Commission (NCUC) is responsible for permitting facilities, cost oversight, and establishing retail rates.

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How do we plan the system today?

The planning of the future power system is highly collaborative and includes public input:

- The North Carolina Transmission Planning Collaborative (NCTPC) plans the future network in North Carolina.
 - Progress Energy, Duke Energy, NCEMC and NCMPA
 - Transmission Advisory Group (TAG) quarterly meetings
 - <http://www.nctpc.org/nctpc/>
- The NCTPC coordinates with neighboring regions: PJM, TVA, South Carolina Regional Transmission Planning
- NC utilities participate in broader regional planning efforts:
 - Southeast Electric Reliability Corporation (SERC)
 - Southeast Inter-Regional Planning Process (SIRPP)
<http://www.southeastirpp.com/>
 - Eastern Interconnection Planning Collaborative (EICP)
<http://eiponline.com/>

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How do we plan the system today?

- For the most part, transmission planning focuses on large, centralized sources of generation transferring power to population centers, industrial centers, etc.
- When we conduct transmission studies, which are computer simulations, we assume that all sources of power are available and that customers are using the maximum amount of electricity (peak period). We may also study periods of lower electricity use.
- We use our computer models to determine whether or not we can continue to serve all customers in the event of an unexpected loss of a generating source, or a transmission line or transformer. These losses are known as “single contingencies”. If a problem arises, we add facilities to the system.
- We also look at how the system responds following an upset. Some machines can ride through a disturbance, some may not.

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What types of renewables do we need to consider?

There are several possible renewable resources which may become an increasing part of the supply system:

- Wind – on-shore and off-shore
- Solar – Photovoltaic and concentrating
- Hydro – run-of-river, impoundment and pumped storage
- Biomass – vegetation, animal waste, landfill gas
- Other – tidal, ocean current, ocean thermal,

What impacts do renewables have on the transmission grid?

It depends!

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The impact any renewable source will have on the transmission grid will depend on:

- Location
- When it is available
- Intermittency and variability
- How the resource reacts to stress

Each renewable resource would have different characteristics in these four areas. For today's discussion, we will focus on wind, which has a very large potential impact in North Carolina.

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What impact could wind resources have?

In June, 2009, the University of North Carolina issued the study ***Coastal Wind: Energy for North Carolina's Future**, A Study of the Feasibility of Wind Turbines in the Pamlico and Albemarle Sounds and in Ocean Waters off the North Carolina Coast*. The study found that there was a significant potential for utility-scale wind production off the NC coast.

If fully developed, the wind resources could produce several thousand MW of power to be fed into the transmission grid in NC. (For comparison, Progress Energy owns ~12,500 MW of generation in NC and SC, and purchases about 1,300 MW more.)

How does this impact the system given our previous four points (location, availability, intermittency and reaction to stress)?

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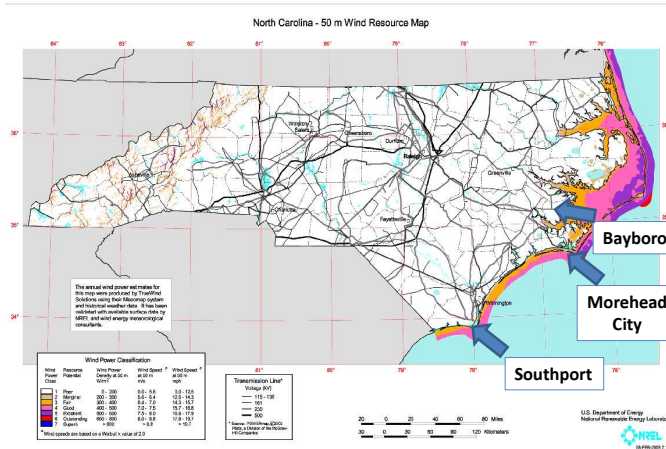
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What impact could wind resources have?

Location:

The wind is where the people aren't.

The strongest wind sources are nearest “weaker” points in the grid, which is currently designed to transport power from west to east. Wind power will flow from east to west.



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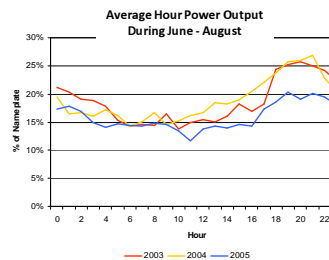
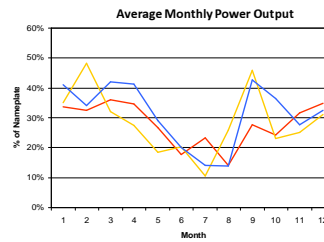
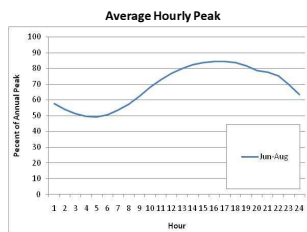
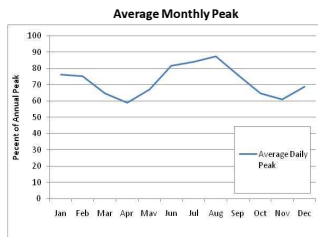
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What impact could wind resources have?

Dispatchability/availability:

The wind isn't when the load is

On the average, the wind is weakest during the summer months and the afternoons when customer demand is highest.



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What impact could wind resources have?

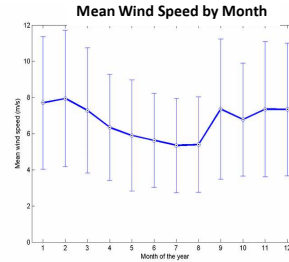
Intermittency/
variability:

The wind
is.....

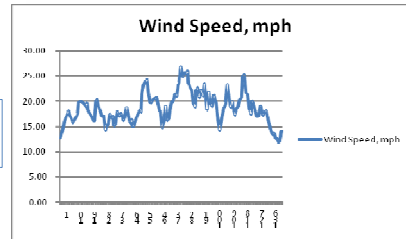
and isn't.

Wind speed is
unpredictable
on both a long
and short-
term basis.

Monthly average
wind speed with
standard deviations



Daily wind speed
measured in 10
minute intervals



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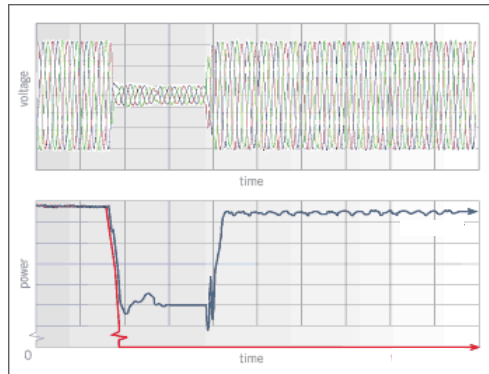
What impact could wind resources have?

Stress reaction

The wind

might be.

The power system is
subject to lightning
strikes and other
disturbances. Power
sources must be able
to withstand these and
continue supplying
power.



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National and local studies of potential wind scenarios

There is a high level of interest in looking at the impact of adding significant wind resource to the grid, particularly transporting large amounts of power from the Midwest to the Southeast. Two recent studies:

- *The Eastern Wind Integration and Transmission Study (EWITS)*, sponsored by DOE

<http://www.nrel.gov/wind/systemsintegration/ewits.html>

- *Integrating Midwest Wind Energy into Southeast Electricity Markets*, sponsored by DOE (in progress)

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Local and national studies of potential wind scenarios

The North Carolina Transmission Planning Collaborative (NCTPC) is currently studying the transmission requirements that might be associated with development of the off-shore wind resources identified in the UNC study.

There appears to be some support at the Federal level for building a national transmission grid to support the transport of wind energy from the Midwest throughout the Eastern Interconnection (basically everything east of the Rockies, including part of Canada) and allocate the costs of this transmission to all, regardless of benefits received. In North Carolina, this approach needs to be weighed against development of off-shore resources and other alternatives.

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How will renewables affect system operation?

- Intermittency may require “backstanding” by other resources or storage alternatives. In other words, conventional generation powered by natural gas might be needed at times when renewable resources are less available.
- Availability of wind at low load periods, e.g. in Spring and Fall during the middle of the night, when customer usage is very low) may require “dumping” of energy or backing down of large, base load generation.
- Some experts have advocated the creation of larger balancing areas (The areas that balance load and generation. Progress Energy is a balancing area, Duke is another) so that there is more diversity among renewable sources of generation, reducing the intermittency.
- Demand response programs may be needed to balance intermittency.

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Where do we go from here?

- Current studies will better define the costs and system impacts of wind and other renewable generation sources.
- Alternative sources (e.g. Midwest vs. off-shore) can be compared to identify the best options for NC and the region.
- More data from existing sites and proposed projects will aid in understanding true impacts and costs.

You can participate in the North Carolina transmission planning process:

<http://www.nctpc.org/nctpc/listDate.do?category=TAG>

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