# Wind Related Senior Projects

## 2010

**Andrew Gronan**
Eastern Shore Regional Wind Analysis
***Abstract:***
*The purpose of this project is to assess the regional wind resource of the eastern shore of Virginia and the Chesapeake Bay. As the need for renewable and clean energy continues to grow, we must work to obtain reliable and sustainable sources such as wind energy. The wind resource in Virginia lies primarily in the coastal areas and thus it is vital that we have a clear understanding of its potential. This assessment uses existing data at seven sites along the coast and data currently being acquired at Tangier Island. The results will also be compared to the American Wind Energy Association's wind resource map projections to determine the validity of the estimates.*

**Corinn Pope**
Development of a Wind Turbine Ordinance Database for Land Use Planners
***Abstract:***
*This project will provide land use planners with an easy to use tool to help develop wind energy specific ordinances. The tool will include a database housed by JMU of wind ordinances from across the United States and will be searchable on a website. It will promote the development of wind ordinances throughout the country and therefore increase the ease of implementing a wind energy system.*

**Evan Williams**
Based Remote Data Acquisition System for a Wind/Solar Hybrid Power Plant
***Abstract:***
*The purpose of this project is to create a data acquisition (DAQ) system for a wind/solar hybrid power plant. The objective is to make the DAQ system reliable, cost effective, and easily accessible and upgradeable via wireless connections to a central location/site. The DAQ system will be designed and implemented to provide web-based, real-time and remotely accessible weather, and power generation and consumption data. In addition, the DAQ system will store the data and make it remotely available for analysis by students or researchers. The system will be built with the capability for two way communications between the power plant and a central site, thus providing the necessary infrastructure for adding control and remote management at a future date.*

**Steven Florian & Will Shoemaker**
Material Selection for Sustainable Wind Turbines
***Abstract:***
*Our senior thesis is aimed at Sustainable Material Substitution in Wind Turbines. We have developed a method of sustainable material selection to examine the environmental impact of the materials used in wind turbine constructions. We have broken the turbine into two different sections for analysis focusing on the tower and blade materials. We have analyzed the current materials used by researching and contacting wind turbine companies in the United States and compared these current materials to*

*alternative materials using CES software. We will make our alternate material selections based on our analysis of the critical mechanical and environmental properties of the selected materials.*

**David Ramsey & Brian Rapp**
Development of a Residential Site Assessment and Economic Feasibility Calculator for Behind-the-Meter Wind Energy Generation in Virginia
***Abstract:***
*This project developed and implemented a public domain, web-based site feasibility analysis tool for behind-the-meter wind power systems. The tool is designed as a site prescreening/suitability calculator for Virginia property owners, and enables them to assess the technical and economic feasibility of a property for wind power before engaging in costly and time consuming site characterization and analysis. The tool was prototyped for the Commonwealth of Virginia, in an effort to help Virginia's Wind Energy Collaborative.*

## 2009

**Brian Burk**
Feasibility Study and Implementation Plan for Wind Power in a Developing Country
***Abstract:***
*The purpose of this project is to design and develop a plan to implement a small-scale wind power system for the town of Paso Bajito located in the Dominican Republic. With consideration for the numerous problems surrounding power generation in these areas such as high fuel costs, lack of infrastructure, and environmental concerns, renewable energy systems present a sustainable alternative to provide these communities affordable access to electricity to meet their basic needs. This project involved analyses of the local needs, the local wind resource, topography, wind turbine technologies, and manufacturers' support, and recommend a wind power system for the community.*

**Kenneth Howell**
First-Order Feasibility Study for Wind Power at a Military Installation in Virginia
***Abstract:***
*The objective of this project is to perform a first-order wind feasibility assessment for a potential wind turbine installation at the Naval Surface Warfare Center (NSWC), Dam Neck, near Virginia Beach, VA. The assessment includes the characterization of land use, topography, and wind resources, and involve site visits, data collection, and the modeling strategies. Potential environmental, regulatory, and technical requirements and conflicts are also examined and addressed. A final report and visual simulation were developed to provide NSWC, Dam Neck with the tools necessary to advance the development of wind power at their site for local power generation.*

**Edward Morrison**

First-Order Feasibility Study for Wind Power at an Aquaculture Facility in Virginia

***Abstract:***

*The purpose of this project was to create a first-order feasibility study for the application of wind power to supplement the electrical demand of Mid-Atlantic Aquatic Technologies in Quinby, Virginia. A 50 m anemometer tower installed on-site recorded wind-speed and direction to confirm and validate existing wind-maps. WA$^S$P and WindFarmer wind-analyzing programs were used to create a model of the potential electrical output and economic viability of a given wind turbine installed in the area. An analysis of multi-level government permitting requirements, environmental impacts, and community input was also completed.*

**Ryan Powanda**

Chesapeake Clean Energy Initiative: Preliminary Study for Onshore Wind Turbine Siting in a Remote Island Community

***Abstract:***

*The purpose of this study is to assess the feasibility of siting a demonstration, commercial-scale wind turbine for onshore applications in the Chesapeake Bay, Virginia. The Chesapeake Bay presents a high-quality wind resource, and several studies have been conducted by the Virginia Wind Energy Collaborative (VWEC) investigating offshore wind development options in the region. Several sites were studied for viability including areas on Tangier Island and Port Isobel. Tangier Island is resident to a small fishing community in the Chesapeake Bay, while the adjacent Port Isobel is owned by the Chesapeake Bay Foundation and is used as an education and outreach center. The wind resource on the islands is being investigated using a 50-meter meteorological tower and the energy infrastructure was studied for potential interconnection of a wind turbine and energy storage equipment. Other considerations include impacts on environment and wildlife, siting concerns, project economics, relevant regulatory issues, and public opinion. The results of this study helped to inform a project proposal to the U.S. Department of Energy for funding for further research, development, and demonstration of commercial-scale wind and energy storage applications in the Chesapeake Bay region.*

**Michael Bornarth**

Market Analysis and Usage Study of a Hand Held Instrument for Infrared-Based Non-Destructive Evaluation of Wind Turbine Blades

***Abstract:***

*In 1998, researchers at the NASA Langley Research Center developed a thermal line-scanning technique to non-destructively detect defects in materials by line-heating the surface of a target and imaging the surface with an infrared imager. Image subtraction was conducted to measure the temperature at each point on the material before and after heating and visualize sub-surface defects. Fellow ISAT students Curt Dvonch and Doug Suliga (2008) successfully developed a benchtop instrument to perform this technique by utilizing a microbolometer-based infrared imager, other miniaturized components, and space-saving design. My project involved the automation and optimization of the instrument with implementation of a stepper motor and application of testing to further the development of a handheld instrument. I have also conducted a market analysis and usage study of such a handheld instrument as would be applied within the wind power industry.*

## 2008

**Megan Shea**

Policy and Economic Barriers and Legislative Solutions for Small Wind Energy in Virginia

***Abstract:***

*Few counties in Virginia have incorporated into their zoning bylaws a mechanism to permit small wind systems. This presents a significant barrier to deployment of these systems as, for most people; the resultant administrative hurdles are often prohibitively onerous or can be met with project delays or cancellations. Analysis demonstrates that the decisions of potential small wind investors are heavily influenced by the perceived burdens associated with the permitting of such projects. Recommendations will be made for possible legislation to facilitate the future deployment and growth of wind power in Virginia.*

**Brian La Shier**

Testing, Evaluation, and Implementation of the Virginia Renewables Siting Scoring System

***Abstract:***

*The goal of the project is to continue to develop and improve the Virginia Renewables Siting Scoring System (VRS3), while laying the groundwork for future projects. The purpose of the VRS3 is to allow a community to proactively assess their lands and quantitatively evaluate and compare wind resources, and thus be well informed to act when wind energy development is considered or proposed. An initial assessment of Bath County, Virginia was compiled to aid future planning efforts. A comprehensive guide to state wind turbine siting policies in the Mid-Atlantic United States was also included for comparison to the VRS3.*

**Paul Dorn, Jr. & Chris Muth**

Development of an Integrated Monitoring and Data Acquisition System for a Hybrid Wind and Solar Power Station

***Abstract:***

*The CISAT Hybrid Electric Plant (CHEP) consists of a 1-kW photovoltaic system and a 1-kW wind turbine. The purpose of this project is to enhance the functionality and educational experience of CHEP. The hybrid electric plant will be enhanced by developing circuitry to collect electrical performance data. This data will be multiplexed with weather data and sent wirelessly to a receiver located in the CISAT building. A LabVIEW frontend was developed to process, store, and display the data over the internet. These improvements will augment the educational potential of the photovoltaic and wind systems in JMU classrooms and help raise awareness of renewable energy use.*

## 2007

**Jennifer Hock and Robert Gallerani**
A Feasibility Study for Wind Power at Tangier Island, Virginia
***Abstract:***
*This project addresses the social as well as the technical issues associated with the development and implementation of community-based wind power at Tangier Island, Virginia. Tangier Island lies centrally in the Chesapeake Bay and the waters that surround Tangier fall under state jurisdiction. This project constitutes a portion of a broader, comprehensive feasibility study and addresses the following aspects: public opinion; jurisdictions; physical resources; environmental impacts; technical infrastructure; wind resource; and options for development. This project analyzes the marine environment as well, and makes recommendations involving the selection and siting of wind turbines as guided by constraint mapping. This effort will inform a report to the Virginia Department of Mines, Minerals, and Energy that describes the feasibility of community-based wind power at Tangier Island.*

## 2006

**Matthew Bonifant, Benjamin Chambers, Dean Gakos, John Trout & Matthew Walters**
Activities and developments to support the mission of the Virginia Wind Energy Collaborative
***Abstract:***
*The college of Integrated Science and Technology (ISAT) at James Madison University (JMU) has coordinated student efforts to support development of wind energy in the Commonwealth of Virginia. With the formation of the Virginia Wind Energy Collaborative (VWEC) in 2002, JMU began collaboration with Environmental Resource Trust Inc. (ERT); Old Mill Power Company; George Washington School of Law; Virginia Polytechnic Institute and State University (VT); the National Renewable Energy Laboratory (NREL); the U.S. Department of Energy's (DOE) Wind Powering America (WPA) Initiative; and the Virginia Department of Mines, Minerals, and Energy (DMME). The James Madison University Office of the Virginia Wind Energy Collaborative (VWEC/JMU) has served instrumentally in its role to promote the development of wind power in Virginia and the subsequent increased diversity of its energy supply.*

*The Virginia Wind Energy Collaborative (VWEC) was established in 2002 and serves as the pioneering alliance to promote and develop wind power in Virginia. The 2005–2006 VWEC/JMU team developed a work plan that addresses a wide variety of tasks designed to promote greater awareness and implementation technologies that harness the wind. The team divided into four groups, each addressed a unique set of issues and tasks.*

*The State-Based Anemometer Load Program (SBALP) was created with two purposes in mind: to validate existing wind resource maps and to inform residents of their potential wind resource. SBALP works toward these goals by providing an instrumented anemometer tower and subsequent data analysis pertaining to the resource at a given site. The SBALP team carried on the administration of this program, and developed a new instructional packet to assist other states who wish to create their own SBALP. The primary objective of the Virginia Small Wind Incentives Program (VSWIP) is to demonstrate the viability of small wind power systems throughout the Commonwealth. The program provides grants to landowners, thus reducing the lifetime cost of a wind energy system. The final round of awards was made in January 2006 bringing the program total number of*

*awardees to twelve. The project team developed and implemented strategies to assist landowners in completing their projects.*

*The Outreach program, the newest addition to the ongoing efforts of VWEC, developed new resources to support public outreach and education including a new touring exhibit. The VWEC Brochure was updated to describe current ongoing projects, and the newsletter, In the Breeze, published three new editions. The touring exhibit offers a comprehensive presentation that encompasses a large background display intended to inform the citizens of Virginia about diversifying their energy portfolio. The CISAT Hybrid Electric Plant (CHEP) project set up performance monitoring and data acquisition for the hybrid system located on the JMU campus. The project specified and installed voltage and current meter displays for the wind turbine and solar array that comprise the hybrid system. Informational posters were created for educational purposes at both the wind turbine and the CISAT Solar Electric Plant (CSEP), a 10-kW solar array also located on the JMU campus. In addition, a data transmission and data acquisition process was developed to log and display data in near real time using a Virtual Instrument developed in LabView™. These activities will further enhance the educational aspects of the two campus-based renewable energy systems. These efforts all support the mission of VWEC.*

## 2005

**Mikhail Kolyadov, Jason Lee, Christopher Wells & Peter Williamson**
Activites and developments to support the mission of the Virginia Wind Energy Collaborative
***Abstract:***
*The Virginia Wind Energy Collaborative (VWEC) was established in 2002 and serves as the pioneering alliance to promote wind energy in Virginia. The VWEC/JMU team collaborated on four distinct tasks. The Next Step task group created an online economic tools page where landowners can obtain a cost analysis for a small wind energy generation system based on their wind resource and electricity usage and rate structure. Users are provided with a guide outlining necessary steps for installing such a system. In addition, the Next Step initiative has continued issuing reports to interested landowners after collecting wind resource data from their property. The State Based Anemometer Loan Program (SBALP) task group validates current wind resource maps of Virginia and educates residents regarding their site-specific wind resource by providing anemometer towers to collect wind data for one year and generating summary analyses of resources. The SBALP task group developed a framework for actively locating sites of favorable wind resource utilizing GIS. The Wind Powering America-DMME task group completed an educational CD-Rom on renewable energy aimed at middle school students, established a regional wind newsletter for quarterly distribution, and developed a guidebook specific to Virginia that breaks down the processes and issues associated with purchasing a small wind system for the average consumer. Finally, The Virginia Small Wind Incentives Program task group demonstrated the viability of small wind systems for the Commonwealth. The program provided grants to landowners to reduce the lifetime cost of small wind energy systems and increase competitiveness with fossil fuel-generated electricity. The program awarded four grants in 2004 and is currently accepting applications for 2005. These combined efforts support the ongoing mission of the Virginia Wind Energy Collaborative.*

## 2004

**Jeffrey Briggs, Kimberly Josephson, Peter Kim, Kathleen Loughney & P. J. Williamson**
Wind Energy in Virginia: Implementing New Strategies for Clean Power across the Commonwealth
***Abstract:***
*The Virginia Wind Energy Collaborative (VWEC) was established in 2002 and serves as the pioneering alliance to promote and develop wind energy in Virginia. The VWEC/JMU team developed a multi-faceted work plan that addresses a variety of tasks designed to promote and encourage the development of wind power in Virginia. The VWEC/JMU team divided into four groups each tasked to assume a unique set of responsibilities. The State Energy Project (SEP) group assisted landowners in determining the viability of small turbine installations on their property. Economic research was extended to create detailed analyses for each of five diverse sites. A Virginia state-specific guidebook for small wind systems was created with NREL support to help educate and inform Virginia residents and businesses. The State-Based Anemometer Loan Program (SBALP) group collected wind data using ten 20-meter meteorological towers installed throughout Virginia. In addition to validation of the Virginia Wind Resource Map it is the intent of the SBALP group to generate interest in wind energy, encourage wind development, and educate the general public. The Wind Powering America (WPA) group conducted public outreach to further the awareness of wind potential and other renewable energy options in Virginia by creating an educational CD-ROM to be distributed to K-12 students; by conducting a series of wind energy workshops; by creating a job and economic development model specific for Virginia; and by upgrading and maintaining a web-based clearinghouse for wind activities and information pertinent to Virginia. The Next Step/VSWIP group generated studies and tools to empower landowners in conducting personal analyses of potential wind energy projects and also established and implemented the Virginia Small Wind Incentives Program. These efforts, collectively, support the ongoing mission of the Virginia Wind Energy Collaborative.*

## 2003

**Urmil Dharamsi, Melissa Leonetti, Mark Lotts, Beth Mast, Robert Munson, W. Dodge Perry, Kyle Proehl, Peter Salmon, Tyson Utt, David VanLuvanee & Alicia White**
Wind Energy in Virginia: An Innovative Plan for Development and Education
***Abstract:***
*The Virginia Wind Energy Collaborative (VWEC) was established in 2002 by this team and its partners across Virginia. VWEC serves as the pioneering alliance to promote and develop wind energy in Virginia and is supported by the U.S. Department of Energy and Virginia Department of Mines, Minerals, and Energy. The VWEC/JMU team developed a work plan to address an array of tasks that reflect the deliverables set forth in three funded grants. The team divided into four project groups, each responsible for a unique set of tasks. The CISAT group conducted analyses to determine the options to develop small wind on the CISAT campus. This group generated economic models and identified potential end-use applications. The SBALP group administered Virginia's State-Based Anemometer Loan Program. Associated tasks included identification of appropriate sites for, and installation of, meteorological towers as well as collection, analysis, and report of wind data. These data are used by the National Renewable Energy Laboratories to validate computational wind resource models. The SEP group researched federal, state, and local issues – legal, political, economic – that present barriers to wind energy development. This group also identified restrictive zoning ordinances, drafted a proposed zoning amendment for Rockingham County, and studied the limitations to consumers of net metering legislation in Virginia. Additionally, the group conducted site-specific feasibility analyses for small-wind systems; these analyses consider wind resources, turbine performance, load profiling, and economic tools to assist*

*landowners to assess the feasibility of wind power on their properties. The WPA group conducted public outreach to promote and raise awareness of opportunities for wind energy in Virginia, developed and distributed educational materials and brochures, organized and hosted a regional wind energy workshop, and established a Virginia wind working group that later evolved into the Virginia Wind Energy Collaborative. The outcomes of these activities will be presented.*

## 2002

Greg Allen, Bryan Frane, Matt Heck, Adam Jones & David Strong
**Wind Energy in Virginia: JMU and Beyond**
*Abstract:*
*We have administered the Wind Powering America (WPA) State-Based Anemometer Loan Program (SBALP). The State-Based Anemometer Loan Program helps develop wind expertise throughout the nation, allows Virginia and the National Renewable Energy Laboratory gather data across the state, and heightens the awareness and development of the nation's wind resources. This program involves siting, permitting, installation, data collection, as well as other tasks required to place a meteorological tower for the program at each of ten different locations. Thus far, data has been collected at six sites and is currently under analysis.*

*We also have begun preliminary studies on the feasibility of installing a wind turbine on the east campus of James Madison University. We have assisted in siting a 30-meter meteorological tower that will gather wind data for future analysis by JMU students. We have studied and modeled other local wind data and have researched relevant issues surrounding wind energy, including visual and noise impacts, regulations, and grid interconnection. We have developed a preliminary economic analysis for a 10-kW turbine located where the 30-meter meteorological tower now stands. The ultimate goal of this study is to further wind energy progress at James Madison University and throughout the state of Virginia.*

## 2001

**Jon Caley, Andrea Illmensee, Amy McGinty, Ben Orr & Jeanette Studley**
Feasibility Study for the Implementation of a Wind Power Installation at Mount Storm, West Virginia
***Abstract:***
*This project comprises several related activities in support of a proposed wind power installation at Mount Storm, West Virginia. The project entails analyses of the local wind profile, visual impact of the installation, the permitting process for executing the project, and the marketing potential of the power generated. The existing wind profile, characterized during a previous study, has been validated and improved. This has allowed for the selection of a turbine model to be used at the installation and estimates of the expected generation to be determined. The recommendations resulting from this project will aid Dominion Virginia Power in their decision of whether to move forward with construction of a wind power installation at Mount Storm, and offers guidance to other wind developers in the region.*

## 1999

**Demetrist Waddy & Margaret James**
The Feasibility of Wind Power in the Shenandoah Valley

**Brent Flaherty Beerley, Joseph Six Mariano**
A Feasibility Study of Implementing a Hybrid Wind Farm and Photovoltaic System on the Island Nation of Malta