Virginia Tech
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Biological Systems Engineering

Welcome to the Introduction to Wind Energy Workshop

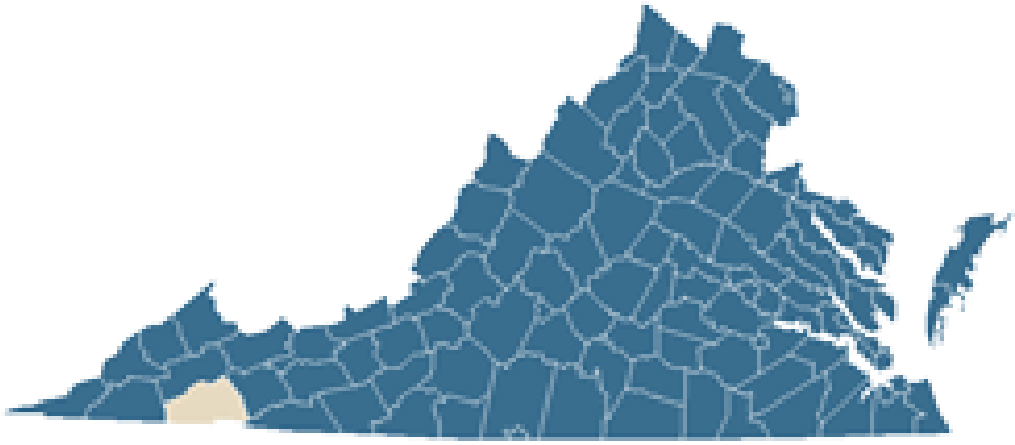
John Ignosh
Biological Systems Engineering
Virginia Cooperative Extension
Virginia Tech
Harrisonburg, VA

Virginia Cooperative Extension
A partnership of Virginia Tech and Virginia State University www.ext.vt.edu

Thank you to our host:

Southwest Virginia Higher Education Center

Thank you !!



Phil Blevins

Extension

Washington County

Virginia Cooperative Extension

Washington County

<u>Thank you to our workshop sponsors:</u>

Virginia Tobacco Indemnification and Community Revitalization Commission

General Agenda

- Start 9AM
  - Phil Blevins, Extension
  - John Ignosh, Extension & Overview of the Ag Energy Efficiency Initiative program
  - Dr. Jon Miles & Blaine Loos, Center for Wind Energy, James Madison University
- Lunch break
  - Craig Barbrow, Rural Business Specialist, USDA Rural Development
  - Dr. Jon Miles & Blaine Loos, Center for Wind Energy, James Madison University
- Adjourn by 3

2014-2015

AGRICULTURAL ENERGY EFFICIENCY INITIATIVE

Program for Southside and Southwest Virginia

Funded by a 2014 grant from the
Virginia Tobacco Indemnification and Revitalization Commission
and is supported by
VCE Community Viability and the
Virginia Tech Biological Systems Engineering Department

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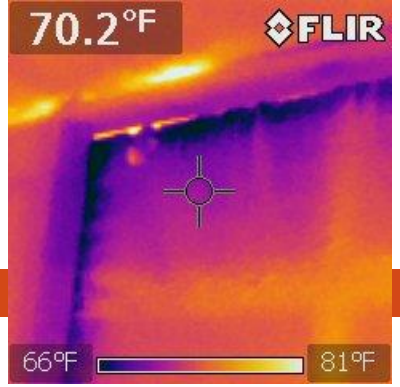
On-Farm Energy Efficiency Program

A Pilot Program for Southside and Southwest Virginia

Virginia Tobacco Indemnification and Revitalization Commission



- In 2007, farmers spent:
  - $156M in fuel , $52M in electricity and other utilities, $208M in total
- A 10% increase in energy efficiency would have produced nearly $21 million additional income to Virginia farms in 2007

How can we find those opportunities?

- Provides research-based information related to best management practices concerning energy via Virginia Cooperative Extension workshops, factsheets, webinars, etc.
- Train energy assessors, energy use BMPs, thermography tools, fuel purchasing, etc.
- Secure grant funding from the Virginia Tobacco Indemnification and Community Revitalization Commission (2010-2012)

2010 - 2012 Impacts

- 58 energy audits completed
- 19 counties throughout Southside and Southwest Virginia
- Completed energy audit reports have identified farm specific energy conservation measures to save:
  - 1,258,776 (kWh) in electrical usage;
  - 603,315 (gallons) propane fuel;
  - 19,336 (gallons) fuel oil;
  - 63,298 Million BTUs;
  - 4,315 (MTCO2e) greenhouse gas emission reductions;
  - $1,178,917 energy savings
  - Approximately 76% of the recommended energy conservation measures have a payback period shorter than five years.

2014-2015 Agricultural Energy Efficiency Initiative: **Objectives**

- > 60 agricultural operations including aquaculture, tobacco, dairy, poultry, swine, greenhouse, lumber/sawmill, and on-farm food value-added agribusinesses will improve farm energy efficiency and/or have an opportunity to explore renewable energy
- > 300 agricultural entrepreneurs will increase their understanding of energy efficient operations.

General Strategy

ENERGY ACTION PYRAMID

COMPLEXITY AND COST

ALTERNATIVE ENERGY

Choices such as installing solar, wind, geothermal, micro hydro or biofuels systems

EFFICIENCY: Investment in Longer Term Energy Savings

Choices such as:

- Installing energy efficient lighting, fixtures, windows, doors, appliances, and equipment
- Installing water-efficient appliances and fixtures
- Investing in items with Energy Star, EnergyGuide or WaterSense labels
- Insulating homes

CONSERVATION: Simple Everyday Actions

Behaviors such as:

- Turning off lights, equipment, fans, and appliances when not in use
- Adjusting thermostats in heated or cooled spaces
- Using powerstrips to control for phantom electrical loads
- Caulking and weatherstripping around windows and doors
- Landscaping with native and xeric plants, and utilizing rain water

ASSESSMENT: Assess your personal objectives and your energy and water use to determine cost-effective strategies for implementing conservation and efficiency measures and integrating renewable energy systems in your home.

Source:

http://www.ces.ncsu.edu/wp-co
Con_PyramidRev1.pdf

2014-2015 Agricultural Energy Efficiency Initiative: Program Activities

Agricultural Energy Efficiency Project Website

- Energy Benchmarking
- Farm Energy 101 Modules

Agricultural Energy Efficiency Project Workshop Series

- Agricultural Production Systems (Greenhouses, Tobacco, Dairy, etc.)
- Emergency Backup Power Generation Systems
- Renewable Energy Technologies & Applications (solar, RETScreen, small wind, biomass, etc.)
- Forest Product Industries (Lean Manufacturing, etc.)

Validation of Energy Savings

- Monitor performance of some of the recommended retrofits

2014-2015 Agricultural Energy Efficiency Initiative:
Energy Audits, Feasibility Studies, and Retrofit/Renewable Implementation

$5,000 per program participant funds will be used toward:

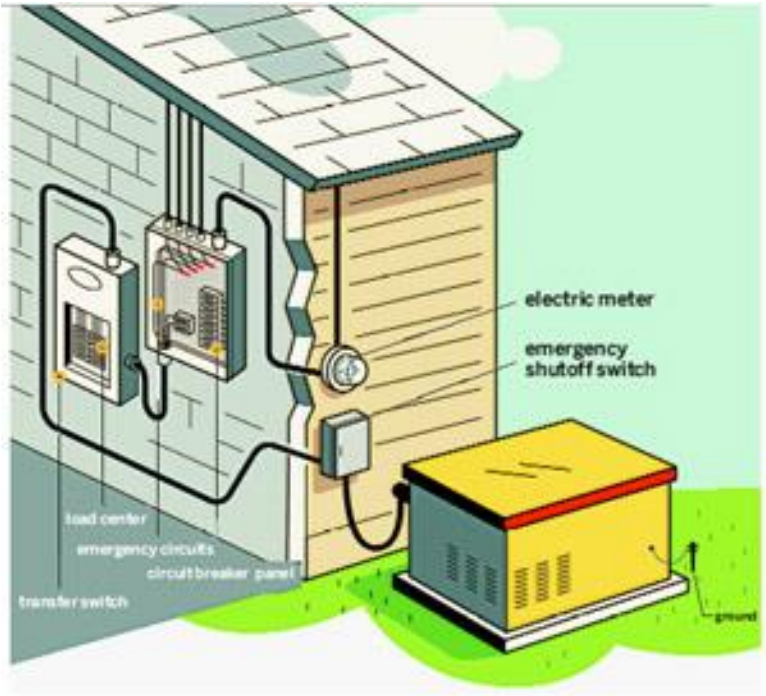
- the energy audit process
- development of a renewable energy feasibility study
- and/or implementation

- **Energy Audits** - ASABE S612 Farm Energy Audit Criteria (Completed by an NRCS Technical Service Provider), or ASHRAE Level II Energy Audit (completed by a Professional Engineer or Certified Energy Manager), as appropriate for entity type.
- **Renewable Energy Feasibility Studies** - Producers who completed the energy audit process and, based on the owner's management goals, have **implemented all relevant energy efficiency retrofit opportunities having a simple payback period of less than 5 years,** may then use the cost-share program to partially fund a renewable feasibility study. The feasibility study must **satisfy the criteria for the USDA Rural Development REAP program,** and where appropriate, include a screening model output from **RETScreen Clean Energy Project Analysis Software.**
- **Implementation Cost-Share Program -** Energy-cost saving opportunities identified in the audit report are eligible for a cost-share from funds remaining in the participant's $5,000 allocation.
- **NOTE:** Cost-share percentage increases (from 25% to 50%) with participation in educational programming (either workshops, mailed fact sheets, and later *"Farm Energy 101 Modules"* online content)

2014-2015 Agricultural Energy Efficiency Initiative:
Agricultural Energy Efficiency Project Workshop Series

Emergency Backup Power Generation Systems (at least 1 workshop)

- During previous project, some participants expressed interest in emergency power systems.
- Interest also grew with outages from *El Derecho* event in June 2012
- Fair amount of confusion between role of: energy efficiency, renewables in backup power (e.g., most net-metered solar PV systems won't energize grid during outage (exceptions)), and emergency power systems.
- Plan to host workshop on Emergency Backup Power Generation Systems



Introduction to Ground Source Heat Pumps - April 2015

Virginia Cooperative Extension's Bioenergy Engineering Education Program (BEEP)

Monday, April 13, 2015 from 9:30 AM to 4:30 PM (EDT)

Appomattox, VA

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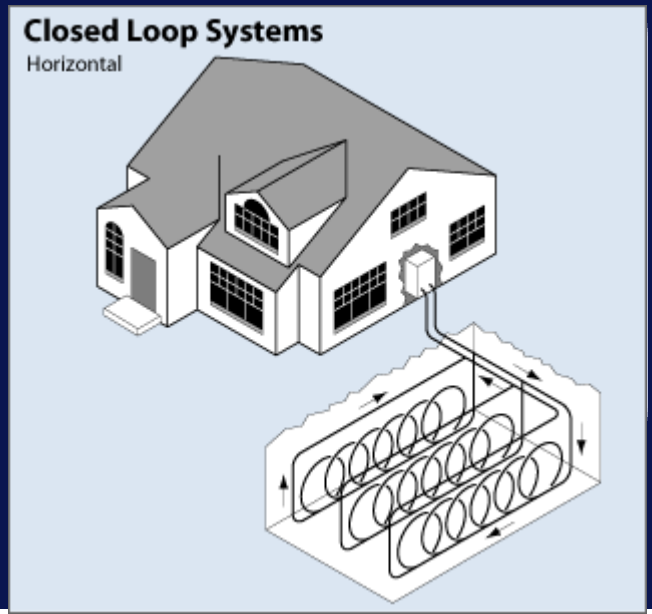
Ticket Information

TICKET TYPE	SALES END	PRICE	FEE	QUANTITY
Introduction to Ground Source Heat Pumps more info	Apr 10, 2015	$20.00	$0.00	1



2014-2015 Agricultural Energy Efficiency Initiative:

Agricultural Energy Efficiency Project Workshop Series

Renewable Energy Technologies & Application Workshops(at least 3 workshops)

- During the previous pilot program many producers expressed an interest in solar energy conversion technologies; therefore, at least one workshop will focus on solar energy (e.g., photovoltaic, thermal, and hot air) (workshop 1).
- Two additional workshops will be held focused on appropriate renewable energy technologies for the region and interest and may include: small wind, thermal conversion of biomass, among others (workshops 2 & 3). **please contact me if you have an idea/suggestion***

Sources:
USDA
https://www.puc.nh.gov/Sustainable%20Energy/GHGERF%202009%20Grantees.htm

WIND TURBINE

Wind turbines produce electricity using the kinetic (renewable) energy from the wind. The energy performance of a wind power system is influenced by a number of factors. For example, these may include resource elements such as the wind speed or wind power density at hub height, the wind shear exponent, the air temperature and the atmospheric pressure. Other factors include design and operation elements such as the wind turbine power capacity and energy curve data, hub height, swept area, number of turbines, array losses, airfoil losses, miscellaneous losses (e.g. parasitic electricity losses, transmission line losses, losses due to low wind energy absorption rate) and the wind turbine availability. Refer to the Schematic of a Horizontal Axis Wind Turbine for more information.

Software & Data

The RETScreen Software Wind Power Model can be used worldwide to evaluate the energy production and savings, costs, emission reductions, financial viability and risk for central-grid, isolated-grid and off-grid wind energy projects, ranging in size from large scale multi-turbine wind farms to small scale single-turbine wind-diesel hybrid systems. The software (available in multiple languages) also includes product, project and climate databases, a detailed user manual, and links to wind Energy resource maps.

Click here to download RETScreen Suite

Training material

RETScreen - Wind Energy Project Analysis - Presentation slides (1.79 MB)
RETScreen - Wind Energy Project Analysis - Voice & slides - part 1/3 (2.90 MB)
RETScreen - Wind Energy Project Analysis - Voice & slides - part 2/3 (1.68 MB)
RETScreen - Wind Energy Project Analysis - Voice & slides - part 3/3 (1.98 MB)
RETScreen - Wind Energy Project Analysis - Speaker's notes

e-Textbook / Guides

RETScreen - Wind Energy Project Analysis - e-Textbook chapter (675 KB)
RETScreen - Wind Energy Project Model (Version 3) - User manual (937 KB)

Case studies / Templates

Power - Wind turbine - 1 kW - Off - grid
Power - Wind turbine - 150 kW - Isolated-grid / Canada
Power - Wind turbine - 390 kW - Isolated-grid / Canada
Power - Wind turbine - 600 kW / Canada
Power - Wind turbine - 9,900 kW / Canada
Power - Wind turbine - 9,900 kW / Germany

RETScreen® International
Clean Energy Decision Support Centre
www.retscreen.net

Clean Energy Project Analysis

RETScreen® Engineering & Cases Textbook

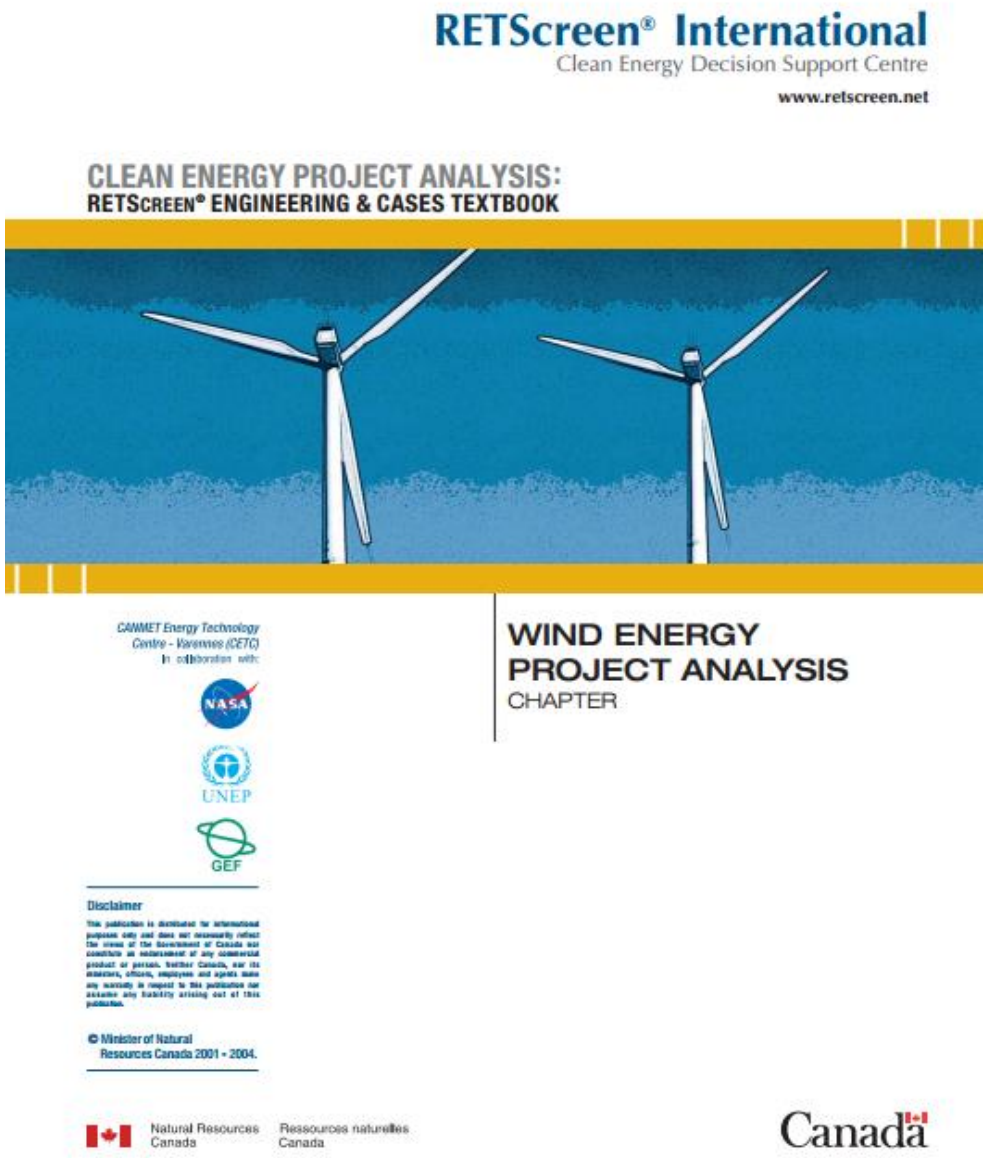
Third Edition

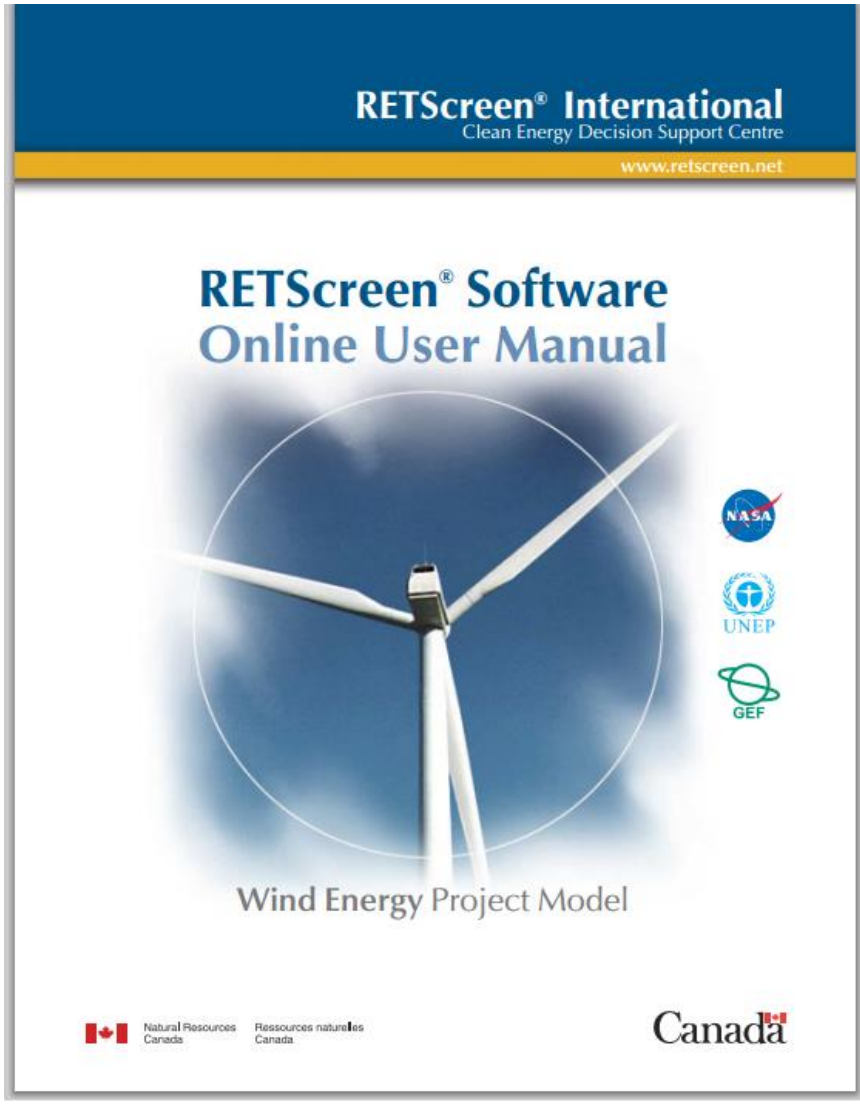
Natural Resources Canada | Ressources naturelles Canada

Canada

CHAPTERS

- [RETScreen - Wind Energy Project Analysis - e-Textbook chapter]





Agenda: Wind Workshop in Abingdon, VA on March 9th, 2015

Start Time	End Time	Session	Details
9:00 AM	9:50 AM	Introduction	Center for Wind Energy overview, state and federal perspective
9:50 AM	10:00 AM	Break	
10:00 AM	10:50 AM	Wind Mechanics	Wind energy basics, wind flow characteristics, turbine design and components, blade design characteristics
10:50 AM	11:00 AM	Break	
11:00 AM	11:50 AM	Turbine Siting and Permitting	Wind measurement, resource assessment, energy production calculation, turbine siting (AWEA siting guide), local permitting, state permitting
11:50 AM	1:00 PM	Lunch/Technology Exhibit	Showcase BAD, anemometer/wind vanes, AIR turbine, weather stations
1:00 PM	1:50 PM	Wind Economics and Financing	Wind economics, financing options, relevant legislation, REAP overview
1:50 PM	2:00 PM	Break	
2:00 PM	2:40 PM	Case Studies	Discussion of successful distributed wind projects across the nation
2:40 PM	3:00 PM	Q&A	Open discussion time

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SEARCH VCWE

Center for Wind Energy

at ***James Madison University***

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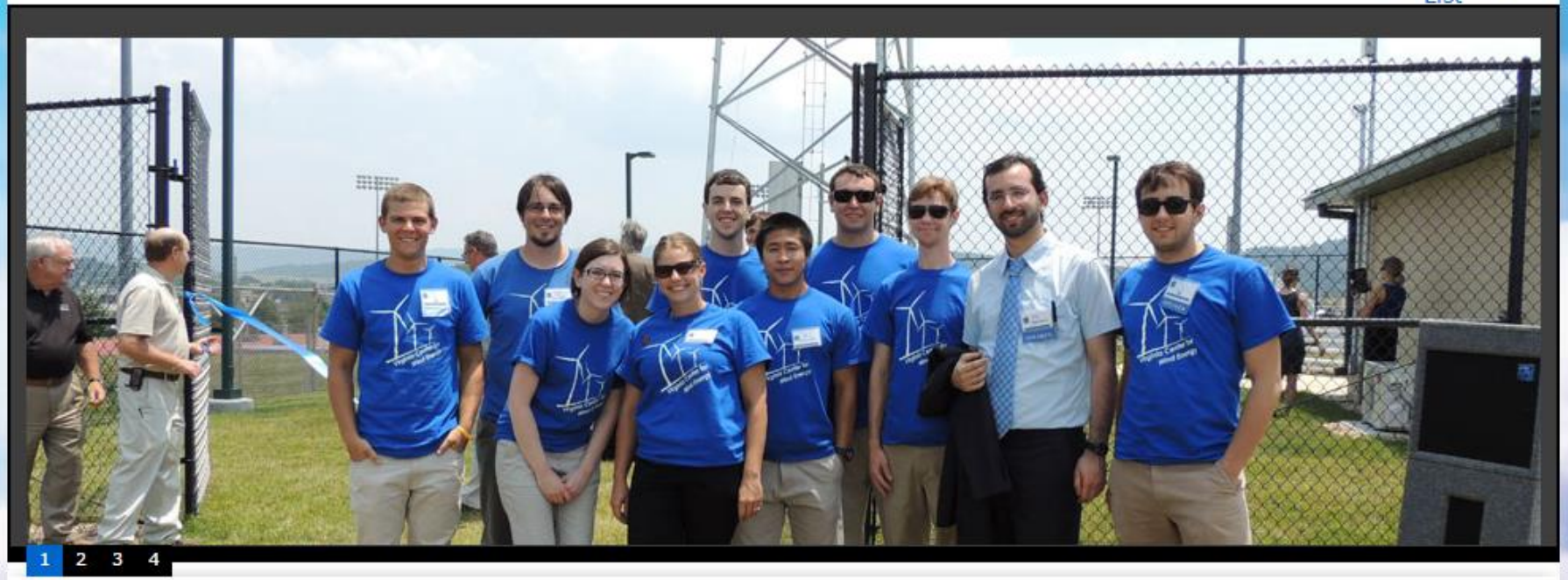

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Community Engagement

- Wind Energy Basics
- Resources
- State Wind Outreach Team (SWOT)

Education & Workforce

- Teacher Professional Development
- K-12 Education
- Undergrad & Graduate

Project Development

- Wind Measurement
- Residential/Business Wind
- Community Wind
- Utility Wind

Research

- Jobs & Economic Development Impacts
- Tangier Island
- Small Wind Training & Testing

Data

- Meteorological Towers
- School Turbines
- Small Wind Training Facility
- Offshore Map & Data Viewer

Center for Wind Energy
at James Madison University

Dr. Jonathan Miles, *Director; Research, Development, & Commercialization Coordinator*

Dr. Jonathan Miles is a Professor of Integrated Science and Technology and Director of the Center for Wind Energy at James Madison University. His background is in physics and mechanical engineering and he teaches a range of courses at all levels involving the applied sciences along with engineering and energy. Dr. Miles has been involved with wind energy since 1998.

Remy Pangle, *Associate Director; Education & Outreach Coordinator*

Remy is the Director of Education and Outreach and State Facilitator for the Wind for Schools (WfS) program in Virginia. She works mainly with educators and school administrators to bring meaningful wind (and all alternative) energy education into the classroom. She also has an interest in offshore wind and other sources of ocean renewable energy. Remy has a background in Integrated Science and Technology as well as Oceanography.

Blaine Loos, *Project Facilitator*

Blaine is the Project Facilitator at the Center for Wind Energy. He responds to all inquiries and serves as the first point of contact for the Wind for Schools (WfS) program and the State-Based Anemometer Loan Program (SBALP). He works to organize and manage CWE equipment and supplies used for the SBALP program, WfS program, and the Small Wind Training and Testing Facility (SWTTF) at James Madison University (JMU). He also coordinates the installation strategies used for meteorological towers installed at SBALP and WfS project sites. Blaine graduated with honors from James Madison University in 2013 with a Bachelor of Science in Integrated Science and Technology concentrating in Energy and Information Knowledge Management.

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