



VirginiaTech
Invent the Future



**Biological Systems
Engineering**

Welcome to the RETScreen Training 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:

Longwood University





**Thank you to our
workshop sponsors:**

**Virginia Tobacco
Indemnification and
Community
Revitalization
Commission**

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



**Biological Systems
Engineering**



Virginia Cooperative Extension

Virginia Tech • Virginia State University



Thank you to our workshop co-sponsor:

“Farm Manure to Energy Initiative”



Farm Manure to Energy Initiative

Using Excess Manure to Generate Farm Income in the Chesapeake's Phosphorus Hotspots

Project Partners: National Fish and Wildlife Foundation, Chesapeake Bay Funders Network, Farm Pilot Project Coordination, Inc., University of Maryland Center for Environmental Science, University of Maryland Environmental Finance Center, Virginia Cooperative Extension, Lancaster County Conservation District, and Sustainable Chesapeake.

Nutrient Management – Pilot Project Development

Regional collaborations to identify technologies and practices to better manage nutrients in response to Bay TMDL & State WIP



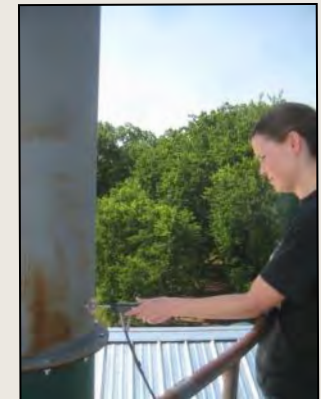
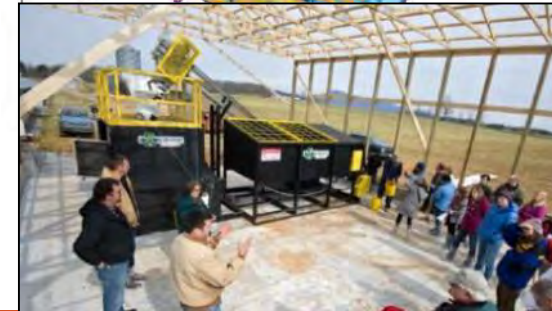
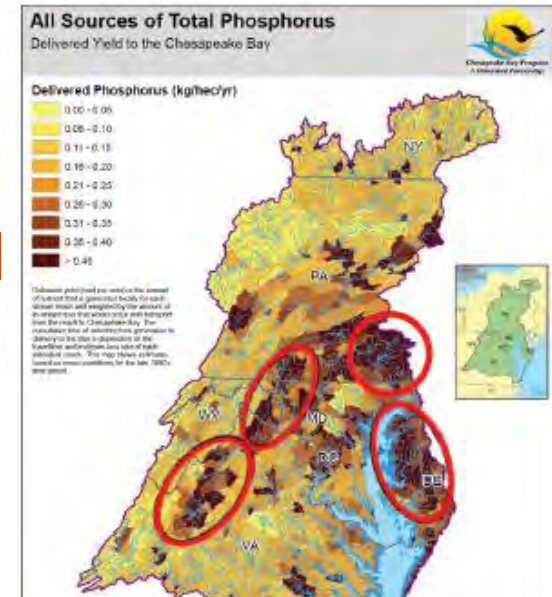
Farm Manure to Energy Initiative

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Collaborative Role Includes:

- Assess system performance, ease of adoption and farm integration
- Conduct preliminary biomass feedstock analysis and emission testing
- Organize farm tours and educational workshops
- Convey results good/bad to clientele and extension network
- One effort focuses on poultry litter and another on smaller dairies



And to DMME for First Bringing
RETScreen to Virginia!



6 Daylong Intro Workshops
Throughout the State in 2012

Exploring Solar Energy Applications in Rural Virginia

Applying Renewable Energy Project Screening, Analysis Tools and Decision Support Software

- RETScreen
 - Webinar
 - Six Workshops
 - Hampton
 - Richmond
 - Alexandria
 - Shen Valley
 - Roanoke
 - Danville
 - Workshop Webpage
 - Videos, resources
- Collaborators
 - NASA Langley
 - Shenandoah Valley Energy Partnership (Blue Ridge Community College)

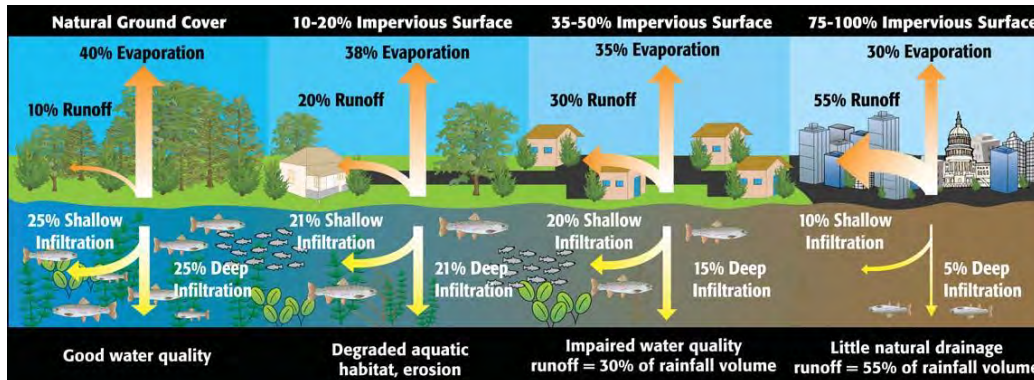
Improving Urban Stormwater Management and Evaluating Energy Benefits— Dr. David Sample

A look at:

- Urban Stormwater
- Low Impact Development
- Green Roofs & Energy



David J Sample
Assistant Professor and Extension Specialist



Available as Adobe Presenter File on Workshop Website (Soon as YouTube)

Energy Aspects of Community Planning & Regulations – Dr. Jonah Fogel

- Challenges and Opportunities for Renewables
- Business friendly communities
- Incentives and Regulations
- Working at the “community scale”
- How can RETScreen help?



Jonah M Fogel
Extension Specialist, Community
Viability

Virginia Cooperative Extension

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VirginiaTech

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Live at Richmond & Alexandria Sessions – *Upcoming YouTube on Workshop Website*

Lean Thinking and Energy Savings

Dr. Henry Quesada-Pineda



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Overview of:

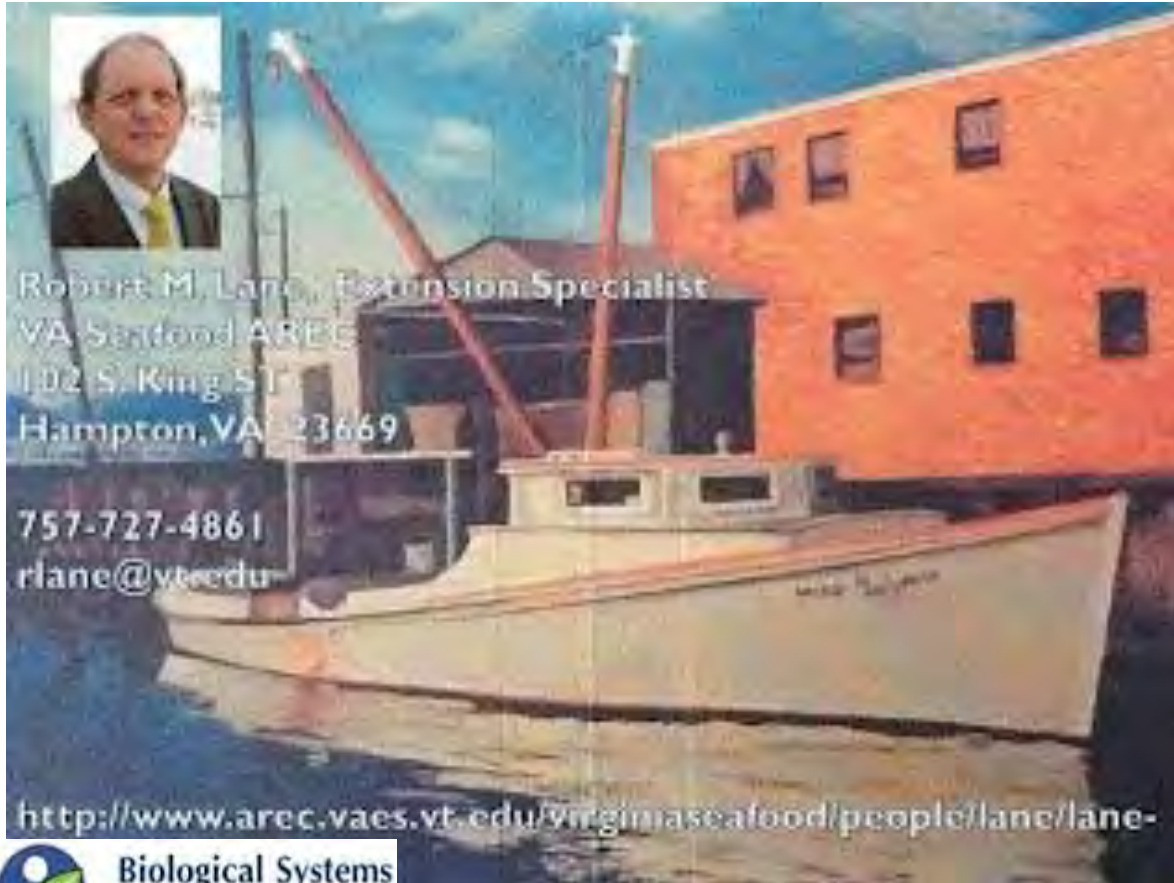
- Lean manufacturing concepts
- Energy audits
- Energy efficiency measures
- Lean manufacturing toolkit

Henry Quesada-Pineda
Assistant Professor



Live at Roanoke – Available as Adobe Presenter File on Workshop Website (Soon as YouTube)

Energy Considerations at a Virginia Fish Farm – Bob Lane, Seafood Extension Specialist



Robert M. Lane, Extension Specialist
VA Seafood AREC
1102 S. King St
Hampton, VA 23669

757-727-4861
rlane@vt.edu

<http://www.arec.vaes.vt.edu/virginiaseafood/people/lane/lane->

A look at
displacing propane
with a solar
thermal project at
an aquaculture
facility on the
Eastern Shore- VA



Live at Hampton Session – *Upcoming YouTube on Workshop Website*



[Jonah Fogel, Community Viability Specialist, Virginia Cooperative Extension](#)

[Presentation on Energy Aspects of Community Planning & Regulations](#)



Jonah is a Community Viability Specialist with Virginia Cooperative Extension. He holds a Ph.D. from the University of Tennessee in Natural Resources with a minor in Environmental Policy, a Masters of Landscape Architecture from Virginia Tech, and a B.S. in Hydrogeology from Western Michigan University. As the Community Viability specialist for Virginia Cooperative Extension Jonah serves as a leader in land use planning and policy education, and community food systems. He has co-developed three Extension curricula for VCE, and has been awarded competitive grants exceeding \$250,000. His work has also led to the development of the Community Food System Explorer, the Richmond Area Food System Council, and developed the Virginia Citizen Planner program. Prior to completing his graduate schooling, Jonah worked as an environmental consultant, conducting soil and groundwater pollution surveys and reporting. His research interests have centered on the interactions between human decision-making and ecological systems.

[Extension](#)

[John Ignosh, Area Specialist, Biological Systems Engineering, Virginia Tech &](#)

[Presentation on Workshop Introduction and Virginia Context](#)

John Ignosh works to promote the efficient utilization of agricultural byproducts as an Area Specialist with Virginia Cooperative Extension and Virginia Tech's Department of Biological Systems Engineering. Prior to his current role, John performed air quality research with the University of California – Davis related to aerosols associated with agricultural production in the San Joaquin Valley, as well as nationally regarding the contribution of fine aerosols to regional haze and public health in protected environments. He has also worked in international development and served as a resource extension agent with the U.S. Peace

Bob Lane, Extension Specialist Seafood, Biological Systems Engineering, Virginia Tech & Extension

Technology Considerations at a Fish Farm



As the Engineering Extension Specialist at Virginia Tech's Seafood Agriculture Research and Extension Center in Hampton, Bob Lane develops practical solutions to address issues such as food safety and processing. Bob works closely with seafood, aquaculture, and agriculture industries to address specific issues they have, from technical difficulties within their facilities to food packaging development. Some of his work includes thermal monitoring in oyster and crab processing. Bob also works with companies to develop efficient energy, water use and waste management systems with the goal of minimizing costs and improving sustainable resource use. He facilitates collaboration on these projects between industry, researchers and regulatory bodies. Bob Lane has been with the Virginia Tech Extension since 1988. Prior to his career with Virginia Tech, Bob worked nine years in the electric utility industry. He holds an M.S. in Agricultural and Life Sciences and a B.S. in Agricultural Engineering, both from Virginia Tech.

Tactone Arogo Ogejo, Extension Specialist, Department of Biological Systems Engineering, Virginia Tech & Extension

Presentations on Anaerobic Digesters: Biomethane Production from Dairy Manure

Anaerobic Digesters: Biomethane Production from Dairy Manure

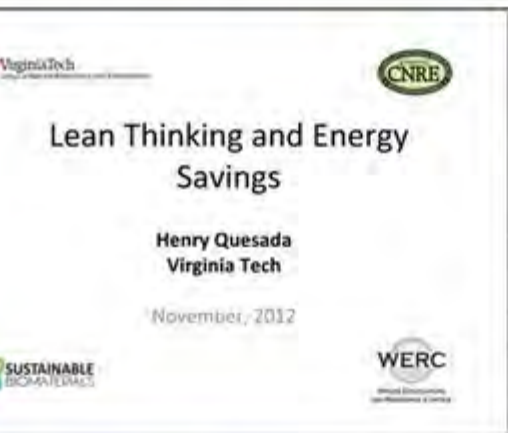
Elizabeth Collins, EIT, Graduate Student
Tactone Arogo Ogejo, P.E., Assoc. Prof

Energy and nutrient recovery from biobased materials. Animal waste management best management practices. Agricultural air quality. Technology Transfer.

[Henry Quesada](#)

[Presentation on Lean Manufacturing Concepts and Tools \(with Audio\)](#)

[Presentation without Audio](#)



Dr. Henry Quesada works for the Department of Sustainable Biomaterials at Virginia has an expert in business management and operations research. His academic program focuses on process improvement for service and manufacturing firms and he has over 12 years of experience as a consultant and researcher in medical device components, forest products, microelectronic, financial, and telecommunications industry sectors

[Michael Ross, RER Energy](#) - Multiple Presentations Below:

[Introduction to Course](#)

[Introduction to the Notion of Prefeasibility Assessment for Energy Projects](#)

[and Financial Analysis with RETScreen](#)

[Introduction to Combined Heat and Power \(CHP\)](#)

[Introduction to Energy Efficiency with RETScreen](#)

[Overview of "other" RETScreen Modules & Kits](#)

[On-line Case Studies](#)

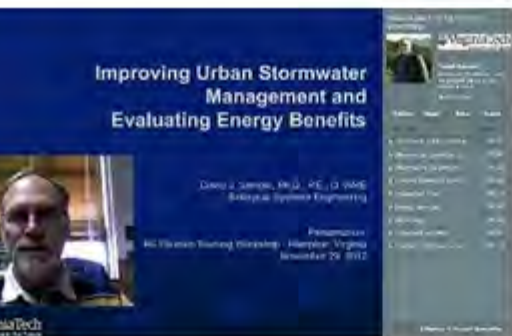
[On-line Case Studies Slides](#)

Michael M. D. Ross has worked with renewable energy systems and other clean energy technologies for over 17 years. Michael has held research positions at CanmetENERGY and the Advanced Energy Systems Group of the Department of Technical Physics and Mathematics at Aalto University, Finland's premier engineering university. Since 2001, in addition to consulting extensively for RETScreen® International, Michael has been contracted to provide expertise in building energy modeling and energy efficiency, research on photovoltaic systems, wind energy resource assessment and site selection,

degree in Systems Design Engineering from the University of Waterloo. RER Energy Inc. is a consultancy focused on energy efficiency and renewable energy. Its main activity is research on system-level topics, including system optimization, component and system characterization, resource assessment, simulation, modelling, and data analysis. One of its specialties is the utilization of renewable energy technologies in cold climates. In addition, RER develops custom software materials and provides training related to energy efficiency and renewable energy.

David Sample, Extension Specialist, Dept. Biological Systems Engineering, VT

Presentation on Aspects of Energy Usage and Runoff Reduction Associated with Green Roofs

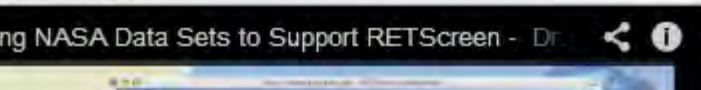


David is an assistant professor and extension specialist in the department of Biological Systems Engineering at Virginia Tech. He received a BS and ME from the University of Florida (Gainesville, FL) in environmental engineering and a PhD from the University of Colorado (Boulder, CO) in Civil Engineering (Water resources). Dr. Sample has approximately 22 years of experience including both consulting and municipal government before coming to Virginia Tech in 2008. Dr. Sample's research focuses upon improving our management of urban water. He is currently researching the effectiveness of different Low Impact Development (LID) Practices and other Best Management Practices (BMPs) with innovative designs. Dr. Sample has developed numerous natural and urban watershed models, developed monitoring plans, and conducted watershed improvement projects, including economic analysis of alternatives. Dr. Sample is a registered engineer in over 7 states, and is a Diplomat of the American Academy of Water Resources Engineers. In 2008, Dr. Sample was appointed to the U.S. Chesapeake Bay Program Science and Technical Advisory Committee (STAC). He also served on the Virginia BMP Clearinghouse for the Virginia Department of Conservation and Recreation since 2008. He has been a member of the Urban Stormwater Resources Research Council of the American Society of Civil Engineers/Environmental and Water Resources Institute since 2003, and has co-chaired a committee on implementing Low Impact Development in Combined Sewer Areas since 2009.

Paul Stackhouse Jr., Senior Research Scientist, NASA Langley Research Center (USA)

Presentation Discussing the Collaboration Between NASA and RETScreen & Near Real-Time Solar and Meteorological Data for Monitoring Building Energy Systems using RETScreen International's Performance Analysis Module

YouTube Video



Dr. Paul Stackhouse is a Senior Research Scientist at the NASA Langley Research Center in Hampton, Virginia. He received his B.S. in Physics and Atmospheric Science from Drexel University in Philadelphia, PA. He received his M.S. in Physics from the University of Virginia in Charlottesville, VA. He received his Ph.D. in Physics from the University of Virginia in Charlottesville, VA.

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ADDITIONAL RESOURCES FROM WORKSHOP

[NASA's "Prediction of Worldwide Energy Resource" \(POWER\) Lab Website](#)

[GRID/Power Profile - Regional Emission Information for Primary Energy Fuel Mixes](#)

[RETScreen NING Online User Forum](#)

[Arlington Community Energy Plan \(Arlington, Virginia\)](#)

A red, five-pointed starburst graphic with a blue outline and a gradient fill, containing the text 'POP QUIZ!' in bold black letters.

**POP
QUIZ!**

What is
Virginia
Cooperative
Extension?



About Virginia Cooperative Extension...

Virginia Cooperative Extension brings the resources of Virginia's land-grant universities, Virginia Tech and Virginia State University, to the people of the commonwealth.

3 Goals of U. S. Land Grant Universities:

- Teaching
- Research
- Extension Service



Virginia Cooperative Extension

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

Objectives

Goals:

- Raise awareness and understanding among clientele of new approaches to increase the efficiency of production systems and opportunities to minimize environmental impact
- Relay emerging issues expressed by clientele to research community

Focus Areas:

1. On-farm energy efficiency
2. Renewable energy conversion technologies
3. Project assessment tools
4. Nutrient management technologies

Clientele:

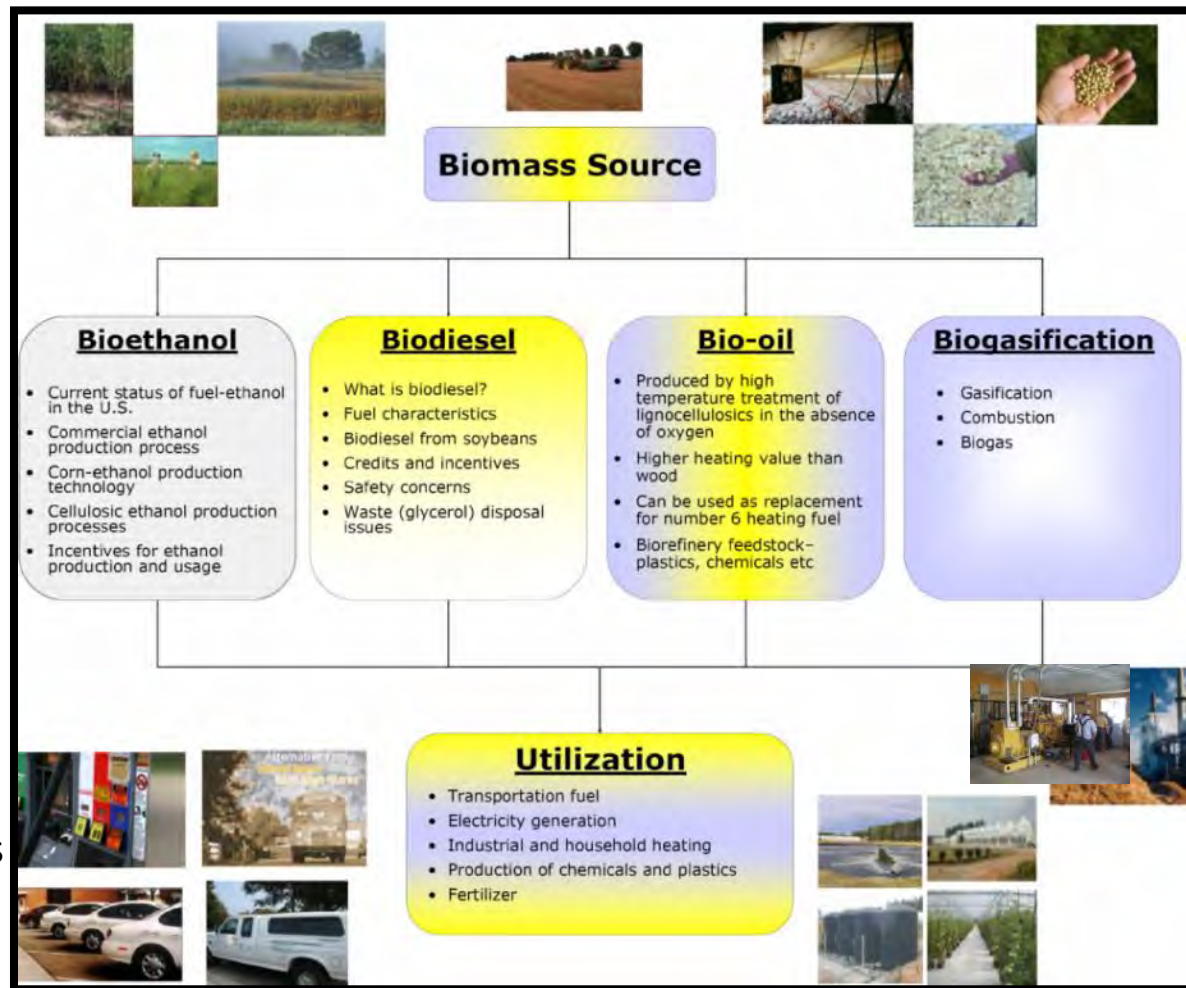
- community leaders
- entrepreneurs
- farmers
- K-12 students
- policy makers
- And more!

Promote the efficient utilization of agricultural byproducts. This role includes:

- Collaborating on regional efforts to assess opportunities to integrate nutrient management technologies with renewable energy generation
- Providing unbiased technical information on bioenergy conversion technologies including anaerobic digestion, biodiesel and thermal conversion processes
- Assisting farmers and rural small businesses in conducting energy assessments and audits of greenhouses, dairies, poultry farms, and other operation

Bioenergy Engineering Education Program

- BEEP provides tailored informational sessions for community leaders, entrepreneurs, farmers, K-12 students, and the general public on renewable energy technologies.
- Started in 2006 by Dr. Arago, BEEP is delivered via webinars, presentations, meetings, field tours and hands-on workshops
- Aimed at providing basic information to Virginian's interested in bioenergy: farmers, students, organizations, anyone interested in learning more.
- Growing to include solar energy conversion technologies new mobile learning lab!



PLEASE JOIN US FOR A FREE EDUCATIONAL EVENT
Virginia Biomass Energy Webinar
Tuesday, February 21st 2:00 – 3:30 PM (EST)

Please join Virginia Cooperative Extension for a **FREE** webinar to briefly explore biomass energy, biomass boiler retrofits, and educational resources related to exploring these opportunities for a variety of facilities in Virginia – schools, industry, hospitals, and other locations. While biomass energy won't be a good fit for all locations, where it does work it can help reduce annual energy costs while increasing demand for local renewable products.

This webinar will highlight a range of biomass energy project examples and introduce a variety of resources for additional information with brief presentations from:

- Biomass Thermal Energy Council
- US Forest Service
- US Department of Energy's Mid-Atlantic Clean Energy Application Center
- VA Department of Forestry
- Virginia Tech
- TRANE
- English Boiler

TO REGISTER FOR THIS FREE EVENT PLEASE EMAIL: VirginiaEnergyWebinars@gmail.com

Please email any questions to the above address or call John Igmosh 540-432-6029 x108

Ecological Systems Engineering | Virginia Tech | Virginia Cooperative Extension | VCU

DM Virginia
ME Department of
 Mines Minerals
 and Energy





Virginia Tech • Virginia State University

www.ext.vt.edu

Welcome to the “Virginia Boiler Workshop”

*Enhancing Energy
Efficiency via Steam System
Assessments*

Wednesday, June 4, 2014
Virginia Museum of Natural History
Martinsville, VA

Welcome to the *“Solar Photovoltaics: Introductory Workshop”*



Biological Systems
Engineering



Virginia
Cooperative
Extension

Virginia Tech • Virginia State University

May 17, 2014
Northern Virginia 4H Camp & Conference Center
Front Royal, VA

Exploring Solar Energy Applications in Rural Virginia

*Applying Renewable Energy Project Screening, Analysis Tools
and Decision Support Software*



Development of Working Educational Demos

- Northern Virginia 4H Center
- Solar PV w/ Monitoring
 - 1-2 kW grid interactive
 - Web monitoring
- Built in ongoing outreach programming via future ongoing field days and remote system performance monitoring
 - ~ 5,000 4H campers with edu programming
 - Appalachian Trail runs by facility, procure local food at cafeteria, (<energy costs, >local food)
 - Public Pool
 - Conference Center (hosting our PV workshop)



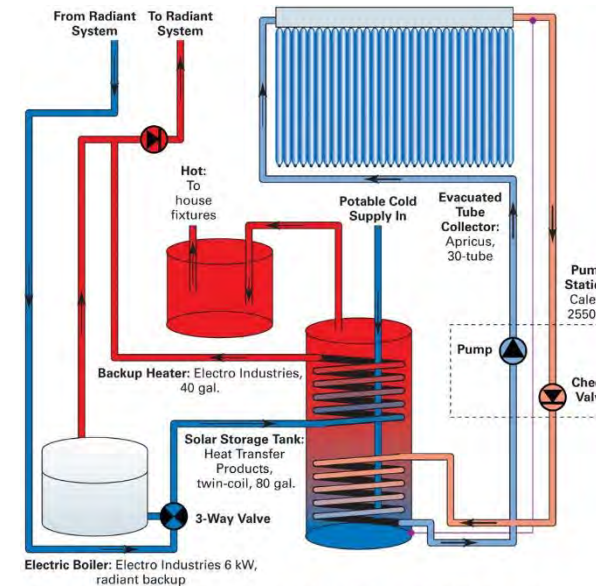
Beyond Project

- Exploring additional opportunities for larger project outside of current project using PV Project Finance vehicle unique to non-profits
- Exploring opportunities with energy efficiency competitions, energy audits, sub-metering, etc. with utility (ODEC)
- 6 facilities in VA

Exploring Solar Energy Applications in Rural Virginia

Applying Renewable Energy Project Screening, Analysis Tools and Decision Support Software

- Development of Working Educational Demos
 - Randolph Farm – VSU
 - Aquaculture
- Solar Thermal w/ Monitoring
 - Off-shelf vs. DIY
 - Web monitoring
- Built in ongoing outreach programming via future ongoing field days and remote system performance monitoring
 - ~ 5,000 people on facility tours each year



Note: This diagram is greatly simplified and does not show or label all the controls, pumps, manifold, and sensors that are part of the system.



Virginia Engineering Design Note 614 (DN-614) Watering Facility



September 2010



1) Assistance Information

Customer:
 County:
 Date: 3/12/2014
 Assisted By:

Project Notes:

2) Water Budget

a) Total Daily Water Demand

Type of livestock:
 Number of Animals:
 Water demand/animal/day: gpd
Total Daily Demand: gpd
See Design Note for watering recommendations for various types of livestock.

b) Daily Peak Water Demand

Number of times herd drinks/day: events
 Time desired to water herd: minutes/event
 Average peak demand: gpm
 Alternate peak demand: gpm
See Design Note for considerations for estimating peak demand.

c) Evaluate Source

Source flow rate: gpm
 Source daily yield: gpd
If source flow rate is close to or less than Peak Demand, consider storage alternatives (see 2nd Tab).
 If source daily yield is less than Daily Demand, consider an alternate or supplemental water source.

3) Design Parameters

a) Trough Information

Trough type(s):
Design flow rate: gpm
Select flow rate to troughs as guided by Step 2 and Design Note. Typical design flow rates are: 8 gpm for frost-free troughs; 5 gpm for storage troughs.
 Maximum float valve pressure: psi
Typical values range from 50-140 psi. Check manufacturer's recommendations.
 Minimum float valve pressure: psi
Varies depending on type of float. Use manufacturer's recommended minimum. Typical value is 10 psi.

b) Pipe Information

Pipe material:
 Pipe nominal diameter:
 Pipe avg. inner diameter: in.
 Pipe cross-sectional area: sq. ft.
 Friction loss/100 ft: ft./100 ft.
 Velocity check (<5 fps): fps
If velocity is greater than 5 fps, consider a larger diameter pipe.
 Pipe length to farthest watering point: feet
 Add 10% for slope and fittings: feet
 Total friction loss: ft. OR psi
 Total friction loss: psi
If friction loss is greater than 10 psi, consider using a larger diameter pipe.
 Pipe pressure rating: psi
 72% of rating (See VA CPS 516): psi Compare with result in Step 5b.

c) Vertical Pumping Distance

High point to pump "to": feet
 Ground elev. of high point:
 Low point to pump "from": feet
 Ground elev. of low point:
 Elevation difference: feet
 OR psi

4) Pump and Pressure Tank Design



Virginia Residual Biomass Inventory

GIS Based Multi Feedstock Bioresidue Assessment

Our Resources

Residual Biomass Inventory Feedstock Estimation Sheets

Sources of bioresidue were classified into one of five categories, these include:

- Agricultural crops
- Agricultural manures
- Forestry
- Food waste
- Municipal sources

Barley Straw

Barley is typically planted as a winter cover crop in Virginia, in the early summer the crop residue is baled as straw.

Current Market

The material is typically used as a form of animal bedding and by construction and landscaping crews as a form of erosion control during earth moving, among other uses.

Potential Conversion Technologies

- Thermohemical Conversion
- Proximate
- Catalytic Ethanol

Summary of Methodology

Barley straw values were obtained from National Agricultural Statistics Service (NASS, 2007). The data retrieved contained three fields aggregated to the county level, number of barley farms, acres of barley, and bushels of barley. Multiples were retrieved from three sources, the Washington biomass study (Pinar, 2006), the NREL report (Kilbratow, 2005), and National Research Council (NRC, 1983). Barley straw values were obtained from the county production levels for each county across the state as published by NASS. The harvest statistics were reported in bushels and later converted to tons. The first estimate used the Washington State studies "bushel to cubic foot (0.8038 ft³) and bulk density of barley (40.3 pounds/cubic foot) were used to determine number of tons" (SMRCS, 2004). Barley straw (460 tons/year) was multiplied by the availability factor 40%, the residue factor 2.5, and the dry biomass 85% to calculate the total dry biomass of barley straw in tons (Tikal, 1980). The second estimate came from the NREL studies, 40 pounds/bushel to determine the number of tons. Barley straw yield (tons/year) was multiplied by the availability factor 25% (Pflaunders, 2006), the residue factor of 1.2 (Kilbratow, 2005), and the dry biomass 85.5% (Kilbratow, 2005) to calculate the total dry biomass of barley straw in tons. The third estimate came from the NREL studies 40 pounds/bushel to determine the number of tons. Barley straw yield (tons/year) was multiplied by the availability factor 60% (NASS, 1998), the residue factor of 2 (NRC, 1983), and the dry biomass 85.5% (adjusted) to estimate the total dry biomass of barley straw in tons.

General Equation

$$\text{Barley Straw BDT} = \text{Yield} \times \text{Availability Factor} \times \text{Residue Factor} \times \text{Dry Biomass Factor}$$

Residual Biomass Estimation Matrix

ESTIMATION FACTORS	RESIDUE AVAILABILITY ESTIMATION			Average	n
	L	M	H		
BDT	\$1,870	46,817	42,443	39,800	26,383
ESTIMATED STATEWIDE TOTAL					
36,900 Annual BDT					

Geographic Distribution of Barley Straw in Virginia

TOP FIVE COUNTIES

Rank	County	Biomass (BDT)
1	Westmoreland	6,204
2	Rockingham	3,857
3	Essex	3,182
4	Augusta	3,009
5	Northumberland	2,084
Statewide Total		39,900

SEASONALITY OF PRODUCTION

Season	General Residue Availability	Output
Spring	Low	Low
Summer	Medium	Medium
Fall	High	High
Winter	Low	Low

LOGISTICAL FACTORS

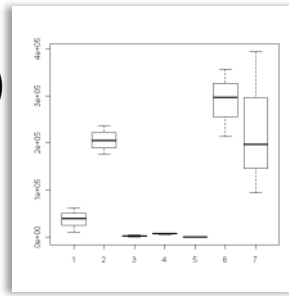
Typical Range of "As-Is" Moisture Content (MC%)	9 - 15
General Estimation of Resource Recoverability	High

HISTORIC VARIABILITY OF OUTPUT

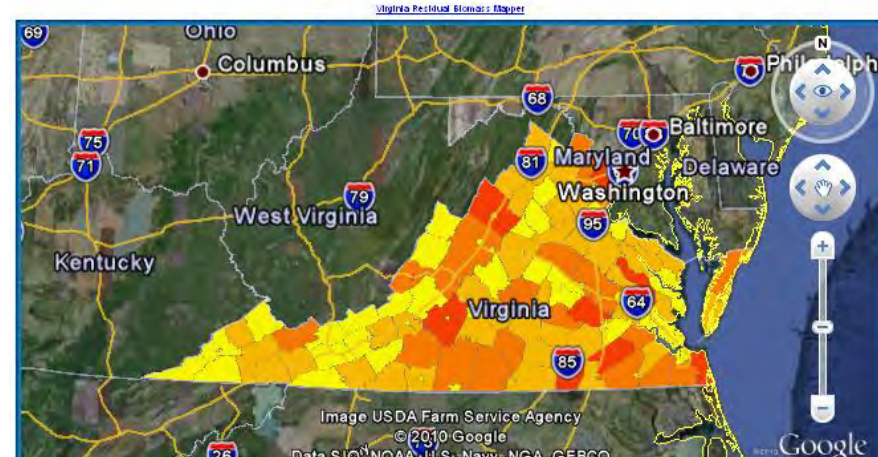
Year	Barley Production in Bushels
2007	100,000
2008	100,000
2009	100,000
2010	100,000
2011	100,000
2012	100,000

Additional Information

Please refer to Appendix "Barley Straw" and the Reference section at the end of the report for more detailed information regarding the estimation process for this bioresidue.



VIRGINIA RESIDUAL BIOMASS MAPPER



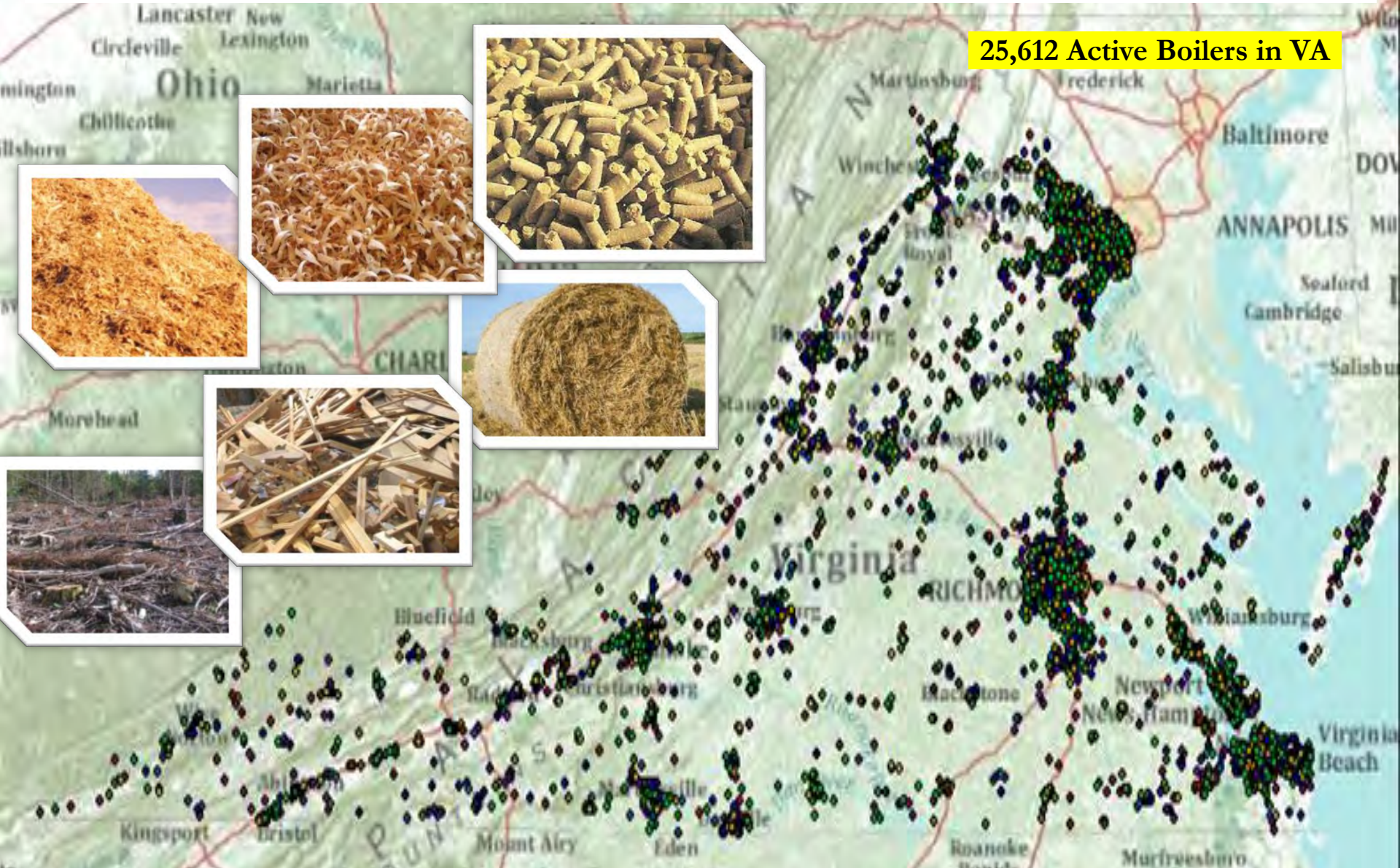
- In addition to dedicated energy crops, what biomass feedstocks do we have to work with? Where and when are they generated? Is there competition for this material? What's its highest/best use?
- Are there other mgmt constraints or opportunities due to location? (SOM, federal land, TMDL, tipping fees, etc.)
- Sought after as initial project screening tool by bioenergy project developers
- Component to Virginia Energy Plan



5 Categories, 23 Feedstocks
With more work underway

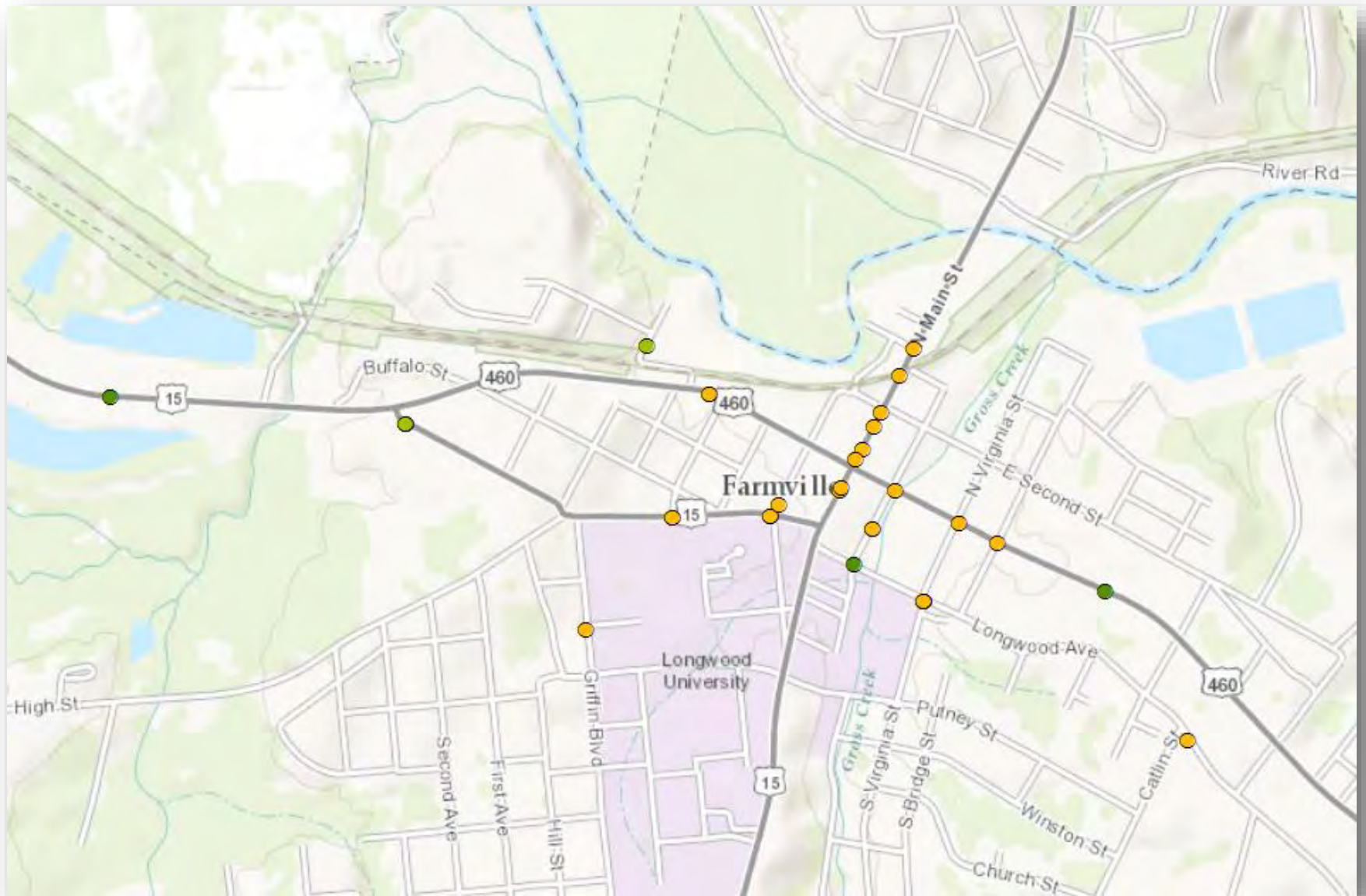
Geocoding & Analysis of Active Boilers

25,612 Active Boilers in VA



Where might it be worthwhile to explore options with biomass?

Active Boilers in Farmville, VA



Nutrient Management – Pilot Project Development

Regional collaborations to identify technologies and practices to better manage nutrients in response to Bay TMDL & State WIP



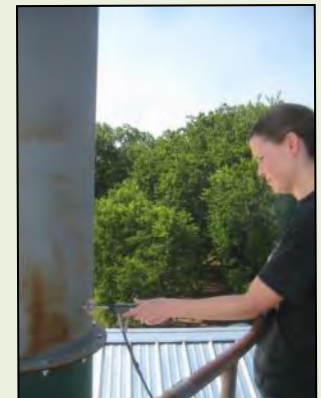
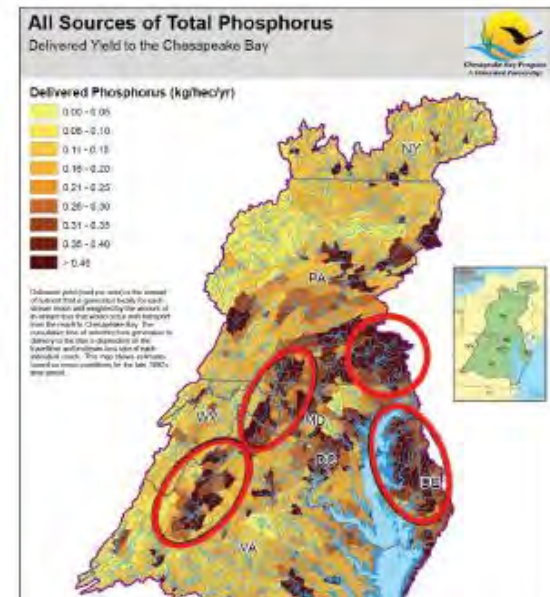
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Virginia Community Wood Energy Program



Welcome to The Center for Natural Capital 2014



The Center is a 501 c-3 applied research, education, and job training and development organization focused on community economic development through health in four program areas - energy, rivers, landscape, and people. [Learn More](#)

Pellet Mills in the Region

NOTES:

- Some: bagged retail only, no bulk deliveries, make product intermittently, are export only, etc.
- Dynamic & details change – worth a phone call for latest information in exploring your project scenarios



Hamer Pellet Fuel Company

1. Elkins, WV
2. Mt. Hope, WV

Enviva Biomass, LP (formerly: Intrinergy, LLC)

1. Ahoskie, NC
2. Northampton County, NC
3. Chesapeake, VA

Lignetics, Inc.

1. Linn, WV
2. Kenbridge, VA

O'Malley Timber Products, LLC

1. Tappahannock, VA

Potomac Supply Corporation

1. Kinsale, VA

Turman Hardwood Pellets

1. Galax, VA

Biomass Energy, LLC (formerly: WoodFuels Virginia)

1. Bumpass, VA

Wood Fuel Developers, LLC

1. Jarratt, VA

American Wood Fibers

1. Marion, VA
2. Jessup, MD

Nash Timber Corporation

1. Gladys, VA

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
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VCE Community Viability and the
Virginia Tech Biological Systems Engineering Department

Martha Walker, Ph.D.
Community Viability Specialist
Virginia Cooperative Extension

John Ignosh
Biological Systems Engineering
Virginia Cooperative Extension



**Biological Systems
Engineering**



Virginia Cooperative Extension

Virginia Tech • Virginia State University



On-Farm Energy Efficiency Program

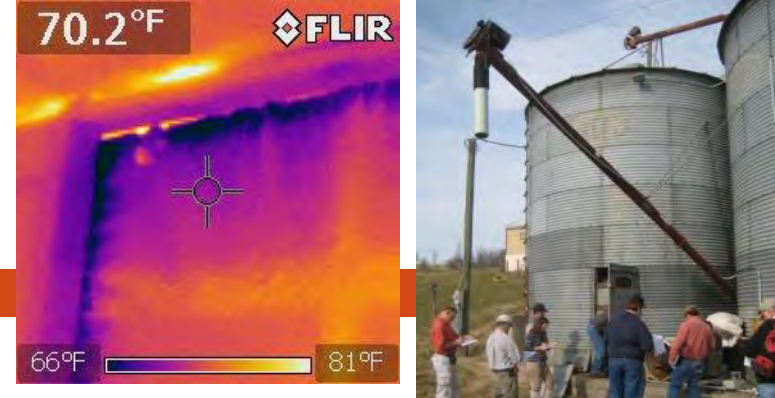
A Pilot Program for Southside and Southwest Virginia

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.

Initial Collaborators

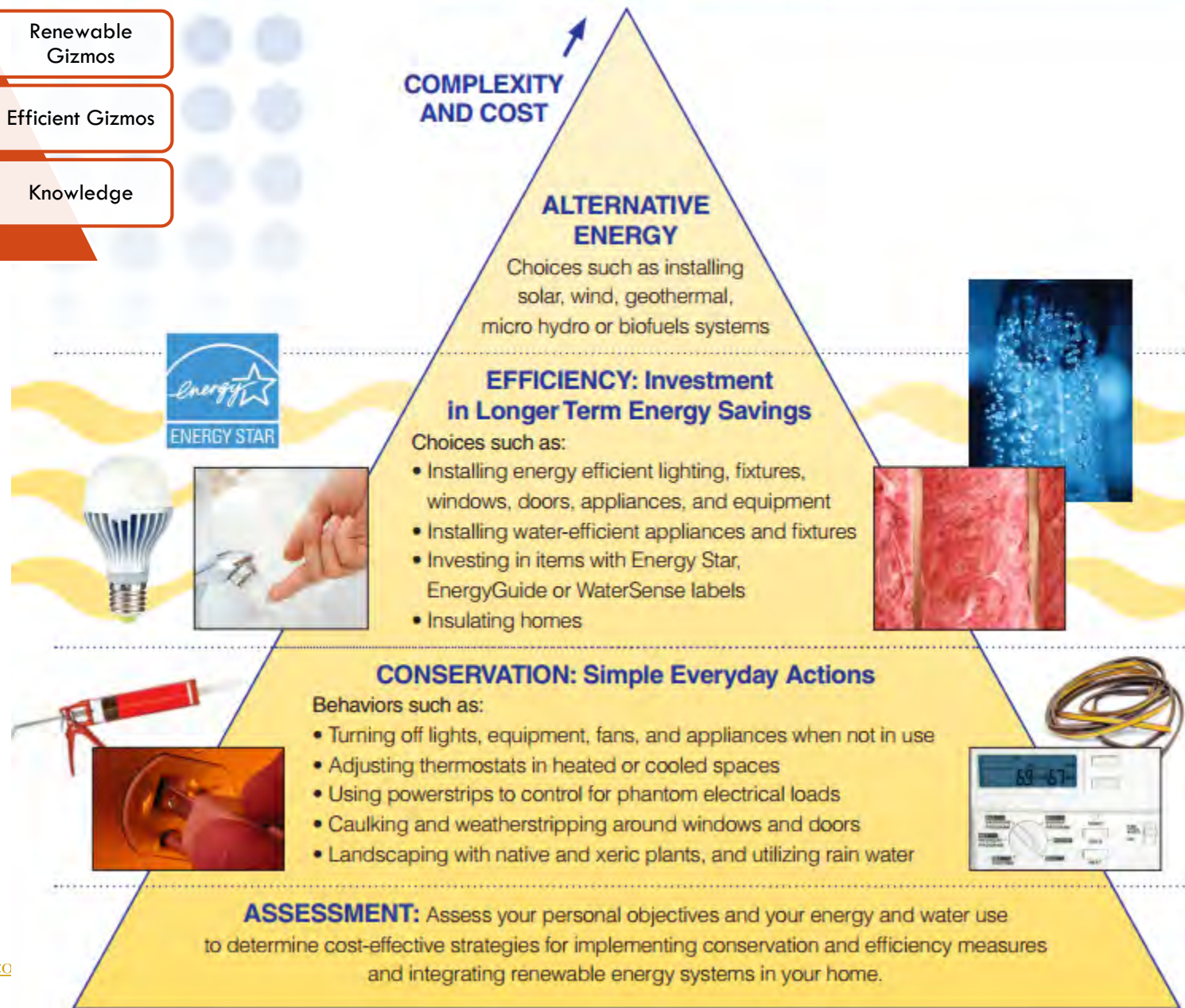
we're always looking for more

- Virginia Cooperative Extension: Martha Walker, John Ignosh, David Reed; Joyce Latimer, Henry Quesada; Stephen Barts (Pittsylvania), Taylor Clarke (Mecklenburg), Mike Parrish (Dinwiddie), and Cynthia Martel (Franklin); Amy Fanon-Osborne (Lee), Scott Jerrell (Scot), Scott Jessee (Russell)
 - **ANY OTHERS IN VCE & WORKING IN REGION THAT ARE INTERESTED CAN PARTICIPATE TOO**
- Old Dominion Electric Cooperatives, Erin Puryear
- Virginia Department Mines, Minerals & Energy, Robin Jones
- Virginia FAIRS, Chris Cook
- USDA NRCS, David Faulkner
- USDA Rural Development, Laurette Tucker
- Natural Capital Investment Fund, Hannah Vargason

General Strategy



ENERGY ACTION PYRAMID



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, be completed by a Professional Engineer that is not affiliated with any particular technology provider, and 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: Energy Audits, Feasibility Studies, and Retrofit/Renewable Implementation

Cost-share percentage increases (from 25% to 50%) with participation in educational programming (flexible format: either via workshops, mailed fact sheets, and later “Farm Energy 101 Modules” online content, etc.)

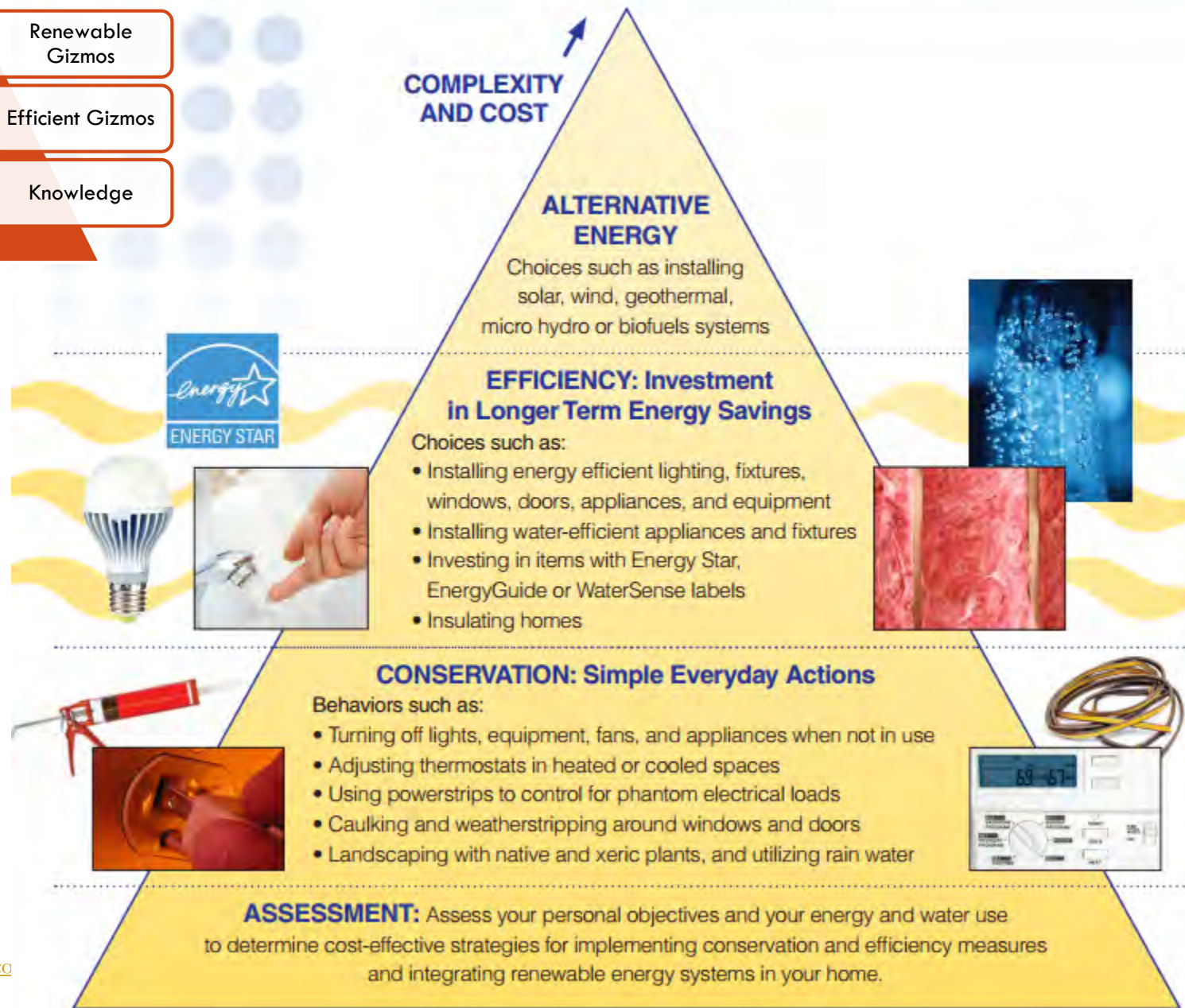
□ **Why?**

- **Significant energy cost savings can be achieved via no-cost and low-cost energy efficiency measures.** Many of the management practices that generate the greatest energy savings often continue to use existing equipment, however, incorporate energy best management practices to do so more efficiently.
- **VCE delivers the educational programming related to energy management practices that are tailored to specific agricultural production systems.**
- **Better yet, any of the more expensive retrofits that are installed will tend to perform better with these same energy BMPs.**

General Strategy



ENERGY ACTION PYRAMID



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

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Agricultural Energy Efficiency Project Website

Farm Energy 101 Modules

- Cost-share percentage increases with participation in educational programming (either workshops, mailed fact sheets, and later “Farm Energy 101 Modules” online content)
- Post workshop presentations on website
- Create additional ag energy related content and post as online educational videos (e.g., lighting, ventilation, etc.)
 - Selected Lectures from BSE Service Course – Dr. Christian Mariger (*more on these later*)
 - ***If you have a suggestion for a specific topic please let me know***
- Later in the project we will attempt to integrate brief “quizzes” within online video content, viewers can use this as one more way to satisfy edu requirement for increased cost- share rate

Energy Conservation in Swine Barns in Virginia

Energy Conservation in Swine Barns in Virginia ...

Annual Energy Usage Estimate

Ventilation Rate	Energy Usage (cal/gallons LPY/1000 pig spaces per year)	Overage Percentage
1-24"	~150	50%
1-24"	~250	55%
1-24"	~350	60%
1-24"	~450	65%
1-24"	~550	70%
1-24"	~750	75%
2-24"	~950	40%

cal/gallons LPY/1000 pig spaces per year

Ventilation Rate

Proper
10% Over
20% Over
30% Over
40% Over
50% Over
60% Over

00:00 / 54:01

YouTube

[Dr. Jay D. Harmon](#)

Ph.D., P.E. Professor & Extension Ag Engineer
Agricultural and Biosystems Engineering
Iowa State University

Agricultural Energy Efficiency Project Website

Energy Benchmarking Online Tool

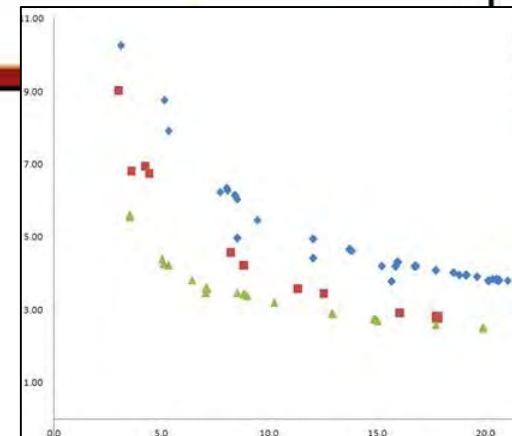
- **Energy Benchmarking** - The process of accounting for and comparing energy performance with its energy baseline, or comparing energy performance with the energy performance of similar types of facilities. Benchmarking can be used to compare performance over time, within and between peer groups, or to document top performers.
- **Benchmarking drives action** – *“You know what’s motivating? Finding out you’re behind the curve and you didn’t even know it...Once you benchmark your energy performance, you’ll have a better idea what to do next...Got a low score? Time to do an energy audit and see where you may be wasting energy. The good news is you have the potential to save money...”* - energystar.gov
- Will work for some production systems better than others..

Energy Efficiency Dairy Benchmark

- Total electrical usage – 750 kWh/cow-yr
- Vacuum pump – 50 kWh/cow-milking-yr
- Milk Cooling – 0.7 kWh/cwt
- Ref: Dairy Farm Energy Audit Summary Report, New York State Energy Research and Development Authority, 2003

Extension
University of Wisconsin

- Audits provide anonymous data
- Interested person can see online how they compare among their peers



Sources:

“Facility Energy Management Guidelines and Criteria for Energy and Water Evaluations in Covered Facilities,” November 25, 2008, at <http://www1.eere.energy.gov/femp/regulations/guidance.html>

Scott Sanford, Univ. Wisconsin

<http://labs21.lbl.gov/wiki/equipment/images/0/0a/Energycomparison.jpg>

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Validation of Energy Savings

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

- Agricultural Production Systems: (at least 13 workshops/webinars)
 - Planned tracks:
 - Dr. Reed: Tobacco Curing Energy Management (*more on these later*)
 - Dr. Latimer: Greenhouse Energy Management (*more on these later*)
 - Anticipated workshop/webinar opportunities for other production systems (based on interest/opportunities): Dairy, Poultry, Swine, Grain Drying, etc.
please contact me if you have an idea/suggestion
- Forest Product Industries (at least 4 workshops/webinars)
 - Dr. Quesada: Lean Manufacturing Principles and Energy Mgmt Practices for Forest Product Industries (*more on these later*)

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



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

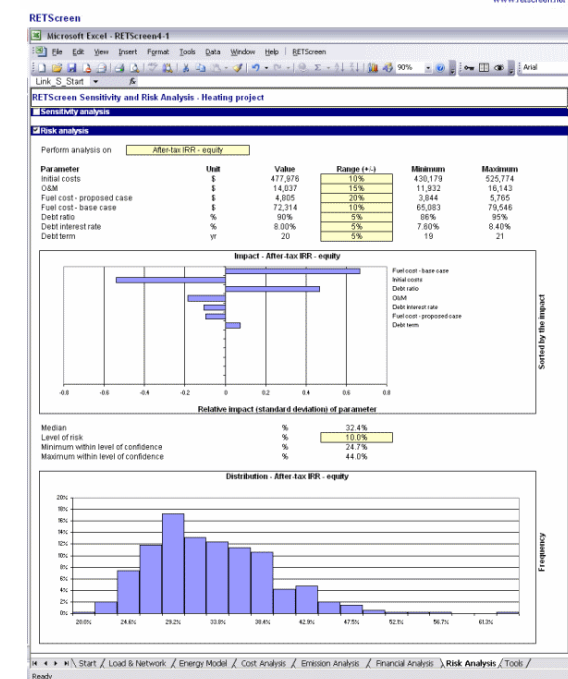
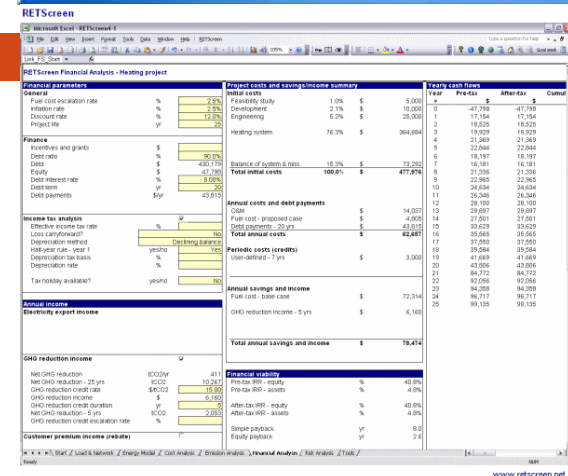
<https://www.puc.nh.gov/Sustainable%20Energy/GHGERF%202009%20Grantees.htm>



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

Renewable Energy Technologies & Application Workshops (1 workshop)

- A two-day workshop will be held on the [RETScreen Clean Energy Project Analysis Software](#)
- RETScreen is a unique decision support tool, provided free-of-charge, to evaluate the energy production and savings, costs, financial viability and risk for various types of Renewable-energy and Energy-efficient Technologies (RETs). RETScreen enables participants to explore a variety of “what-if” scenarios to see how a solar PV system might work on their poultry house, or how a solar water pumping unit would perform, or the potential energy-cost savings in swapping a propane-fired heater with biomass pellets, among many other scenarios. The RETScreen program is a free Excel-based program, which utilizes research-based information, and incorporates an energy and financial analysis model to enable sensitivity analysis to anticipate the effect from variations from predicted to the actual performance, costs, and revenue.
- **Technical assistance providers will be encouraged to attend the training workshop as the RETScreen Model Output is a required component to any renewable energy feasibility studies cost-shared through this program.** They can use other programs too, but must also provide a RETScreen run.
- Workshop materials will also be made available on the project webpage.
- Tool helps folks know what they’re getting into

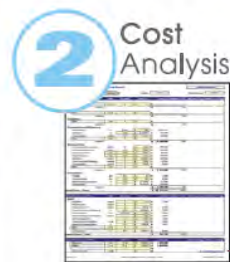
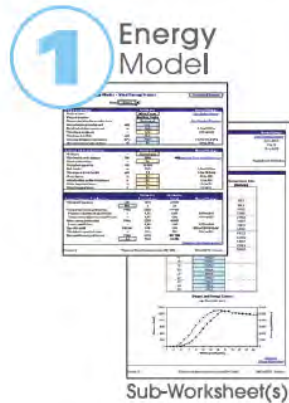


Sources:
RETScreen

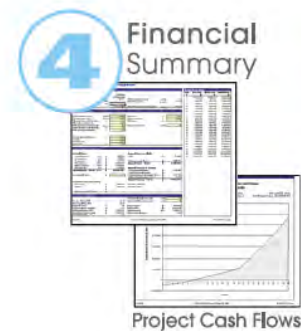
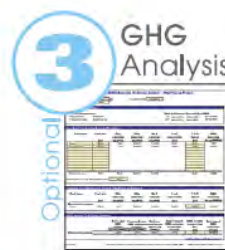
RETScreen

RETScreen Software Model Flow Chart

Five Step Standard Analysis ➔



click on blue hyperlinks
or floating icon to access data



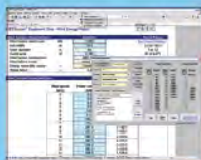
➔ Ready to make a decision

Integrated Features

Weather Data



Product Data

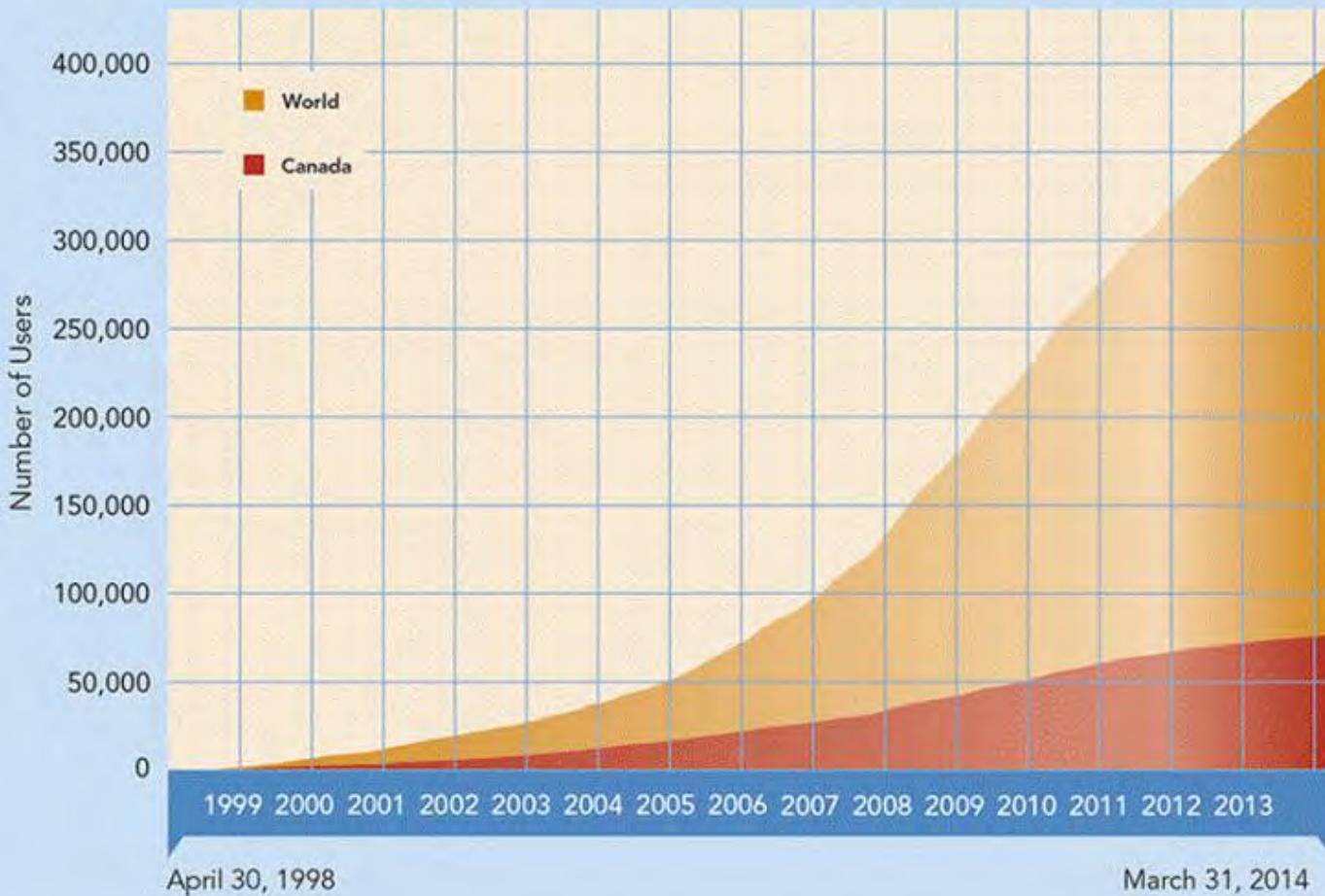


Online Manual



- Training Course
- Engineering Textbook
- Case Studies
- Online Marketplace
- Internet Forums

RETScreen Software: Cumulative Growth of User Base



402,821 users in 222 countries and territories

Top Twenty Countries		
1	Canada	77,169
2	USA	51,600
3	France	35,674
4	Italy	20,813
5	United Kingdom	16,086
6	Spain	13,502
7	China	9,918
8	Greece	9,006
9	Portugal	8,868
10	India	8,596
11	Poland	8,390
12	Brazil	7,096
13	Germany	6,756
14	Chile	6,417
15	Australia	6,132
16	Romania	5,599
17	Mexico	4,785
18	Belgium	4,324
19	Ireland	4,296
20	South Korea	3,679

As of March 31, 2014

Clean Energy Project Analysis

RETScreen® Engineering & Cases Textbook

Third Edition



CHAPTERS



Introduction to Clean Energy Project Analysis

INTRO



Wind Energy Project Analysis

WIND



Small Hydro Project Analysis

HYDRO



Photovoltaic Project Analysis

PV



Combined Heat & Power Project Analysis

CHP



Biomass Heating Project Analysis

BIOH



Solar Air Heating Project Analysis

SAH



Solar Water Heating Project Analysis

SWH



Passive Solar Heating Project Analysis

PSH



Ground-Source Heat Pump Project Analysis

GSHP

RETScreen® International



- Participants are from a variety of backgrounds – *some concepts, terms, technologies will be new. Hopefully, at least something will be new for everyone!*

***PLEASE ASK QUESTIONS
THROUGHOUT THE PROGRAM***

RESOURCES:

- Integrated educational tools within RETScreen software and website:
 - Help
 - E-textbook
 - Case studies
 - And more!
- Our workshop website:
 - Presentations
 - Links to RETScreen User Groups (Ning Network, etc.)

Some final details...

*PLEASE LET US KNOW IF WE CAN
BE OF ANY HELP THROUGHOUT
THE PROGRAM*

- Coffee
- Restrooms
- Please sign-in on the sheet
- Lunch is on your own (will break around Noon)
- Want to accommodate as much 'hands-on' time as possible for those interested
- We'll wrap up by 5:30 – understand if people need to leave earlier
- Evaluations – please take a minute to complete the evaluation (even if you leave early). Your feedback helps us improve which is the goal.

Course Outline

This beginner-level course will provide an intensive introduction to the RETScreen Clean Energy Project Analysis Software, including:

- Overview of the RETScreen software
- Energy efficiency, heating, cooling and power project analysis
- Greenhouse gas emissions analysis
- Financial & risk analysis
- Databases & engineering tools
- Overview of legal and policy toolkits
- On-going energy performance analysis
- Hands-on completion of project templates and case studies

Target Audience

Course participants typically include engineers, architects, scientists, technicians and financial planners who are relatively new to RETScreen, as well as other key stakeholders in clean energy.

Prerequisites

A university or college degree in a technical or analytical field, or equivalent experience.

Duration: 3 days

Cost: \$1,499 + sales tax



**Thank you to our
workshop sponsors:**

**Virginia Tobacco
Indemnification and
Community
Revitalization
Commission**

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



**Biological Systems
Engineering**



Virginia Cooperative Extension

Virginia Tech • Virginia State University



Thank you to our workshop co-sponsor:

“Farm Manure to Energy Initiative”



Farm Manure to Energy Initiative

Using Excess Manure to Generate Farm Income in the Chesapeake's Phosphorus Hotspots

Project Partners: National Fish and Wildlife Foundation, Chesapeake Bay Funders Network, Farm Pilot Project Coordination, Inc., University of Maryland Center for Environmental Science, University of Maryland Environmental Finance Center, Virginia Cooperative Extension, Lancaster County Conservation District, and Sustainable Chesapeake.

Nutrient Management – Pilot Project Development

Regional collaborations to identify technologies and practices to better manage nutrients in response to Bay TMDL & State WIP



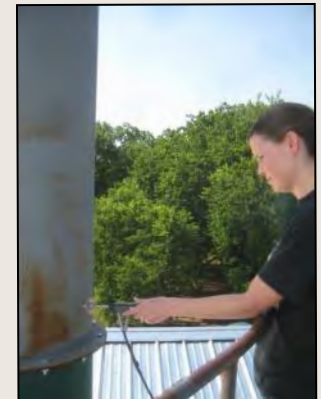
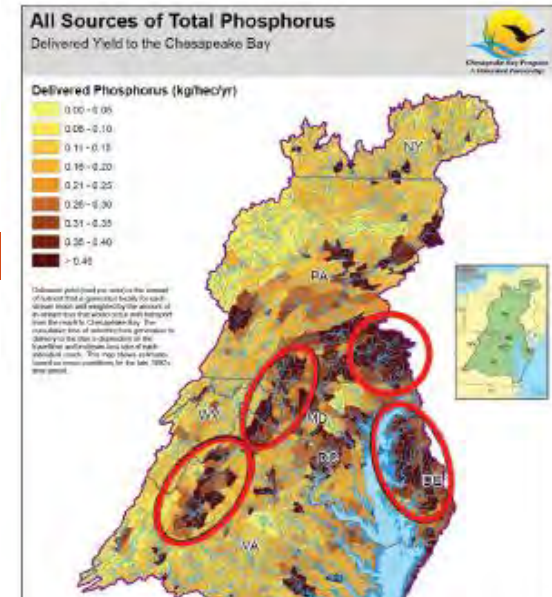
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Collaborative Role Includes:

- Assess system performance, ease of adoption and farm integration
- Conduct preliminary biomass feedstock analysis and emission testing
- Organize farm tours and educational workshops
- Convey results good/bad to clientele and extension network
- One effort focuses on poultry litter and another on smaller dairies



Participant Introductions



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



Virginia Cooperative Extension

MICHAEL ROSS, RER Energy – Montreal Canada

Michael M. D. Ross has worked with renewable energy systems and other clean energy technologies for over 17 years. Michael has held research positions with CanmetENERGY and the Advanced Energy Systems Group of the Department of Technical Physics and Mathematics at Alvar Aalto University, Finland's premier engineering university. Since 2001, in addition to consulting extensively for RETScreen® International, Michael has been contracted to provide expertise in building energy modeling and energy efficiency, research on photovoltaic systems, wind energy resource assessment and site selection, assessment of icing losses and mitigation methods for wind turbines, quantification of greenhouse gas emissions associated with various energy technologies, and inspection of residential solar thermal systems. Since 2003, Michael has been the head of RER Energy Inc, which provides services for federal, provincial, and municipal governments as well as utilities, wind developers, engineering consulting firms and private homeowners.

Michael has a Bachelor of Applied Science degree in Systems Design Engineering from the University of Waterloo.