# Sustainable Siting of Utility-Scale Solar PV Projects: Agriphotovoltaics + Environmental Performance + Social/Equity Performance

***Virginia Tech Renewable Energy Facilities Siting Project***
***Promoting consensus around renewable energy projects***

Ron Meyers, Ph.D., rbmeyers@vt.edu

Research, Teaching, Demonstration

Energy + Food + Employment +

Affordable Education / Student Success

## Climate Change

- Major emission reductions needed to avoid annual average global temperature increase of 9°F (5°C) or more by the end of this century"[1]
- No more than 2 ° C increase or major extinction event, extreme weather, rising sea levels
- Significant emissions reductions can limit increase to 2 ° C or less

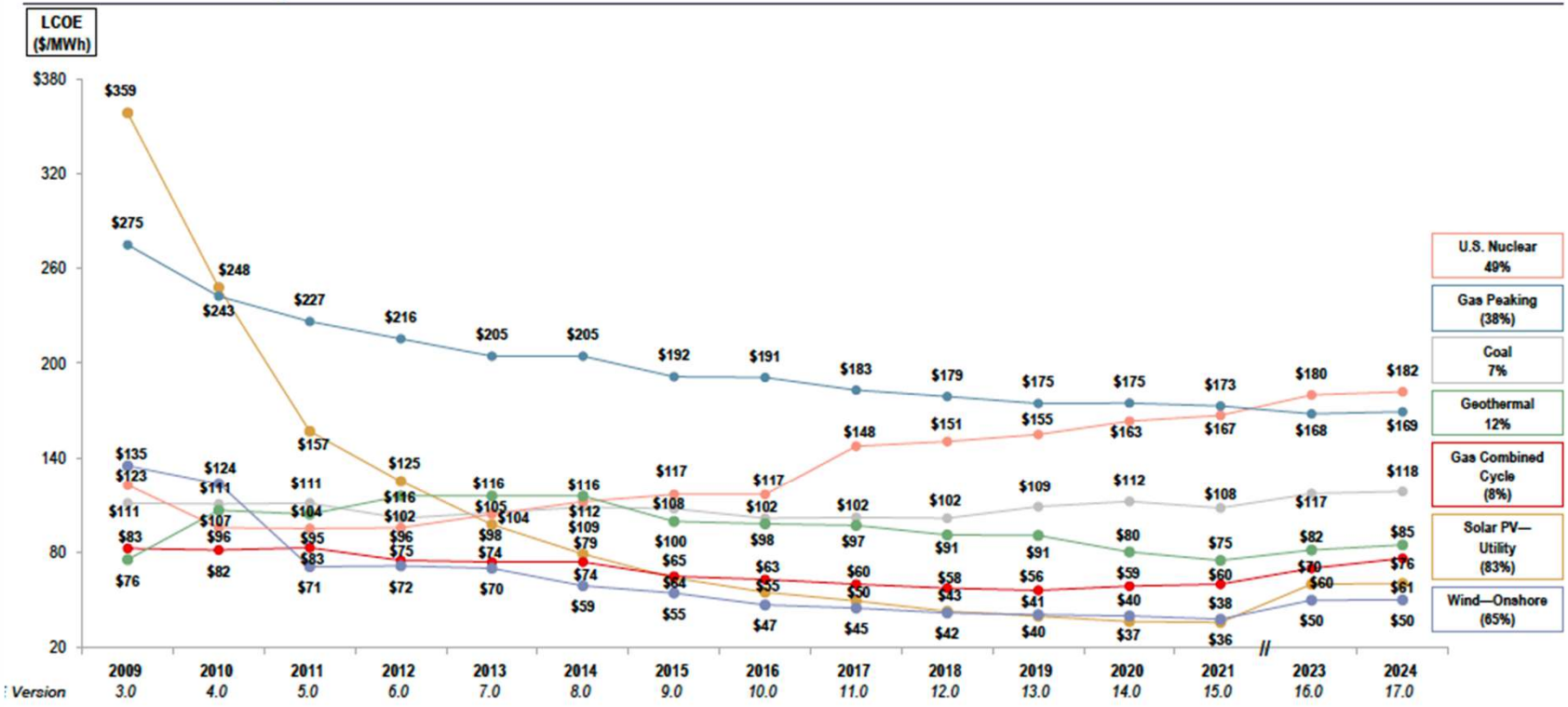
## Renewables Revolution

- Extreme manufacturing cost reductions
- In Virginia, new solar PV cheaper than new coal plants.
- Virginia rankings solar PV
  - 18th for installed
  - 7th projects in development
  - industry rapidly expanding

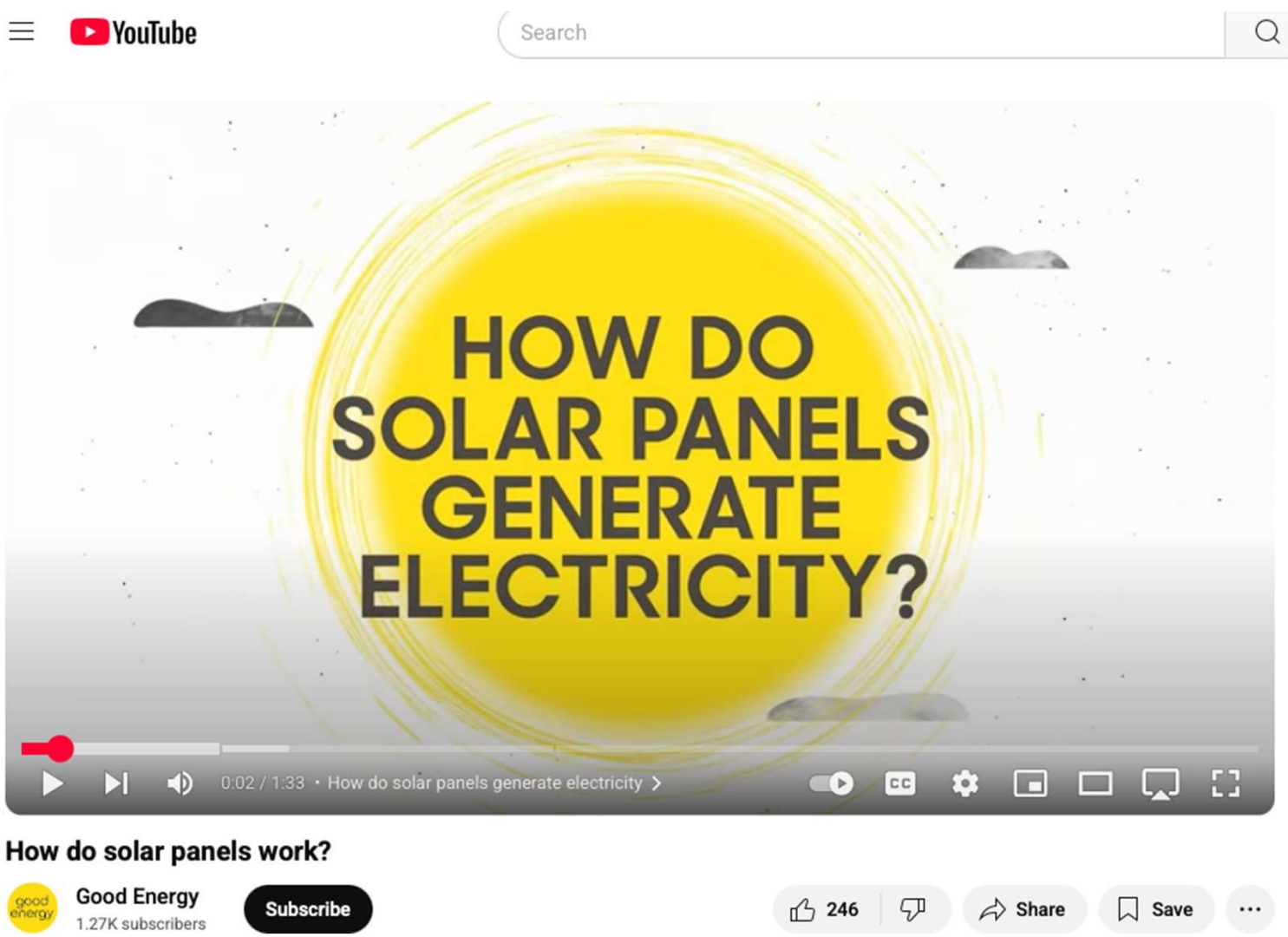
# Levelized Cost of Energy Comparison—Historical LCOE Comparison

**Lazard's LCOE analysis indicates significant historical cost declines for utility-scale renewable energy generation technologies, which has begun to level out in recent years and slightly increased this year**

## Selected Historical Average LCOE Values(1)




*Source:* *Lazard and Roland Berger estimates and publicly available information.*
(1) Reflects the average of the high and low LCOE for each respective technology in each respective year. Percentages represent the total decrease in the average LCOE since Lazard's LCOE v3.0.




https://www.youtube.com/watch?v=oo5NSp7sZKQ

# SOLAR PV & LAND USE

100% clean electricity by 2035 in VA

- 161,000 acres (TNC 2022)

Decarbonize economy

- ~ 805,000 acres in VA (Meyers)
- ~45,000 acres agricultural land converted 2020-2040 (AFT)

100% clean electricity by 2035 for U.S.

- 4.9 my acres (NREL 2022)

Decarbonize economy

- 19,768,430.5 my acres (NREL 2022)

# Virginia residents protest proposed solar farm in Spotsylvania

Land designated for agricultural use

By Laura Kelly - The Washington Times - Monday, December 10, 2018

TOP STORY

# Culpeper County planners deny solar project

By Allison Brophy Champion Jul 12, 2018

FOX NEWS 1:18 MT

U.S. World Opinion Politics En

Hot Topics Stampede at Soleimani's funeral

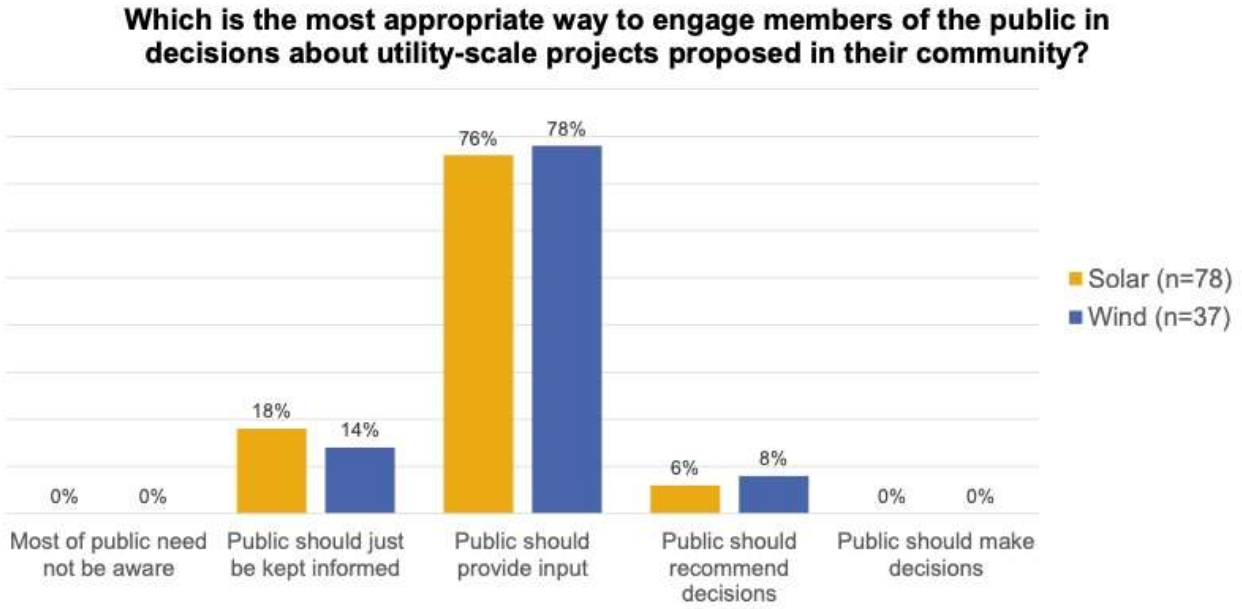
LOCAL · **Published** February 15 · **Last Update** February 16

# Massive East Coast solar project generates fury from neighbors

By **Alex Pappas | Fox News**

# SOLAR DEVELOPERS STUDY[1]

## Most developers agree the public should provide input, but not recommend or make decisions about projects






1 Nilson, R., Hoen, B., & Rand, J. 2024. Survey of Utility-Scale Wind and Solar Developers Report. https://live-etabiblio.pantheonsite.io/sites/default/files/w3s_developer_survey_report_-011824_version.pdf

# SUSTAINABLE RENEWABLE ENERGY DEVELOPMENT

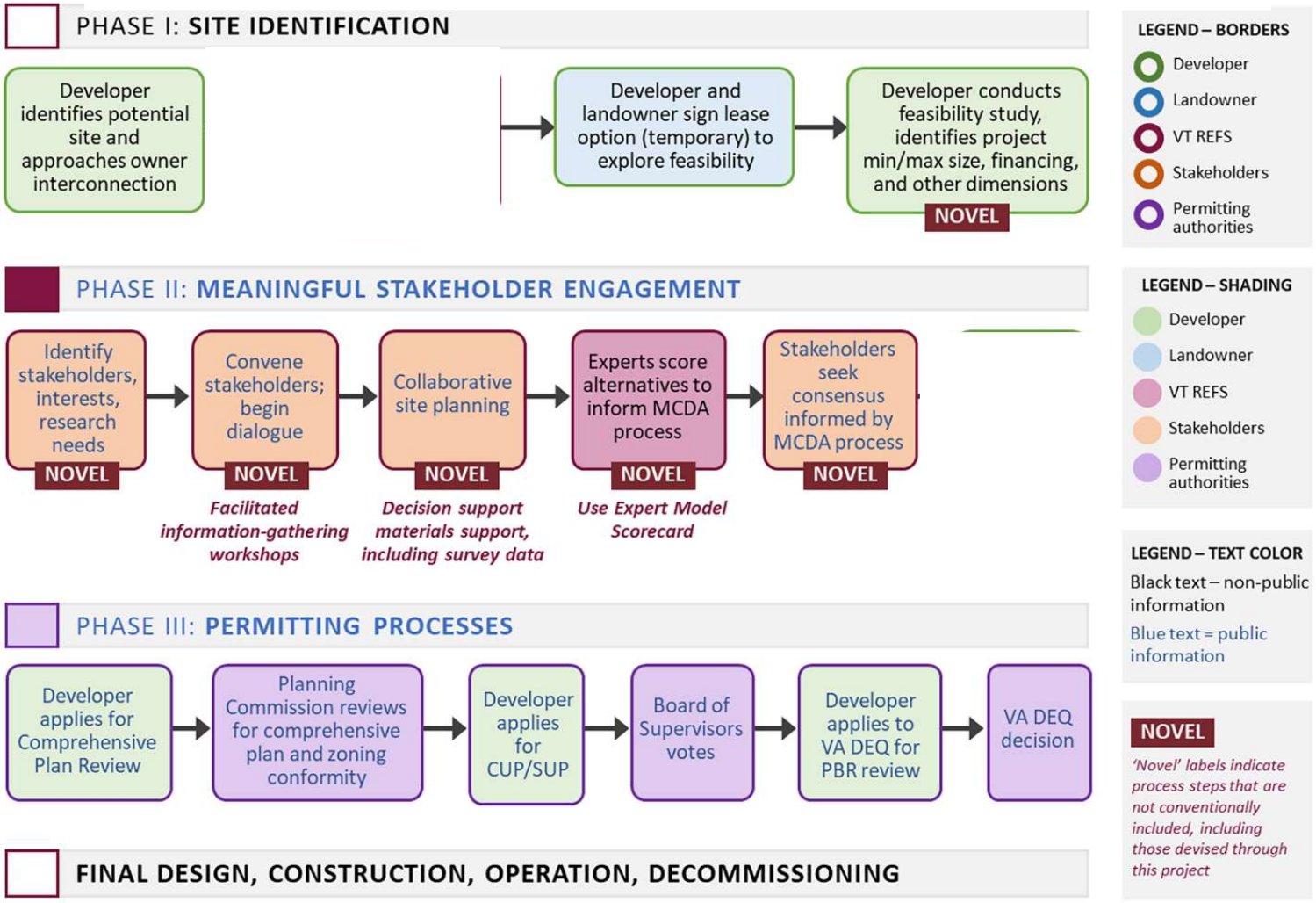
- Renewable energy development that meets the needs of the present without compromising the ability of future generations to meet their own needs

**Three pillars**

- **Economic development -** Grow carbon-free economy, protect agriculture
- **Environmental protection -** Ecological integrity maintained
- **Social equity -** Meaningful public engagement, fair distribution costs & benefits

Meyers, et al. 2020

# VT – REFS SITING PROCESS




**LEGEND – BORDERS**

- Developer
- Landowner
- VT REFS
- Stakeholders
- Permitting authorities

**LEGEND – SHADING**

- Developer
- Landowner
- VT REFS
- Stakeholders
- Permitting authorities

**LEGEND – TEXT COLOR**

Black text – non-public information

Blue text = public information

**NOVEL**

*'Novel' labels indicate process steps that are not conventionally included, including those devised through this project*

# SIMPLIFIED SITING PROCESS

- **Local permitting process**
  - VA section 2232 review – compliance with local comprehensive plan
  - Early Public hearing/meeting requirements vary from none to one/two
  - Developers sometimes hold one or two open houses
  - Local Planning Commission
    - Sometimes one public hearing or developer presentation
    - One or more readings at planning commission before decision
    - Additional permit conditions usually added.
  - Local Board of Supervisors
    - One, sometimes two meetings to discuss, decide, may require additional public hearing.
    - No locality requires meaningful stakeholder engagement
    - Additional permit conditions usually added
    - Developer may sell project at this point

# SIMPLIFIED SITING PROCESS

- **State/federal permitting process**
  - •Developer applies to either VA Department of Environmental Quality (VA DEQ) or State Corporation Commission
  - •VA DEQ sends to VA DCR, VA DWR, DHR for review
  - •VA DEQ reviews to ensure compliance, may add own condition on erosion and sedimentation, wildlife, other conditions from other agencies conditions.
  - •Required to complete review in 90 days.

**Catawba Sustainability Center and**
**Catawba Hospital Renewable Energy Social Feasibility Assessment, 2023 Update**

January 29, 2024

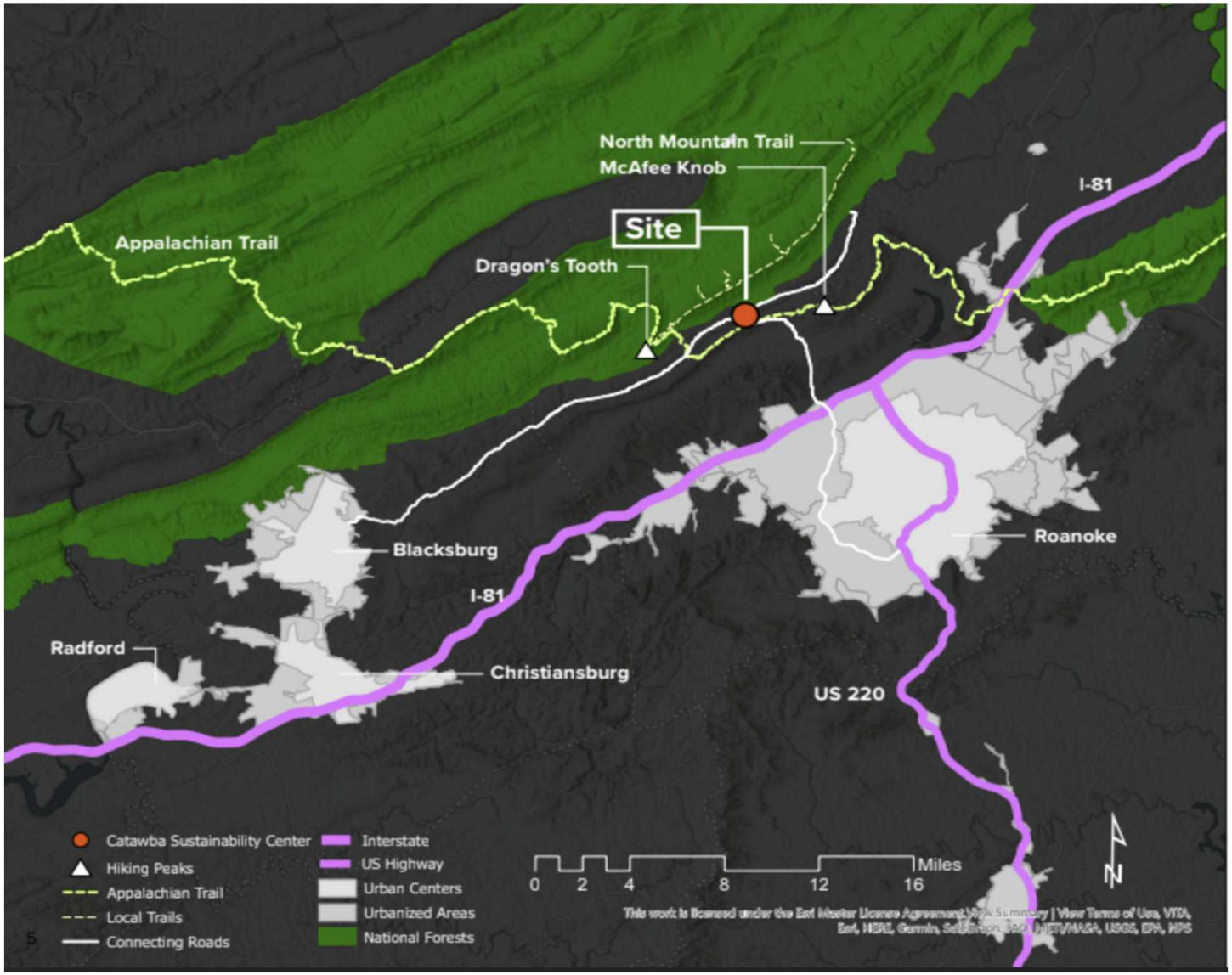
Research, Teaching, Demonstration
Energy + Food + Employment +
Affordable Education / Student Success

Ron Meyers, Ph.D., Associate Professor of Practice, Department of Fish and Wildlife Conservation, Director, VT-Renewable Energy Facilities Siting Project; Pardis Akbari, Ph.D. student, Nathan Drummond; Jack Leff, Climate Action Fellow; Michael Justice, Senior Geospatial Technician

## Study Purposes

- Support Phase II, VT Climate Action Commitment, 2020
- Secure social license to site arrays on VT/state lands
- Identify stakeholder requirements for siting large PV facility
- Methodological – Proof of Concept for sustainable siting process:
  - Economically beneficial
  - Environmentally beneficial
  - Socially beneficial

# Catawba Setting




Source: Arshadi, 2022

(VT Senior Project)

# STUDY HISTORY

- 2019 – Pilot test beta version. EPP 4354 Studio course Catawba Renewable Energy Feasibility Study
- 2023 – Proof of Concept for stakeholder engagement process and content VT CPIF grant to Dr. Meyers
- Stakeholders include VT faculty, students, staff, Catawba Hospital, Appalachian Trail regional and local commissions, community
- Six stakeholder meetings in each study to collaboratively:
    - Identify research questions
    - Evaluate research results
    - Co-decide acceptable locations, sizes, conditions


# ENVIRONMENTAL PERFORMANCE

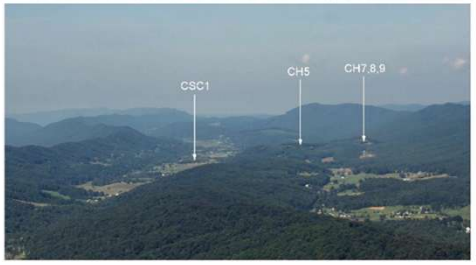
- Green house gas reductions
- Visual
- Soil protection
- Stormwater management and receiving stream protection
- Forest protection
- Invasive species reduction
- Wildlife protection/enhancement

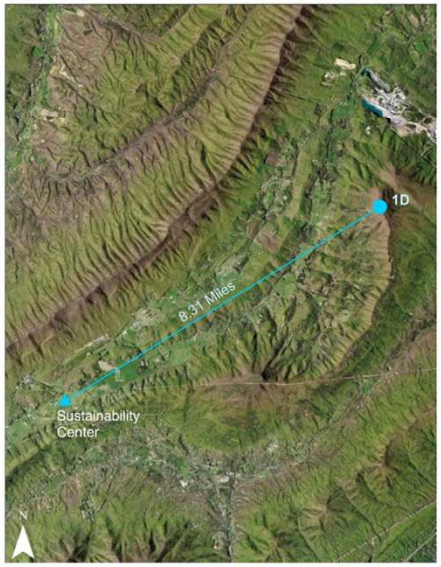
# Environmental Performance - Visual Impact

- Performance standard:
- Areas with arrays are acceptable to stakeholders

Simulation

Existing Conditions




Viewpoint 1D
Photograph from viewpoint 1D Tinker Cliffs toward 241°

VT Catawba Sustainability - Visual Study Simulations September 7, 2023

# ENVIRONMENTAL PERFORMANCE - SOILS

- Plan and implement development based on appropriate use of soils.
- Protect sensitive features ( riparian zones, drainage swales, sinkholes, rock outcrops, wetlands, etc.)
- Minimize soil disturbance
- Use conservative runoff estimators to protect soils
- Ensure vegetative establishment during and after construction phase, and during operations phase, and during and after decommissioning stages
- Compaction from vehicular traffic, construction activities

# ENVIRONMENTAL PERFORMANCE - SOILS

- **Predevelopment**
  - Identify and verify all soils on site
  - Establish & map appropriate & required buffers around sensitive features ( riparian zones, drainage swales, sinkholes, rock outcrops, wetlands, etc.)
  - Use information to minimize grading (cut/fill) and other site development impacts to existing soil resources while avoiding impacts to particularly sensitive features.
  - Utilize conservative runoff estimators (e.g. NRCS CN's and/or VRRM RV's) for stormwater and erosion prediction modeling and SW BMP specifications.
  - Adjust design BMP SW volumes to account for (a) site disturbance and (b) panel imperviousness per DEQ GM 22-2012 guidance.
  - Develop detailed apriori vegetation establishment and management plans to meet initial site stabilization demands coupled with longer term operational vegetation management needs.
  - Develop traffic management to limit areas compacted
  - Develop vehicle use plan to limit weight of vehicles & use tracked vehicles off roads

# Environmental Performance - Goals

## Stormwater management and receiving stream protection

- Stormwater basins rated for x year storm event to reduce number of overflow events
- Receiving stream must receive no substantial bank erosion for 100 year storm event
- Additional goals to be identified

# ENVIRONMENTAL PERFORMANCE - WILDLIFE

*Connexus solar farm in full bloom. Photo courtesy of Prairie Restorations.*

- 201 acres Increased quantity and diversity of high value terrestrial wildlife habitat
  - Use APV
  - Convert fields with cool-season grasses to warm season grasses, native pollinators, native shrubs
  - Plant warm season grasses, etc. under and around arrays
  - If no grazing, plant 25' transitional habitat just inside fence
  - Plant early successional habitat in 50 foot band next to forests
  - Use rotational mowing schedule for early successional
- Increase wildlife corridors/ wildlife friendly fencing
- NY DEQ stormwater basin design for invertebrate habitat

https://www.solarpowerworldonline.com/2017/05/pollinator-friendly-solar-vegetation/

# Social/Equity Performance

- Overview
  - Procedural, substantive, and representational justice
  - Local community benefits
  - VT community benefits
  - Economic justice
  - Environmental justice

# Social/Equity Performance

- Stakeholders
  - Developer
  - Landowner
  - Agricultural renters
  - Proximate neighbors (viewshed?)
  - Affected community members (viewshed from roads, parks, cultural sites; interest in maintaining rural landscape, ag economy)
  - Non-profit organizations with interests (solar advocates/opponents, trade associations, farm bureau, American farmland trust, Energy Right, et al)
  - Local officials (planning commission, board of supervisors, others)
  - State officials

# Social/Equity Performance

- Landowner
  - Needs good lawyer
  - Offered ~ $1,400/acre/year
  - Provide option to continue farming, farm improvements
  - Provide environmental performance enhancements
- Agricultural rentor – compensation for increased land rental costs (due to increased land price)
- Neighbors
  - Visual, compensation for lower property values
- Community
  - Procedural, representational justice - Meaningful stakeholder engagement: co-research, co-decision making
  - Host community benefits: scholarships, firehouse/equipment, parks, etc.
- Workers - Economic justice =
  - Living wage
  - Health insurance
  - No sweat-shop labor used in supply chain

# Social/Equity Performance

- Catawba community
  - See local employment/training opportunities
  - See VT will seek community solar
  - If VT Market, provide food for local residents in need
  - If VT Market, provide employment opportunities
  - If education/training, include local residents
  - Support VT efforts to support Catawba Hospital, Catawba Sustainability Center
  - Meaningfully engaged in planning

# Social/Equity Performance

- Virginia Tech
  - If producing food for VT Dining Services/The Market:
    - Develop food growing program
    - Provide employment opportunities for students
  - Seek VT ownership of project to maximize potential revenues for VT Advantage
  - If education/training, provide opportunities for students
  - Advance progress on Climate Action Plan goals

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