Utility Scale Solar Suitability Analysis

Rappahannock-Rapidan

Regional commission





- Utility Scale vs. Small Scale vs. Residential
- Constraints to industrial scale
- Location & General data
- Methodology
- GIS Modeling
- Results
- Conclusions
- Further Analysis & Other Possible Considerations





- Small Scale- purpose of offsetting energy costs Ag., Commercial or private < 5 acres
- Residential- rooftop solar
- Gov't solar- school and other public infrastructure

Constraints to Utility Scale Solar

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- Suitable land
- Transmission Capacity
- Off-site Impacts









Existing Data

County	Sq. Miles	Parcels
Fauquier	651	34,617
Culpeper	383	23,264
Madison	322	9,833
Orange	343	22,021
Rappahannock	267	6,047
Total	1966	95,782



Methodology

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Step	Criteria	
0	Total study area	
1	Not in 100-year floodplain	
2	Not in wetland	
3*	Not in protected areas	
4	Slope < 5 or 5-10% and South Facing	
5	Adjacent to high capacity transmission line (within 1 mile)	
6	Within 3 miles of substation	
7	Not on prime ag lands	





GIS Modeling

Step 0- Total Study Area



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חMiles 10

0

Results Step 1- Not in 100 Year Floodplain



Miles



Step 2- Not in Wetlands







Results Step 3*- Not in Protected Areas

Lands on protected areas excluded

- 1. Battlefields (core and study areas)
- 2. Protected lands Model
 - National Park holdings State Parks Local Parks National and State Forest lands State Wildlife Management Areas Publicly and Privately-held Conservation Easements * Virginia Outdoors Foundation holdings The Nature Conservancy Preserved lands
- 3. Cultural Lands Model

Archaeological Sites & Architectural Sites

National Historic Districts

National Historic Landmarks

National Historic Register Sites

State Inventoried Sites (Eligible for possible National Register and Easements) American Indian Areas

4. Easements-updated '18



 Step 4- Lands on slope over 5% OR over 10% and not South Facing excluded







 Step 4- Lands on slope over 5% OR over 10% and not South Facing excluded





 Step 4- Lands on slope over 5% OR over 10% and not South Facing excluded





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Aspect Map

7Miles

10

 Step 4- Lands on slope over 5% OR over 10% and not South Facing excluded





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 Step 4- Lands on slope over 5% OR over 10% and not South Facing excluded





Results **Step 5** -Lands not adjacent (within 1 mile) of high capacity transmission lines excluded





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Results Step 6 -Lands more than 3 miles away from substations excluded





Results Step 7 -Lands on prime agricultural lands excluded









Step	Criteria	Sq. Miles Not Excluded
0	Total study area	1966
1	Not in 100-year floodplain	1856
2	Not in wetland	1842
3	Not in protected areas	1152
4	Slope < 5 or 5-10% and South Facing	1102
5	Adjacent to high capacity transmission line (within 1 mile)	490
6	Within 3 miles of substation	150
7	Not on prime ag lands	120

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County	Sq. Miles Optimal Land	% of Total Land
Fauquier	40.2	6.2%
Culpeper	23.2	6.1%
Madison	5.4	1.7%
Orange	45.5	13.3%
Rappahannock	5.1	1.9%
Total	119.4	6.1%



Conclusions

- Proximity to Substations (step 5) and High Capacity Transmission Lines (Step 6) are the biggest limiting factors for utility scale solar development
- Most areas of unsuitable slope are also in protected areas (like Shenandoah National Park)
- Optimal areas for utility scale solar are mostly located in the Eastern part of the region
- Protected areas especially:
 - Mine Run Battlefield Study and Core areas in Orange
 - Rappahannock Station, Brandy Station & Kelly's Ford areas in Culpeper and Fauquier Counties
 - In Proximity to substations and high capacity transmission lines and otherwise suitable utility scale solar areas
 - future applications may target areas nearby such as surrounding farms
 - Potential to impact viewsheds
- Available capacity of transmission lines is the big 'unknown' that is an even greater limiting factor than proximity to transmission infrastructure- requiring an interconnected study by Dominion



Conclusions

Fauquier County

- Large amount of conservation easements & lack of transmission infrastructure make Northern area unsuitable
- Optimal areas mostly near current Dominion operated solar farm near Remington and surrounding area

Rappahannock County

- have large amounts of steep and protected land unsuitable for utility scale solar
- limited access to high capacity transmission lines
- Most suitable land areas along border of Fauquier County and near Sperryville
- Inclusion of Land cover data as input would likely show large amount of forested area that would be disturbed in event of utility scale solar installation and great pristine viewsheds

Madison County

- have large amounts of steep and protected land unsuitable for utility scale solar
- limited access to high capacity transmission lines
- Most suitable land areas also in historic and agricultural area of the county with pristine views



Conclusions

Culpeper County

Open Road Renewables did a targeted study and this gis analysis confirms the findings-upper gabage

Rappahannock-Rapidan

- North and West Culpeper is too hilly
- Cedar Mt. Battlefield and other protected areas further limit suitability of utility scale solar
- Areas surrounding Route 522 North of the Rapidan River & outside of the town of Culpeper are most optimal for utility scale solar based on this assessment

Orange County

- limited access to high capacity transmission lines
- Most suitable land areas also are north of Orange and generally south and east of Paytes.
- Other factors not considered in this analysis may also limit suitability of these areas and in all other areas shown on the map on the next page





Further Research/ Considerations

- Land Cover eg. Non-disturbed Forests
- DCR Environmentally Protected Areas
- Population projections/ future land value
- Regional analysis- kept from getting 'parcel specific'
- County analysis OR site specific/application based analysis done by RRRC could build off layers and include:
 - Local zoning ordinance requirements
 - Data from interconnected study
 - LIDAR/solar insolation values from NREL or other national sources
 - Minimum parcel size (at least 35 acres)
 - Create heat maps for inputs into the model such as floodplain or prime Ag. Lands
 - Using PV mapper tool to screen parcels (parcel perspective rather than general area)
 - Viewshed analysis
 - Use Sketch-Up to do sun/shade analysis and consider zoning buffer requirements



Further Research/ Considerations





Population Projections- Future Demand

County	2010	2020	2030	2040
Culpeper	46,689	50,912	60,253	68,572
Fauquier	65,203	70,302	78,259	84,973
Madison	13,308	12,889	13,182	13,288
Orange	33,481	34,442	39,587	44,080
Rappahannock	7,373	7,236	7,401	7,460
Total	166,054	175,781	198,682	218,373

Source: Weldon & Cooper

Sources

Step	Criteria	Dataset
0	Total study area	US Census-Tigerline
1	Not in 100-year floodplain	FEMA-NFHL
2	Not in wetland	VGIN-Land Cover Data
3	Not in protected areas	RRRC- Green Infrastructure Maps
4	Slope < 5 or 5-10% and South Facing	USGS-DEM
5	Adjacent to high capacity transmission line	Dept. of Homeland Security
	(within 1 mile)	
6	Within 3 miles of substation	Dept. of Homeland Security
7	Not on prime ag lands	RRRC- Green Infrastructure Maps

Brawner, Eric, et al. "Assessing Land Availability for Utility Solar in North Carolina Using GIS." *DukeSpace*, Duke University Libraries, 28 Apr. 2017, dukespace.lib.duke.edu/dspace/handle/10161/14180.