The potential for utility-scale solar development in South Carolina

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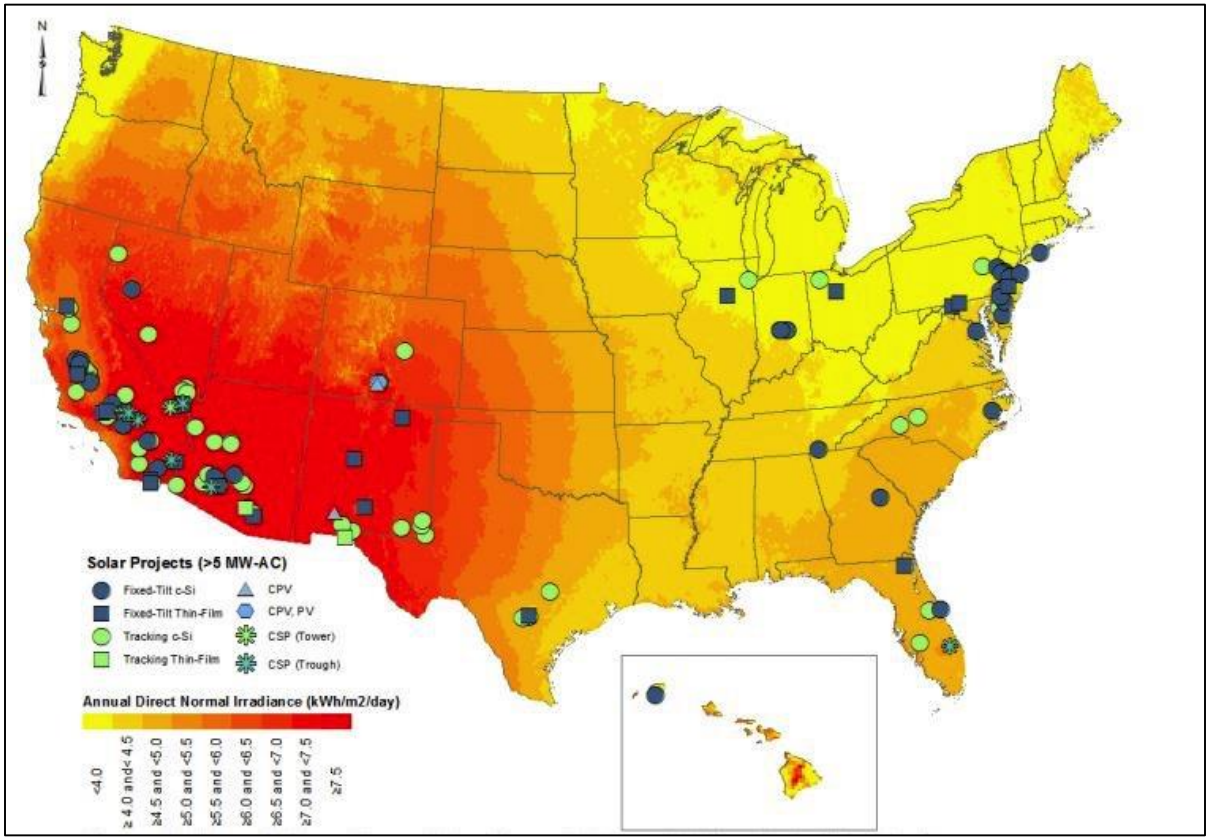
The US Solar Industry

- Direct Normal Irradiance (DNI) and Utility-Scale Solar Project Locations in the U.S



Lawrence Berkeley National Lab (2013) Utility-Scale Solar 2013

The US Solar Industry

- Despite high solar resource availability, restrictive policies have kept many southern states, particularly South Carolina , from experiencing the same growth in solar PV as the northeast and southwest.
- the state ranks 32nd in the country in installed capacity http://www.seia.org/state-solar-policy/south-carolina
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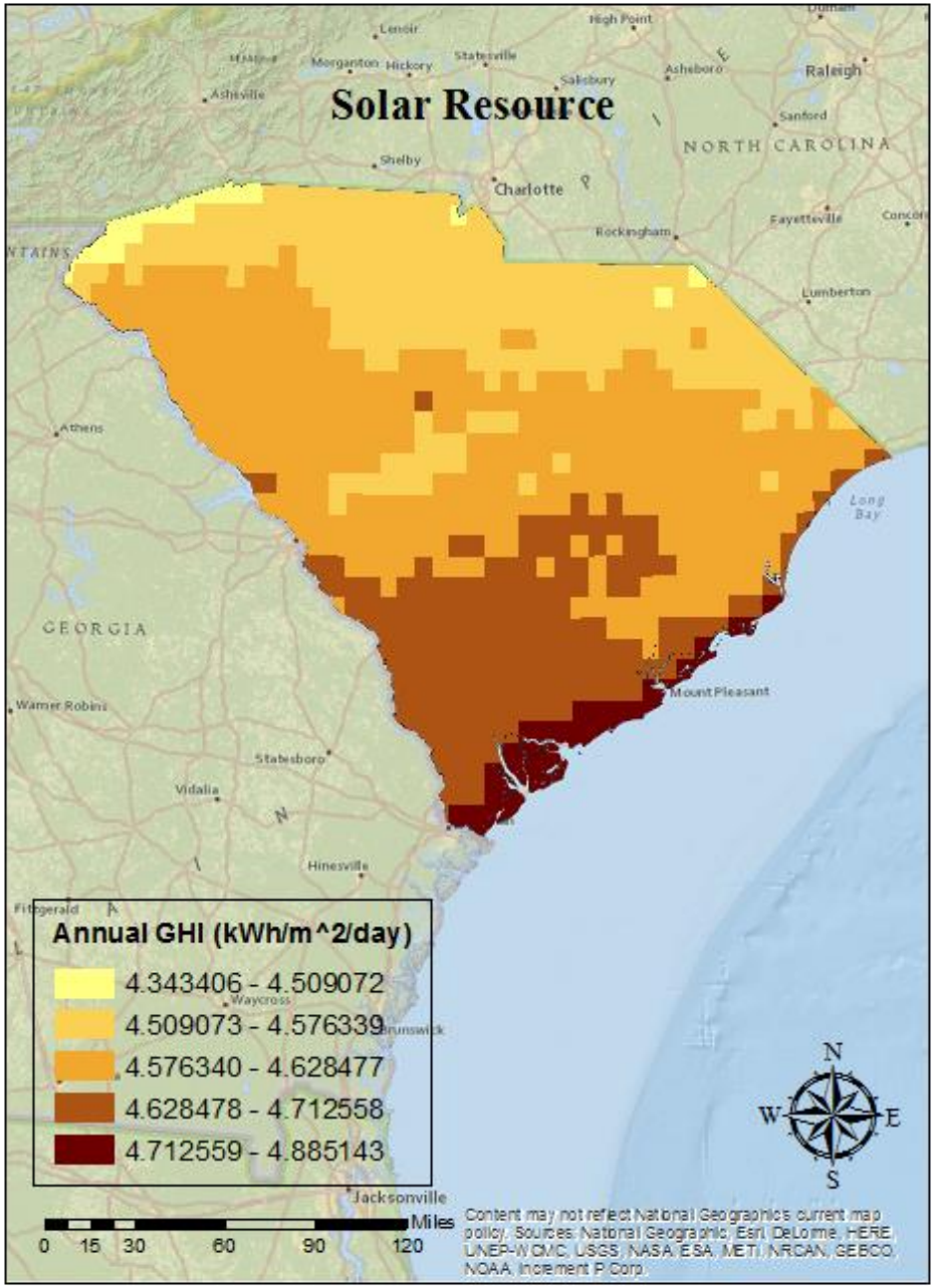
This study

- Locate land areas suitable for implementation or further analysis and demonstrate the maximum solar flux extractable on these lands.
- The process was divided into the following steps:
  1. Data preparation
  2. Creation of analysis mask
  3. Determination of impact categories and reclassification of data
  4. Weighting of layers and combination into suitability layer
  5. Calculation of solar potential on lands above suitability and size cutoffs

Data preparation

	Data	Source	File Type
1	State Boundary	ArcGIS Data and Maps	Polygon
2	Land Cover	US Geological Survey[1]	Raster
3	Statewide DEM for SC	SC Department of Natural Resources[2]	Raster
4	Urban areas	ArcGIS Data and Maps	Polygon
5	U.S Parks (national, county, state, regional, local)	ArcGIS Data and Maps	Polygon
6	Airport areas	ArcGIS Data and Maps	Polygon
7	U.S. National Atlas Federal and Indian Land Areas	ArcGIS Database	Polygon
8	Protected Marine Environment	ArcGIS Data and Maps	Polygon
9	Global Horizontal Irradiance (10km resolution) 1998 to 2009	NREL[3]	Polygon

[1] http://landcover.usgs.gov/classes.php
[2] http://www.dnr.sc.gov/GIS/descdem.html
[3] http://www.nrel.gov/gis/data_solar.html


Solar Resource
Annual GHI (kWh/m^2/day)
4.343406 - 4.509072
4.509073 - 4.576339
4.576340 - 4.628477
4.628478 - 4.712558
4.712559 - 4.885143
Miles
0 15 30 60 90 120
N
W
E
S
NORTH CAROLINA
GEORGIA
Lenoir
Morganton
Hickory
Statesville
Salisbury
Asheboro
High Point
Raleigh
Sanford
Asheville
Shelby
Charlotte
Rockingham
Fayetteville
Lumberton
Athens
Warner Robins
Statesboro
Vidalia
Hinesville
Fitzgerald
Waycross
Jacksonville
Mount Pleasant
Long Bay
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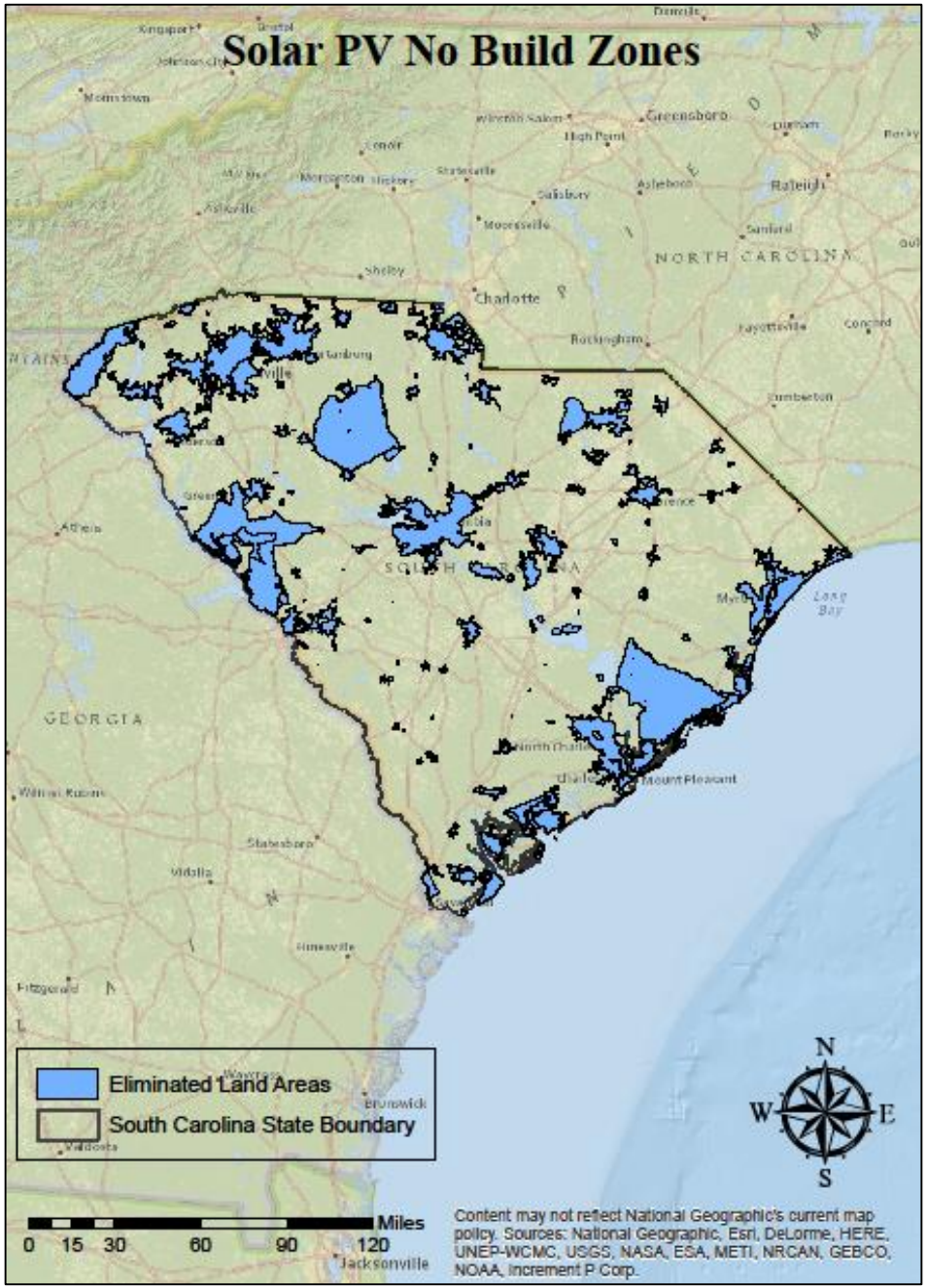
No Build Zones

- Several areas excluded:
  - urban areas;
  - national, county, state, regional, and local parks;
  - airport areas;
  - national forests;
  - historic sites;
  - national wildlife refuges;
  - wilderness areas; and
  - protected marine environments


Solar PV No Build Zones
Eliminated Land Areas
South Carolina State Boundary
N
W
E
S
Miles
0 15 30 60 90 120
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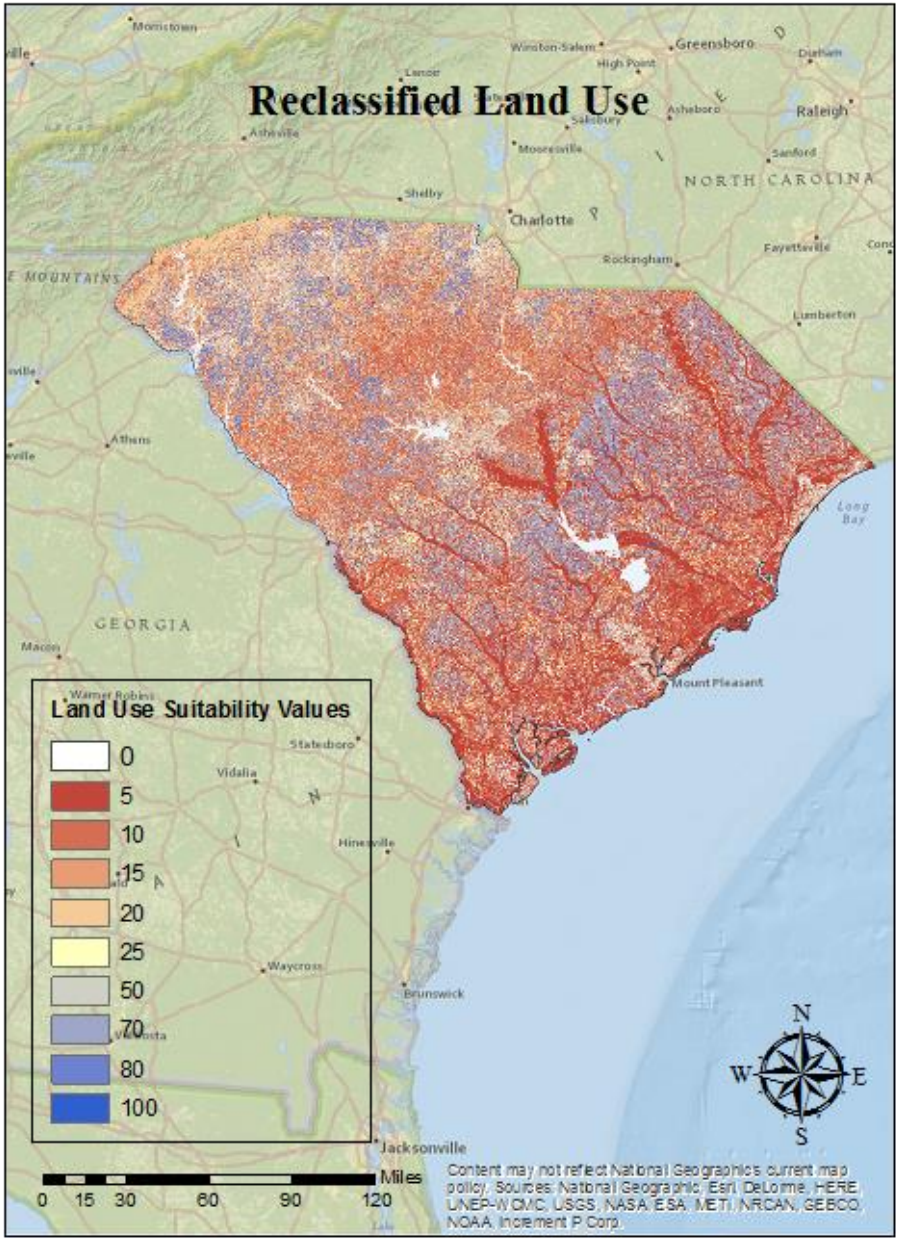
Reclassification of land use

Category	Reclass Values
Unclassified	100
Open Water	0
Perennial Snow/Ice	0
Developed, Open Space	0
Developed, Low Intensity	50
Developed, Medium intensity	15
Developed, high intensity	10
Barren Land	100
Deciduous Forest	20
Evergreen Forest	10
Mixed forest	10
Shrub/Scrub	25
Herbaceous	10
Hay/pasture	80
Cultivated Crops	70
Woody Wetlands	5
Emergent Herbaceous Wetlands	5


Reclassified Land Use
Land Use Suitability Values
0
5
10
15
20
25
50
70
80
100
Miles
0 15 30 60 90 120
NORTH CAROLINA
GEORGIA
Charlotte
Greensboro
Raleigh
Jacksonville
Mount Pleasant
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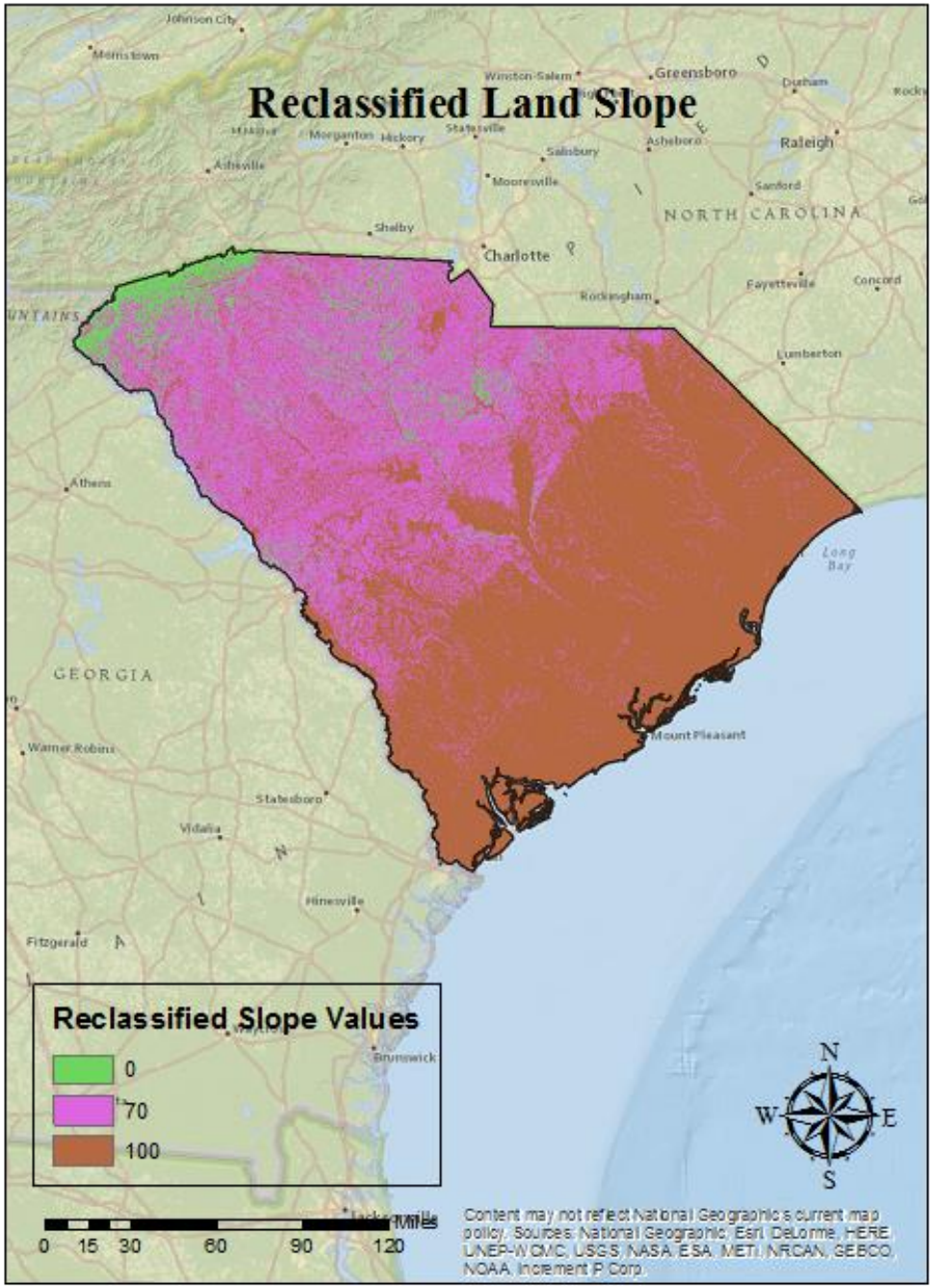
Slope

- High slope is unsuitable for two reasons
  - Lower solar irradiation
  - Difficulty building plant

Slope [°]	Reclass Values
0 - 5	100
5 - 20	70
20 - 90	0


Reclassified Land Slope
Johnson City
Morristown
Winston-Salem
Greensboro
Durham
Asheville
Morganton
Hickory
Statesville
Salisbury
Asheboro
Raleigh
Moorresville
Sanford
NORTH CAROLINA
Shelby
Charlotte
Rockingham
Fayetteville
Concord
Lumberton
Athens
Long Bay
GEORGIA
Warner Robins
Mount Pleasant
Statesboro
Vidalia
Hinesville
Fitzgerald
Brunswick
Reclassified Slope Values
0
70
100
N
W
E
S
0 15 30 60 90 120
Miles
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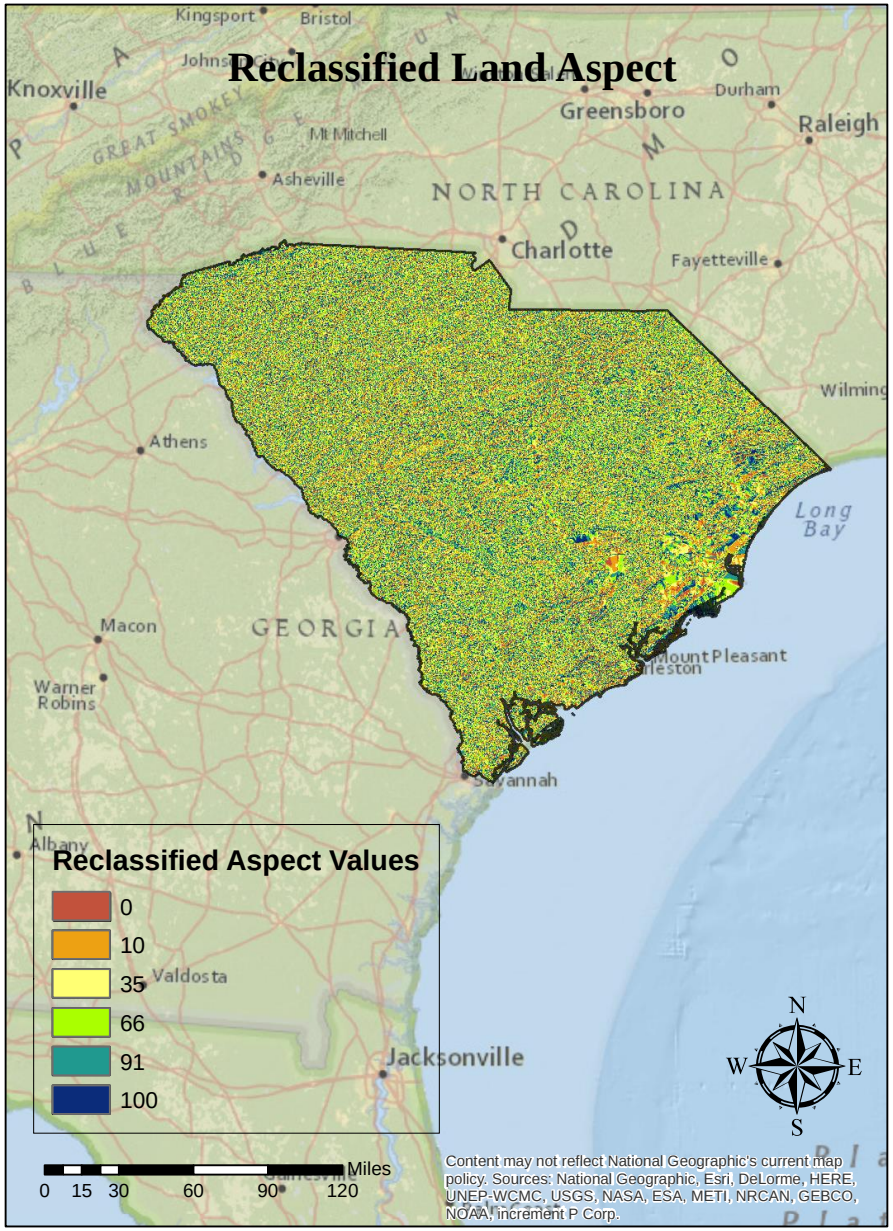
Aspect

Aspect [°]	Cos(x+PI)+1	Normalized Values	Reclass Values
0-36	0.19	9.5	10
36-72	0.69	34.5	35
72-108	1.31	65.5	66
108-144	1.81	90.5	91
144-180	2.00	100.0	100
180-216	1.81	90.5	91
216-252	1.31	65.5	66
252-288	0.69	34.5	35
288-324	0.19	9.5	10
324-360	0.00	0.0	0


Reclassified Land Aspect
Kingsport
Bristol
Knoxville
Greensboro
Durham
Raleigh
Mt Mitchell
Asheville
NORTH CAROLINA
Charlotte
Fayetteville
Athens
Long Bay
Macon
GEORGIA
Mount Pleasant
Warner Robins
Savannah
Albany
Valdosta
Jacksonville
Reclassified Aspect Values
0
10
35
66
91
100
Miles
0 15 30 60 90 120
N
W
E
S
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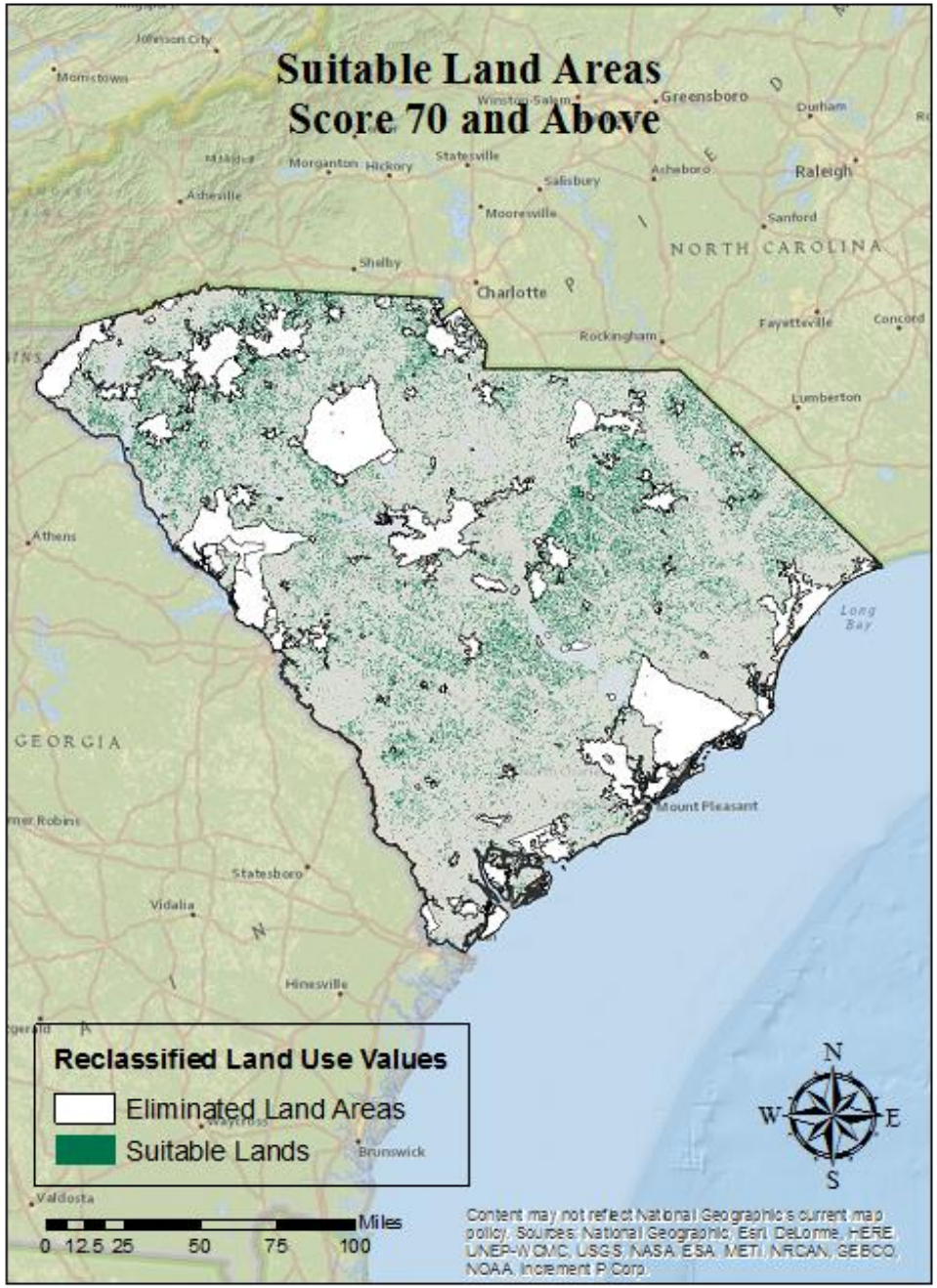
Weighting

Weighted Layer = aspect * 0.20 + slope * 0.10 + land_use * 0.70


Suitable Land Areas
Score 70 and Above
Johnson City
Morristown
Greensboro
Durham
Asheville
Morganton
Hickory
Statesville
Salisbury
Asheboro
Raleigh
Mooresville
Sanford
NORTH CAROLINA
Shelby
Charlotte
Fayetteville
Concord
Rockingham
Lumberton
Athens
Long Bay
GEORGIA
Mount Pleasant
Statesboro
Vidalia
Hinesville
Brunswick
Valdosta
Reclassified Land Use Values
Eliminated Land Areas
Suitable Lands
N
W
E
S
Miles
0 12.5 25 50 75 100
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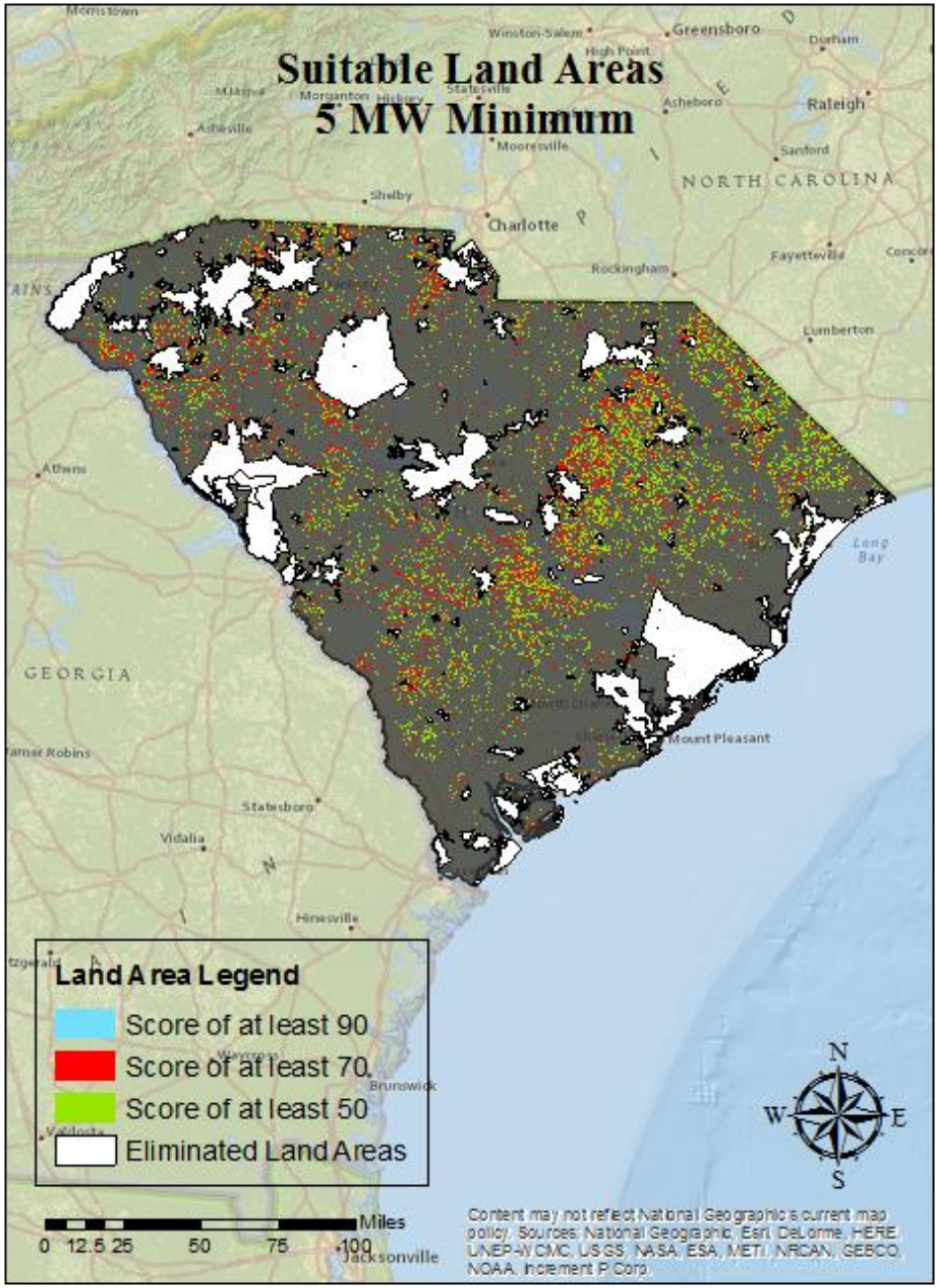
Results

Minimum Suitability Rank	Minimum Contiguous Land Area [km^2]	Total Annual Energy Available [TWh]	Land Area [km^2]	State Land Use
50	0.18	14,384	8,570	11.01%
	0.036	18,660	11,120	14.28%
70	0.18	5,573	3,320	4.26%
	0.036	10,317	6,147	7.90%
90	0.18	38	22	0.03%
	0.036	108	64	0.08%


Suitable Land Areas
5 MW Minimum
Land Area Legend
Score of at least 90
Score of at least 70
Score of at least 50
Eliminated Land Areas
Miles
0 12.5 25 50 75 100
N
W
E
S
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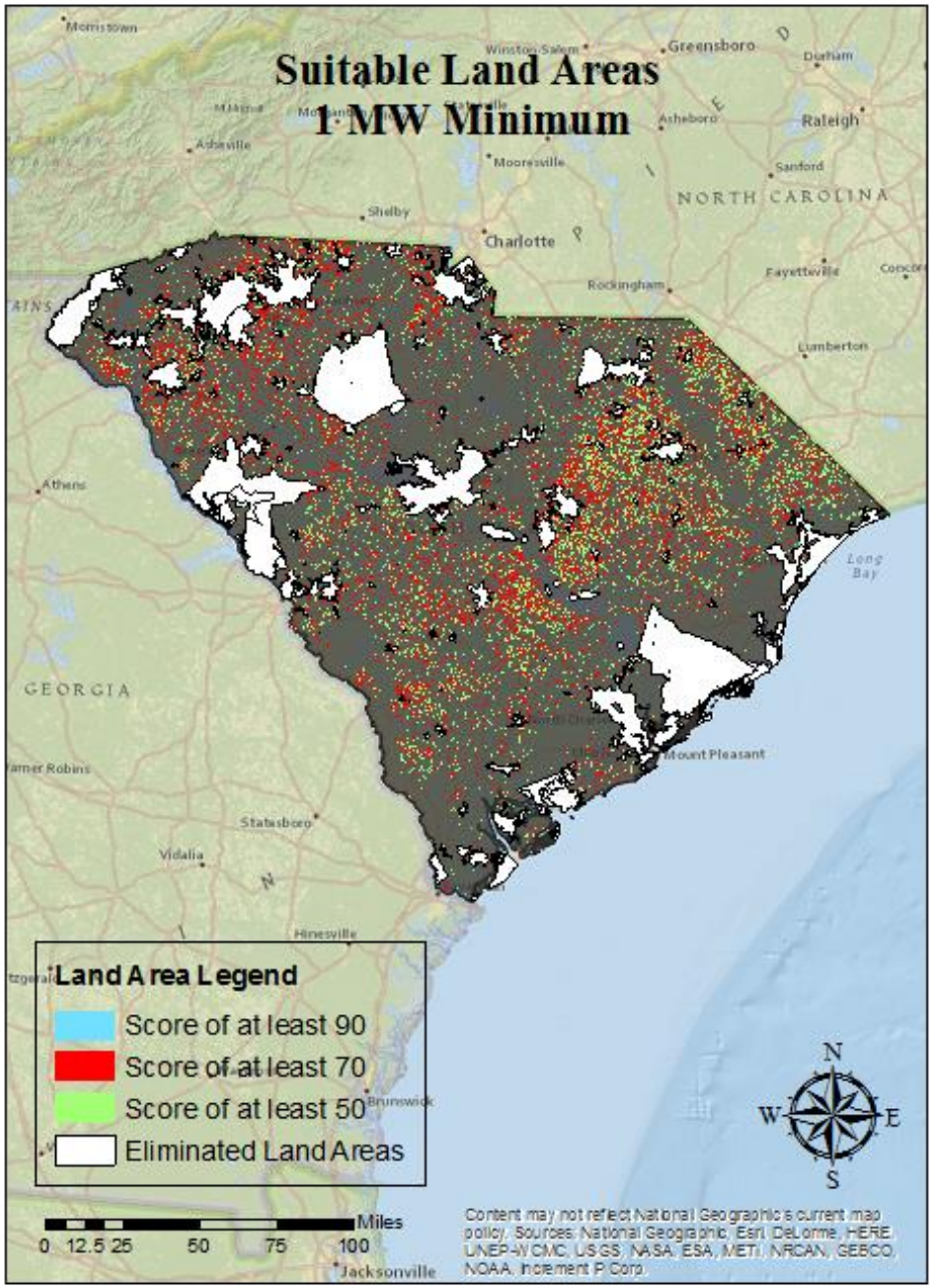
Suitable Land Areas
1 MW Minimum
Land Area Legend
Score of at least 90
Score of at least 70
Score of at least 50
Eliminated Land Areas
Miles
0 12.5 25 50 75 100
N
W
E
S
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