

STATEWIDE ANALYSIS FOR OPTIMIZED SOLAR FARM LOCATION

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THE PROBLEM

Electricity generated from non-renewable sources = ☹

- Climate change
- Pollution
- Unsustainability (i.e. “non-renewable”)
- Inefficiency

Oregon’s Renewable Standards Portfolio (RPS) bill

- State mandate for Oregon’s largest utilities to be 25% renewable by 2025.
- Similar, but lesser, requirements set for smaller utilities.

THE SOLUTION

- **Solar Energy**
 - The simplest, most readily-available and abundant energy source
 - Geographically unbiased at small scales
- **The Catch**
 - Maximum generating capacity varies as a function of local surface conditions/ factors
 - Atmosphere
 - Terrain
 - Maximum usable wattage is spatially-dependent
 - Voltage drop over distance

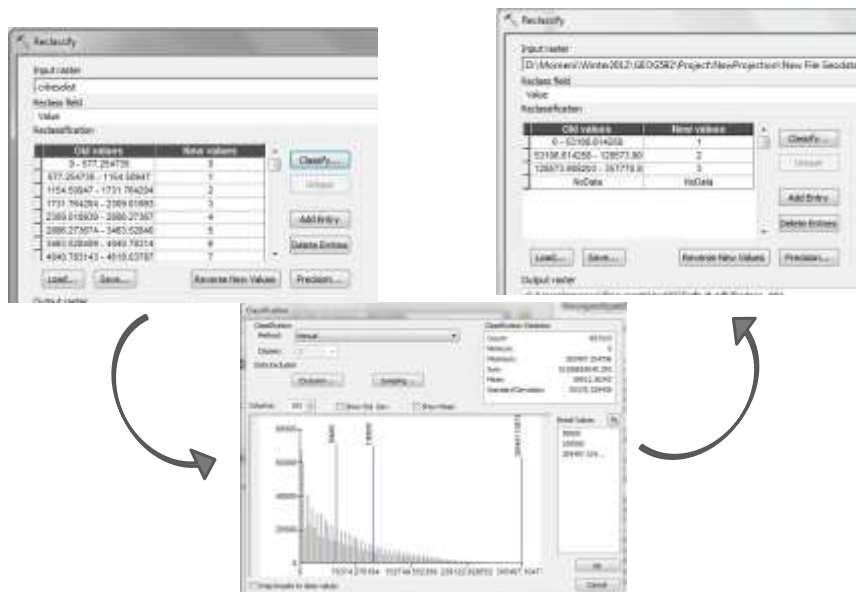
OUR RESEARCH

- **Determine the most suitable areas for solar energy development in Oregon based on multiple criteria.**
 - 2000ft scale
 - Multi-Criteria Analysis
 - Assigned weights based on existing (“expert”) research
 - *Multicriteria GIS modeling of wind and solar farms in Colorado* - Janke 2010
 - *PV site suitability analysis using GIS-based spatial fuzzy multi-criteria evaluation* - Charabi and Gastli 2011.

CRITERIA

GIS criteria used to model solar farms							
Variable	Ideal Conditions	Original Data	Type	Final Data	Type	Possible Values	Weight
Solar Potential	Maximize W/m ² /day	Categorical	Polygon	Categorical	Grid	[1, 6, 10]	0.30
Distance to Transmission Lines	Close to Transmission Lines	Discrete	Line	Categorical	Grid	[1, 6, 10]	0.20
Distance to Cities	Far Away from Cities	Discrete	Point	Categorical	Grid	[1, 6, 10]	0.15
Distance to Roads	Close to Roads	Discrete	Line	Categorical	Grid	[1, 6, 10]	0.10
Landcover	Short Vegetation, Subdued, Stable Topography	Continuous	Grid	Categorical	Grid	[1, 6, 10]	0.10
Land Ownership	Not in National Parks or Monuments, Native American Reservations, etc.	Categorical	Polygon	Categorical	Grid	[restricted, 10]	0.05
Slope	Less than 5%	Continuous	Grid	Categorical	Grid	[restricted, 10]	0.10

RECLASSIFICATION



SOLAR RADIATION

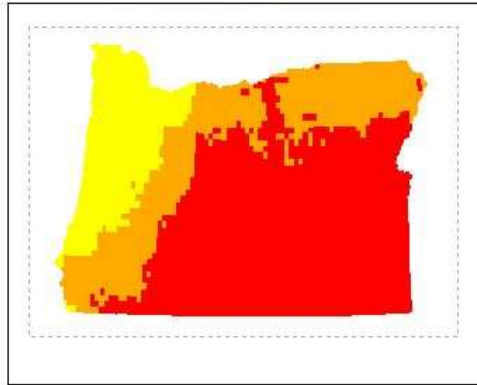
Oregon Solar Map- DNIANN



Display attribute: DNIANN
(Direct Normal Irradiance)

- Reclassified
 - Best class: >5000 DNIANN
 - Mid Class: 4000-5000 DNIANN
 - Low < 4000

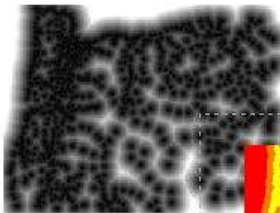
Solar Radiation Reclass



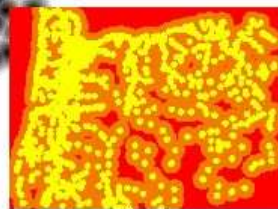
CITIES

- Euclidean Distance
- Reclassified - 3 classes (mi)
 - <5
 - 5-15
 - >15

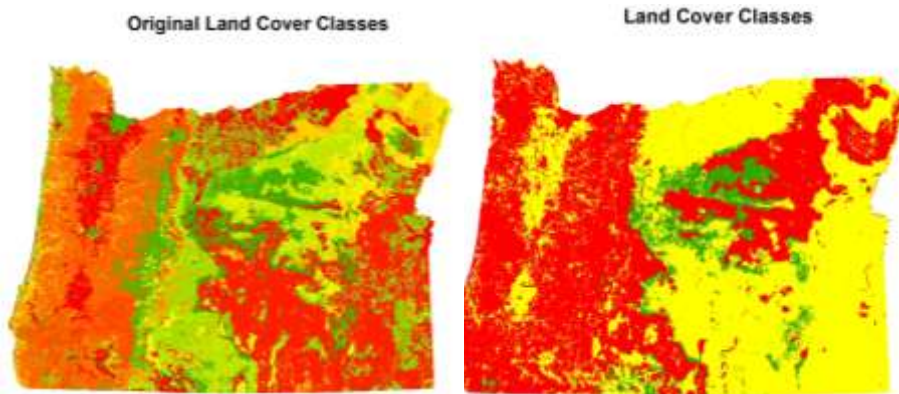
Cities- Euclidean Distance



Cities- Reclass

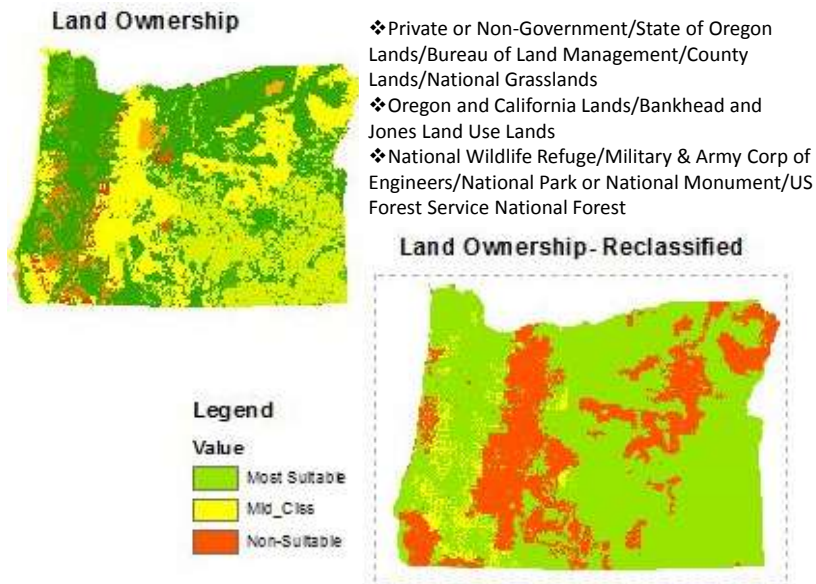


LAND COVER



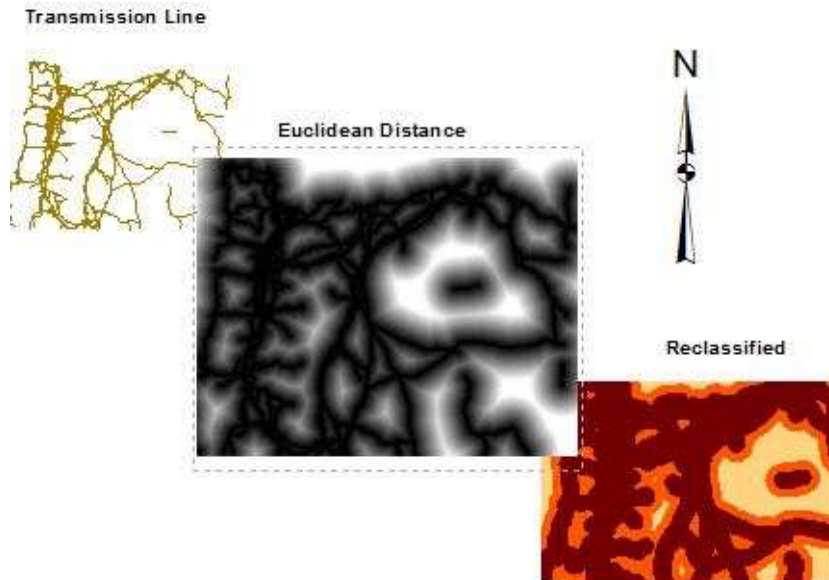
- Most Suitable: Mixed Conifer/Mixed Deciduous Forest/ Sitka Spruce-W. Hemlock Maritime Forest/ Urban
- Moderately Suitable: Exposed Tidal Flat/ NWI Palustrine Emergent/ NWI Estuarine Emergent/ Western Juniper Woodland/ Wet Meadow/
- Non-Suitable: NWI Palustrine Scrubland/ Grass-shrub-sapling or Regenerating young forest/ Agriculture

LAND OWNERSHIP



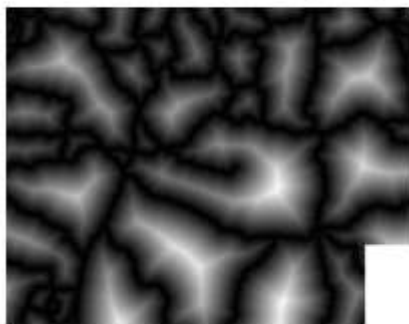
- ❖ Private or Non-Government/State of Oregon Lands/Bureau of Land Management/County Lands/National Grasslands
- ❖ Oregon and California Lands/Bankhead and Jones Land Use Lands
- ❖ National Wildlife Refuge/Military & Army Corp of Engineers/National Park or National Monument/US Forest Service National Forest

TRANSMISSION LINES



HIGHWAYS

Highway Distance



- Used to calculate Distance from Highways Raster
- Process: Euclidean Distance (Cell size 2000), Classes: 0-5 Mile, 5-15 Mile, >15 Mile



SLOPE

Original Slop Classes



- Display attribute: DNIANN (Direct Normal Irradiance)
- Derived from Oregon DEM (80 m)
- Process: Resample to 2000*2000ft

Reclassified Slop



Reclassify to
0-5%
5-10%
>10 %

RESULTS

Oregon Solar Suitability Classes



RESULTS

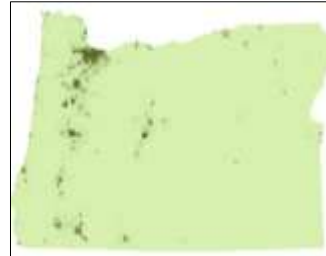
Oregon Solar Suitability

Solar Suitability Class	Total Area (Sq Km)	Percent area (of the state)
0	109269	43.56
3	3	0
4	680	0.27
5	11162	4.45
6	15387	6.13
7	27096	10.8
8	26649	10.62
9	32861	13.1
10	22737	9.06

	Suitability class Area (sq km)			
Land Ownership Class	10	9	8	7
PRIVATE_OR_NON_GOVERNMENT	8522	18916	12649	19219
STATE_OF_OREGON_LANDS	562	482	524	545
BUREAU_OF_LAND_MANGEMENT	13312	13033	12636	7129
OREGON_AND_CALIFORNIA_LANDS	98	224	483	203
BANKHEAD_AND_JONES_LAND_USE_LANDS	232	183	355	0
NATIONAL_GRASSLANDS	11	23	3	0

FUTURE CONSIDERATIONS

- **Population Density/ Electricity Demand weighting**
- **Finer Resolution**
- **Other variables**
 - Soil Erosion Susceptability
 - Aspect
 - Proximity to manufacturing facilities
- **Integration of other renewable sources**
 - Wind, Geothermal
- **Urban regions/ smaller scale site selection**
 - County, City, Neighborhood



BIBLIOGRAPHY

Charabi, Yassine, and Adel Gastli. "PV Site Suitability Analysis Using GIS-based Spatial Fuzzy Multi-criteria Evaluation." *Renewable Energy* 36.9 (2011): 2554-561. Print.

Janke, Jason. "Multicriteria GIS Modeling of Wind and Solar Farms in Colorado." *Renewable Energy* 35 (2011): 2228-2234. Print

Data Resource

1. Cities: Obtained from Oregon Geospatial Enterprise (GEO)
(<http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml>)

2. Block Groups (2010 Census): Obtained from Oregon Geospatial Enterprise (GEO)
(<http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml>)

3. Highways: Obtained from Oregon Geospatial Enterprise (GEO)
(<http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml>)

4. Slope: Derived from Oregon DEM (80 m) Original DEM was obtained from I Drive

5. Solar Layer: Display attribute: DNIANN (Direct Normal Irradiance)

Annual average solar resource for flat plate tilted south collectors for the contiguous USA

<http://app.databasin.org/app/pages/datasetPage.jsp?id=5b50bd1aa04448b59f80da977b672eb2>

6. Land cover Oregon Landcover was obtained from I Drive

7. Land ownership Obtained from Oregon Geospatial Enterprise (GEO)
(<http://gis.oregon.gov/DAS/EISPD/GEO/alphalist.shtml>) (Source 9BLM and SSCGIS, 1:100,000)