

Generation Siting Process for Long-Term Studies

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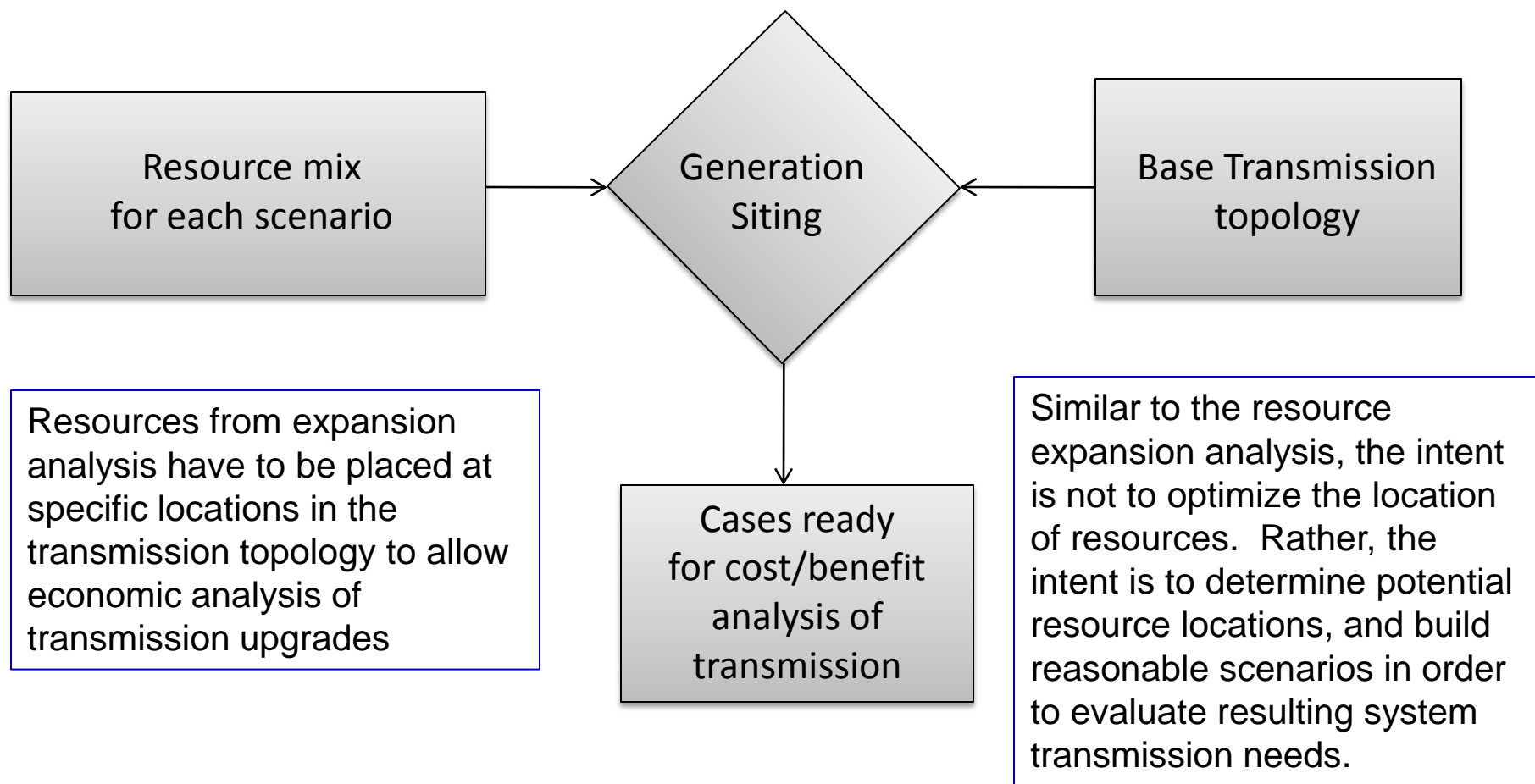
K. Hanson
G. Thurnher

The purpose of this presentation is to describe the process proposed to site resources selected in the expansion analysis.

Although a specific siting methodology has been developed, this process is still being revised and improved. Comments received from stakeholders will be incorporated to improve the process. ERCOT appreciates comments on the proposed methodology.

Specific siting criteria have been evaluated and are described in this presentation. Additional relevant criteria can be added to the analysis.

How Generation Siting goes into the big picture?



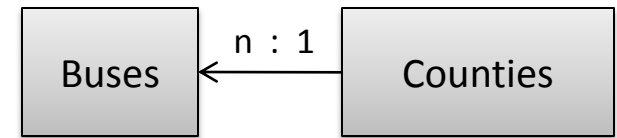
Generation Siting Process

The goal of this generation siting methodology is to have each 345-kV transmission bus characterized in terms of its likelihood to become the point-of-interconnection for new generators.

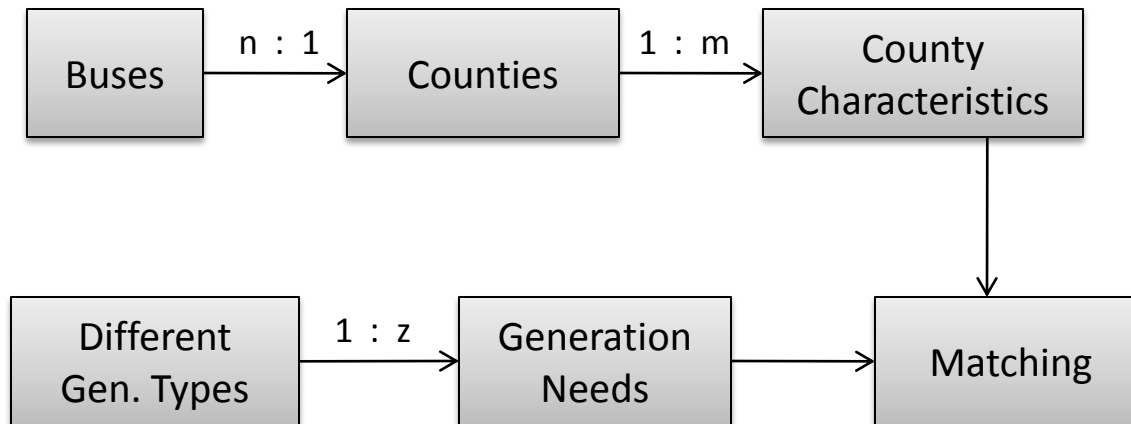


All 345-kV substations within a county are considered equal candidates for interconnection for certain generation type (the level of granularity is a county).

Each county is ranked by certain characteristics (such as water availability, pipelines, etc.).



These characteristics will be used to grade each county according to its viability as a site for new resources.



Counties Characteristics

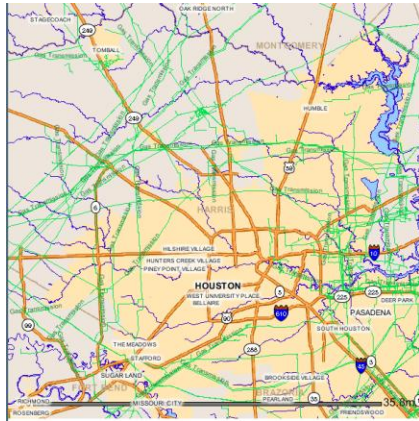
Counties characteristics that have been assessed to date:

- Gas pipelines density/capacity
- Railroads density
- Wind conditions
- Solar thermal and PV conditions
- Surface water conditions
- Current/prospective air quality Non-Attainment zones
- Urban density
- Significant environmental constraints

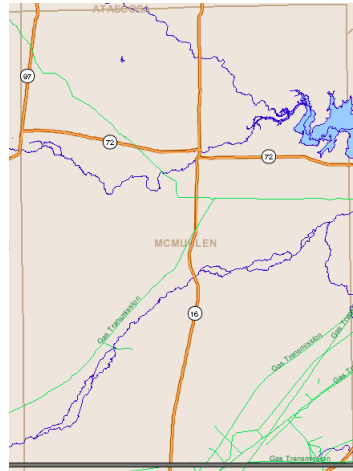
Other characteristics that affect resource development can be considered in this analysis.

Counties Characteristics – Gas Pipelines Density/Capacity

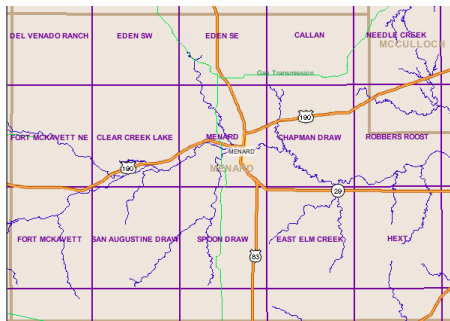
Examples of Counties:



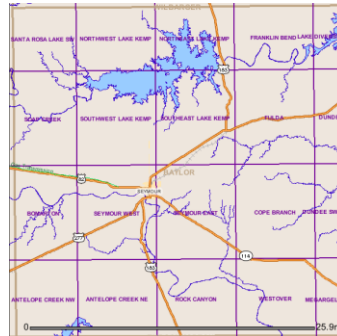
Harris - grade High



McMullen – grade Medium



Menard – grade Low



Baylor – grade Low

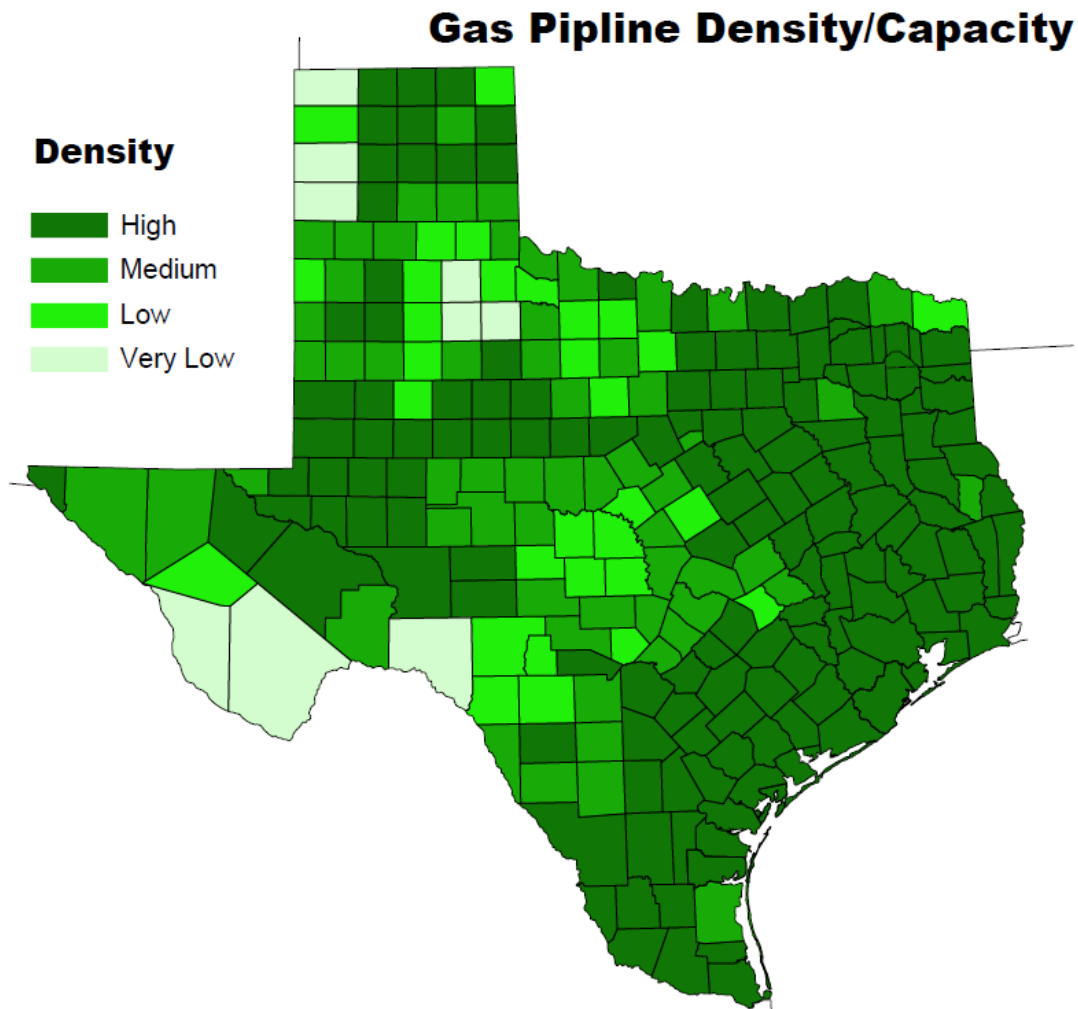


Val Verde – grade Very Low

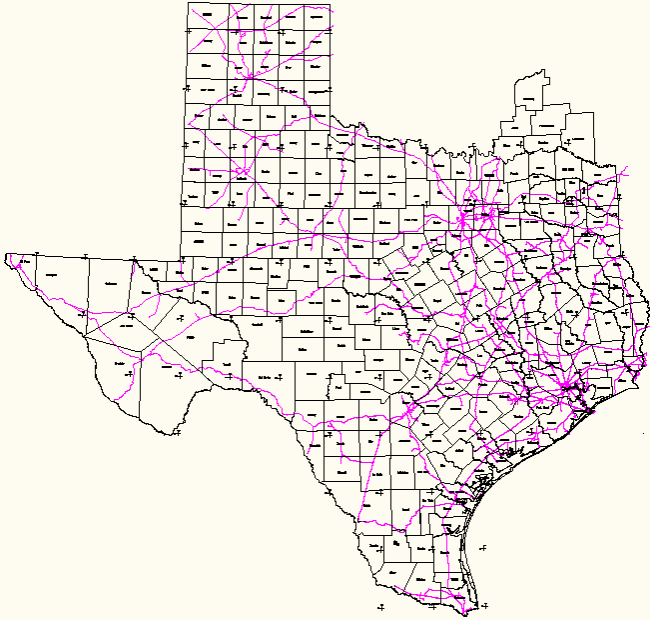
Density	No. of Counties
High	154
Medium	59
Low	31
Very Low	10

Source: Railroad Commission of Texas

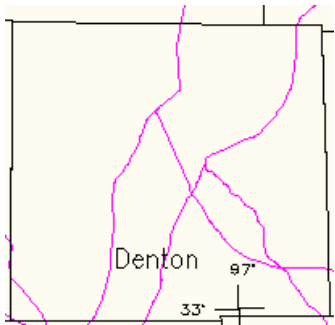
Counties Characteristics – Gas Pipelines Density/Capacity



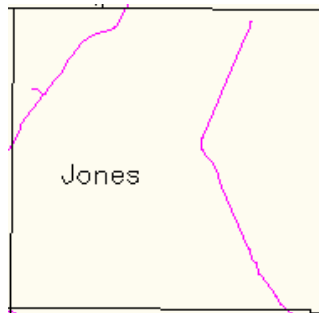
Counties Characteristics – Railroads Density



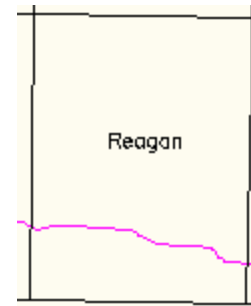
Density	No.
High	57
Medium	63
Low	89
Very Low	45



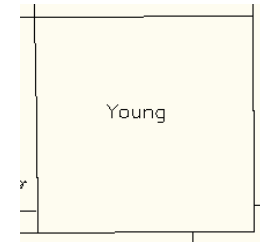
Denton – grade High



Jones – grade Medium



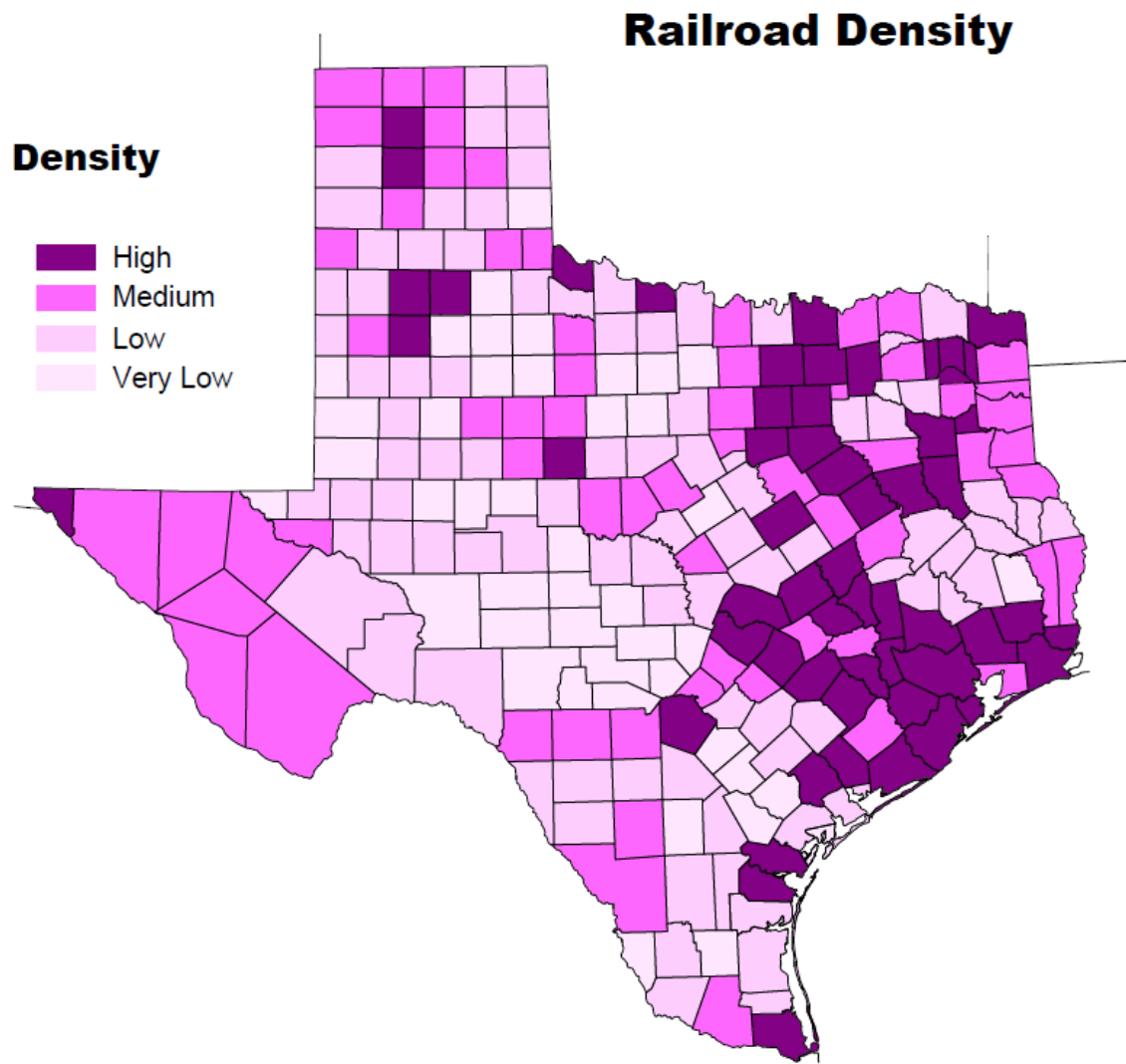
Reagan – grade Low



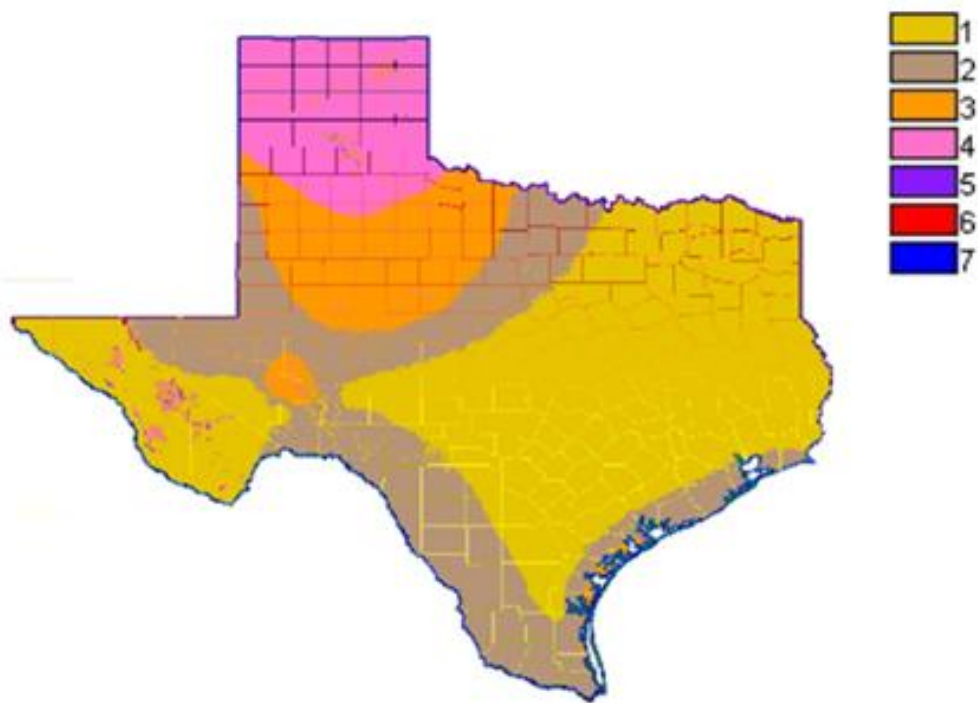
Young – grade Very Low

Source: ERCOT maps

Counties Characteristics – Railroads Density



Counties Characteristics – Wind Conditions

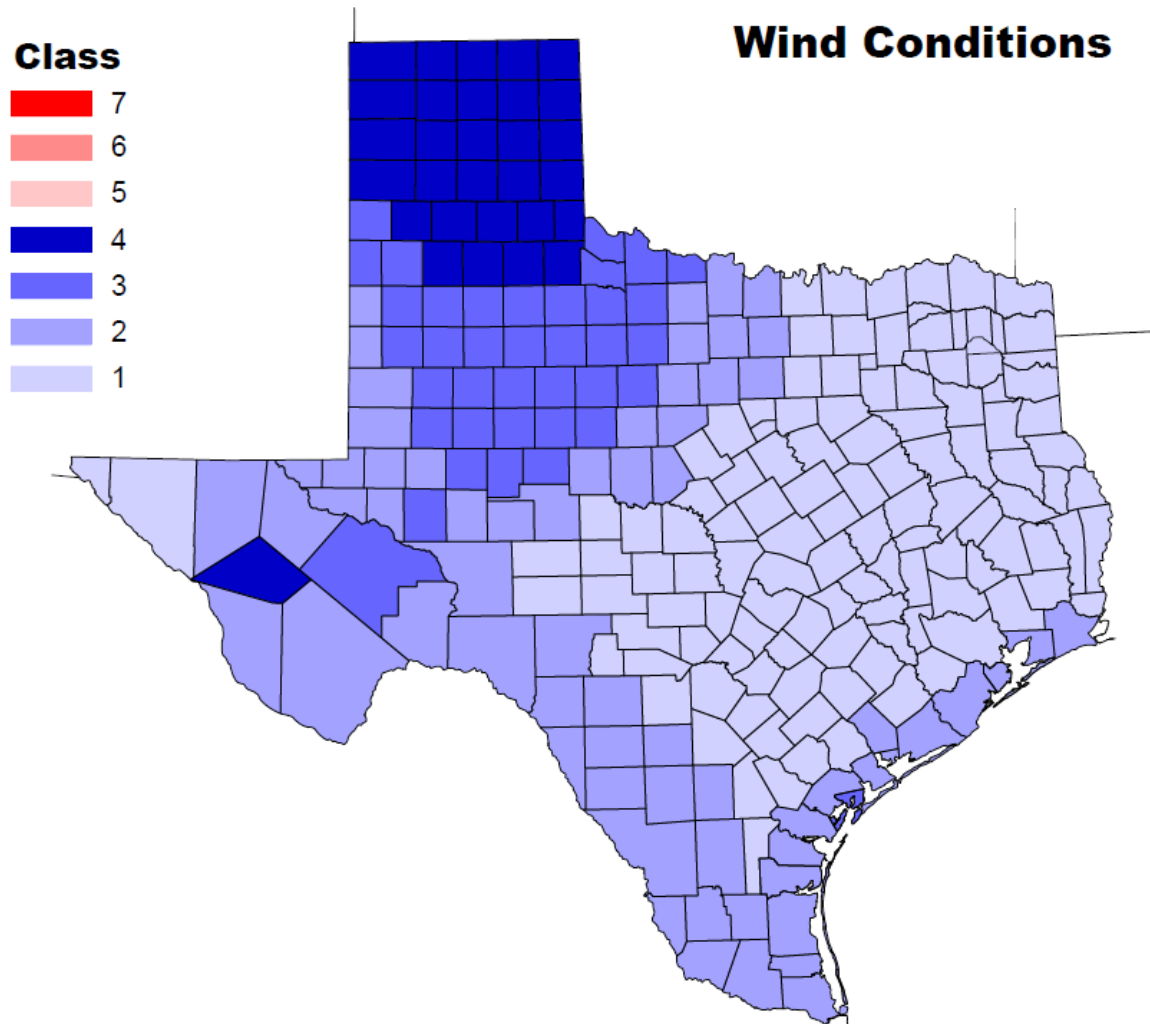


Wind Class	No.
7	0
6	0
5	0
4	30
3	38
2	64
1	122

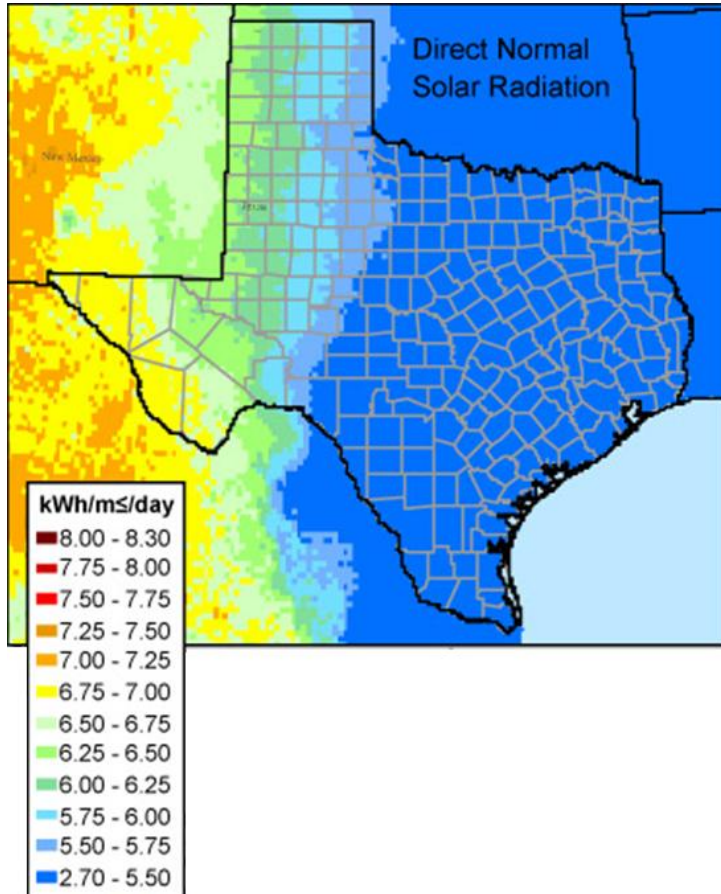
Wind classes for land areas,
excluding off-shore potential

Source: Alternative Energy Institute, West Texas A&M Univ.

Counties Characteristics – Wind Conditions

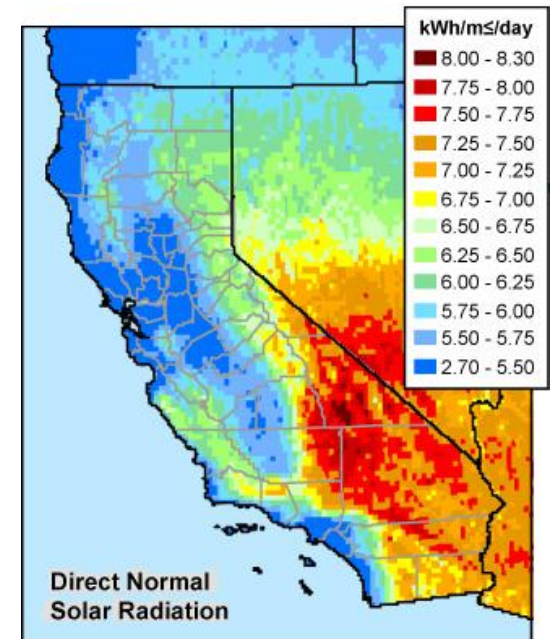


Counties Characteristics – Solar Thermal Conditions

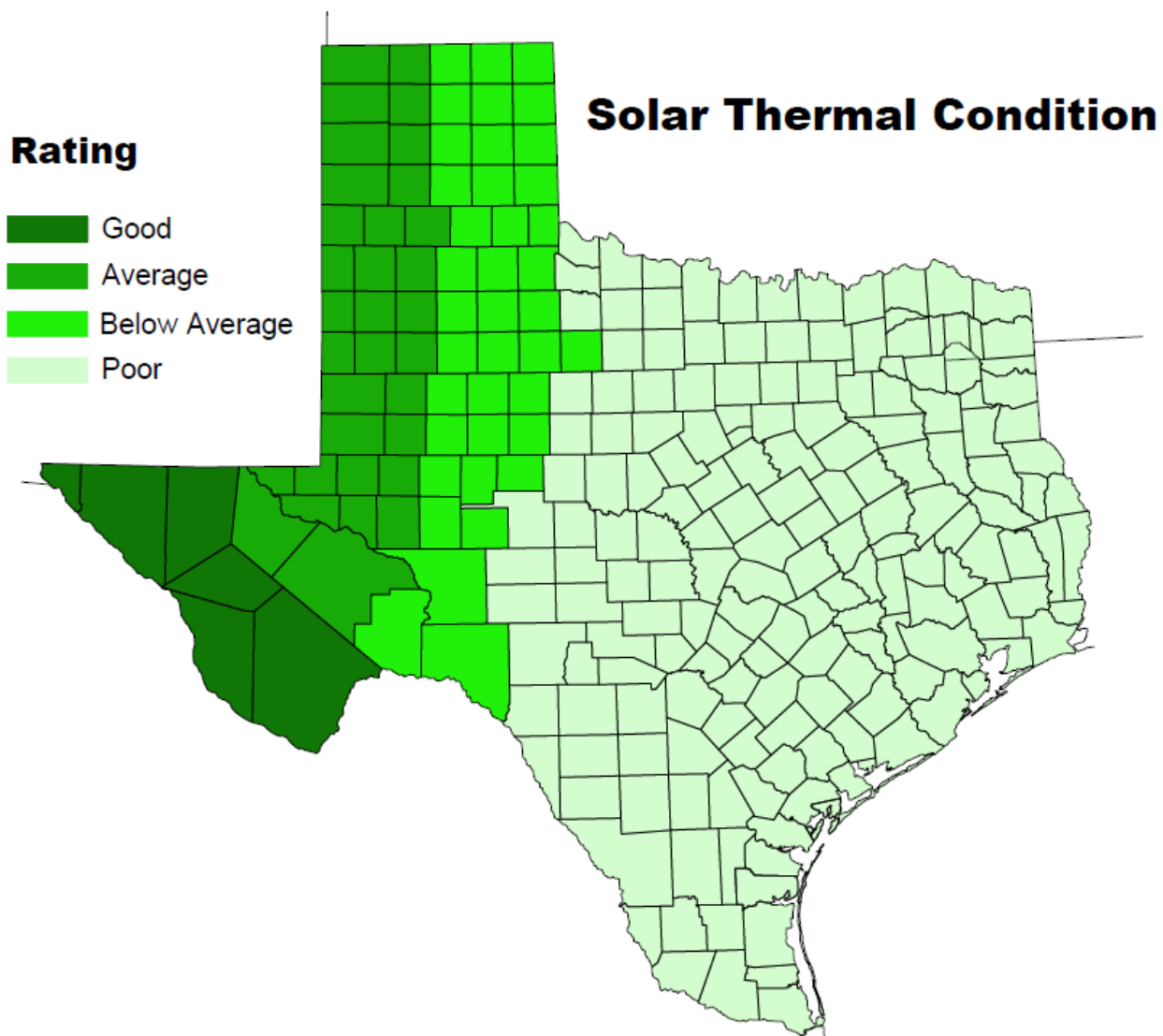


Source: National Renewable Energy Laboratory

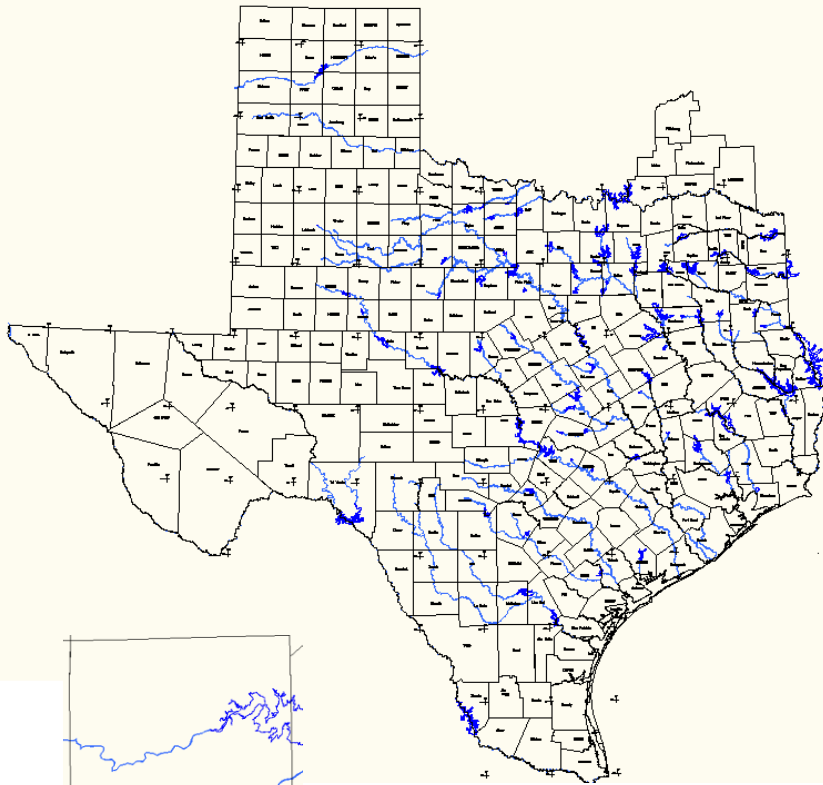
Solar Thermal Conditions		No.
Good	6.5-7 kWh/m per day	6
Average	6-6.5 kWh/m per day	32
Below Average	5.5-6 kWh/m per day	49
Poor	≤ 5.5 kWh/m per day	177



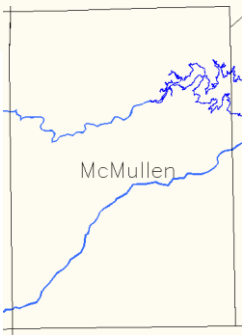
Counties Characteristics – Solar Thermal Conditions



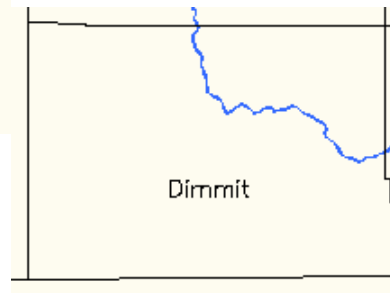
Counties Characteristics – Prevalence of Surface Waters



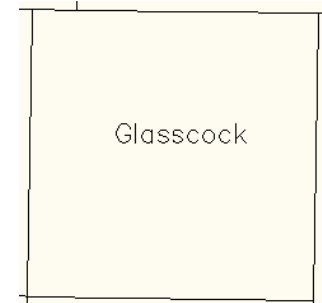
Surface Water Conditions	No.
High	97
Medium	77
Low	80



McMullen – grade High

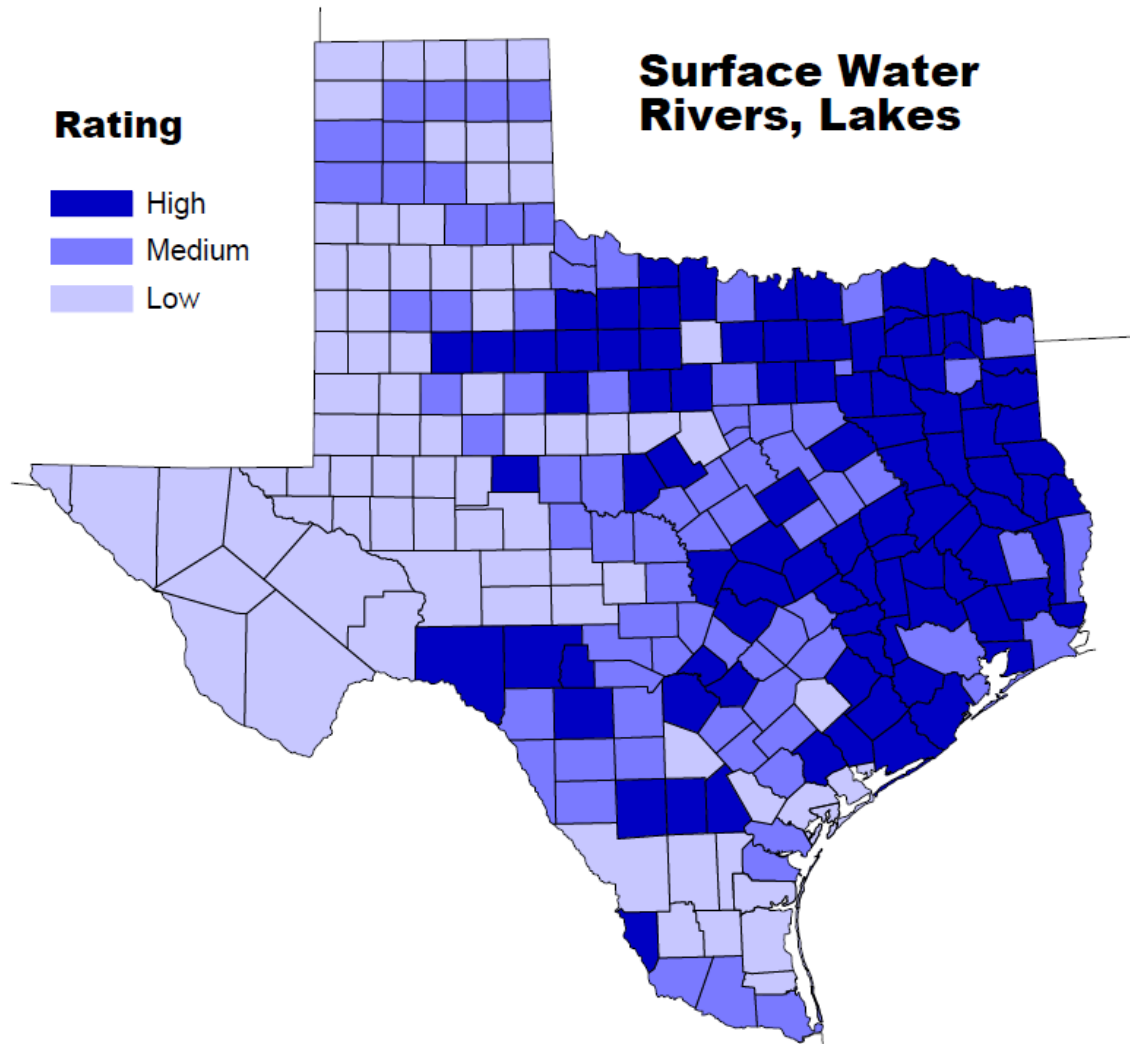


Dimmit – grade Medium



Glasscock – grade Low

Counties Characteristics – Surface Waters Conditions



Counties Characteristics – Current/Prospective Non-Att. Zones

Non-Attainment Counties:

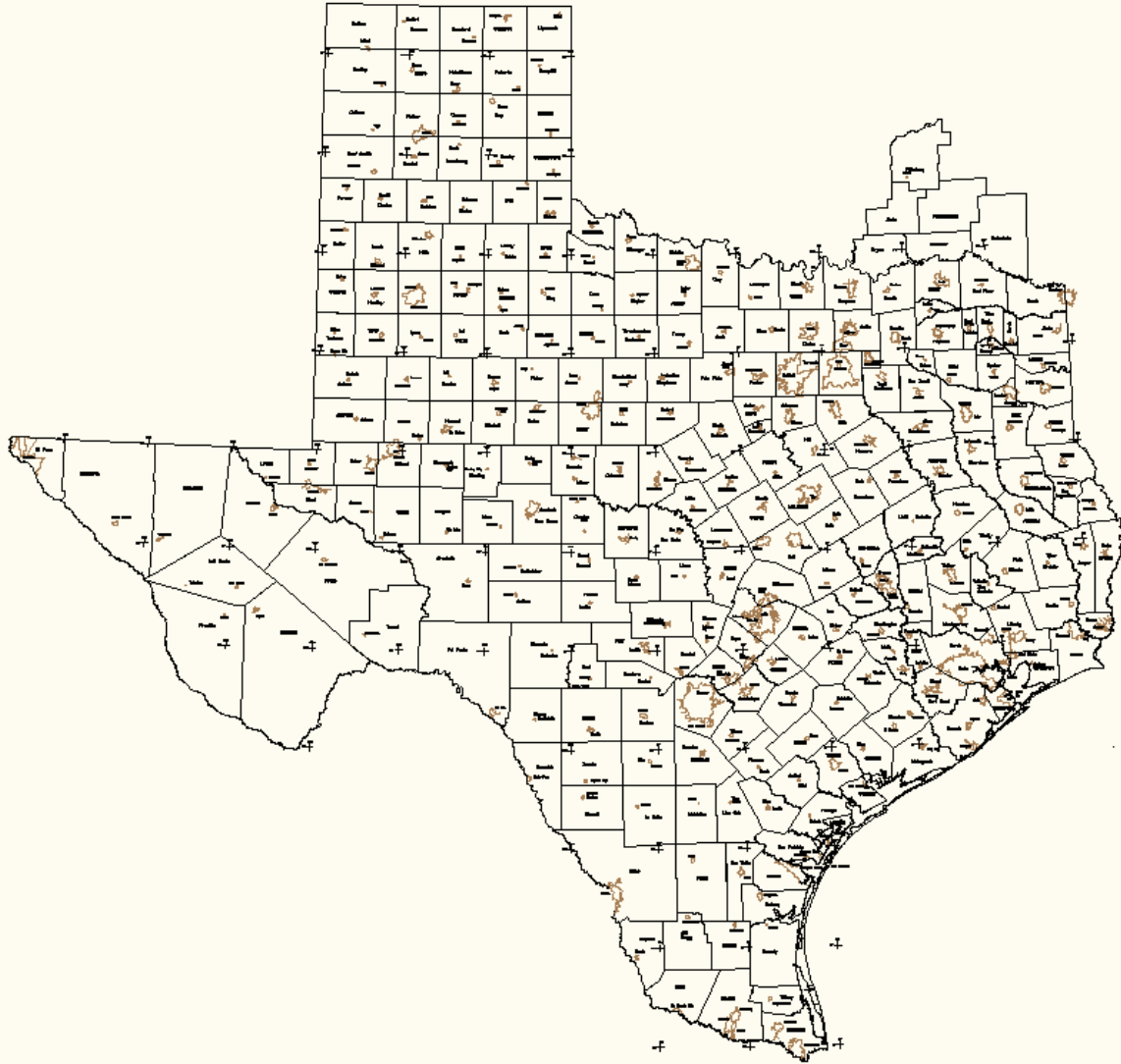
Brazoria, Chambers, Collin, Dallas, Denton,
Ellis, Fort Bend, Galveston, Hardin, Harris,
Jefferson, Johnson, Kaufman, Liberty,
Montgomery, Orange, Parker, Rockwall,
Tarrant, Waller

Potential Non-Attainment Counties:

El Paso, Smith, Hood, Gregg, Rusk, Travis, Bexar

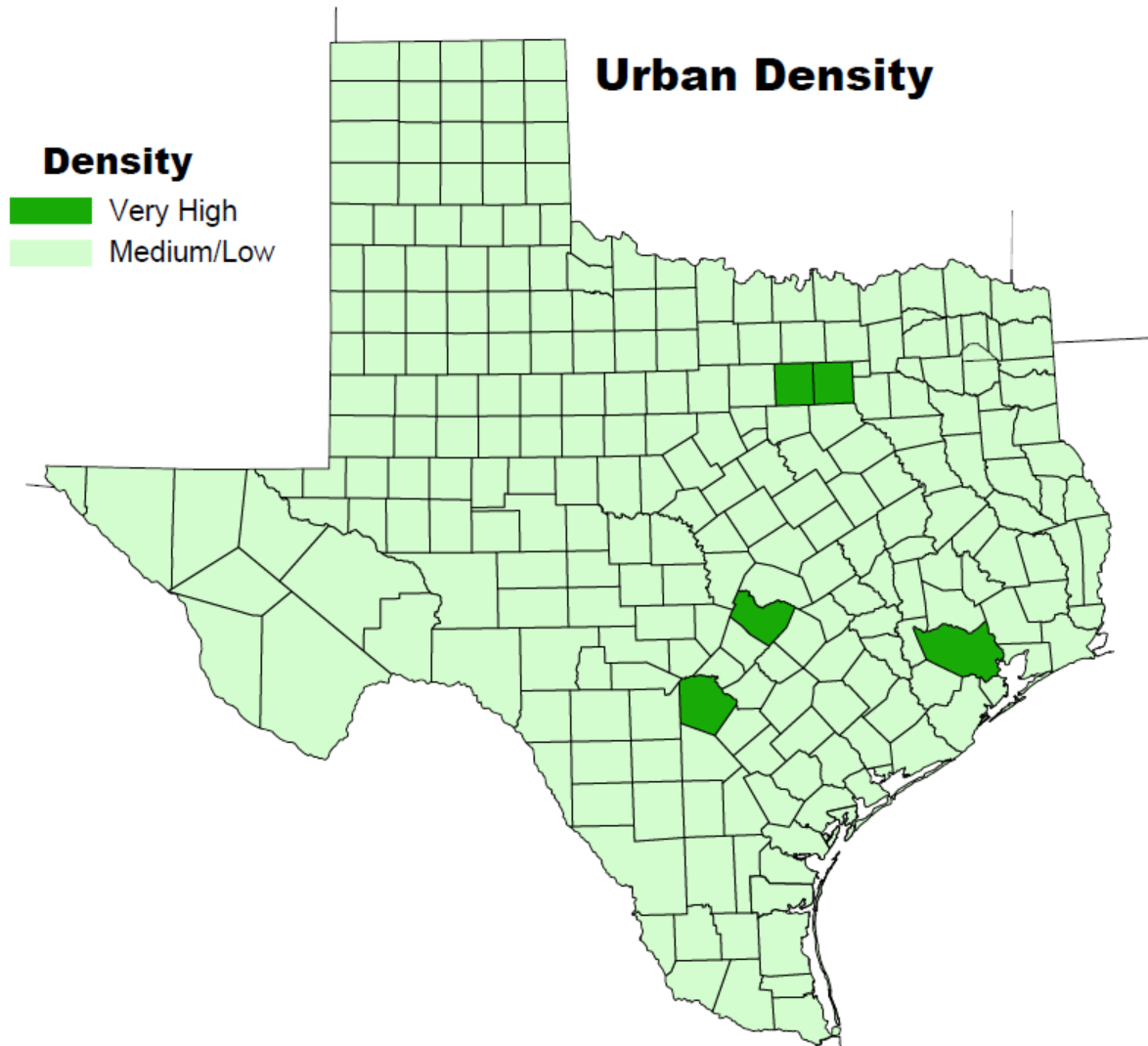
Non-Att. Zones	No.
Yes	21
Potential	6
No	228

Counties Characteristics – Urban Areas



High Density Urban Counties:
Tarrant, Dallas, Harris, Travis, Bexar

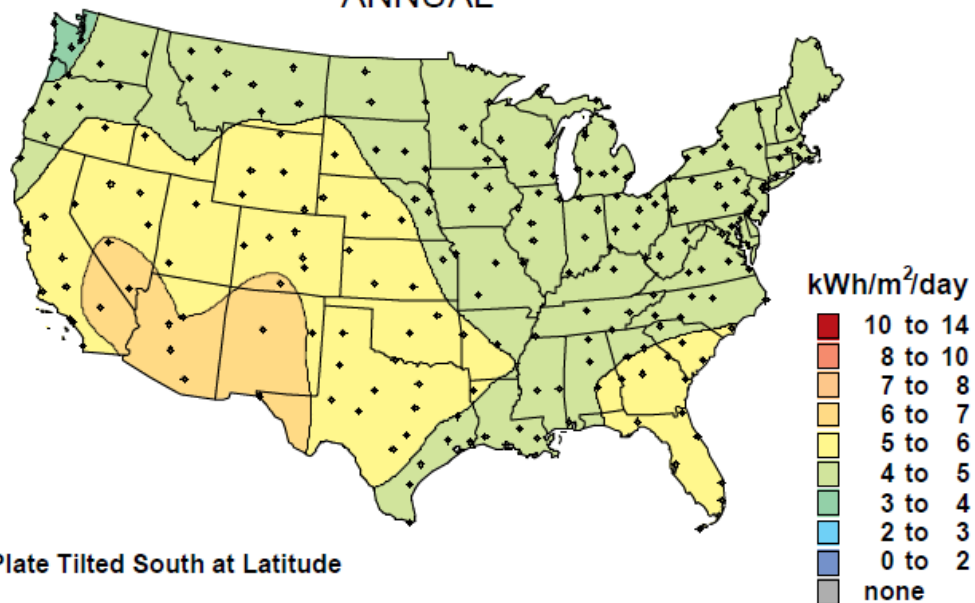
Counties Characteristics – Urban Areas



Counties Characteristics – Solar PV Conditions

Average Daily Solar Radiation Per Month

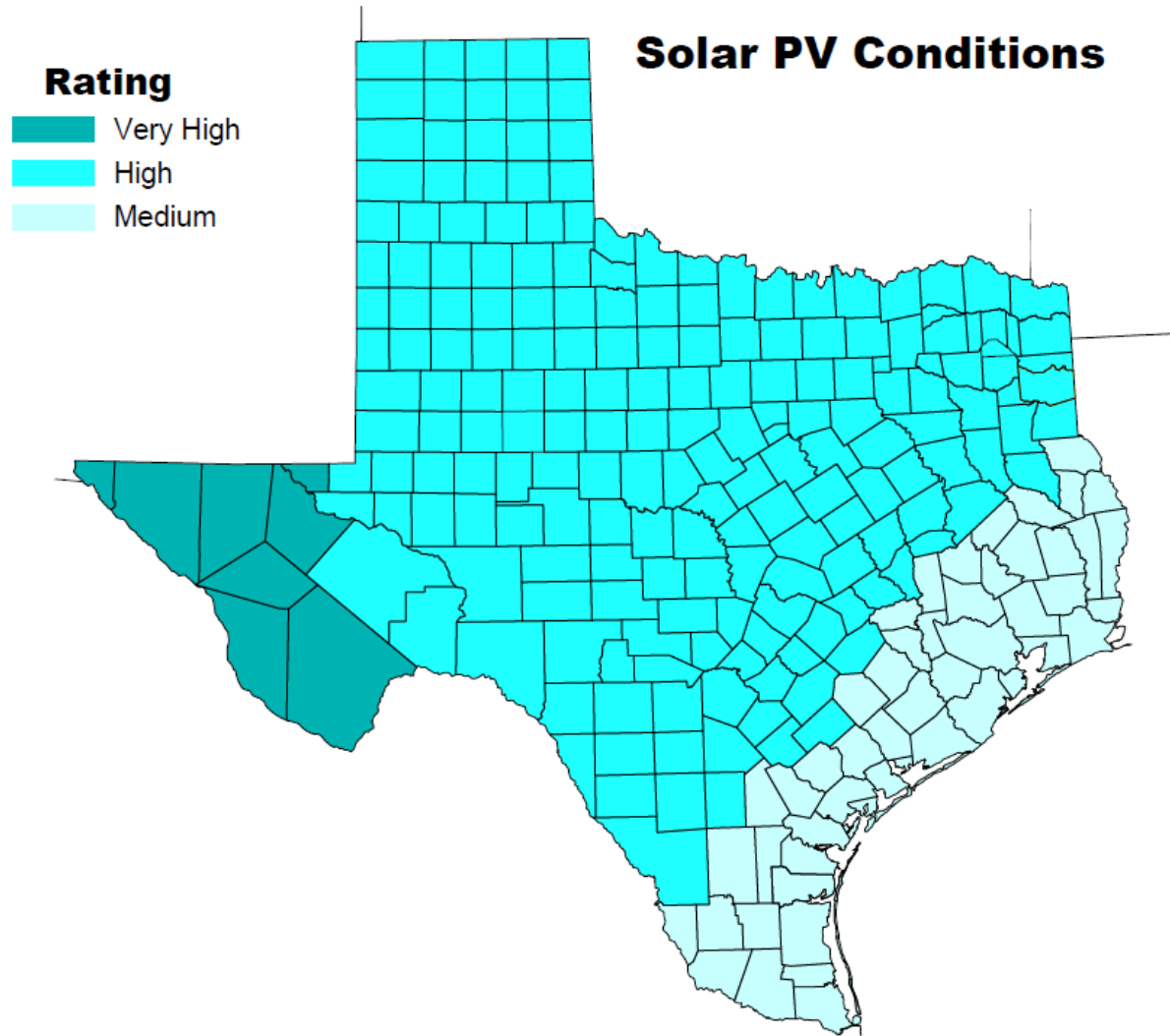
ANNUAL



Solar PV Conditions	No.
Very High	8
High	197
Medium	49

Source: National Renewable Energy Laboratory

Counties Characteristics – Solar PV Conditions



Resource Needs

	gas pipelines density/capacity	railroad density	urban density	Non-Att zone	amount of sign. env. constr.	wind cond.	solar therm. cond.	surface waters	solar pv cond
.Gen type	High (H); Medium (M); Low (L); Very Low (VL)	High (H); Medium (M); Low (L); Very Low (VL)	Very High (VH); Medium/Low (L)	Yes (Y); Potential (P); No (N)	High (H); Medium (M); Low (L)	1-7	Good (G); Average (A); Below Average (BA); Poor (P)	High (H); Medium (M); Low (L);	Very High (VH); High (H); Medium (M)
Wind good			L		M or L	3-4			
Wind aver.			L		M or L	2			
Solar Thermal good			L		M or L		G	H	
Solar Thermal aver.			L		M or L		G or A	H or M	
NG CT good	H		L	N	M or L				
NG CT aver.	H or M		L	N	M or L				
NG CC good	H		L	P or N	M or L			H or M	
NG CC aver.	H or M		L	P or N	M or L			H or M	
Coal		H or M	L	N	L			H or M	
Biomass		H or M or L	L		M or L				
Nuclear			L					H	
Geo-Thermal			L		M or L				
Solar PV good									VH or H
Solar PV aver.									

Combining Relevant Factors by Resource Type

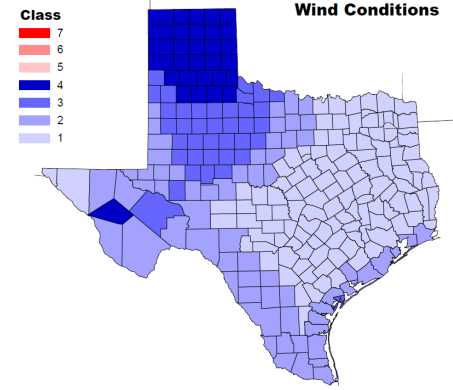
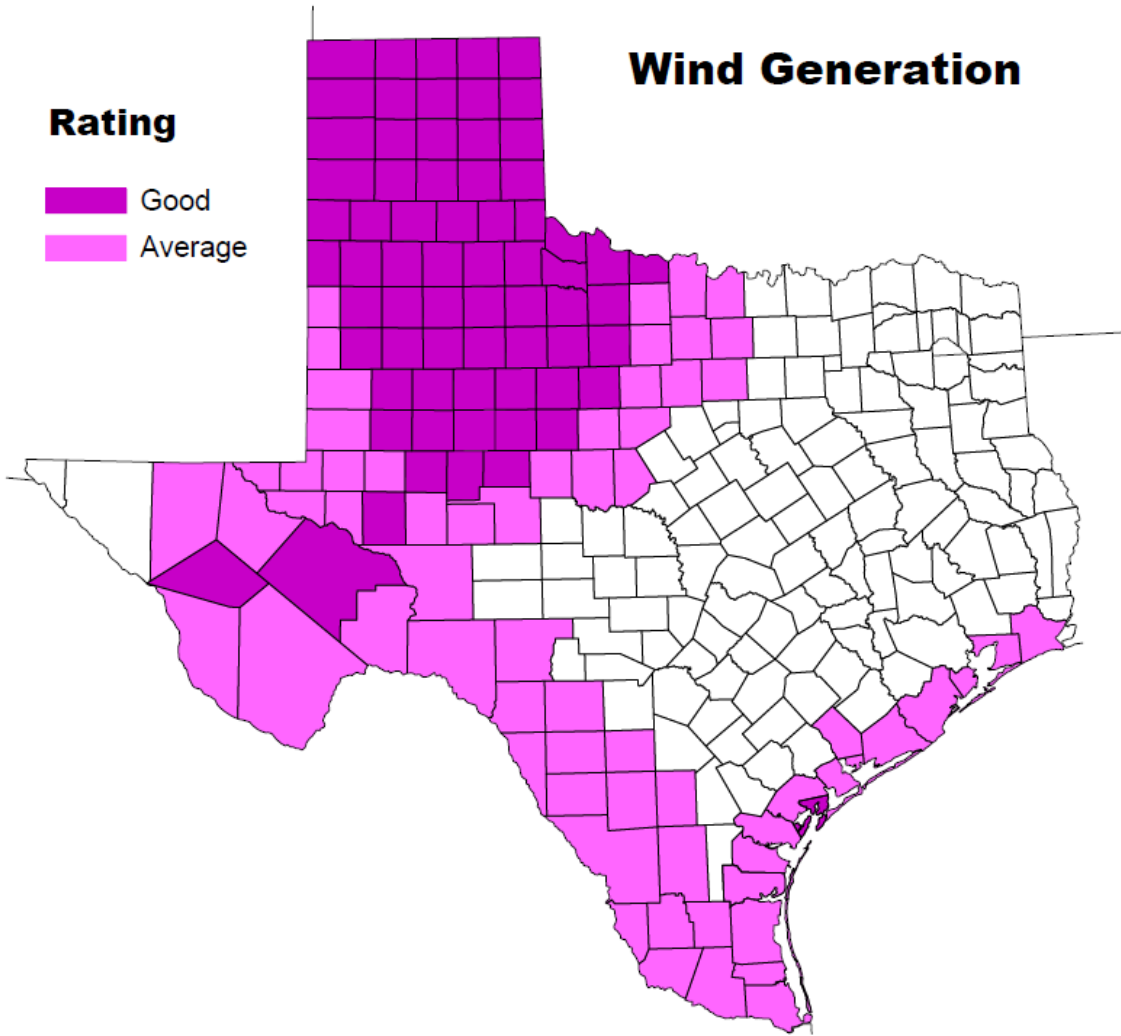
The following slides depict the combinations of relevant factors by resource type

Combined Factors for Wind Generation

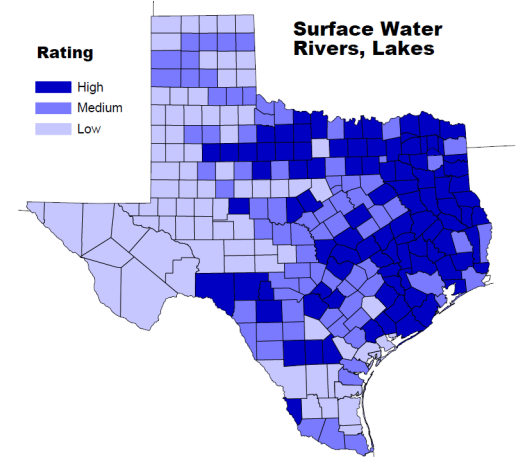
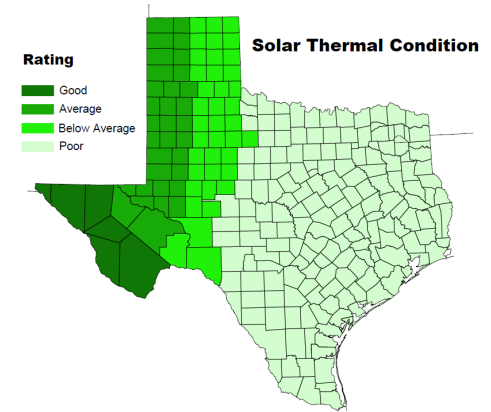
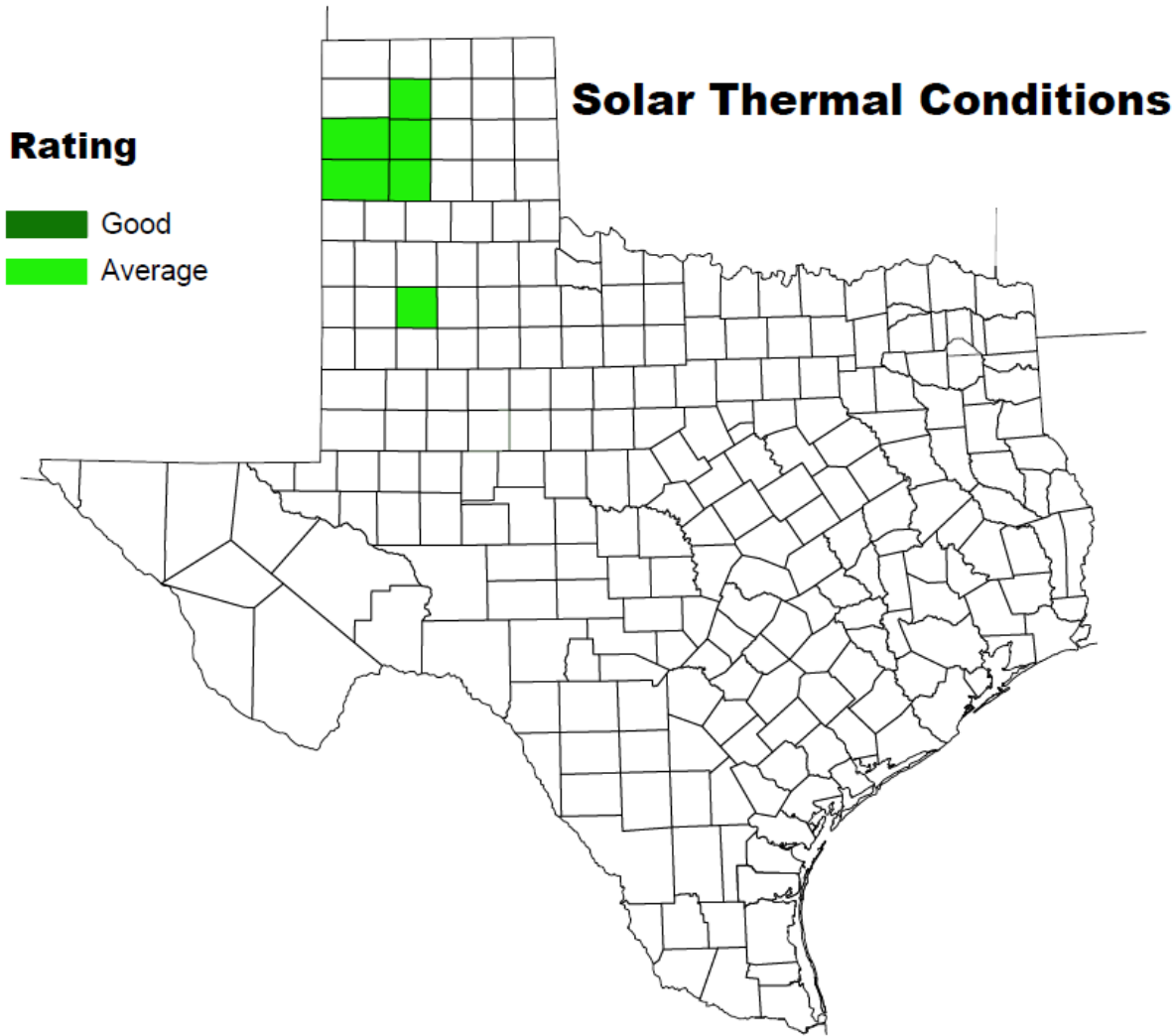
Wind Generation

Rating

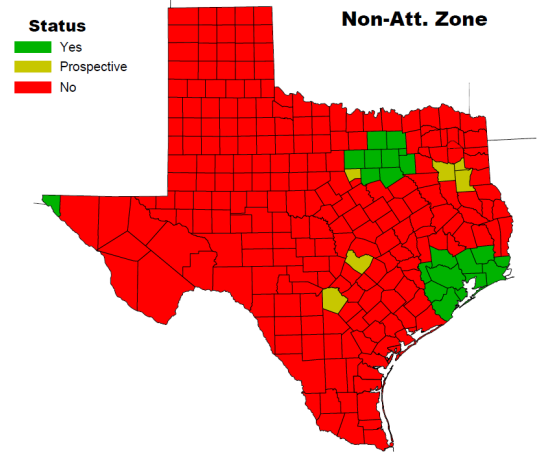
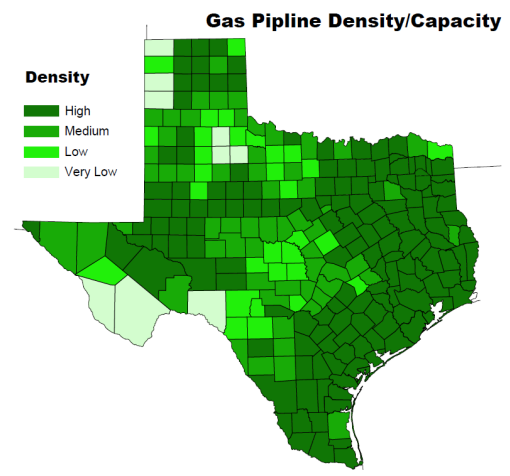
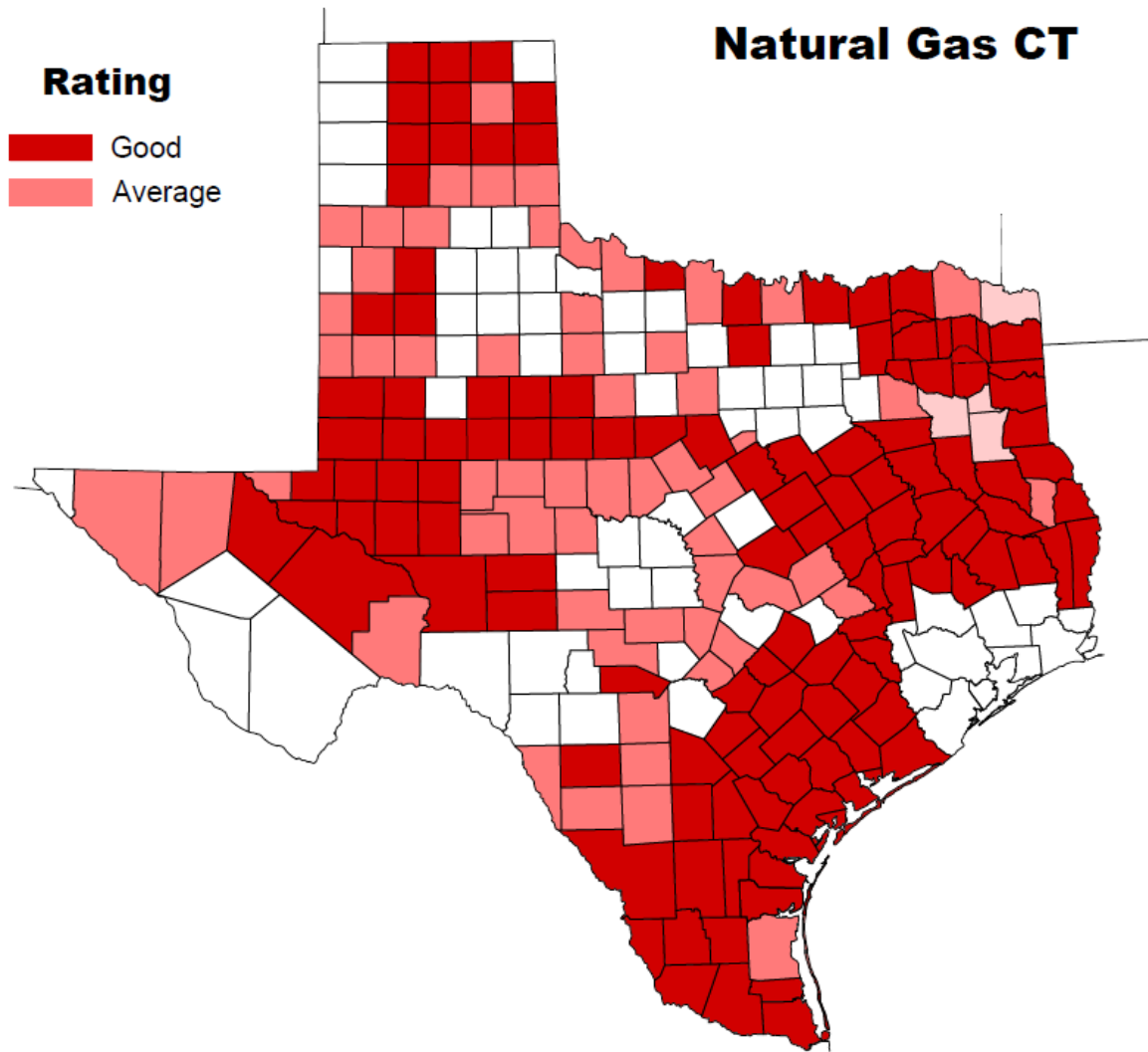
- Good
- Average



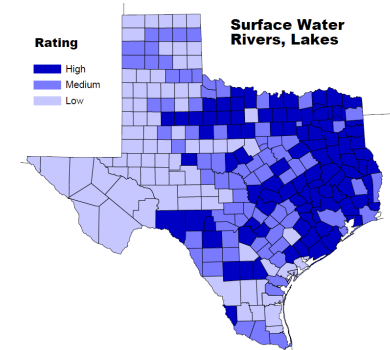
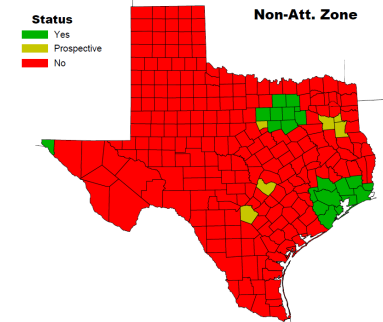
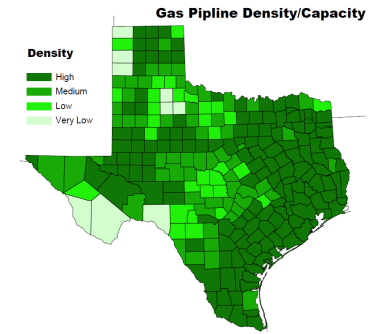
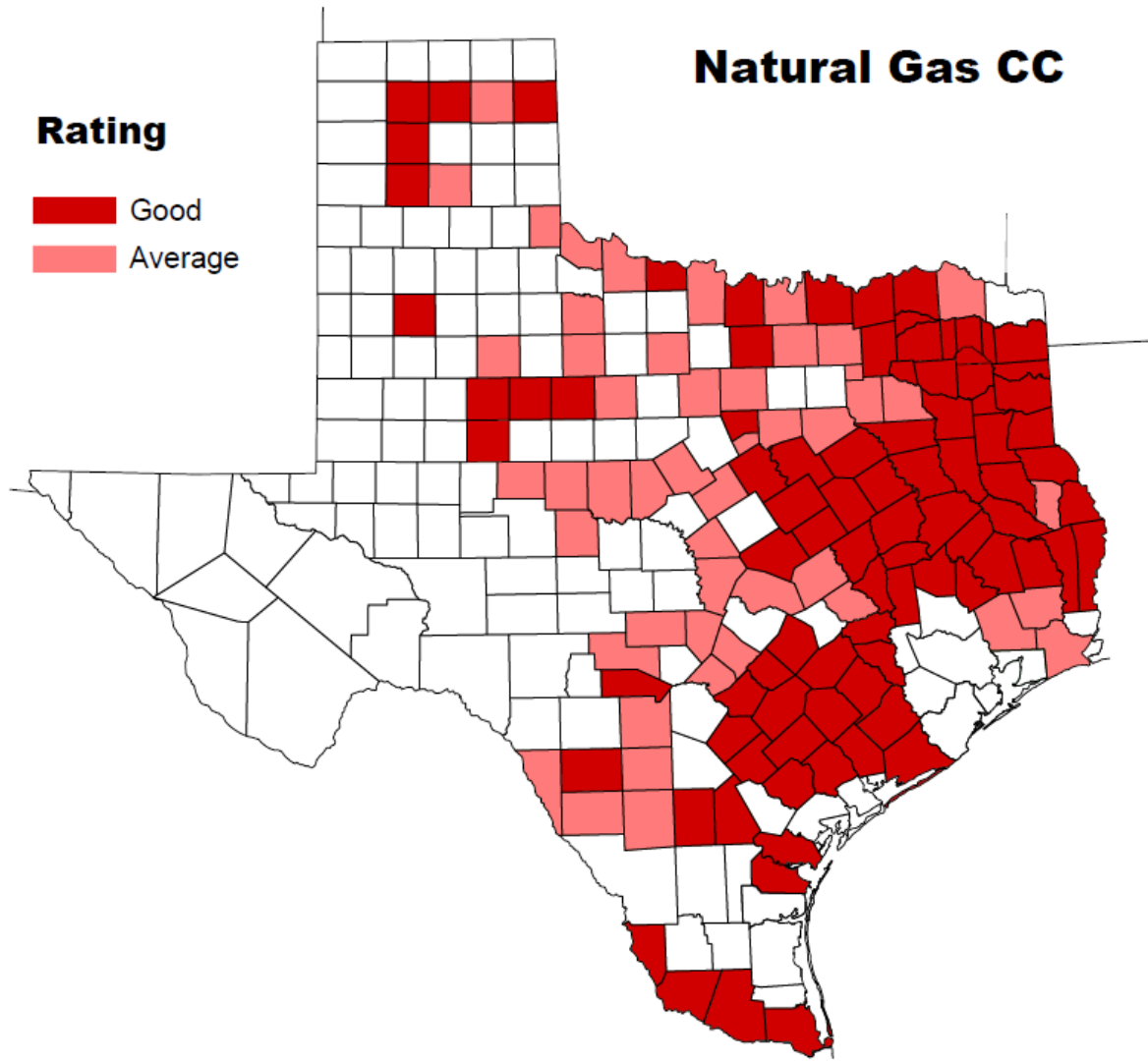
Combined Factors for Solar Thermal Facilities



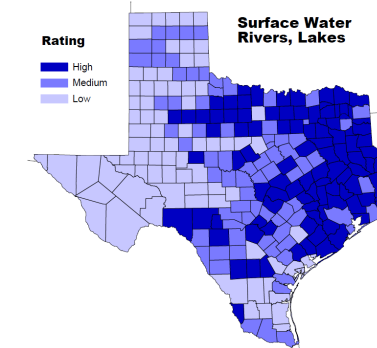
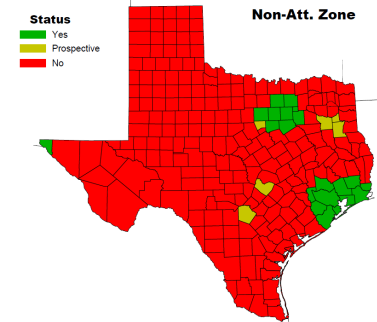
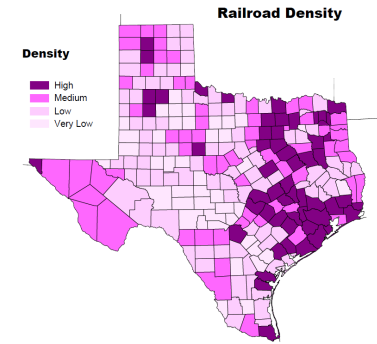
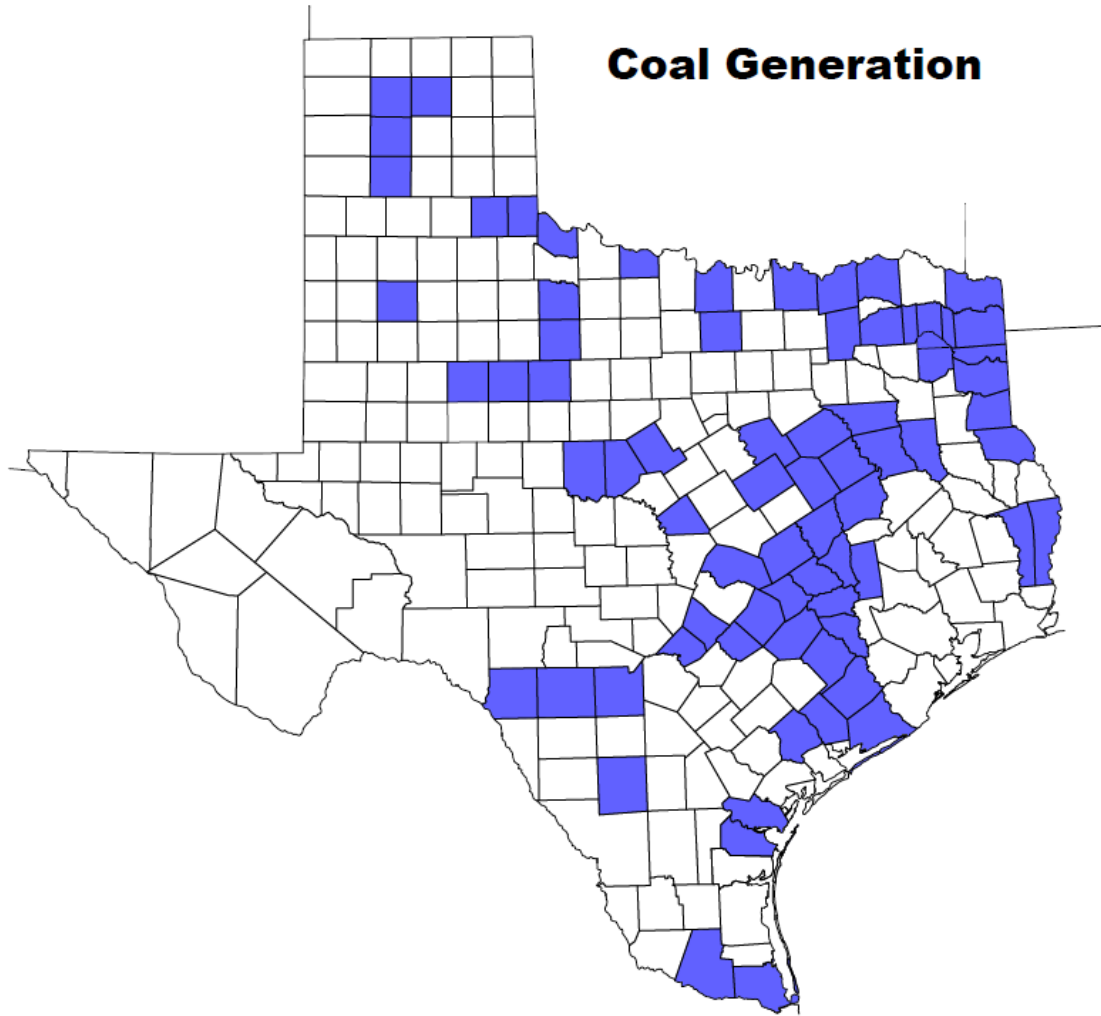
Combined Factors for Natural Gas Combustion Turbine Facilities



Combined Factors for Natural Gas Combined Cycle Facilities

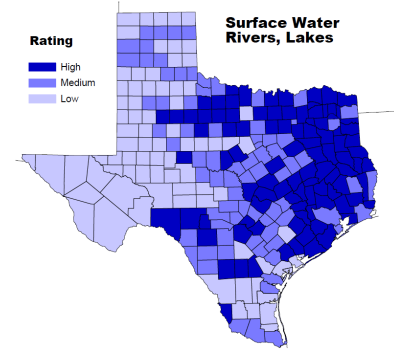
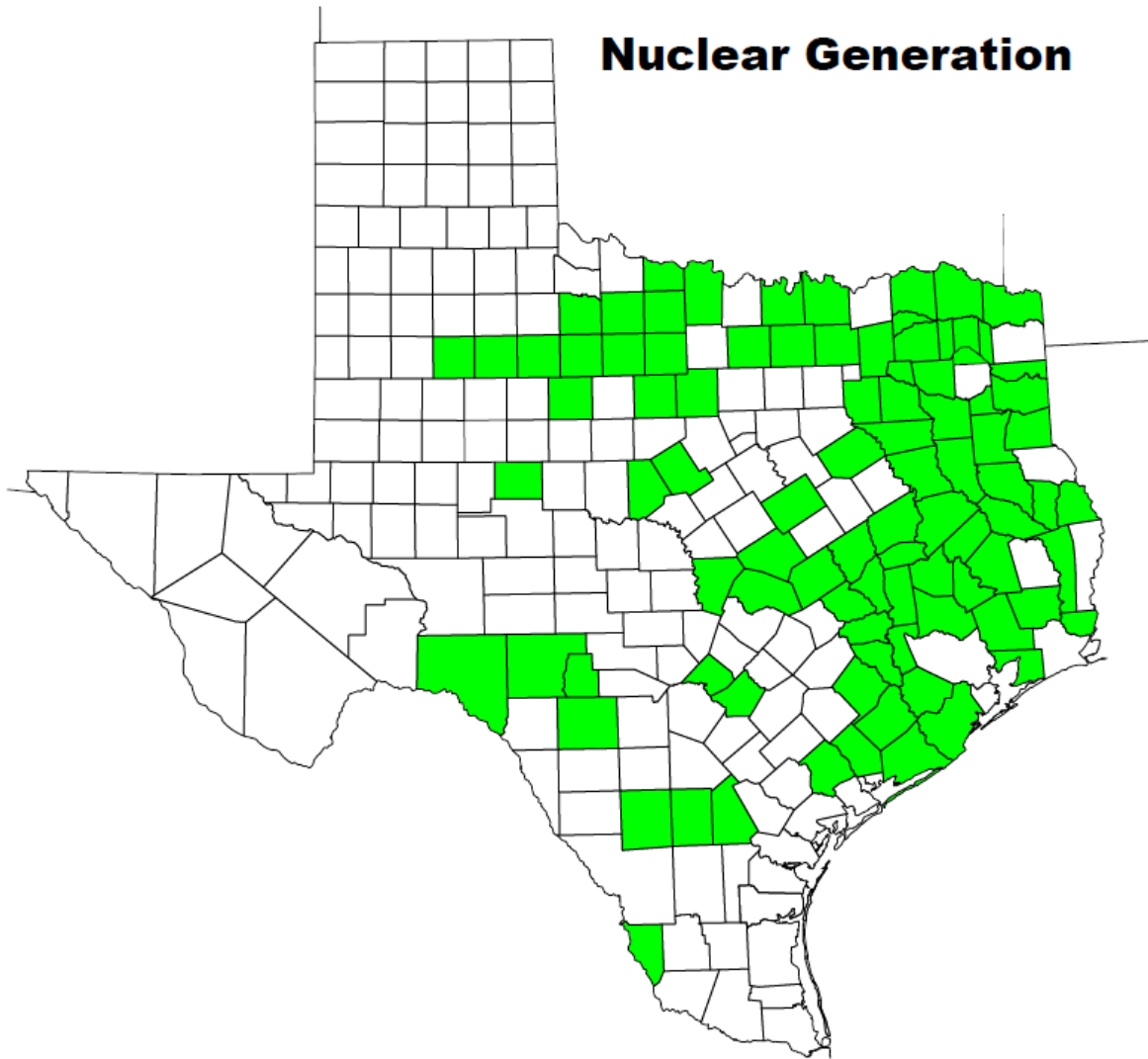


Combined Factors for Coal Generation Facilities



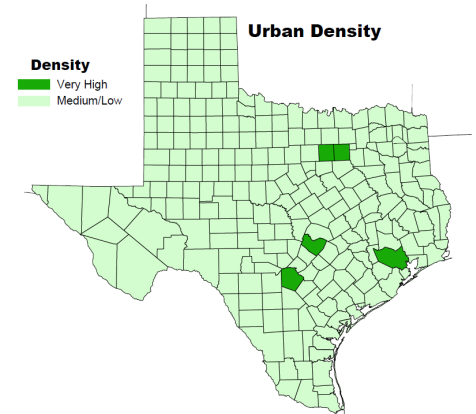
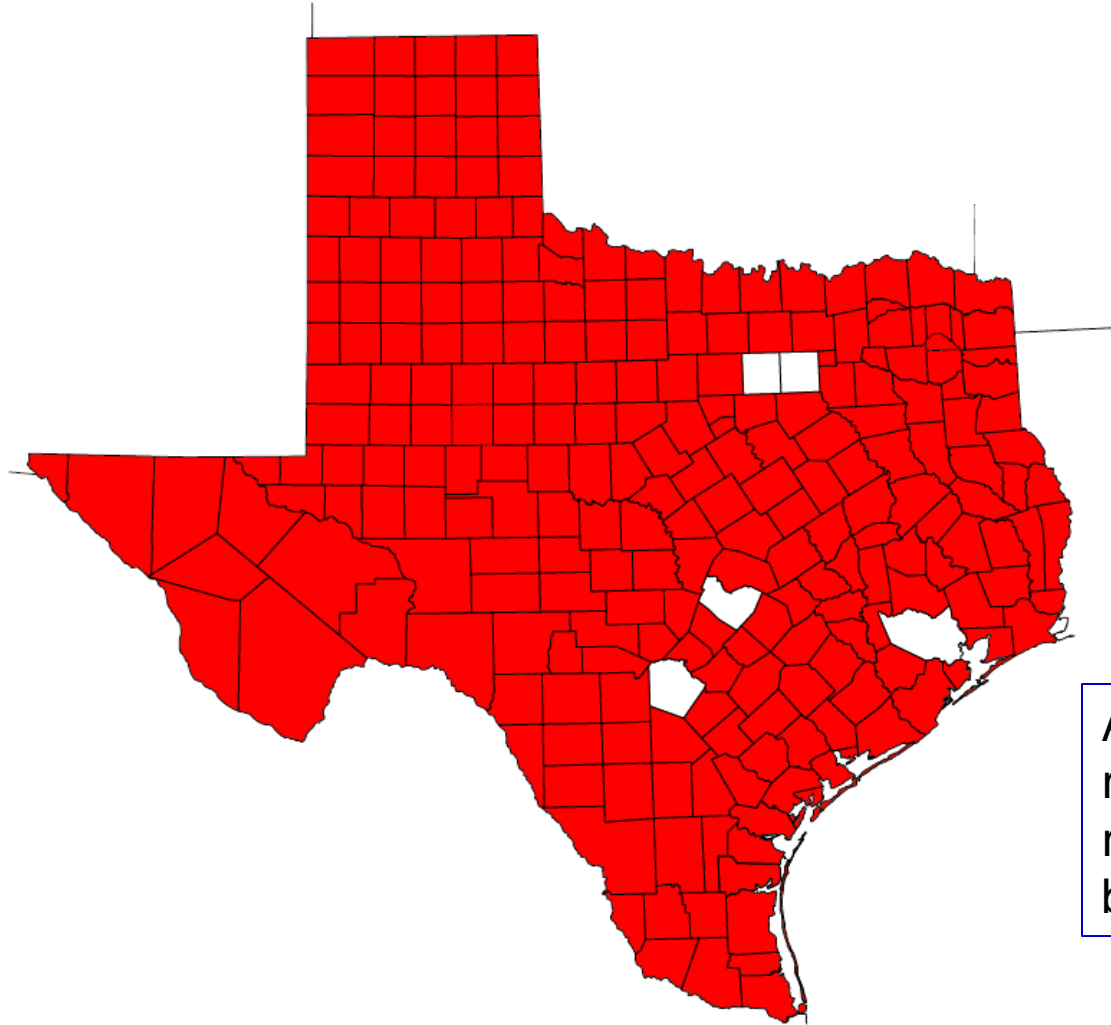
Combined Factors for Nuclear Generation Facilities

Nuclear Generation



Combined Factors for Geo-Thermal Facilities

Geo-Thermal Generation



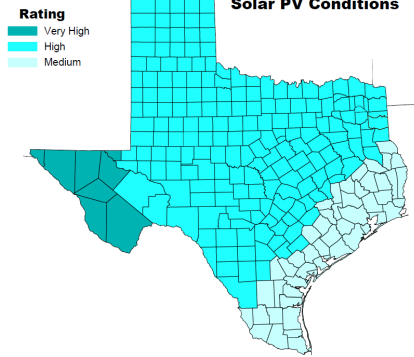
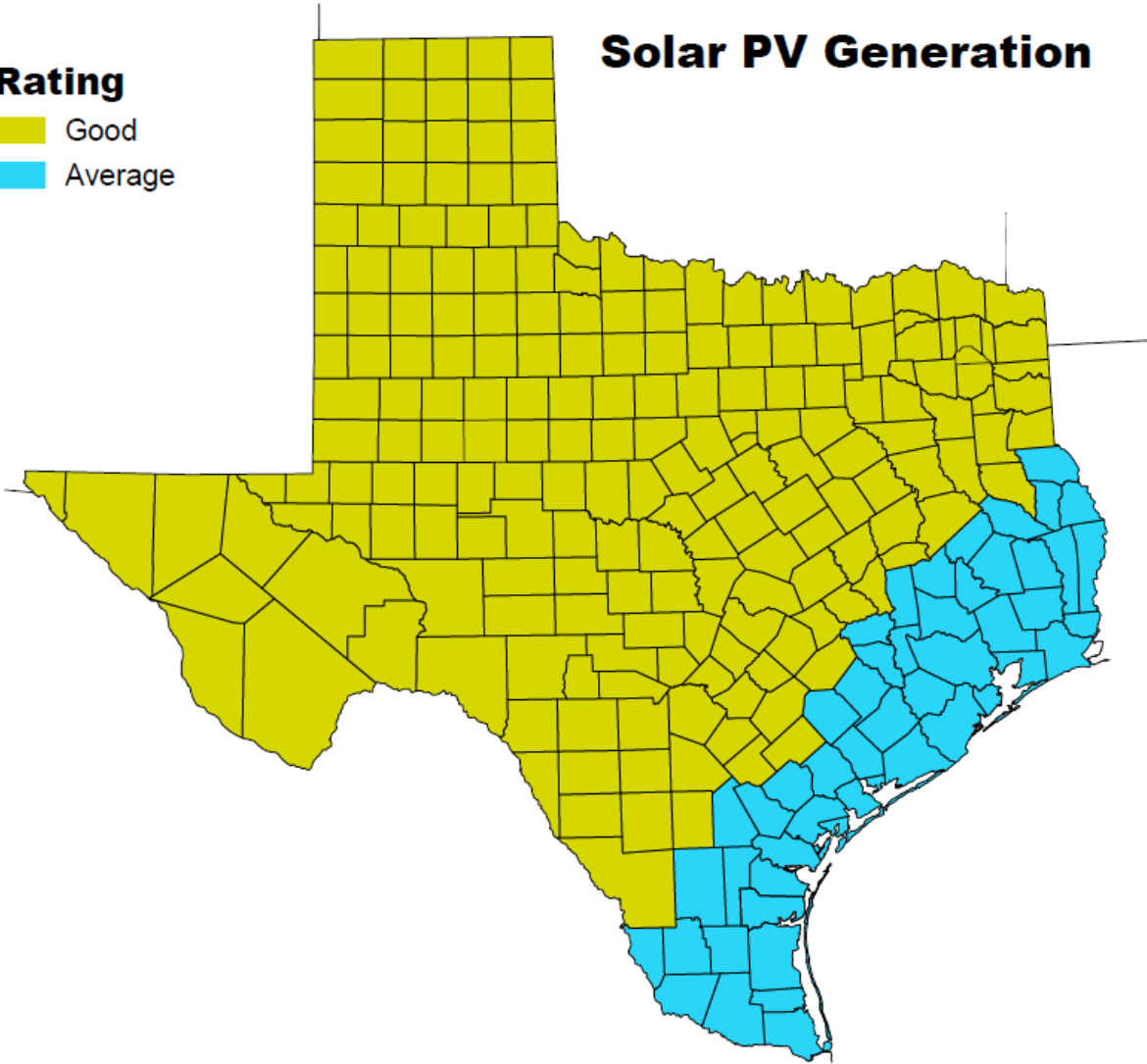
Additional analysis regarding geothermal resources in Texas is being conducted

Combined Factors for Solar PV Facilities

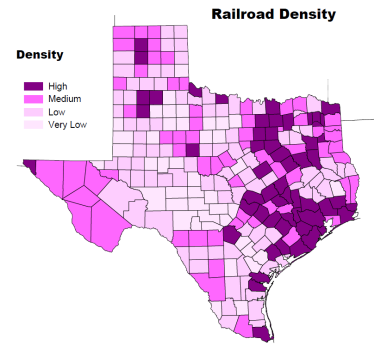
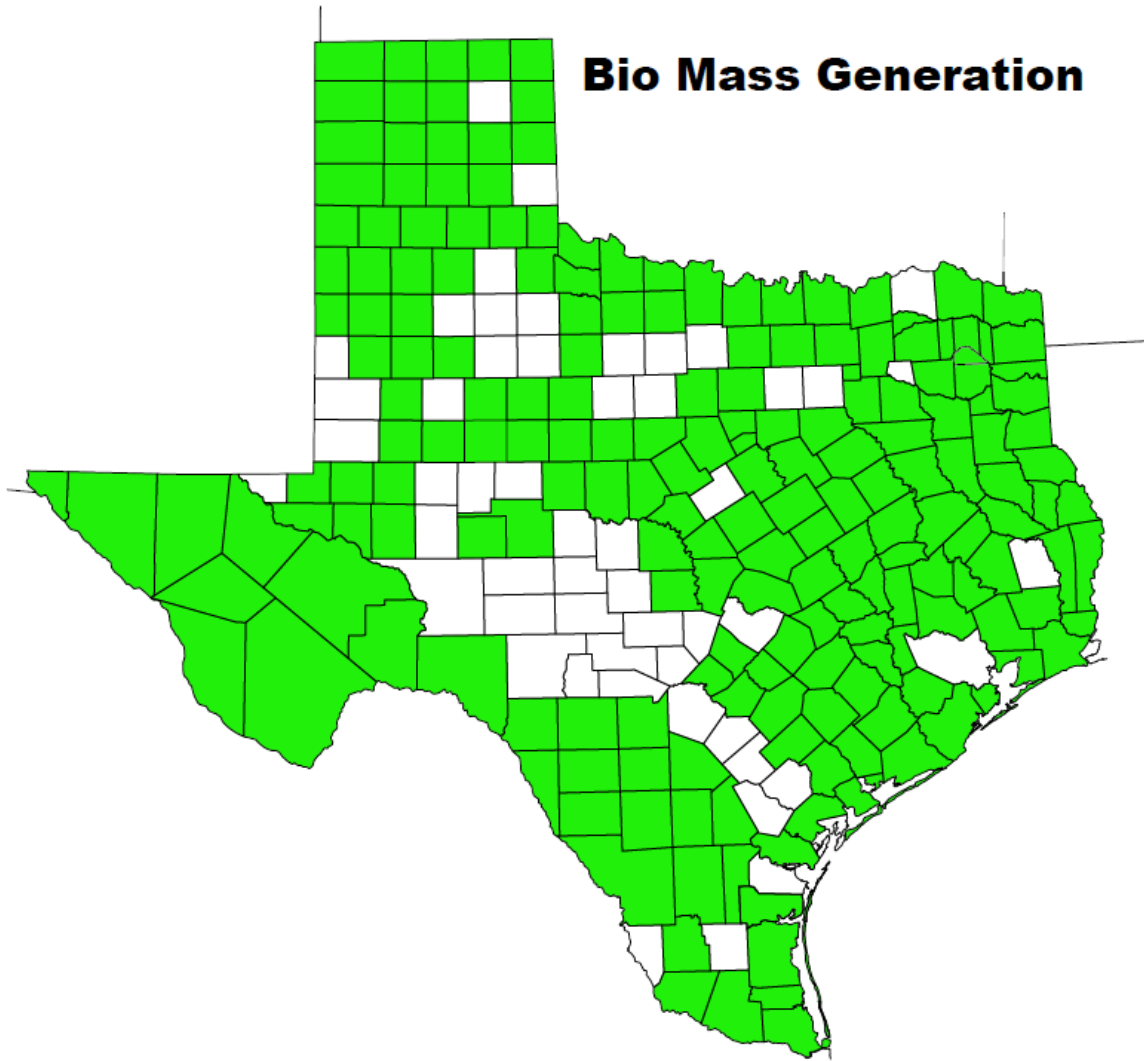
Solar PV Generation

Rating

- Good
- Average



Combined Factors for Bio-mass Generation Facilities



Siting Results from Counties Perspective

Generation Type	No. of Texas Counties fulfilling Gen. Type Req.	Percentage of Texas Counties fulfilling Gen. Type Req.
Wind good	68	26.77%
Wind aver.	132	51.97%
Solar Thermal good	0	0.00%
Solar Thermal aver.	6	2.36%
NG CT good	128	50.39%
NG CT aver.	186	73.23%
NG CC good	105	41.34%
NG CC aver.	144	56.70%
Coal	74	29.13%
Biomass	115	45.28%
Nuclear	93	36.61%
Geo-Thermal	249	98.03%
Solar PV good	205	80.71%
Solar PV average	254	100.00%

Siting Results from Buses Perspective

Generation Type	No. of 345kV* Buses in Counties fulfilling Gen. Type Req.	County Span** of 345kV Buses from Column 1
Wind good	76	27
Wind aver.	127	48
Solar Thermal good	0	0
Solar Thermal aver.	1	1
NG CT good	148	57
NG CT aver.	196	76
NG CC good	142	53
NG CC aver.	175	66
Coal	85	39
Biomass	151	57
Nuclear	100	38
Geo-Thermal	260	92
Solar PV good and aver.	333	103

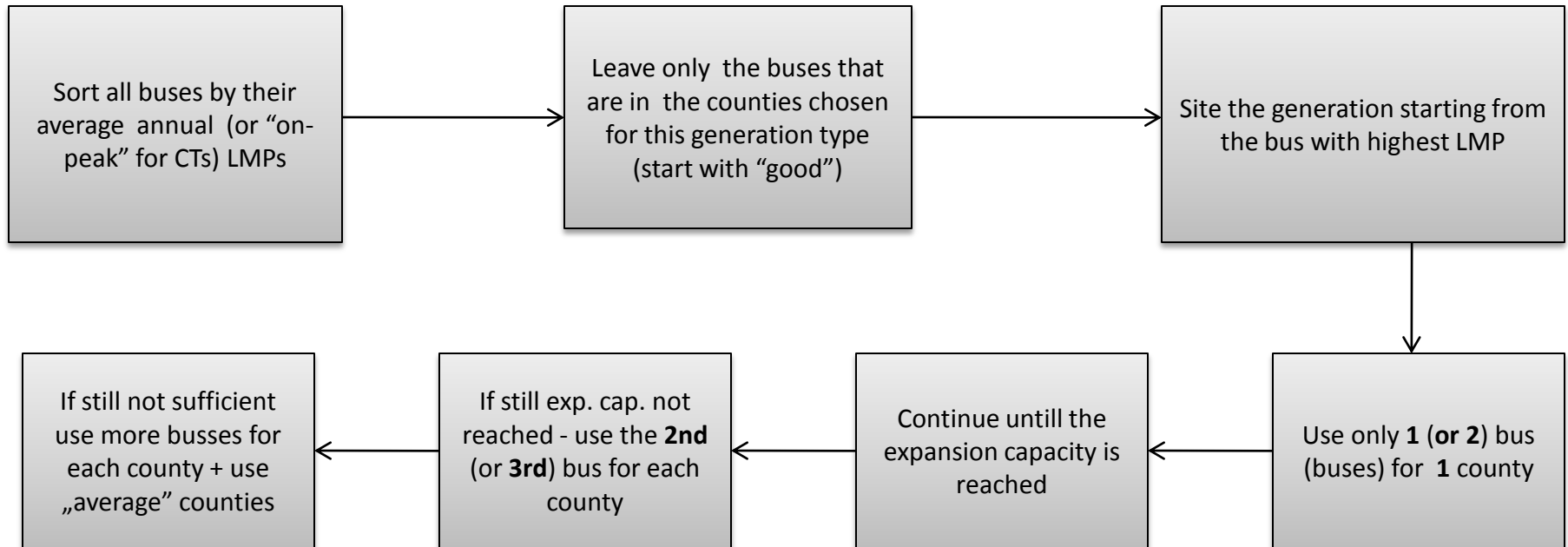
* there are total of 333 345 kV buses in the simplified topology

** 345kV buses span over 103 counties, 138kV over 169 counties, all buses over 197

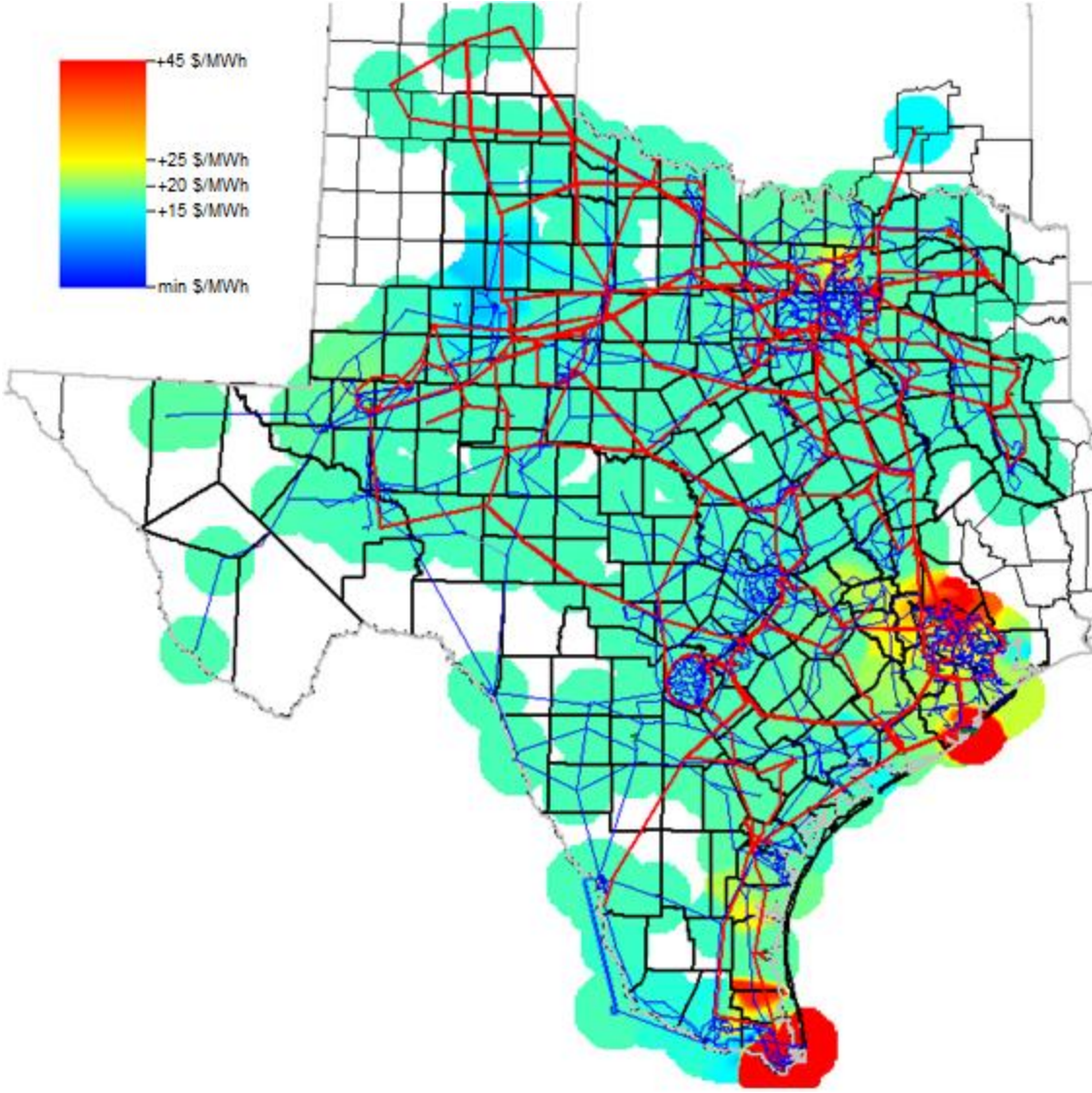
Generic Generation Type Capacities to be Sited

Category	Unit Name	Max Capacity [MW]
CC-F Class	Conventional Combined Cycle-F Type	500
CC-G&H Class	Advanced Combined Cycle-H/G Type	400
CT-F Class	Conventional Combustion Turbine-F Type	170
CT-LMS100	Advanced Combustion Turbine-LMS100	100
Coal	Supercritical Coal	600
Coal	Supercritical Coal with CCS	625
Coal	IGCC	625
Coal	IGCC with CCS	539
Nuclear	Nuclear	1100
Biomass	Biomass	40
Wind	Wind Onshore	100
Solar PV	Solar PV	100
Solar Thermal	Solar Thermal	250

Siting Methodology from County to Bus level



Average LMPs for Preliminary 2013 Case



On Peak Average LMPs for Preliminary 2013 Case

