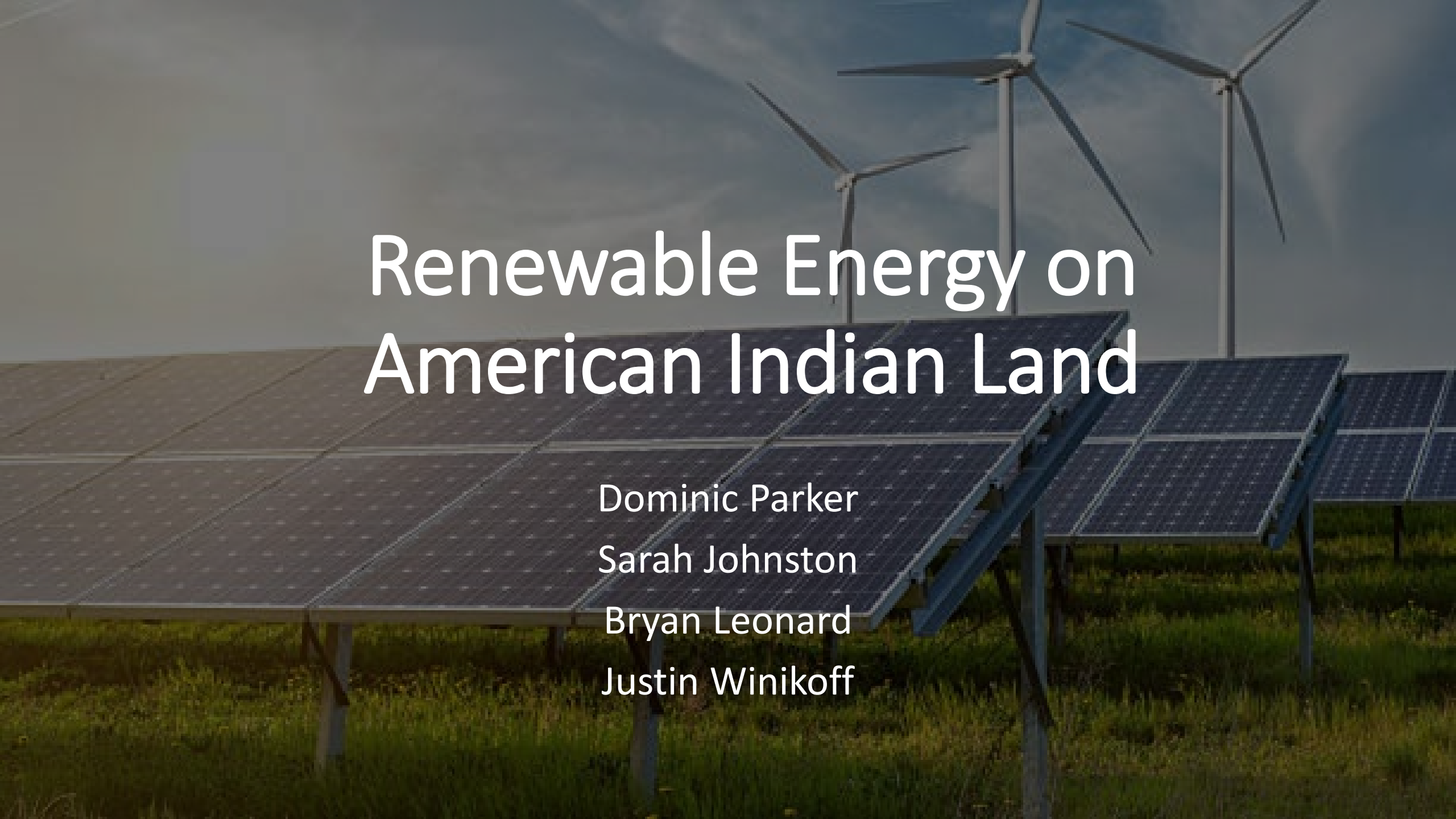

Renewable Energy on American Indian Land

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Sarah Johnston
Bryan Leonard
Justin Winikoff

HOOVER INSTITUTION

RENEWING INDIGENOUS ECONOMIES

A PROJECT FROM THE HOOVER INSTITUTION

Motivation & Questions

- Native Americans on reservations are America's poorest
- Stems, in part, from historical policies that appropriated and/or locked up land & natural resources
- Will the future play out differently wrt to renewable energy?
- Can wind and solar provide economically meaning development?

Approach

1) Measure endowments
   - Compare with off-reservation sites
   - Correlate with reservation poverty

2) Estimate “disparity” in realized potential vs. neighboring land

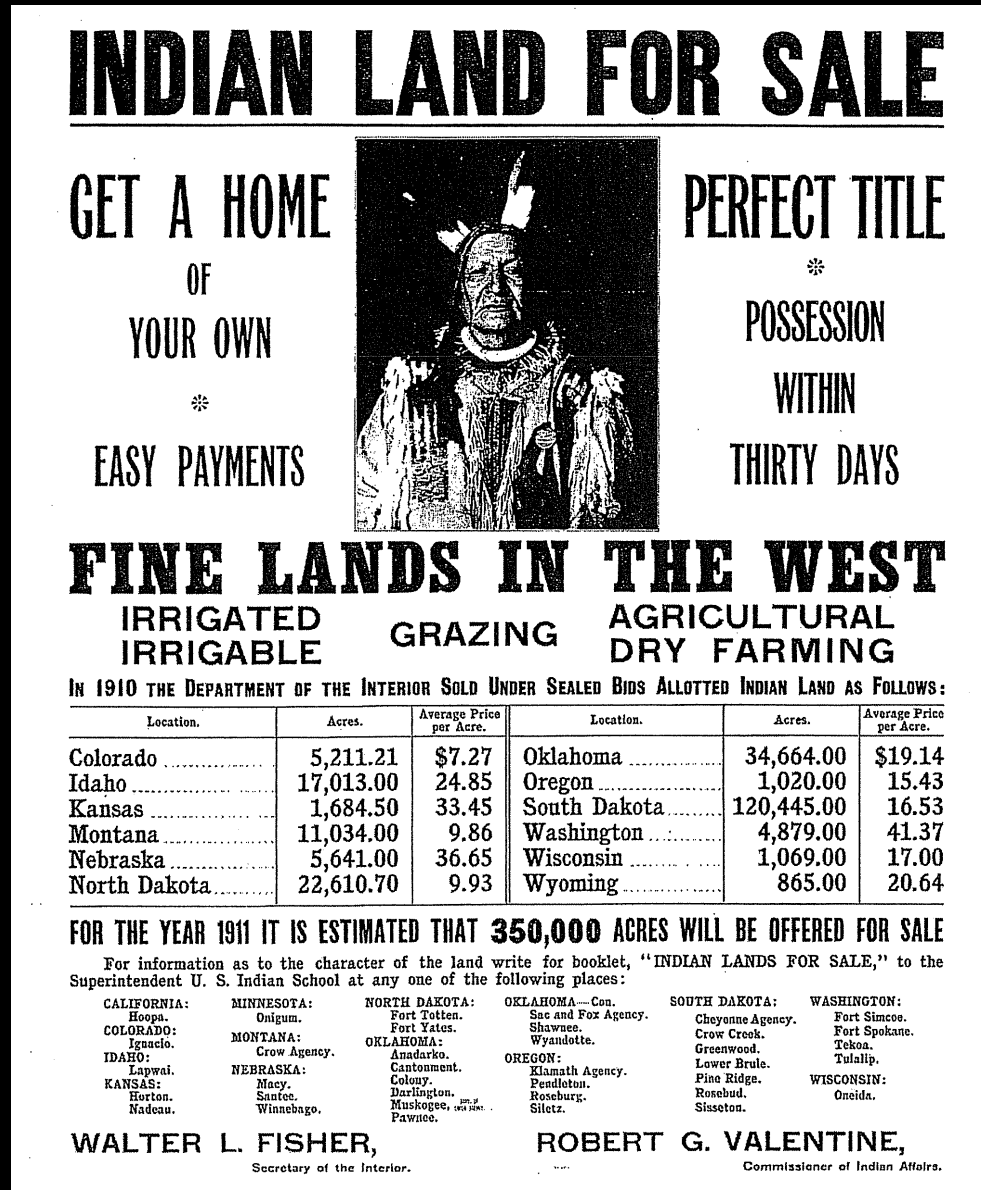
3) Forecast future losses if disparity persists through 2050

4) Identify obstacles to realizing potential/eliminating disparity

Part 1:
Evaluating Renewable Endowments

Traditional Resource Endowments

- Tribes relocated from gold and silver deposits (Dippel 2014)
- Prime agricultural lands declared surplus, privatized, sold (Leonard, Parker, Anderson 2020)
- Compared to rest of US, present day reservations have less minerals and oil and gas (Farrell et al. 2021)



INDIAN LAND FOR SALE

GET A HOME OF YOUR OWN

EASY PAYMENTS

PERFECT TITLE

POSSESSION WITHIN THIRTY DAYS

FINE LANDS IN THE WEST

IRRIGATED IRRIGABLE GRAZING AGRICULTURAL DRY FARMING

IN 1910 THE DEPARTMENT OF THE INTERIOR SOLD UNDER SEALED BIDS ALLOTTED INDIAN LAND AS FOLLOWS:

Location.	Acres.	Average Price per Acre.	Location.	Acres.	Average Price per Acre.
Colorado	5,211.21	$7.27	Oklahoma	34,664.00	$19.14
Idaho	17,013.00	24.85	Oregon	1,020.00	15.43
Kansas	1,684.50	33.45	South Dakota	120,445.00	16.53
Montana	11,034.00	9.86	Washington	4,879.00	41.37
Nebraska	5,641.00	36.65	Wisconsin	1,069.00	17.00
North Dakota	22,610.70	9.93	Wyoming	865.00	20.64

FOR THE YEAR 1911 IT IS ESTIMATED THAT **350,000** ACRES WILL BE OFFERED FOR SALE

For information as to the character of the land write for booklet, "INDIAN LANDS FOR SALE," to the Superintendent U. S. Indian School at any one of the following places:

CALIFORNIA:
Hoopa.
COLORADO:
Ignacio.
IDAHO:
Lapwai.
KANSAS:
Horton.
Nadeau.

MINNESOTA:
Onigum.
MONTANA:
Crow Agency.
NEBRASKA:
Macy.
Santee.
Winnebago.

NORTH DAKOTA:
Fort Totten.
Fort Yates.
OKLAHOMA:
Anadarko.
Cantonment.
Colony.
Darlington.
Muskogee,
Pawnee.

OKLAHOMA—Con.
Sac and Fox Agency.
Shawnee.
Wyandotte.
OREGON:
Klamath Agency.
Pendleton.
Roseburg.
Siletz.

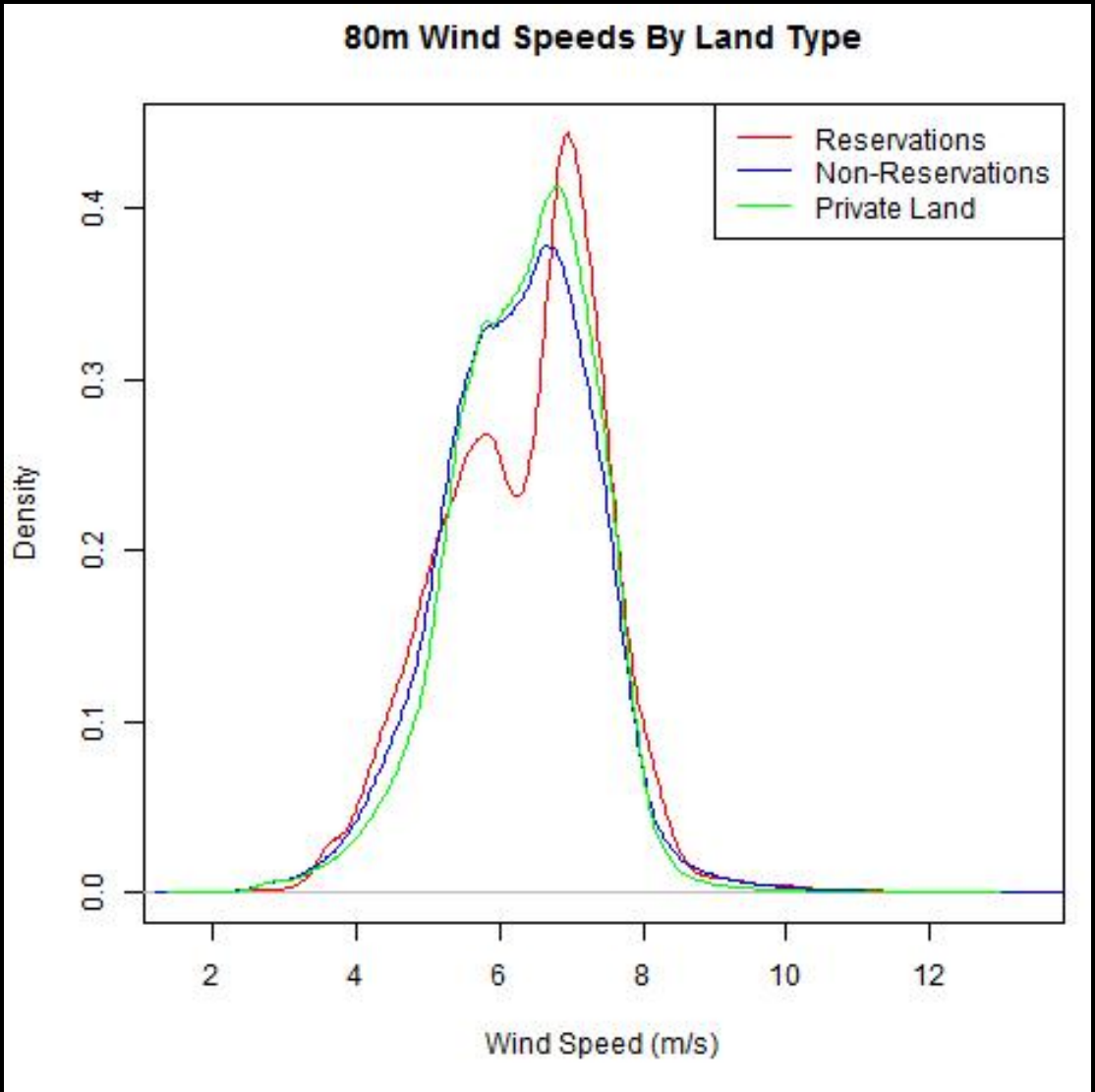
SOUTH DAKOTA:
Cheyenne Agency.
Crow Creek.
Greenwood.
Lower Brule.
Pine Ridge.
Rosebud.
Sisseton.

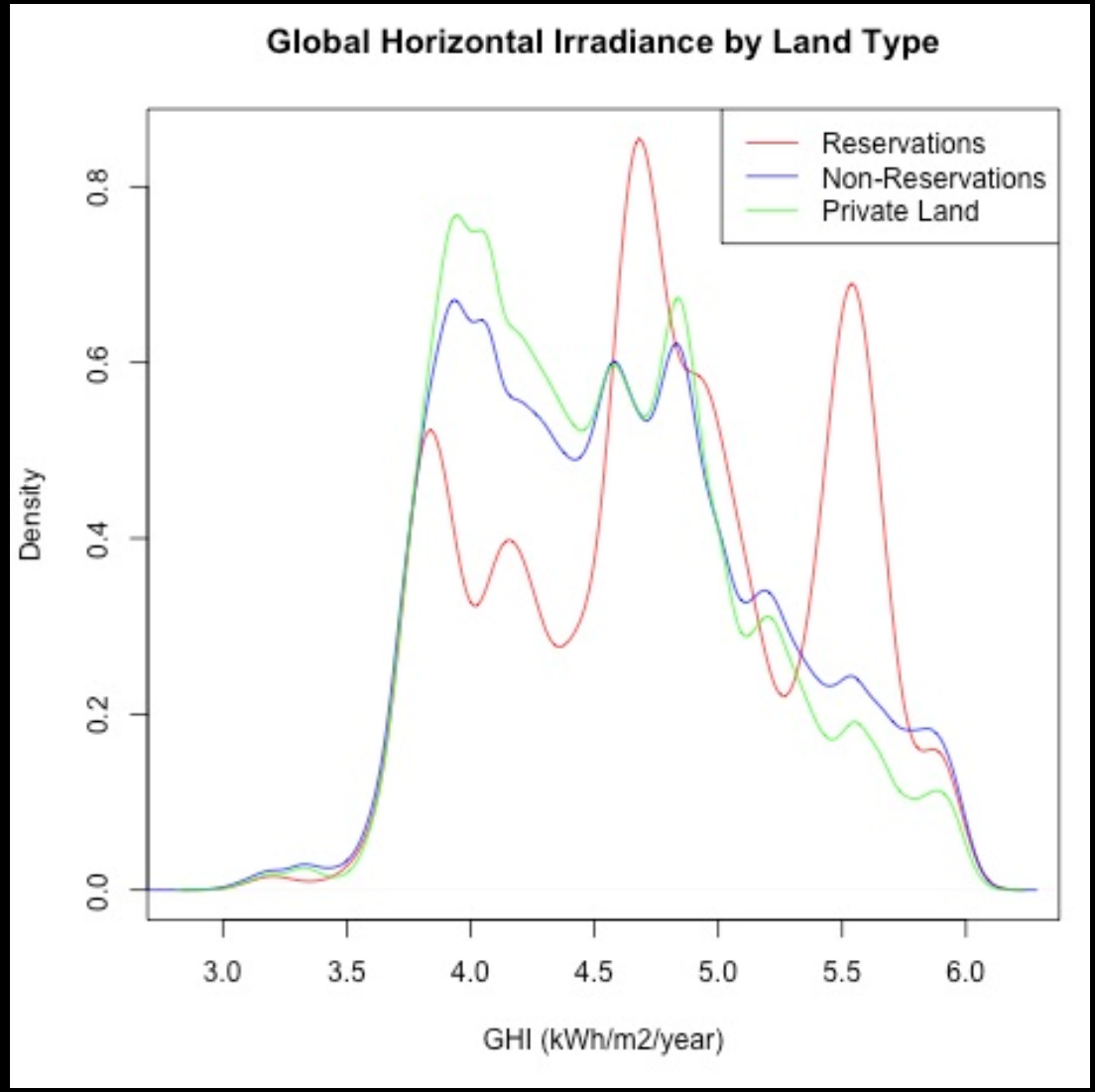
WASHINGTON:
Fort Simcoe.
Fort Spokane.
Tekoa.
Tulalip.
WISCONSIN:
Oneida.

WALTER L. FISHER,
Secretary of the Interior.

ROBERT G. VALENTINE,
Commissioner of Indian Affairs.

What about Renewables?





Notes: Wind speeds are calculated using data from the National Renewable Energy Laboratory (NREL) and solar PV potential data come from the Global Solar Atlas. Wind speeds greater than 6.5 m/s are considered viable (Center for Sustainable Systems, 2021).

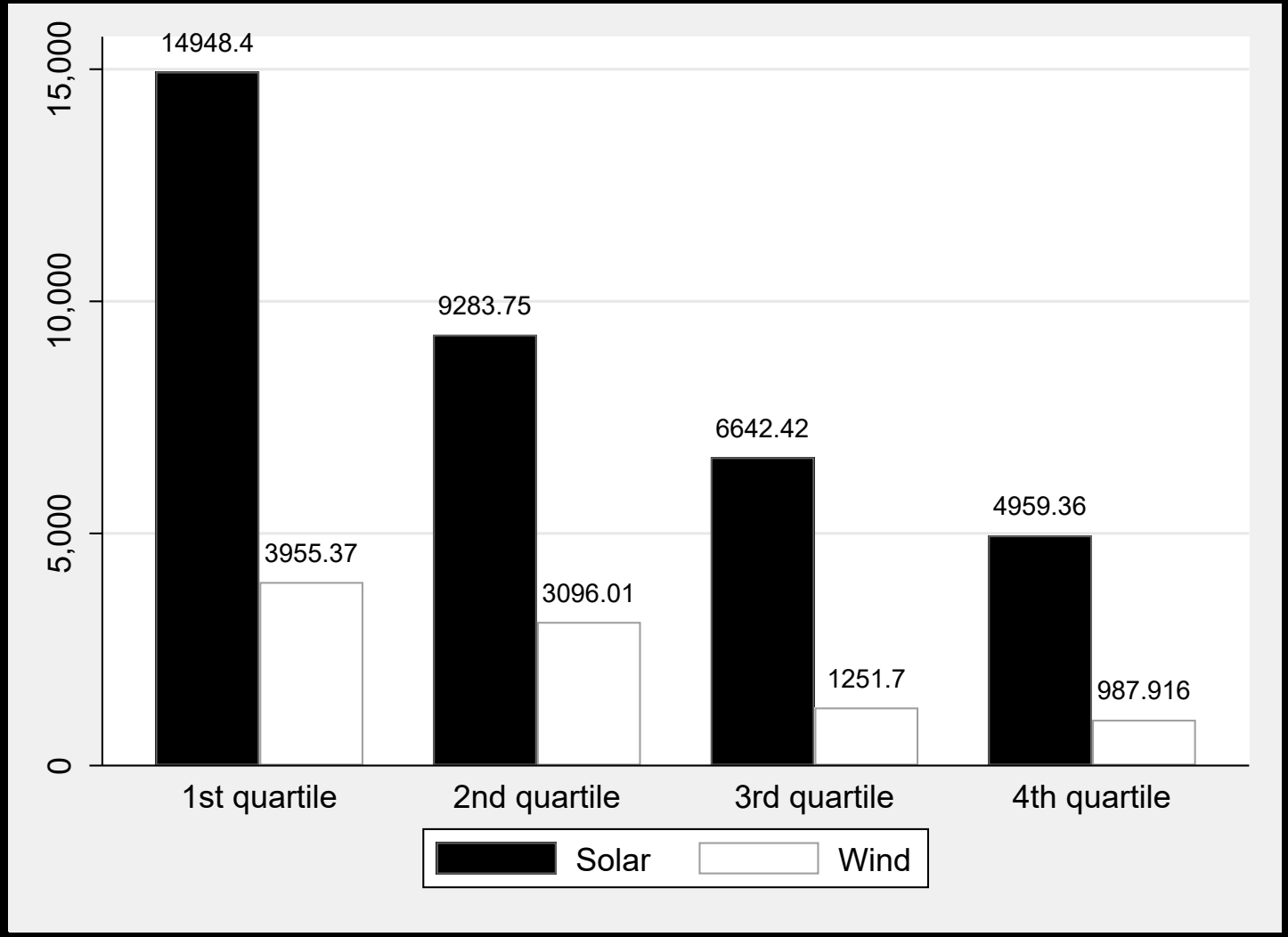
Complementary Endowment Measure

~ 9.0% of wind energy potential

~ 5.0% of utility scale photovoltaic potential

Source: Milbrandt et al. 2018. Techno-Economic Renewable Energy Potential on Tribal Lands. *National Renewable Energy Laboratory Technical Report*. NREL/TP – 6A20-7087.

Mean Endowments by Income Quartile



Notes: The graph shows that mean solar and wind endowments are declining in mean per capita income on reservation, indicating that poorer reservations are better endowed with renewables. The number of observations are N = 69 reservations in each income quartile. The lowest income quartile is for American Indian per capita income less than $12,952 in 2018; the 2nd quartile is for income between $12,952 and $16,064; the 3rd quartile is for income between $16,064 and $20,528; the 4th quartile is for income greater than $20,528. The vertical axis shows the "potential capacity" (in kilowatt hours) on the reservation and adjacent trust lands (based on Milbrandt et al. 2018) divided by the American Indian population in 2018.

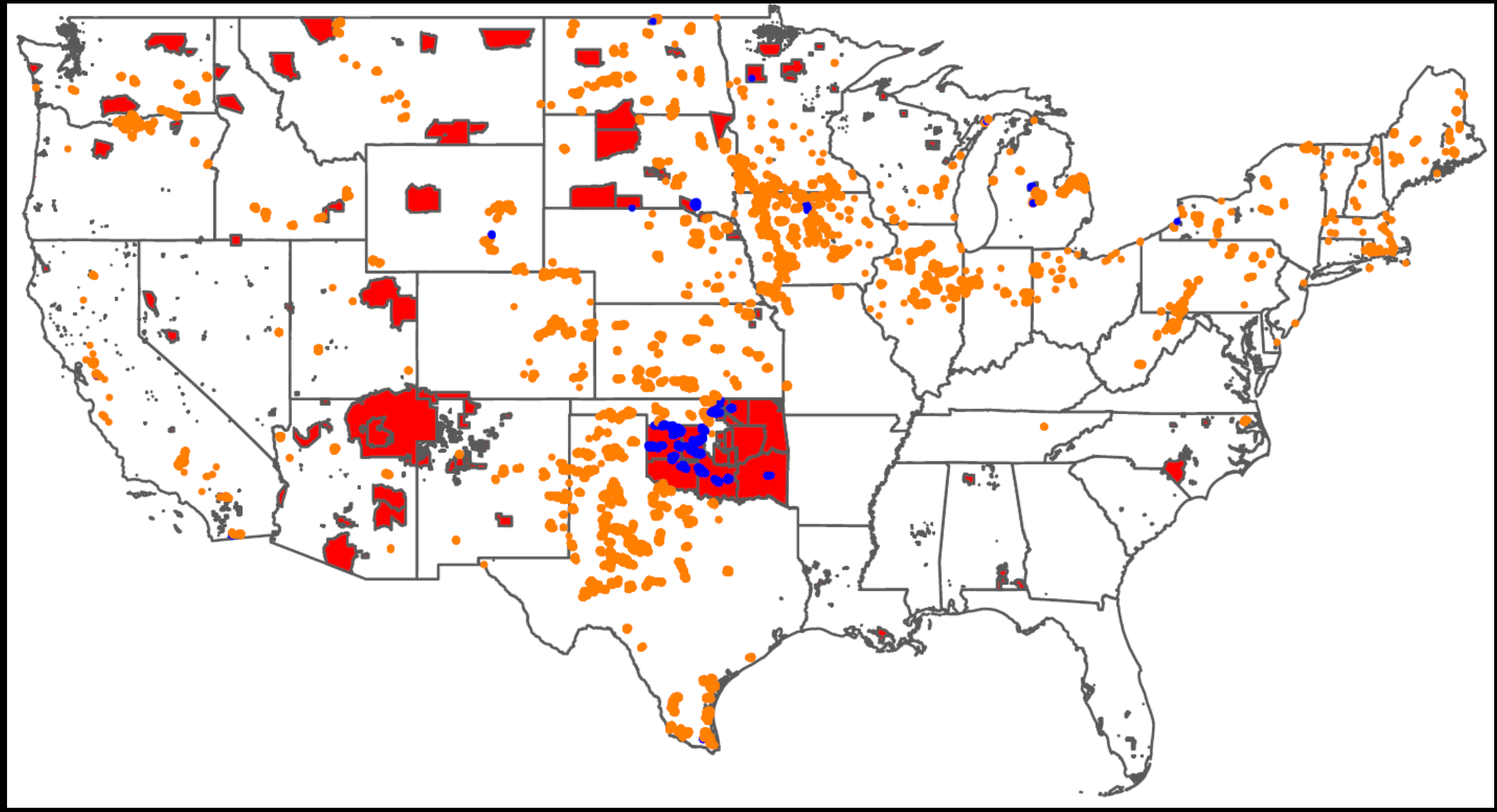
Qualifications on Endowments

- Not all technically feasible capacity is economically feasible
  - Utility-scale potential must account for the costs required to sell the electricity.
  - Costs are sensitive to the availability of transmission lines

- Example: Navajo Nation solar projects
  - Decommissioned coal plant established network of transmission lines
  - Similar for water dam projects on or near reservations

Part 2:
Realized Potential vs. Neighboring Land

Commercial Wind Farms



Notes: The orange dots indicate the presence of installed commercial wind capacity off reservation areas and the blue dots show the location on reservation areas. There were 68,792 turbines as of April 2021.

Summary Stats – Part 1

Statistic	Mean	Min	Max
Wind Capacity (MW)	1.050	0	1,446
=1 if Any Turbines	0.020	0	1
Solar Capacity (MW)	0.560	0	949
=1 if Any Solar Farm	0.017	0	1
Share Reservation	0.033	0	1
Share Public Land	0.379	0	1
Mean Wind Speed	6.156	1.823	12.65
Solar Potential (kWh/kWp)	1,648	952.3	2,123
Km Transmission (2017)	6.508	0	195.1
Dist. To 2017 Trans. Lines (km)	12.68	0	131.0

Notes: The full sample size of townships is N = 86,466.

Summary Stats – Part 2

Statistic	Mean	Min	Max
Airports	0.101	0	5
Share Developed	0.042	0	1
Share Barren	0.016	0	1
Share Forest	0.210	0	1
Share Shrubland	0.314	0	1
Share Grassland	0.155	0	1
Share Cropland	0.152	0	1
Share Pasture	0.043	0	0.914
Share Wetlands	0.051	0	1
Share Water	0.016	0	1
Slope	2.502	0	37.24
Terrain Ruggedness Index	4.219	0	84.77

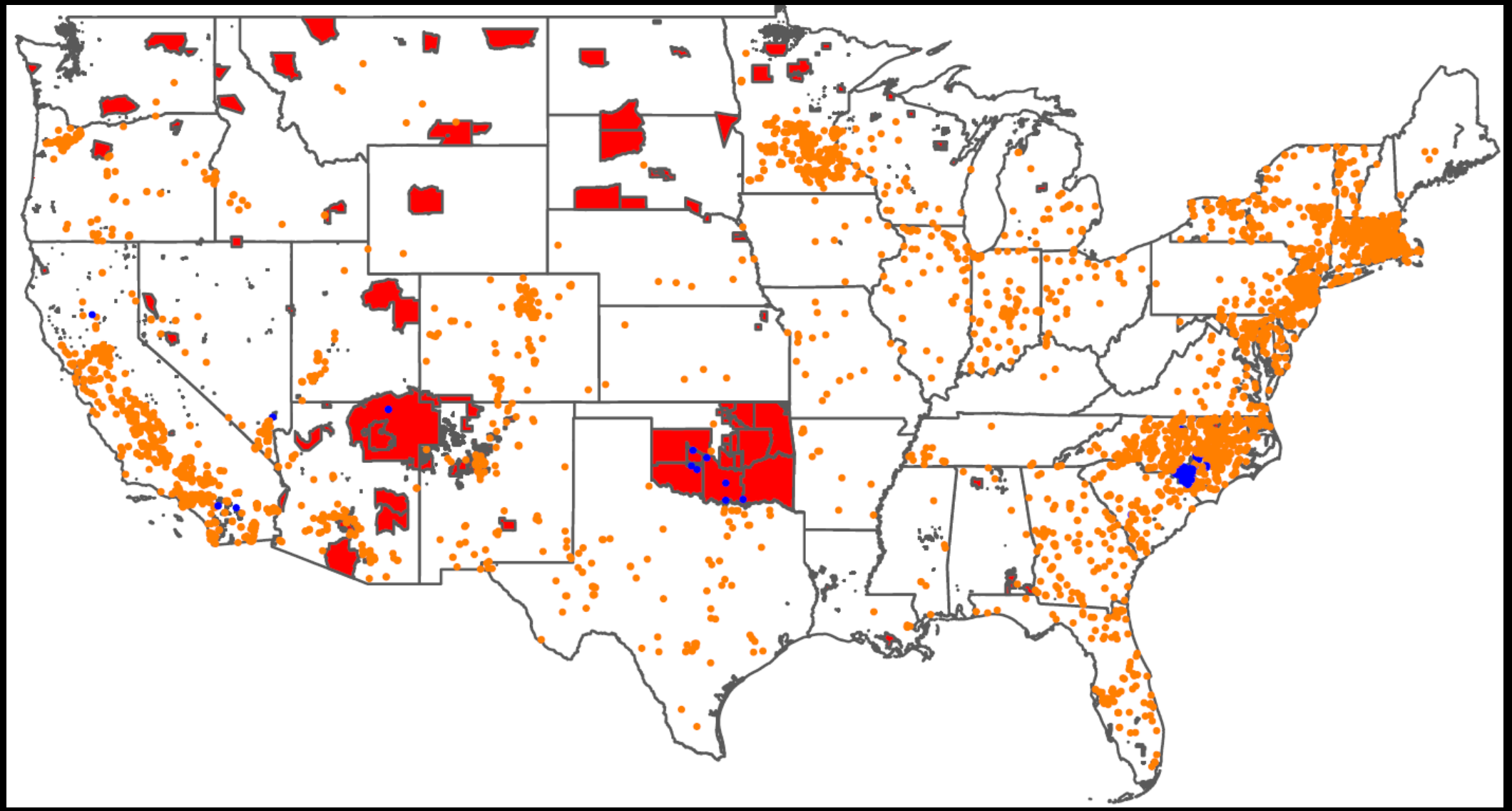
Note: The full sample size of townships is N = 86,466.

Predictors of Observed Wind Farm Capacity

	Y = Any Wind Farm			*Y = MW*		
	(1)	(2)	(3)	(4)	(5)	(6)
Share Reservation Land	-0.013***	-0.010**	-0.010**	-0.713***	-0.474**	-0.450**
	(0.004)	(0.004)	(0.004)	(0.265)	(0.222)	(0.219)
Share Public Land	-0.013***	-0.010***	-0.010***	-1.129**	-0.920*	-0.908*
	(0.003)	(0.003)	(0.003)	(0.555)	(0.555)	(0.505)
Mean Wind Speed	0.017***	0.018***	0.018***	1.734**	1.761**	1.763**
	(0.003)	(0.003)	(0.003)	(0.736)	(0.738)	(0.738)
Transmission Lines (km)		0.006***	0.005***		0.444***	0.426***
		(0.001)	(0.001)		(0.107)	(0.107)
Distance to Trans. (km)			-0.0001**			-0.004
			(0.0001)			(0.003)
Land Use Controls	x	x	x	x	x	x
Infrastructure Controls	x	x	x	x	x	x
County Fixed Effects	x	x	x	x	x	x
Observations (townships)	86,466	86,466	86,466	86,466	86,466	86,466
R^2	0.409	0.411	0.412	0.235	0.237	0.237
Mean of Dependent Variable	0.020	0.020	0.020	1.050	1.050	1.050

Notes: Robust standard errors, clustered by county, are in parentheses. * p<0.1, ** p<0.05, *** p<0.01. In Columns 1-3 the dependent variable is an indicator for whether or not a wind farm is present. In Columns 4-6, the dependent variable is the MW of installed capacity. The unit of observation is a township in all specifications.

Commercial Solar Farms



Notes: The orange dots indicate the presence of solar farms off reservation areas and the blue dots show the location on reservation areas. There are 4,203 solar farms that began operation in 2001-2020.

Predictors of Observed Solar Farm Capacity

	Y = Any Solar Farm			*Y = Solar MW*		
	(1)	(2)	(3)	(4)	(5)	(6)
Share Reservation Land	-0.026***	-0.023***	-0.023***	-0.547**	-0.306	-0.312
	(0.007)	(0.007)	(0.007)	(0.243)	(0.246)	(0.248)
Share Public Land	-0.026***	-0.023***	-0.023***	-0.915	-0.698	-0.700
	(0.005)	(0.005)	(0.005)	(0.587)	(0.562)	(0.568)
Solar PV Potential	-0.00005	-0.00004	-0.00004	0.001	0.002	0.002
	(0.00004)	(0.00004)	(0.00004)	(0.004)	(0.004)	(0.004)
Transmission Lines (km)		0.006***	0.006***		0.440***	0.444***
		(0.001)	(0.001)		(0.113)	(0.118)
Distance to Trans. (km)			0.00005			0.001
			(0.0001)			(0.004)
Land Use Controls	x	x	x	x	x	x
Infrastructure Controls	x	x	x	x	x	x
County Fixed Effects	x	x	x	x	x	x
Observations (townships)	86,466	86,466	86,466	86,466	86,466	86,466
R^2	0.247	0.250	0.250	0.073	0.075	0.075
Mean of Dependent Variable	0.017	0.017	0.017	0.560	0.560	0.560

Notes: Robust standard errors, clustered by county, are in parentheses. * p<0.1, ** p<0.05, *** p<0.01. In Columns 1-3 the dependent variable is an indicator for whether or not a solar farm is present. In Columns 4-6, the dependent variable is the MW of installed capacity. The unit of observation is a township in all specifications.

Part 3:
Implications for Future Earnings from Expanded Renewable Energy

Back-of-the-Envelope Calculations

1. Use coefficient estimates from Columns 4 (“disparity coefficients”)
2. Multiply disparity coefficients by forecasted rate of utility scale wind & solar growth through 2050 (across lower 48)
3. Multiply foregone electricity generation by estimates of landowner lease payments and tax payments to governments
4. Discount stream of foregone landholder rents, express in PV terms

Assumptions

- Wind lease payments: annual to landowners, $6,686 per MW.
- Solar lease payments: annual to landowners, $7,500 per MW.
- Tax payments: annual to local governments, $8,637 per MW
- Decarbonization scenarios: 6 scenarios from Princeton Net-Zero America; 5-year intervals 2020-2050
- Discount rate: 3% real discount rate

PV of Foregone Revenue by 2050 if Disparity Persists

	Capacity Lost (000s MW)		Royalties Lost (Million $s)			Tax Revenue Lost (Million $s)			Total All
	Solar	Wind	Solar	Wind	Total	Solar	Wind	Total	(Million $s)
REF	9	6	753	562	1,315	893	748	1,641	2,957
B+	46	21	3,648	1,639	5,287	4,327	2,181	6,508	11,796
E+	59	25	4,604	1,909	6,512	5,461	2,540	8,000	14,513
E-	56	31	4,296	2,085	6,381	5,095	2,774	7,870	14,250
E+ RE-	21	11	2,090	1,015	3,105	2,479	1,350	3,829	6,934
E +RE+	108	58	7,349	3,118	10,467	8,717	4,149	12,866	23,333

Range is from $6.9b to $23.3b.
Divide by American Indian population: $13,071 to $43,986
Divide by American Indian population on 25% best endowed reservations: $19,396 to $65,267
Perspective: US Census reports annual per-capita income on reservations $15,153 in 2018.

Qualifiers: Over or Under Estimate?

- B-of-E do not consider labor/employment benefits & spillovers

- Lease & tax payments could go up
  - ❑ Supply curves slope upward
  - ❑ Transmission networks are expanding
  - ❑ Harvest technology is improving

- Tribal members may not get full benefit from renewables on private lands
  - ❑ Payments to non-members who own some fee-simple land
  - ❑ Debated jurisdiction of tribes to tax energy development on fee land

Part 4:
What Explains Disparity?

Candidate Factors

1. Trusteeship (lack of self-governance)
2. Land ownership fractionation and fragmentation
3. Perceptions of tribal rule of law
4. Lack of public infrastructure (transmission lines)

Federal Trusteeship → Lack of Self-Governance → Leasing Challenges

- Energy leases require approval of Bureau of Indian Affairs

- President of the Navajo Nation:
  - ❑ Biden's renewable policies only benefit tribes if "red tape" is minimized (Nez 2021).
  - ❑ Study: erroneous BIA records & understaffing delayed permitting (Dreveskracht 2012)

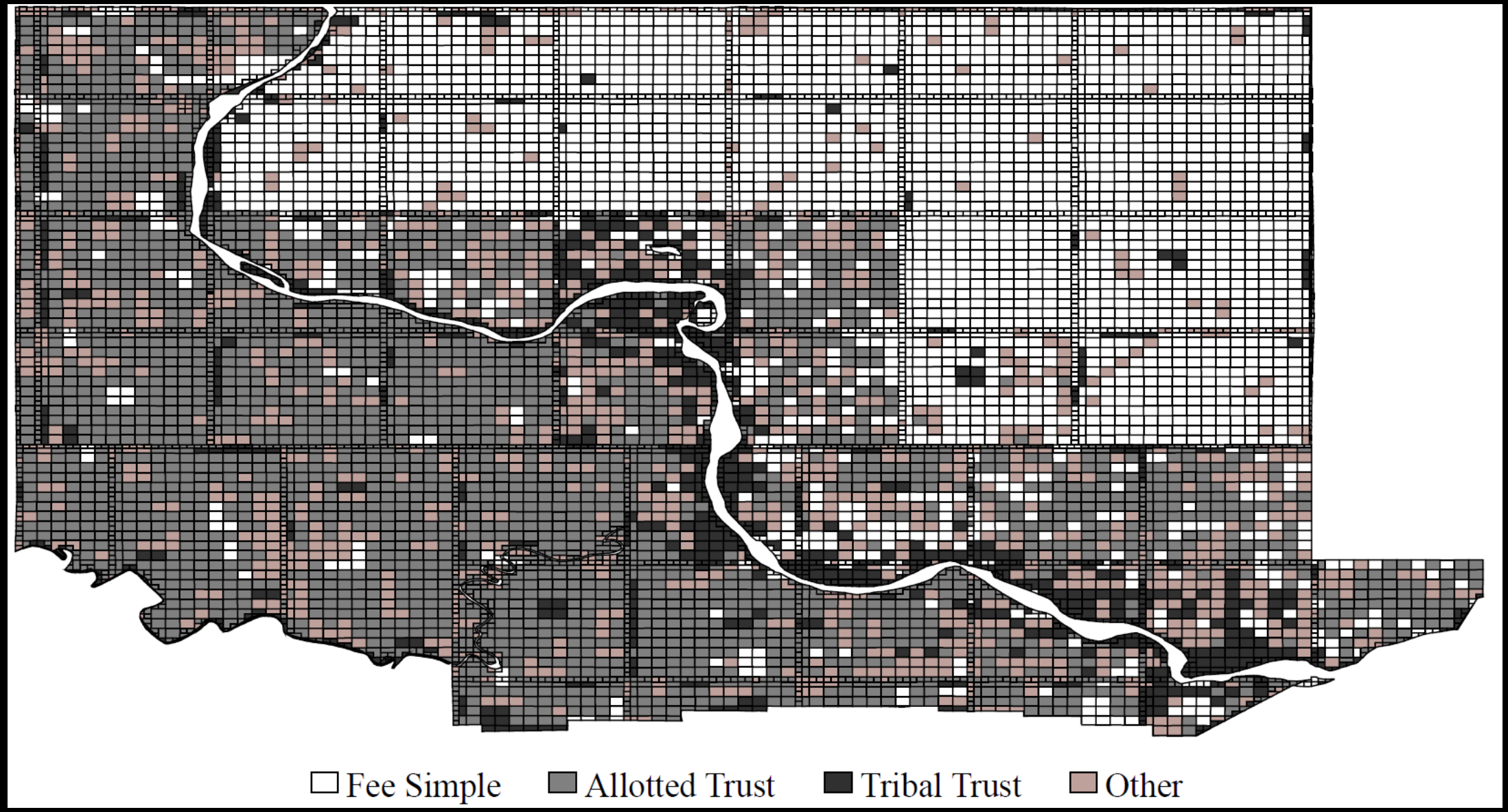
- Compare with oil and gas
  - ❑ One instance: 49 regulatory steps vs. 5 off reservations (Regan and Anderson 2014)
  - ❑ $1.5 trillion subsurface minerals untapped (US Senate 2009)

Fractionation

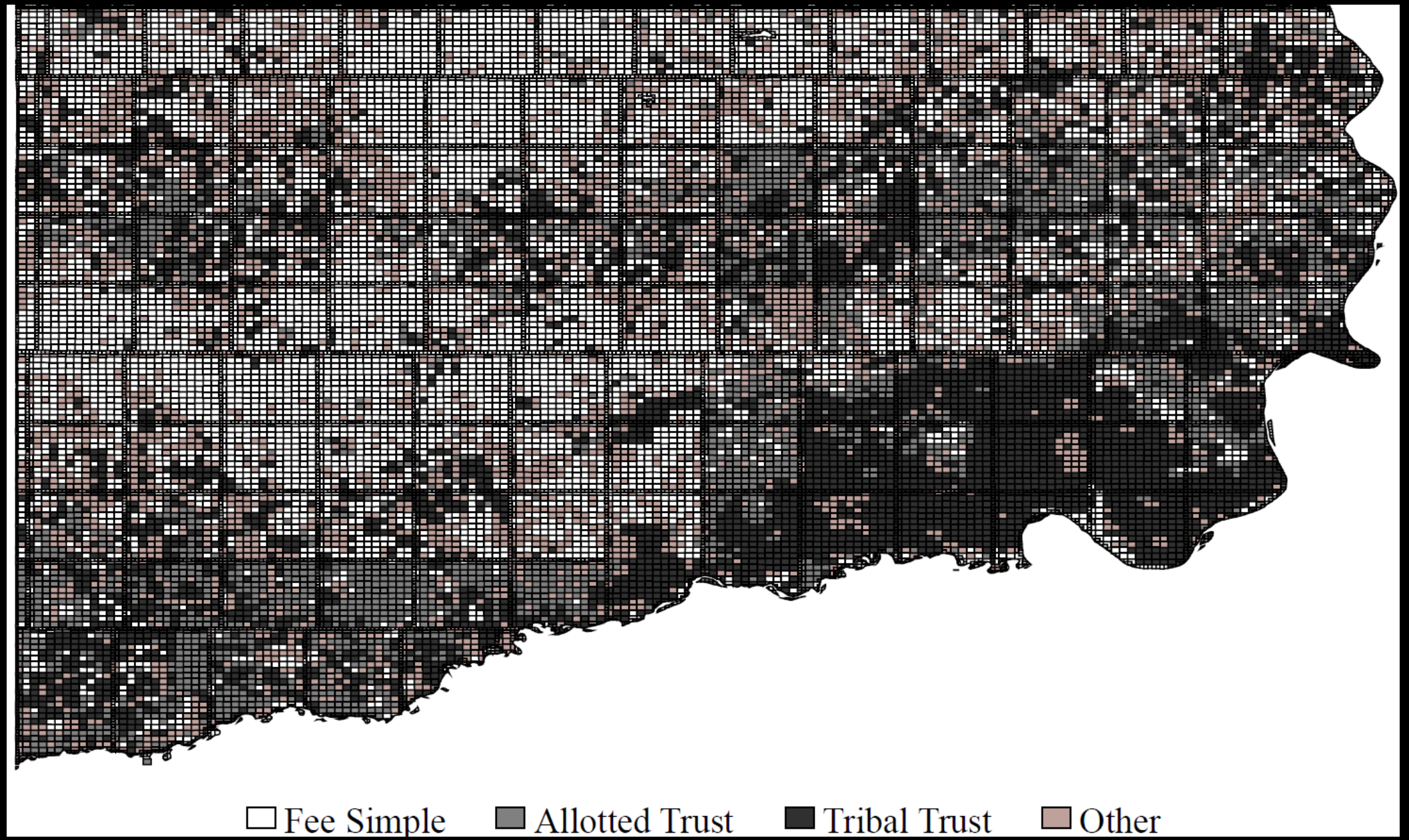
The Department of Interior's report (2013, 7):

"Unless an individual or a tribe owns a controlling interest in a fractionated tract, they must seek and **obtain approval from co-owners for any purpose, including leasing or economic development.** When tracts have hundreds or thousands of co-owners, there is no practical way to obtain the required approvals for leases or other uses of such lands."

Example: Fort Berthold (ND)



Example: Cheyenne River (SD)



Determinants of Wind Farming Within Reservations

Conditional on wind speed…

- Trust land 120% less likely than fee simple land

- Does not account for jurisdictional fragmentation…

Tribal Rule of Law

- Sunk capital investments
- Jurisdictional uncertainty
- Uncertainty of future regulations, taxes

Conclusions

- Renewable development is possibly a “double-dividend”…

  BUT

- Many challenges exist; development will likely require federal & tribal reform

- If problems not addressed, America’s poorest minority group will continue to not benefit from federal and state renewable subsidies, miss out on energy boom. Redux of coal, oil, and gas booms

- None of this is to suggest tribes “should” develop. It is their sovereign choice. This research project is NOT a call for the federal govt to impose its energy priorities on tribes.