MEMO

Date: June 23, 2022

To: Land Use and Environmental Exclusions Subcommittee of the National Transmission Planning Study Technical Review Committee

From: David Hurlbut, senior analyst, National Renewable Energy Laboratory

Subject: Draft interregional renewable energy zone (IREZ) methodology

This memorandum describes the interregional renewable energy zone (IREZ) methodology for the National Transmission Planning (NTP) Study. The aim is to develop a data-driven, replicable IREZ methodology for the purposes of long-term regional and interregional transmission planning. IREZs will be used in scenarios tested in the NTP Study.

An IREZ is a collection point on the transmission system that is easily accessible to a very high volume of low-cost developable renewable energy potential. The identification of an IREZ assumes a single collection point for the purposes of description and analysis. Nevertheless, a subsequent transmission development plan for an IREZ may include multiple lines and substations, taking into account network characteristics that do not enter into the IREZ analysis. An IREZ has no defined geographic boundary, although sites farther from the collection point would require longer gen-ties and would naturally diminish in economic viability with distance.

IREZ identification is based on renewable resources like wind and solar that (a) are already economically competitive and are in demand; (b) depend on location for optimal productivity and cost effectiveness; and (c) can be developed in zonal concentrations large enough to "supersize" new transmission (i.e., full utilization at line voltages that are at least as high as the region's highest-voltage lines). Resources that do not meet all these criteria may connect to transmission built for an IREZ if they are present, but by themselves they do not define an IREZ. Such resources might be important to grid decarbonization, but by their nature they are better supported by tools other than transmission zones. IREZs are only intended to reveal large-scale interregional transmission development options. They do not replace or change any process for local resource procurement or for the development of distributed energy resources.

The quantity of resource potential in an IREZs is significantly larger than the carrying capacity of the associated transmission (even with supersizing the lines). Surplus potential supports competition, and it provides a buffer for siting constraints that are not captured in the IREZ screening methodology.

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Some identified IREZs might not be included in a transmission scenario. A follow-on analysis of the identified zones will determine which of them best fit the needs of the load they would serve. Those that can economically serve load in multiple planning regions will be treated as priority IREZs.

After the webinar on June 24th, members of the Land Use and Environmental Exclusions Subcommittee will receive by email links to comment forms that ask about certain aspects of the IREZ methodology. Members are invited to provide their feedback by the close of business on Wednesday, June 29th.

1. Methodology

a. *Apply the most recent wind and solar resource data.* In the NTP Study, the geography of interest is the 48 contiguous U.S. states (CONUS). The most recent solar data is from the National Solar Radiation Database[1], and the most recent wind data is from the Wind Integration National Dataset (illustrated in Appendix A).[2]

b. *Identify developable areas based on site exclusions.* Exclude from analysis lands where development is prohibited, and lands that are impractical for development due to terrain or current land use. (**See Appendix B for a listing of exclusions. Subcommittee members are invited to comment on items that should be added to or removed from the list.**)

c. *Derive critical objectives and land attributes to map friction related to stakeholder preferences*. "Friction" means preferences for where to encourage or discourage project siting, apart from exclusions identified in Step (b). Use established techniques (e.g., Analytic Hierarchy Process) with the NTP Study's technical review committee (TRC) and subject-matter experts to solicit preferences across a decision hierarchy. Develop spatial datasets representing criteria that pertain to key decision objectives, including potentially competing land uses, environmental sensitivities, areas of cultural importance and socioeconomic descriptors relating to energy justice. Stakeholder preferences across the discrete set of criteria will be collected via survey of TRC members and subject matter experts. Numerical techniques will be used translate preferences into quantitative weighting schemes that inform land avoidance priorities used in the next step's clustering process. (**See Appendix C for a list of decision criteria and metrics. Subcommittee members are invited to comment on items that should be added to or removed from the list.**)

d. *Identify least-cost collection points.* Perform clustering analysis of developable regions to identify potential nodal locations. Nodes are connection points that concentrate the provision of maximal energy supply at minimal cost while adhering to stakeholder preferences. Characterize nodes based on logistical information including location (indicative geospatial coordinates), proximity to adjacent nodes and wind and solar supply curves.

[1] *See* NSRDB: National Solar Radiation Database, https://nsrdb.nrel.gov
[2] *See* Wind Integration National Dataset Toolkit, https://www.nrel.gov/grid/wind-toolkit.html

e. *Identify IREZs.* Refine the set of nodes based on contiguity screens, eliminating areas that are relatively small and isolated (based on land use constraints). The nodes that remain are considered IREZs.

2. Implementation

Apply methodology to the WestConnect planning region, revise methodology as needed based on TRC feedback. Apply revised methodology to CONUS. Provide IREZ nodes to NTP Study scenario team.

3. Load analysis

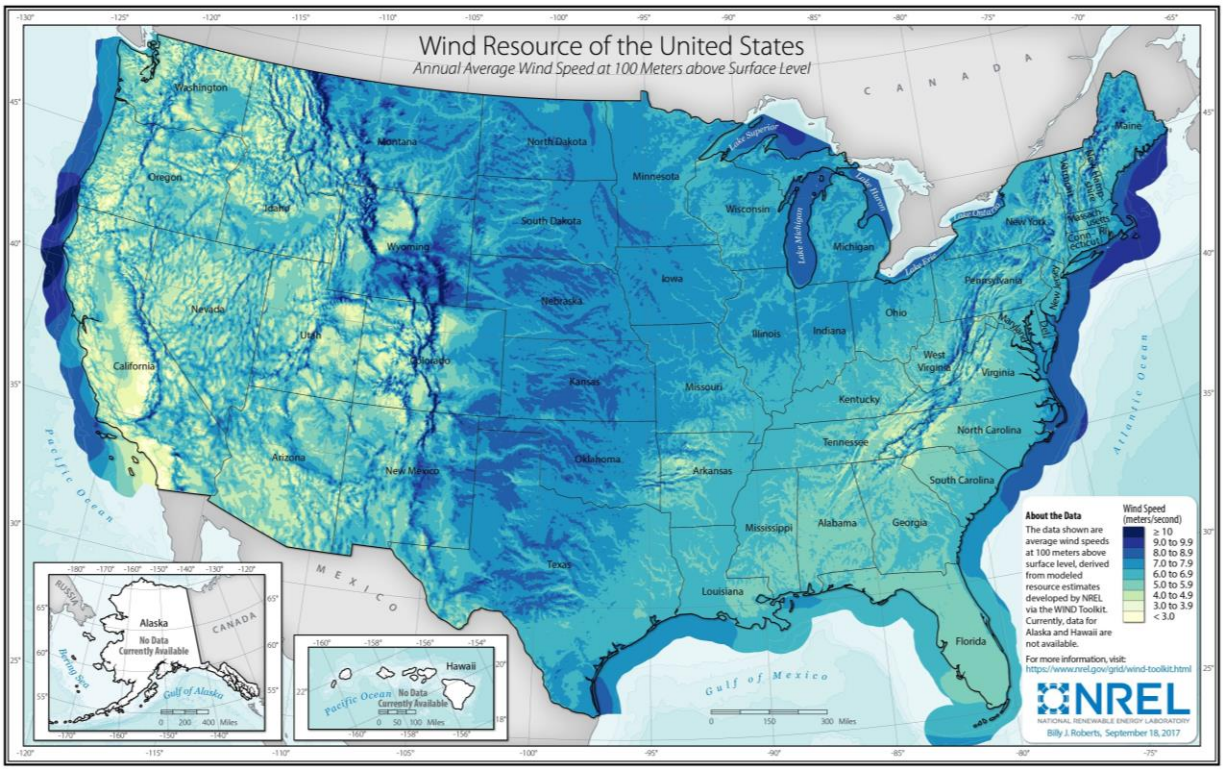
a. *Regional analysis.* Estimate 2035 and 2050 load for each planning region (from NTP Study scenarios). For each region, identify the IREZs inside and outside the region sufficient to meet 2035 and 2050 load at the least cost. Compare the average cost of selected IREZ resources with the region's average cost of generation.

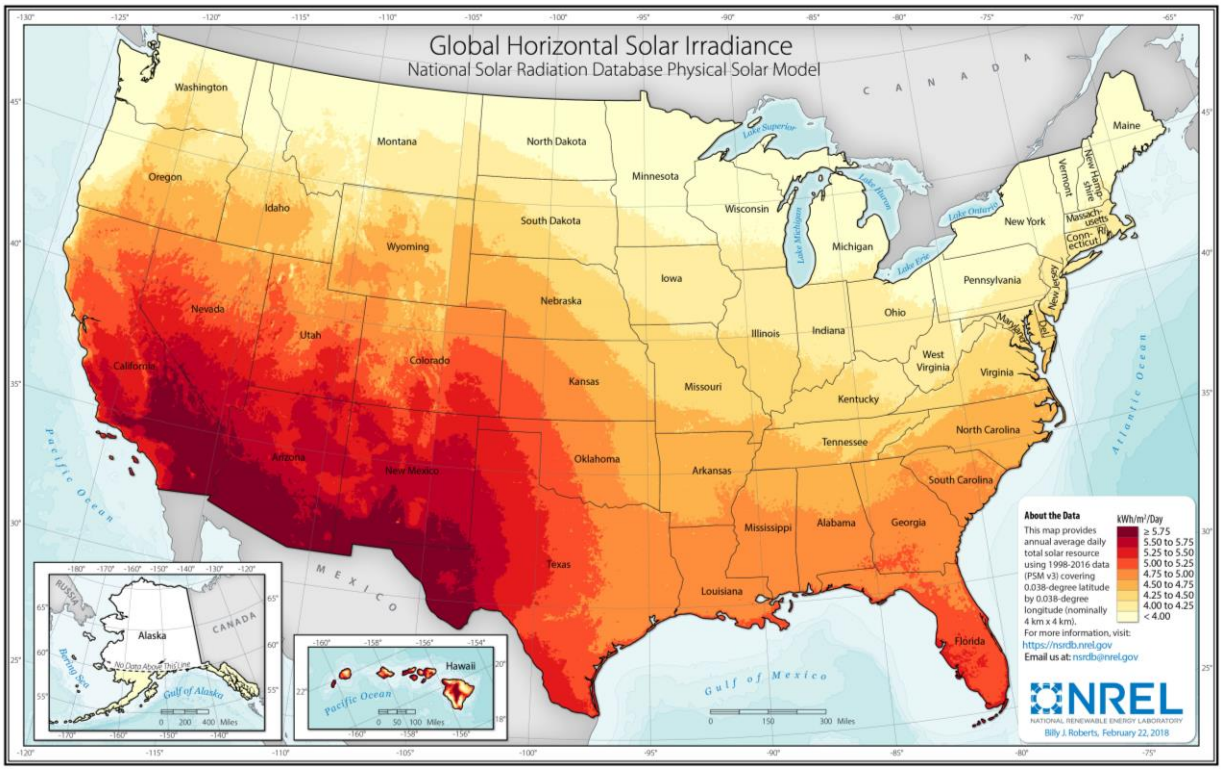
b. *Interregional analysis.* Where the regional analysis identifies one or more IREZs that are common to multiple regions, combine regions into an aggregated load analysis.

Milestones

June 24	Apply provisional methodology to the WestConnect region, present provisional methodology to TRC (land use subcommittee) for review and comment.
Late July	Post revised methodology on TRC website.
Early August	Apply revised methodology to CONUS. Post IREZ map on TRC website.
Aug. 17	*Comments due in FERC's notice of proposed rulemaking.*
Late August	Finalize technical report on IREZ methodology. Conduct load-matching analysis, present results to TRC (government and land use subcommittees) for review and comment.
Sept. 19	*Reply comments due in FERC's notice of proposed rulemaking.*
Sept. 30	Solicit interest from TRC (government subcommittee) in customizing analysis for specific regions.

Appendix A: Wind and Solar Potential for CONUS





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Appendix B: List of Land Categories Excluded from IREZ Analysis

Land-based wind spatial exclusions

Category	Variable
Federal Land	Areas of Critical Environmental Concern (BLM)
	Inventoried Roadless Areas (USFS)
	National Battlefield
	National Conservation Area
	National Fish Hatchery
	National Monument
	National Park
	National Recreation Area
	National Scenic Area
	National Wilderness Area
	National Wildlife Refuge
	Wild and Scenic River
	Wildlife Management Area
Existing Structures and Setbacks	Airports
	Existing Moratoriums
	Height Limits
	Rail Setbacks (existing plus extrapolated 1.1x tip-height)
	River Setbacks (existing plus extrapolated 1.1x tip-height)
	Road Setbacks (existing plus extrapolated 1.1x tip-height)
	Structure Setbacks (existing plus extrapolated 1.1x tip-height)
	Transmission Setbacks (existing plus extrapolated 1.1x tip-height)
	Existing Rail
	Existing Roads
	Existing Structures
	Existing Transmission right-of-way
	Existing Wind Facilities (used as an inclusion layer)
	Urbanized Areas (GHSL SMOD)
Natural Landscapes	Water bodies

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	Woody Wetlands 1,000ft buffer
	Herbaceous Wetlands 1,000ft buffer
Physical Land Characteristics	Include land mass only (no barrier islands, keys, etc.)
	High Mountains
	Radar (NEXRAD 4km)
	Radar (DoD 9km)
	Shadow Flicker - Over 30 hours exposure per year for 120m hub height turbine.
	Slope
Protected Areas	Land Managed for Biodiversity (NCED)
	Land Managed for Biodiversity (PAD-US)

Utility-scale photovoltaic spatial exclusions

Category	**Variable**
Federal Land	National Battlefield
	National Fish Hatchery
	National Monument
	National Park
	National Recreation Area
	National Scenic Area
	National Wilderness Area
	National Wildlife Refuge
	Wild and Scenic River
	Wildlife Management Area
Natural Landscapes	Water bodies
	Woody Wetlands
	Herbaceous Wetlands
	'Existing' Prime / Important Farmlands on Current Croplands
Land Use	Buildings
	Airports
	Railways
	Transmission Right-of-Ways
	Roadways
	Landmarks

	Parks
	Urban Areas
	Suburban Areas
	NG HGL Petroleum Crude Pipelines
Physical Land Characteristics	High Mountains
	Slope Threshold
Protected Areas	USFS Inventoried Roadless Areas
	Land Managed for Biodiversity
	Areas of Critical Environmental Concern
	Land Managed for Biodiversity

Sources are from Maclaurin, Galen, Nick Grue, Anthony Lopez, Donna Heimiller, Michael Rossol, Grant Buster, and Travis Williams. 2019. *The Renewable Energy Potential (reV) Model: A Geospatial Platform for Technical Potential and Supply Curve Modeling*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-73067. On line at https://www.nrel.gov/docs/fy19osti/73067.pdf.

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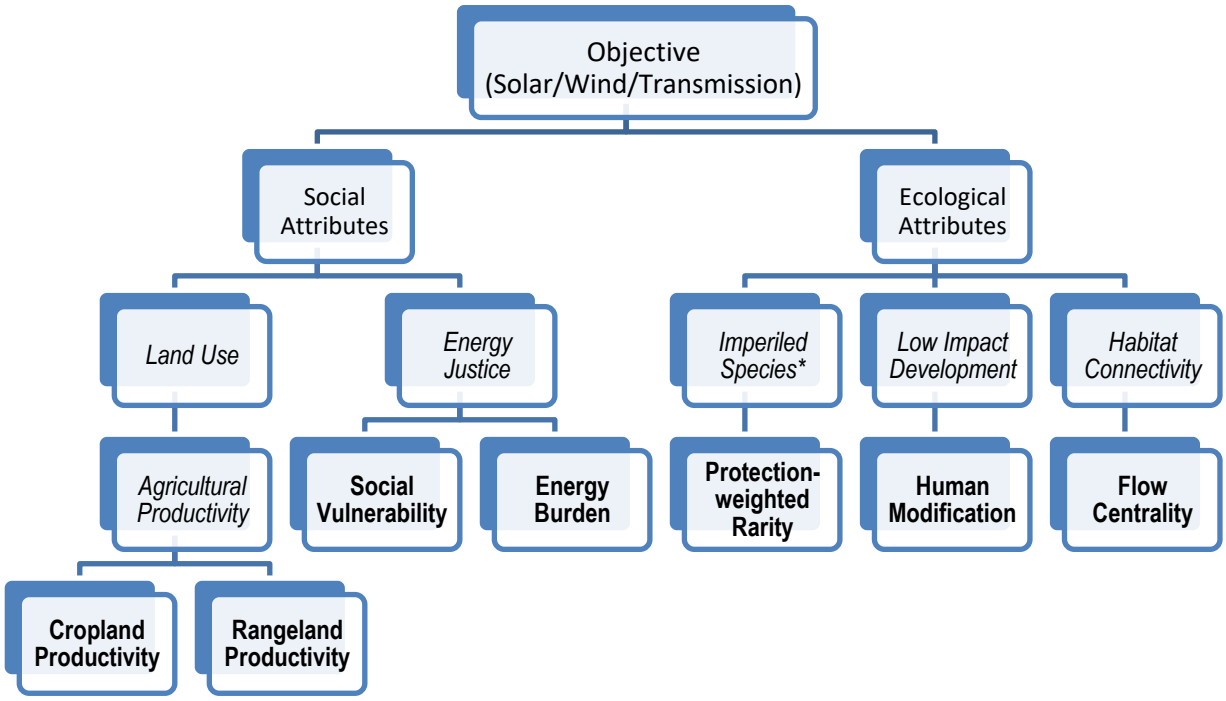
Appendix C: Initial List of Preferences to be Surveyed in AHP

Transmission, wind plants, and solar plants affect land use differently. Therefore, TRC members will be asked to evaluate the criteria and metrics below in separate surveys for each application. Target criteria are in *italics*, indicators associated with the criteria are in **bold**.



*Not otherwise addressed through land use exclusions listed in Appendix B.

Weights derived for these metrics will be applied universally to land where the indicators are present.

In addition to these universal weights, NREL will apply site-specific weights to tribal lands based on preferences expressed by tribal authorities.

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