

DOE OFFICE OF INDIAN ENERGY

Step 1: Identifying Project Potential

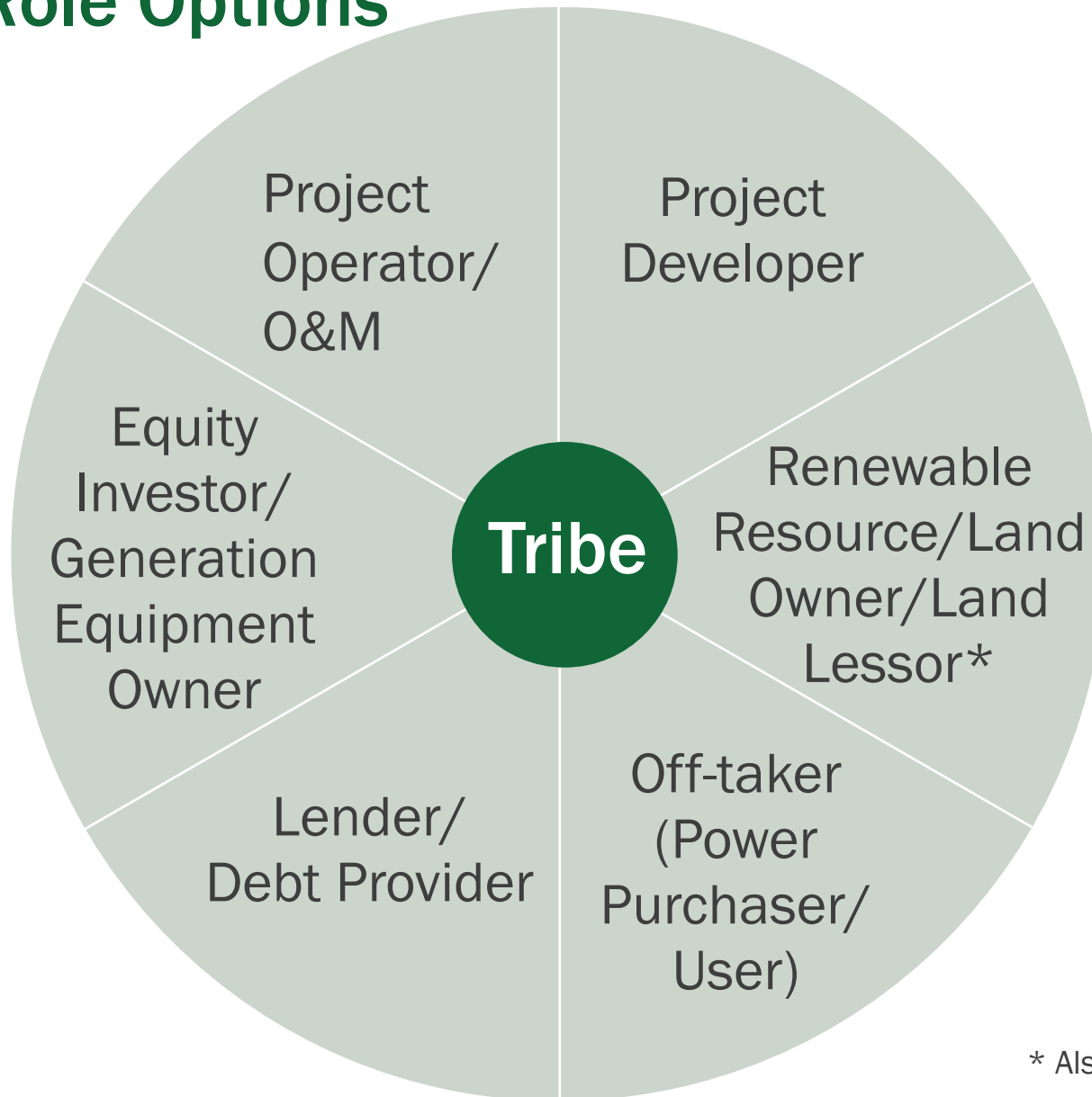
Commercial Scale Workshop



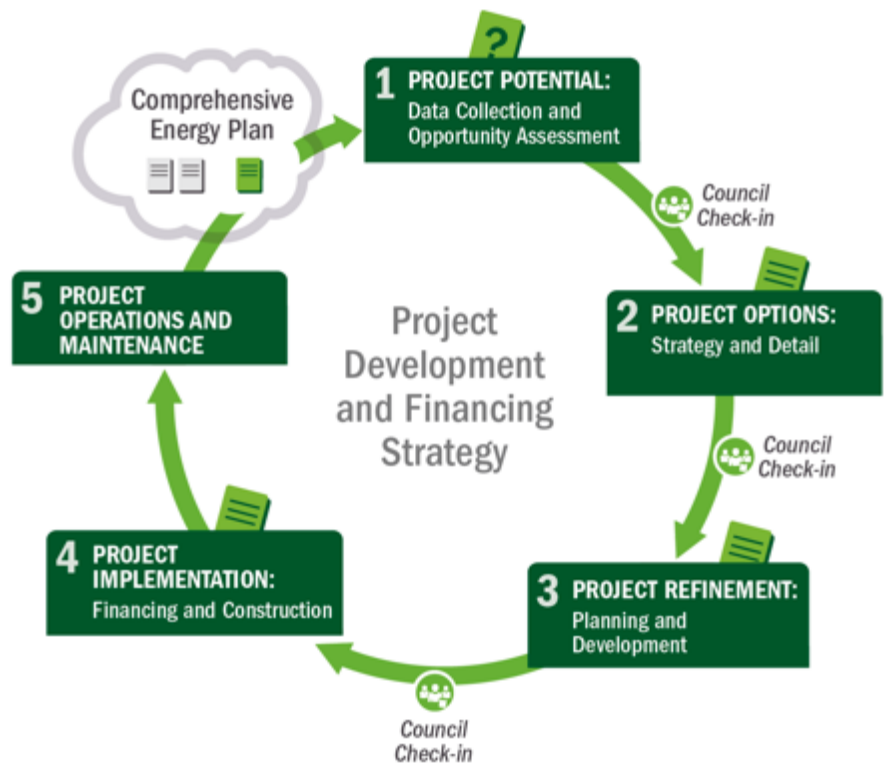
U.S. DEPARTMENT OF
ENERGY

Office of
Indian Energy

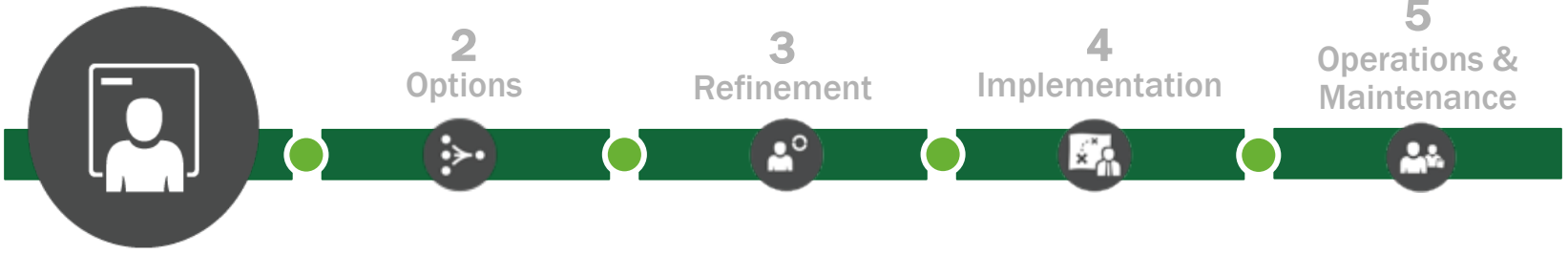
Tribal Role Options



* Also called Tribal Host



1 Potential





■ | Agenda

- Market and Offtakers
- Initial Site Considerations
- Resource
- Permitting & Regulation
- Project Savings and Production Potential



MARKET & OFFTAKERS



Commercial-Scale Considerations

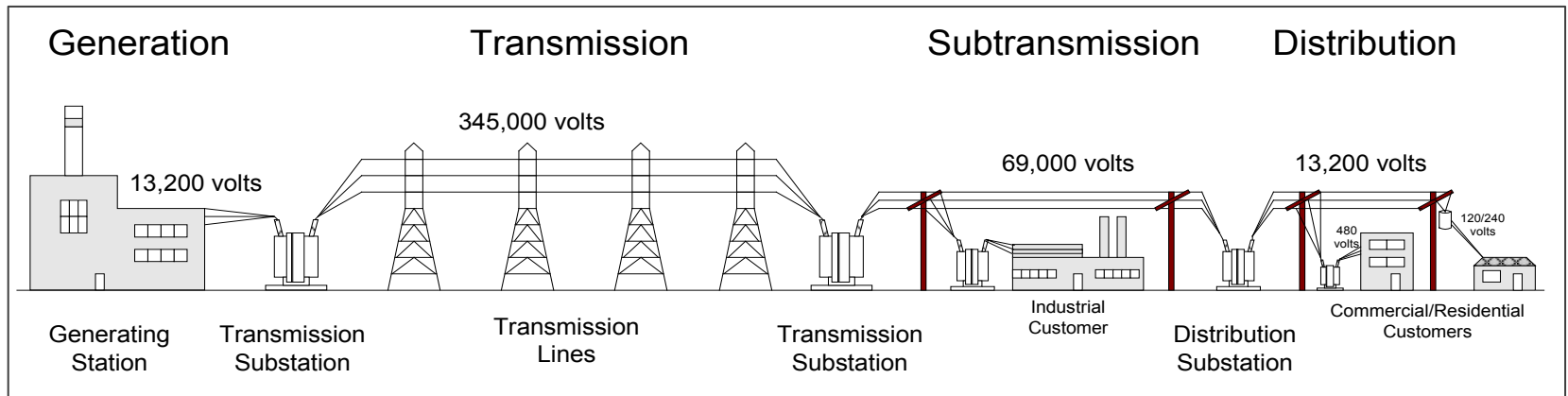
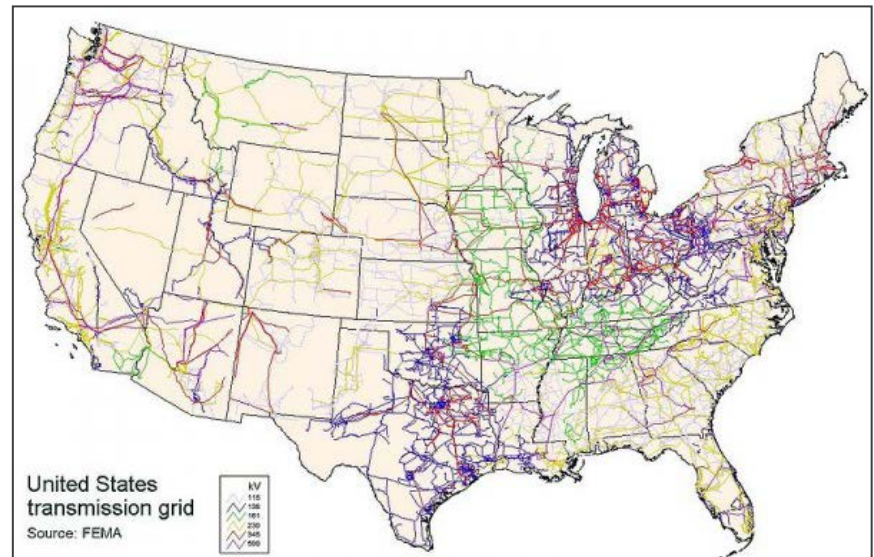
- Need an off-taker to buy your electricity
 - A utility
 - A large commercial, industrial, or government agency (e.g., military base)
- Utility motivated by RPS compliance
- Nonutilities motivated for a number of reasons, including: cost savings, sustainability goals, and energy hedging

The Electricity Grid

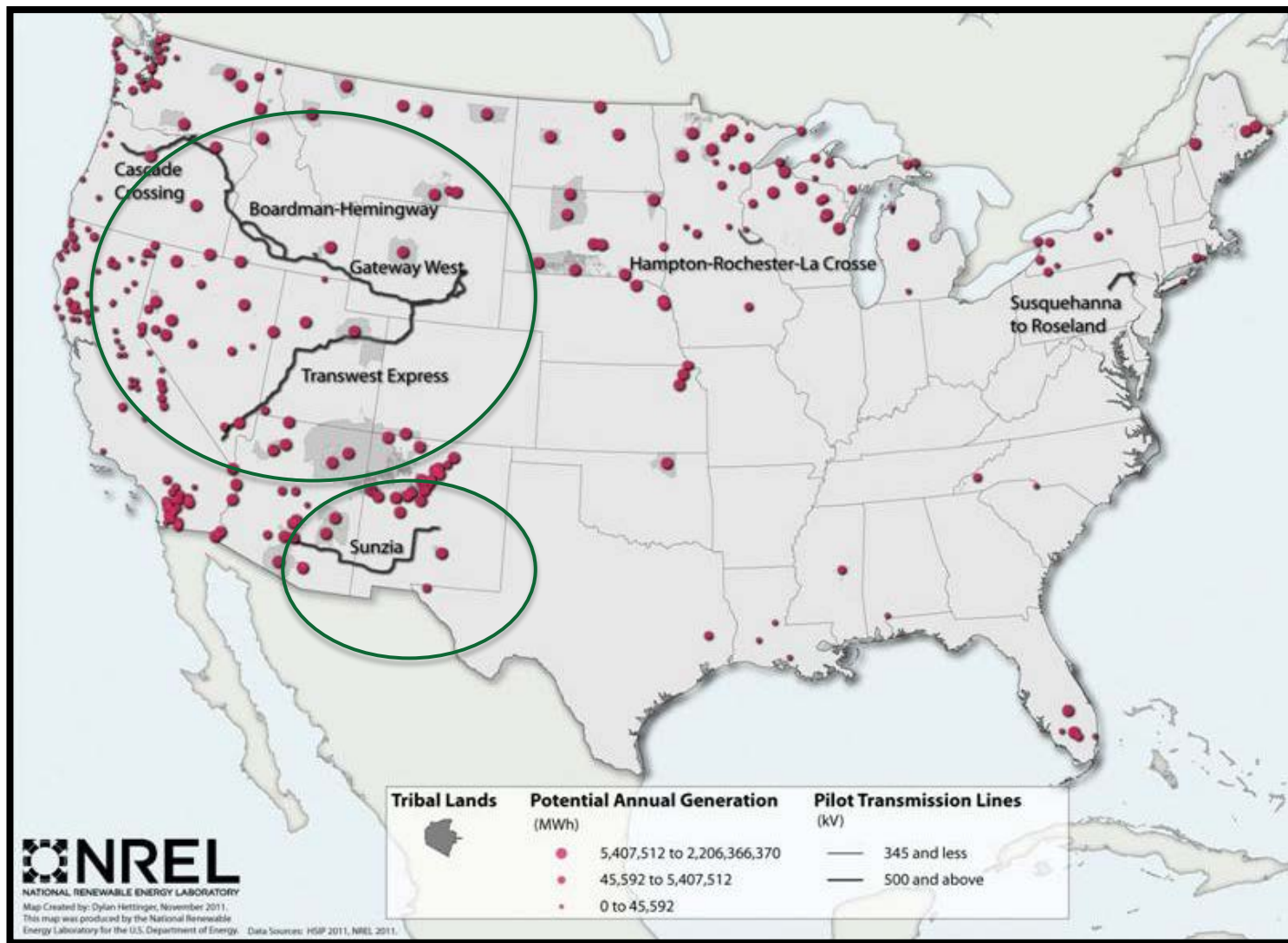
It is not enough to identify a market for the electricity

Can you get the electricity to market?

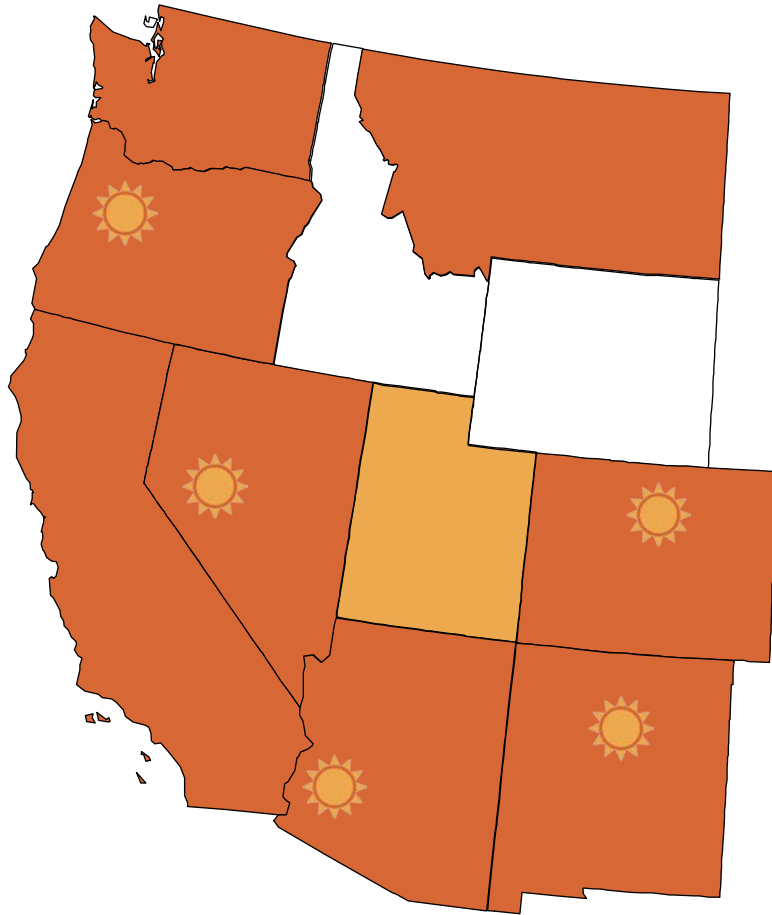
- Existing transmission lines?
- Capacity on those lines?



Projected Transmission



Identifying a Market: Western States' RPS Policies



State	RPS
AZ	15% by 2025
CA	33% by 2020
CO	30% by 2020 (IOUs) 10% by 2020 (co-ops/munis)*
MT	15% by 2015
NM	20% by 2020 (IOUs) 10% by 2020 (co-ops)
NV	25% by 2025*
OR	25% by 2025 (large utilities)* 5%–10% by 2025 (small utilities)
WA	15% by 2020*
UT	GOAL: 20% by 2025

Orange square: Renewable portfolio standard

Sun icon: Minimum solar or customer-sited requirement

Yellow square: Renewable portfolio goal

Star icon: Extra credit for solar or customer-sited renewables

Source: www.dsireusa.org

California

- Projected to need an additional 400–13,000 MW installed by 2020 to meet RPS obligations
- No major projected transmission expansion in California

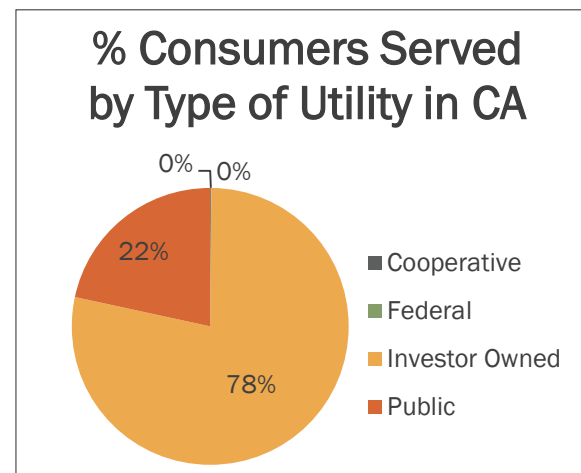
Electricity Sales				
Total	% US Res	% US Comm	% US Ind	% Total US
19,000 GWh	6.2%	8.8%	4.3%	6.6%

State TECHNICAL Potential (GW)					
Roof Solar	Utility Solar	CSP	Wind	Bio.	Geo.
61	4,111	2,726	1,052	4	16.7

Tribal RESOURCE Potential (GW)					
Roof Solar	Utility Solar	CSP	Wind	Bio.	Geo.
ND	13.8	10.6	0.68	.127	9

Avg Elec. Prices (c/kWh)	
Retail (2012)	Wholesale (2011)
12.96	3.00

Policy	Limit
RPS	33% by 2020
Interconnection	No Limit
Net Metering	1 MW



Major Utilities

Los Angeles Department of Water & Power
 Pacific Gas & Electric Co.
 San Diego Gas & Electric Co.
 Southern California Edison Co.

Oregon

- RPS obligations began in 2011
- Projected to have 340–1,700 MW in excess of RPS obligations in 2020
- Large projected transmission expansion across the state

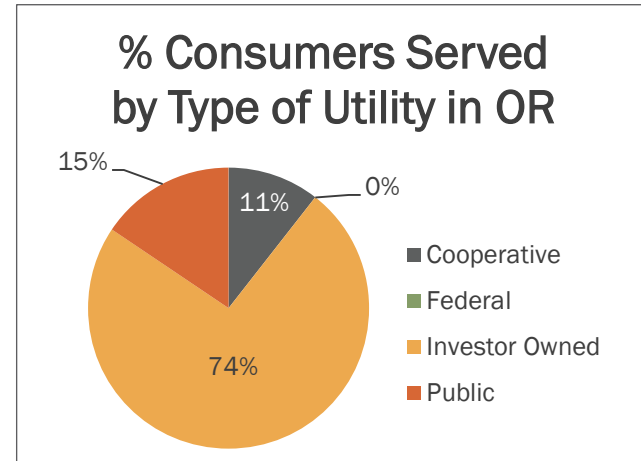
Electricity Sales				
Total	% US Res	% US Comm	% US Ind	% Total US
4,000 GWh	1.7%	1.3%	1.2%	1.4%

State TECHNICAL Potential (GW)					
Roof Solar	Utility Solar	CSP	Wind	Bio.	Geo.
5	1,898	1,017	252	2	2.4

Tribal RESOURCE Potential (GW)					
Roof Solar	Utility Solar	CSP	Wind	Bio.	Geo.
ND	26.4	7.8	1.12	.0001	6

Avg Elec. Prices (c/kWh)	
Retail (2012)	Wholesale (2011)
8.32	3.00

Policy	Limit
RPS	25% (large utilities), 10% (small), 5% (smallest) by 2025
Interconnection	No limit
Net Metering	2 MW



Major Utilities
None

Renewable Project Finance

Key Contract: Power Purchase Agreement (PPA)

- A long term, financeable commitment to buy project output
- Generally addresses energy and attributes (like RECs)
- Allows developer to monetize tax or other policies
- Finding a power purchaser/off-taker is key for securing capital

Summary: Understanding Electricity Markets

- **Who Is Your Market?**
 - On-site
 - Utility/utilities
 - Nearby federal agencies (especially Department of Defense)
 - Large commercial or industrial off-taker
- **Getting Power to the Market**
 - Proximity to transmission
 - Current capacity of existing transmission
 - New transmission being planned
 - Required transmission studies take time; start early
- **Contracts Needed to Put It All Together**
 - Signed power purchase agreement (PPA) with creditworthy buyer
 - Signed interconnection agreement
 - Signed transmission agreement

Summary: Understanding Market Potential

- Free tool for understanding local current energy needs/costs: State & Local Energy Data ([SLED Tool](http://www.eere.energy.gov/sled)) www.eere.energy.gov/sled
 - Lists utility names
 - Shows available rates
 - Electricity demand by sector
 - Consumption trends
 - Renewable energy resource maps
- Think through growth and energy need scenarios (e.g., building a new recreation center will increase load)

Sled Demonstration

(<https://www.youtube.com/watch?v=VAzAGIX1zag&list=UU7EGgnYFEIOaAa47ZBpninw>)



PERMITTING AND REGULATION



Permits

Purpose:

Understanding necessary regulatory requirements for the project particularly if seeks to inter-connect and/or deliver off reservation.

Considerations:

- Interconnection
- Environmental (National Environmental Protection Agency (NEPA): Environmental Assessment (EA) or Environmental Impact Statement (EIS)
- Cultural
- Federal, Tribal, and/or State Use Permits

Policy: Regulatory Bodies for the Electricity Grid

- Federal Energy Regulatory Commission (FERC)
- North American Electric Reliability Corporation (NERC)
 - Regional Reliability Councils
- Utility commissions and districts regulate privately and publicly owned electricity providers
 - Utilities Commission
 - Utility Regulatory Commission
 - Public Utilities Commission
 - Public Service Commission (may be civil service oversight body rather than utility regulator)
 - Public Utility District (*Tribal*, state, or government owned utility, consumer owned and operated, small investor owned)
 - Publicly owned utilities include cooperative and municipal utilities
 - Cooperative utilities are owned by the customers they serve (farmers and rural communities)

Considerations for Permitting, Regulations, and Laws



- A. Determine ownership before applying for federal, tribal, and state laws and regulations. <http://teeic.indianaffairs.gov/triballand/>
- Two types of **individually owned land**: (1) trust land and (2) restricted fee land
 - Three types of **tribally owned land**: (1) trust land, (2) restricted fee land, (3) fee land purchased by Tribes
 - Consider whether the project will fall under as a government function for the Tribe or a profit-making enterprise?
- B. Consult with a lawyer early in the renewable energy development process to verify business model and eligibility of the project for federal incentives.
- C. What local tribal laws might apply for this renewable energy project? Projects are more likely to get external investment (if necessary) if there is evidence that tribal leadership is committed to the project. See http://www1.eere.energy.gov/tribalenergy/guide/legal_issues.html.

Permitting and Regulating

Outside Tribal Boundaries

- In general, if located on private, non-tribal land, or state properties; local and state land-use policies do apply.
- If located on tribal-owned fee land outside of reservation boundaries, then subject to state and local land-use, permitting jurisdiction.

Inside Tribal Boundaries

- In general, state and local land-use laws do not apply.
- In addition, the extent to which federal rules and regulations apply depends on the type of project, its location, and size.
- Tribal law, regulations, and policies will apply.
- Tribes may “self-regulate” under federal law including TERA’s and Hearth Act.

Determine What Type of Permitting is Necessary

Operations & Maintenance

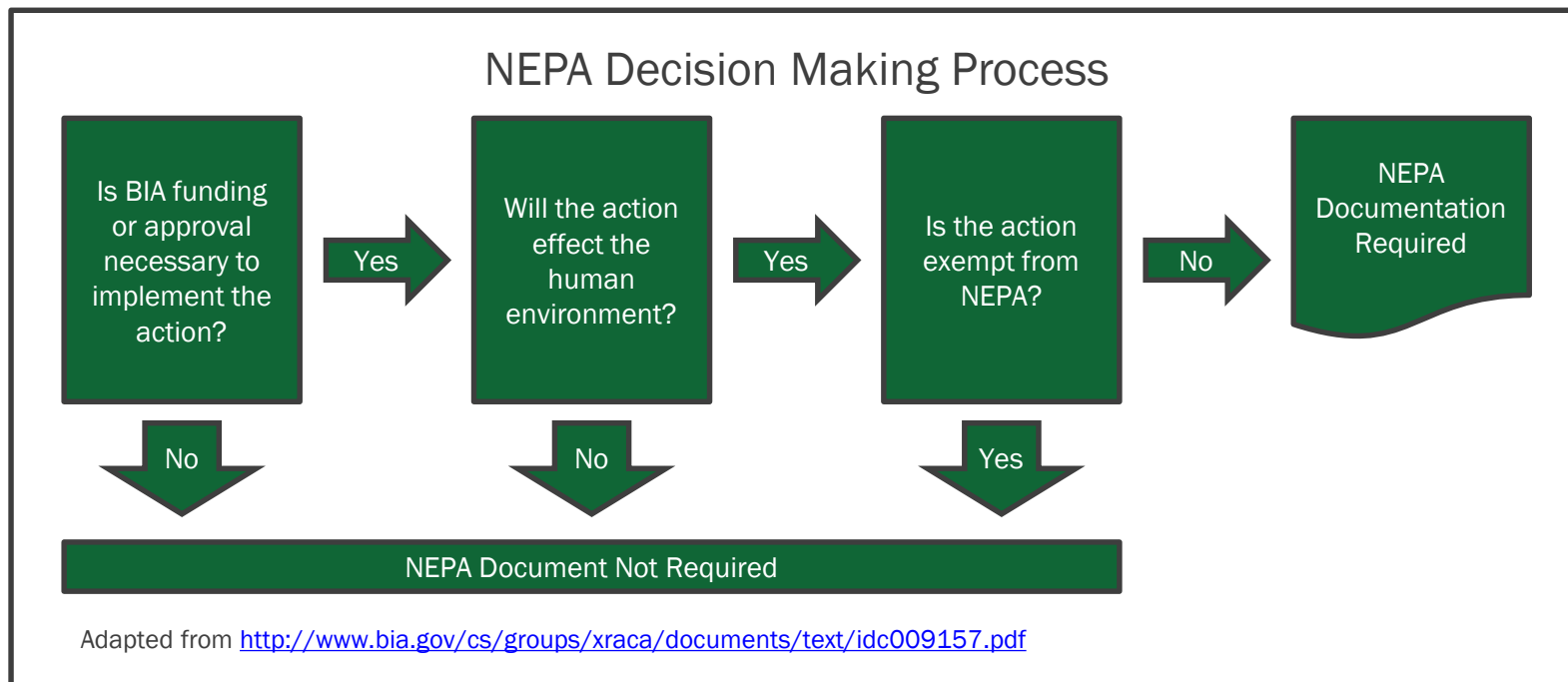


Key Types of Permitting at Tribal Community & Facility Level	Always	Sometimes	Rarely
Interconnection agreement	✓		
Environmental permitting		✓	
Transmission permitting		✓	
Off-take agreement	✓		
Local and State permitting			✓
Federal permitting		✓	
Local Tribal permitting	✓		

Environmental Regulations to Consider – NEPA

National Environmental Policy Act (NEPA)

- All federal agencies must assess environmental impact of proposed actions
- Federal funding may trigger assessment for tribal projects (federal nexus, e.g. federal grants, BIA initiated/approved projects)
- Each federal agency may have their own particular NEPA procedure – need to check with appropriate agency
- Timeline: Approximately 1 to 3 years depending on project size and complexity (unlikely for community scale)
- Recommendations:
 - Draft the EIS concurrently with other applicable federal statutes and regulations
 - If necessary, work with NEPA experts to determine and prepare required analysis



NEPA cont.

Three types in order of complexity and time:

Types	Complexity	Timeline
<p>Categorical exclusions (CX)— Categories of actions that federal agencies have determined do not have a significant effect on the quality of the environment and neither an environmental assessment (EA) nor an environmental impact statement (EIS) is required.</p>	<p>Does not require any public reviews, hearings, and unless any ‘extraordinary circumstances’ exist, an EA or an EIS is not required.</p>	<p>The Categorical Exclusion Exception Review (CEER) conducted by the BIA is an internal two step process and mainly involves a simple check-box form.</p>
<p>Environmental assessment (EA)— The document that provides sufficient analysis for determining whether a proposed action may or will have a significant impact on the quality of the environment and therefore require the preparation of an EIS.</p>	<p>Usually requires a 30 day public commenting period and may also require a 14-30 day scoping period upfront.</p>	<p>Generally allow 6-9 months for this process before issuing either a FONSI or proceed with an EIS.</p>
<p>Environmental impact statement (EIS)— If an action is expected to have significant impacts, or if the analysis in the EA identifies significant impacts, then an EIS will be prepared.</p>	<p>Requires more rigorous and expanded review including public involvement, public meetings and hearings.</p>	<p>Generally should allow 18 to 24 months for completing this process.</p>

<http://www.bia.gov/cs/groups/xraca/documents/text/idc009157.pdf>

Environmental Regulations to Consider – Other

Clean Air Act (CAA)

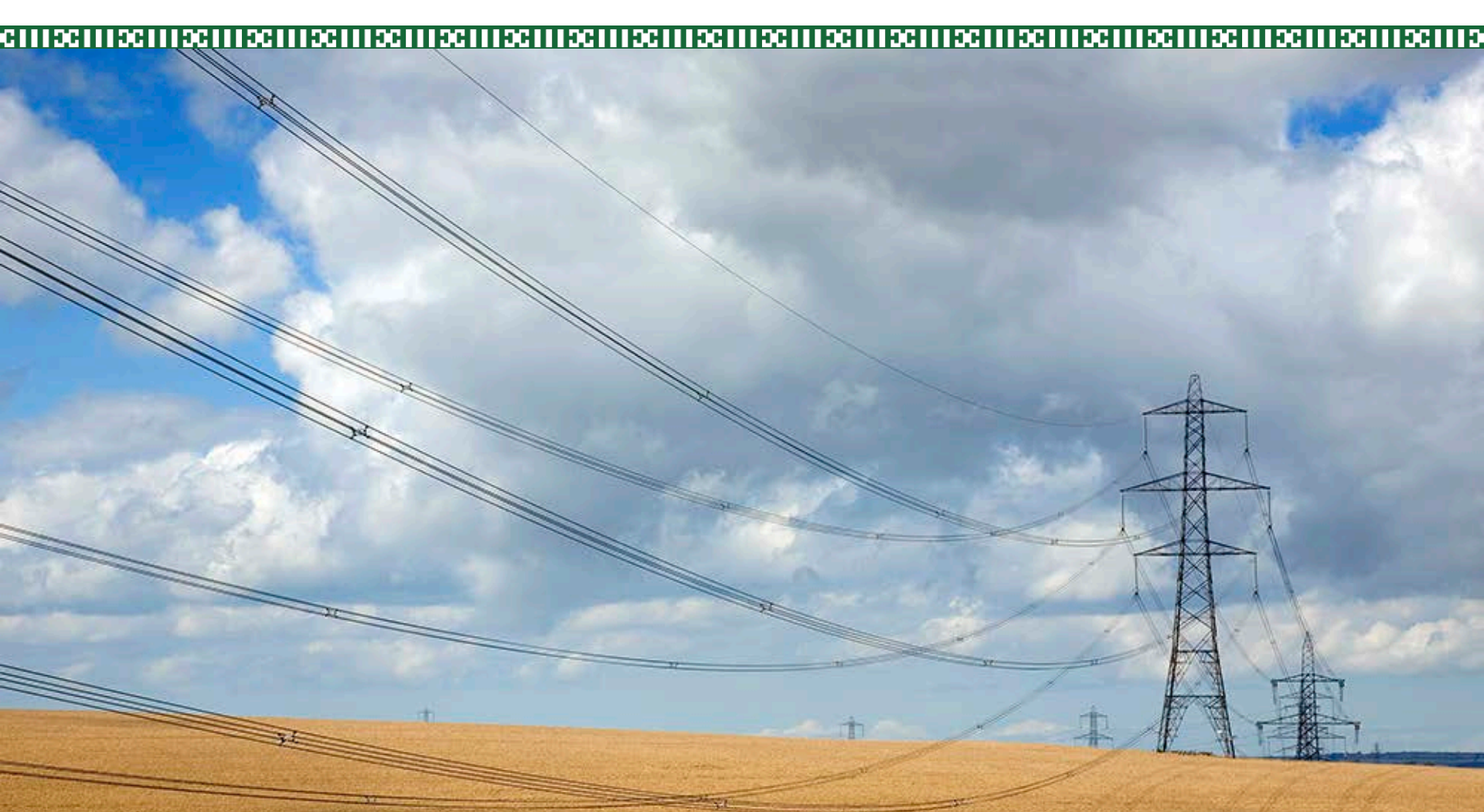
- Purpose is to protect the nation’s air and public health.
- Mandates identification of both mobile and stationary pollutants and the sources—gives authority to U.S. Environmental Protection Agency (EPA) for listing such pollutants.
- Establishes a process for the states and applying the National Ambient Air Quality Standards (NAAQS).

Clean Water Act (CWA)

- Goals are to make the nation’s water fishable and swimmable by 1983 and eliminate the discharge of pollutants into navigable waters by 1985.
- Gives authority to the EPA to regulate National Ambient Water Quality Standards (and effluent limitations applied to all point sources of pollution).
- Paved the way for nationally uniform technology-based standards imposed on individual sources through a permit system (NPDES permit; National Pollutant Discharge Elimination).

Endangered Species Act (ESA)

- The purpose is to protect plants and animals that are listed by the federal government as “endangered” or “threatened”.
- Enforced by the U.S. Fish and Wildlife Service (FWS—see Secretary of the Interior) and the National Marine Fisheries Services (NMFS—See’s Secretary of Commerce).



INITIAL SITE CONSIDERATIONS



Site Due Diligence

Consideration	Applicability	Resources
Wetlands/ Waterways	<ul style="list-style-type: none"> • Are there wetlands, water bodies, washes, arroyos, drainage considerations, or floodplain on site? 	http://www.fws.gov/wetlands/Data/Mapper.html https://msc.fema.gov/portal/search
Soils	<ul style="list-style-type: none"> • Soil conditions impact structural design and site feasibility. <ul style="list-style-type: none"> • Caliche or bedrock may require costly drilling. • Sandy soils may require deeper post embedment to meet wind and snow loading requirements. • Corrosive soils can require measures to protect embedded posts. 	http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
Wildlife/habitat/ flora	<ul style="list-style-type: none"> • Check for critical habitat, riparian areas, and endangered species of flora or fauna that may be impacted. 	http://ecos.fws.gov/crithab/flora/crithabMapper.jsp
Driveway/access	<ul style="list-style-type: none"> • Is a new driveway required? If so, is access available? (Limited access highways may not allow a driveway.) • Can equipment and materials be safely delivered to the site with no obstructions such as overhead utilities, trees, or vehicle weight limits? 	<p>Check local, state, or federal department of transportation or equivalent</p>



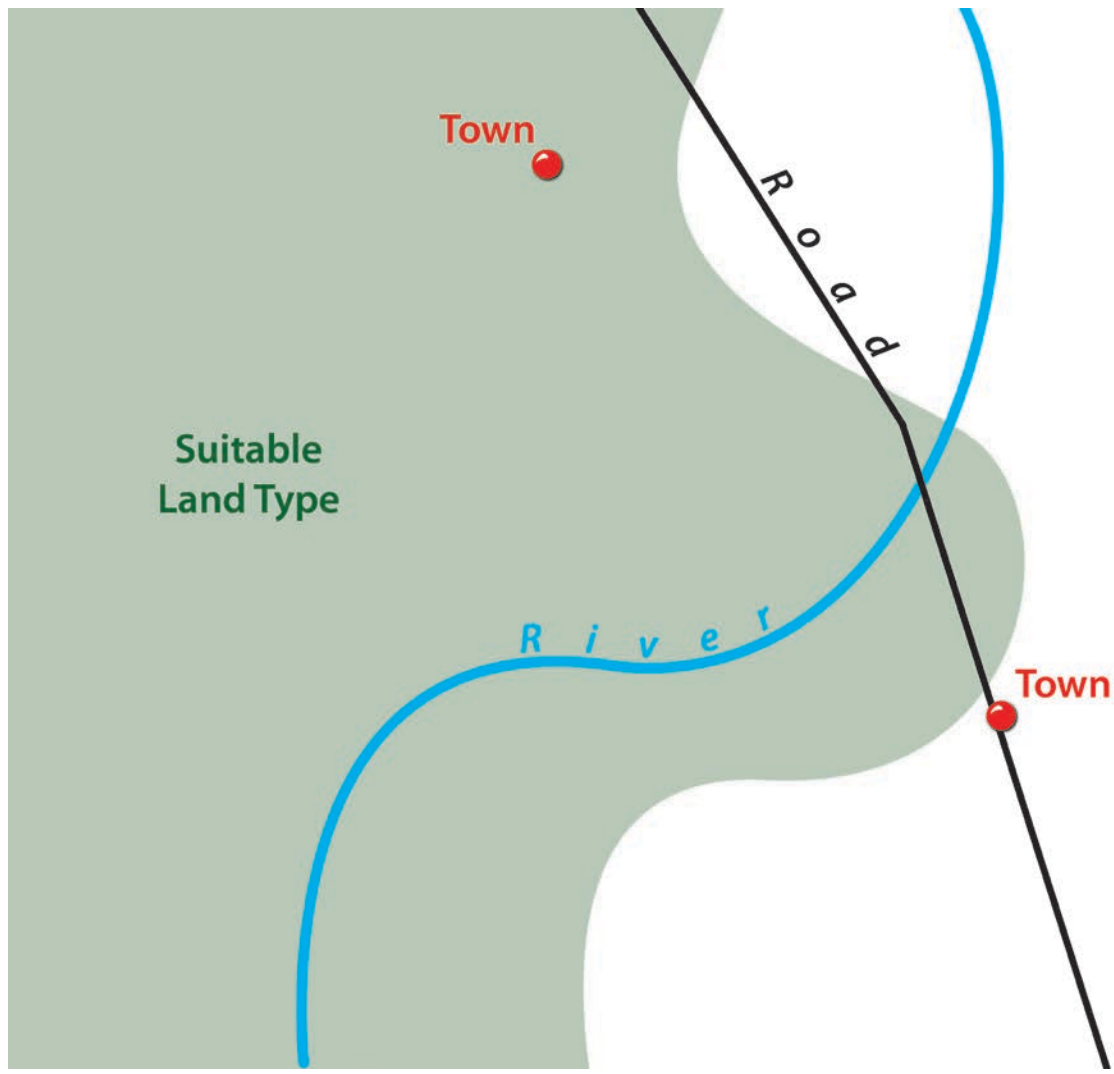
Site Due Diligence (cont.)

Consideration	Applicability	Resources
Easements/ Encumbrances/ Rights-of-way	<ul style="list-style-type: none"> • Are there easements or rights-of-ways for pipelines, utilities, or rail roads that will be crossed or impacted? • Are there plans for road expansions or improvements, new pipelines, or future utility rights-of-ways at any time during the life of the project? 	Check with land management authorities, transportation plans, USGS maps
Cultural resources	<ul style="list-style-type: none"> • Are there known cultural resources on or near the site? If not, are further studies required? 	Tribal Historic Preservation Office http://nrhp.focus.nps.gov/natreg/docs/Download.html (Google Earth layer)
Land use and building permits	<ul style="list-style-type: none"> • Building permit requirements • Land use/zoning permits – Is the facility allowed as a primary or accessory use? Is a special or conditional use permit or re-zoning required? • Rights-of-way permits, including interconnection line, driveway, drainage 	Local tribal government
Storm water	<ul style="list-style-type: none"> • Is the site one acre or more? If so, a construction storm water permit and mitigation measures are required. • Are measures such as retention ponds or swales required for erosion and sediment control or storm water mitigation during and after construction? 	http://water.epa.gov/polwaste/npdes/stormwater/EPA-Construction-General-Permit.cfm

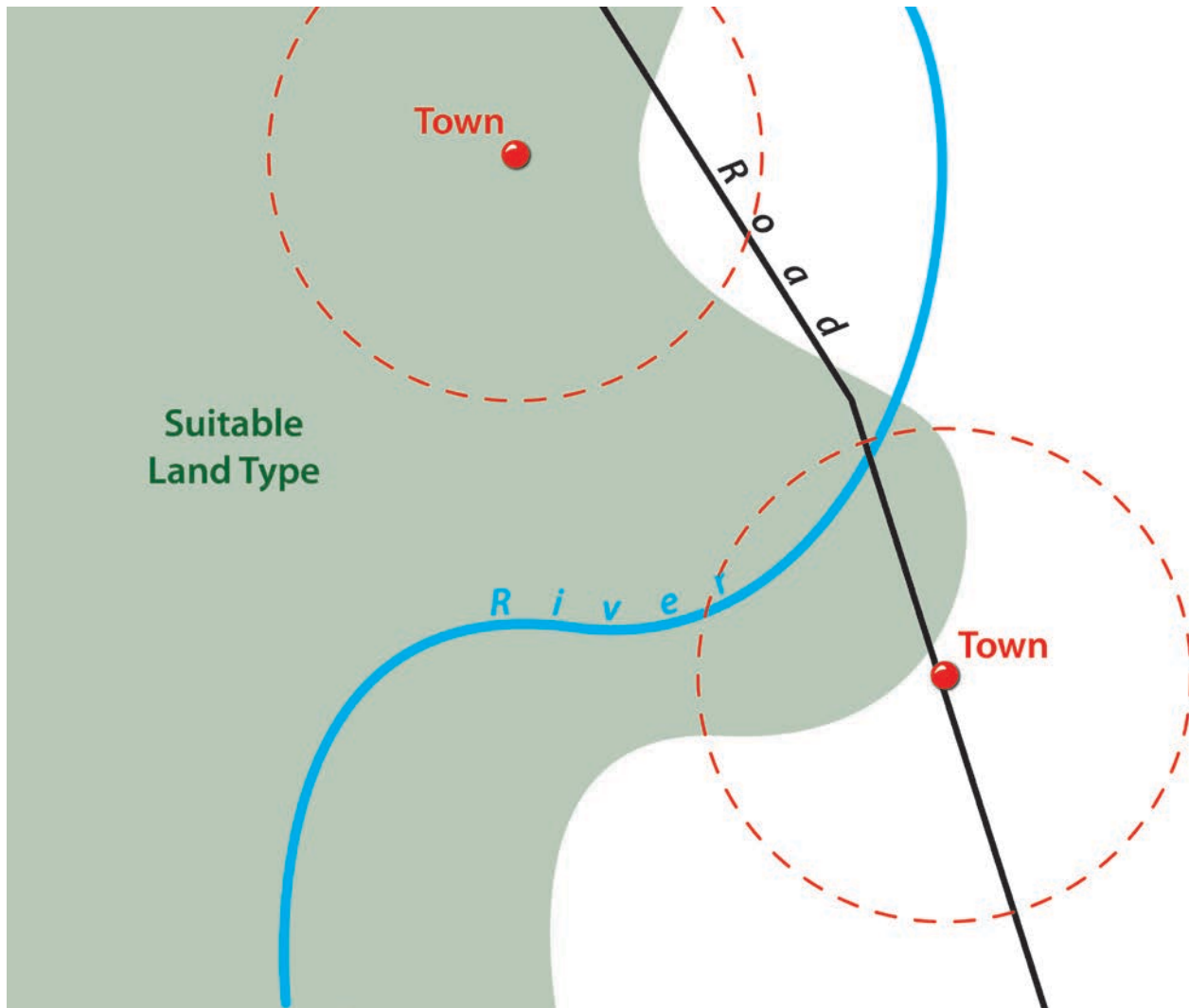




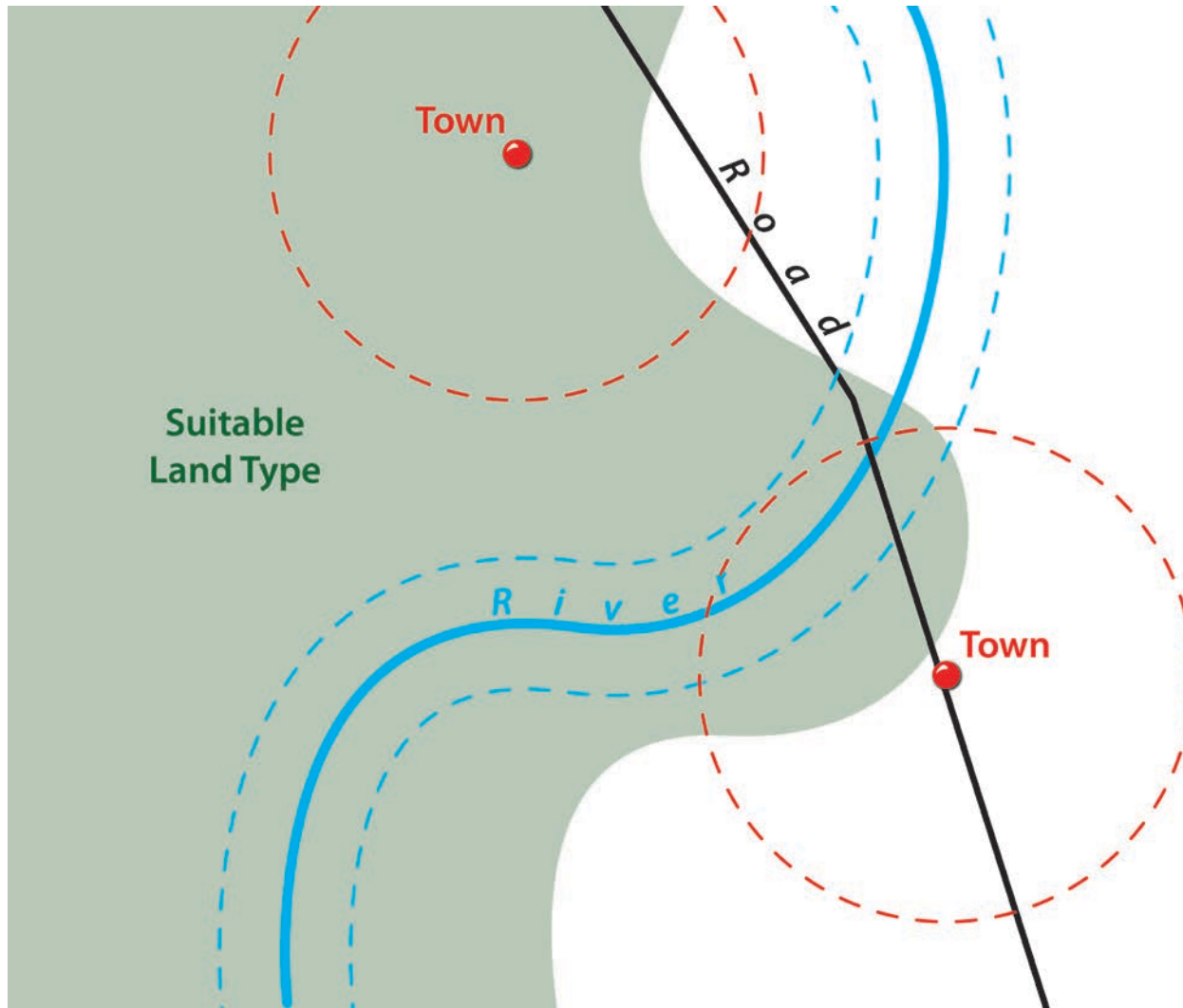
Initial Site Considerations



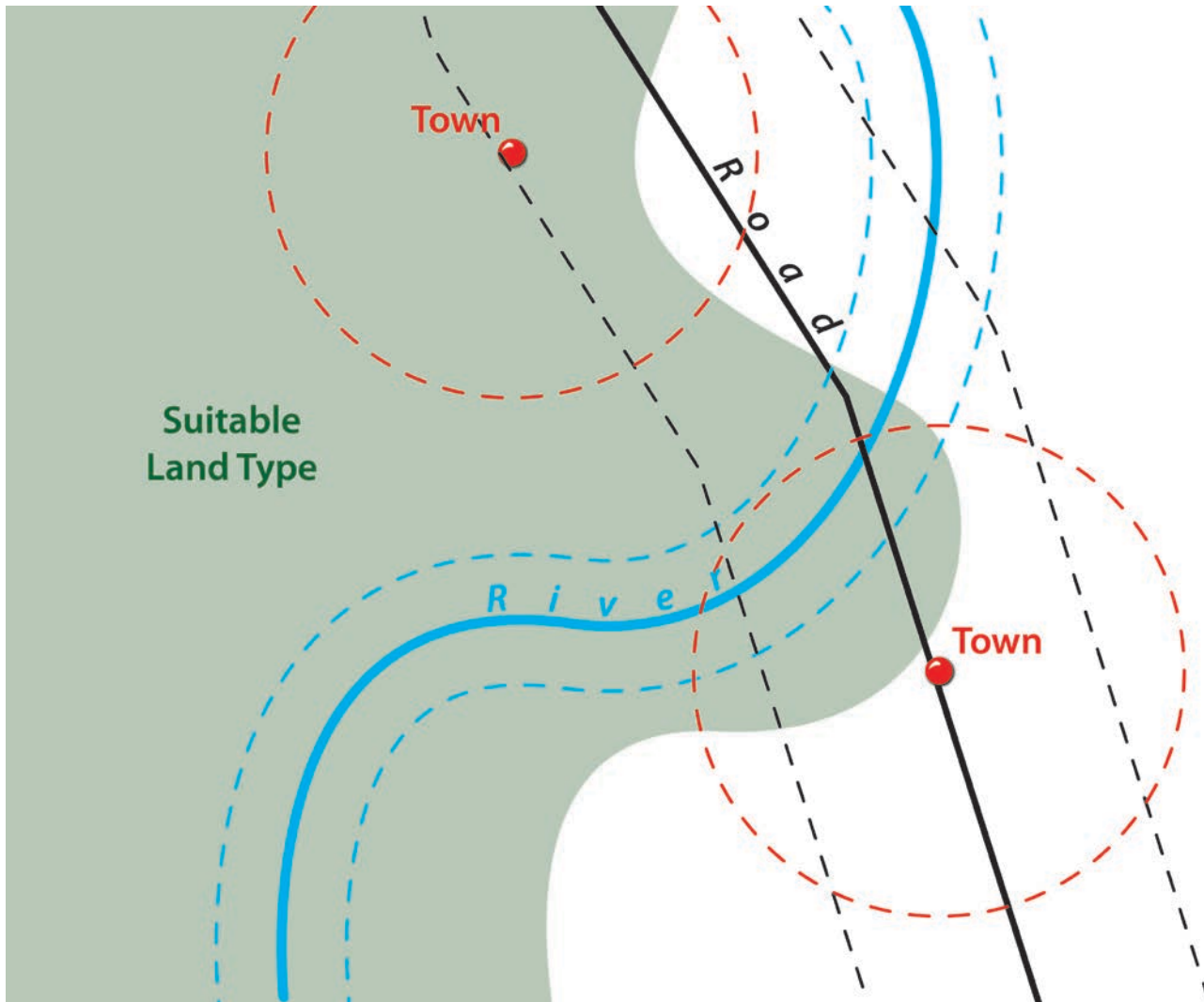
Initial Site Considerations – Urban Centers



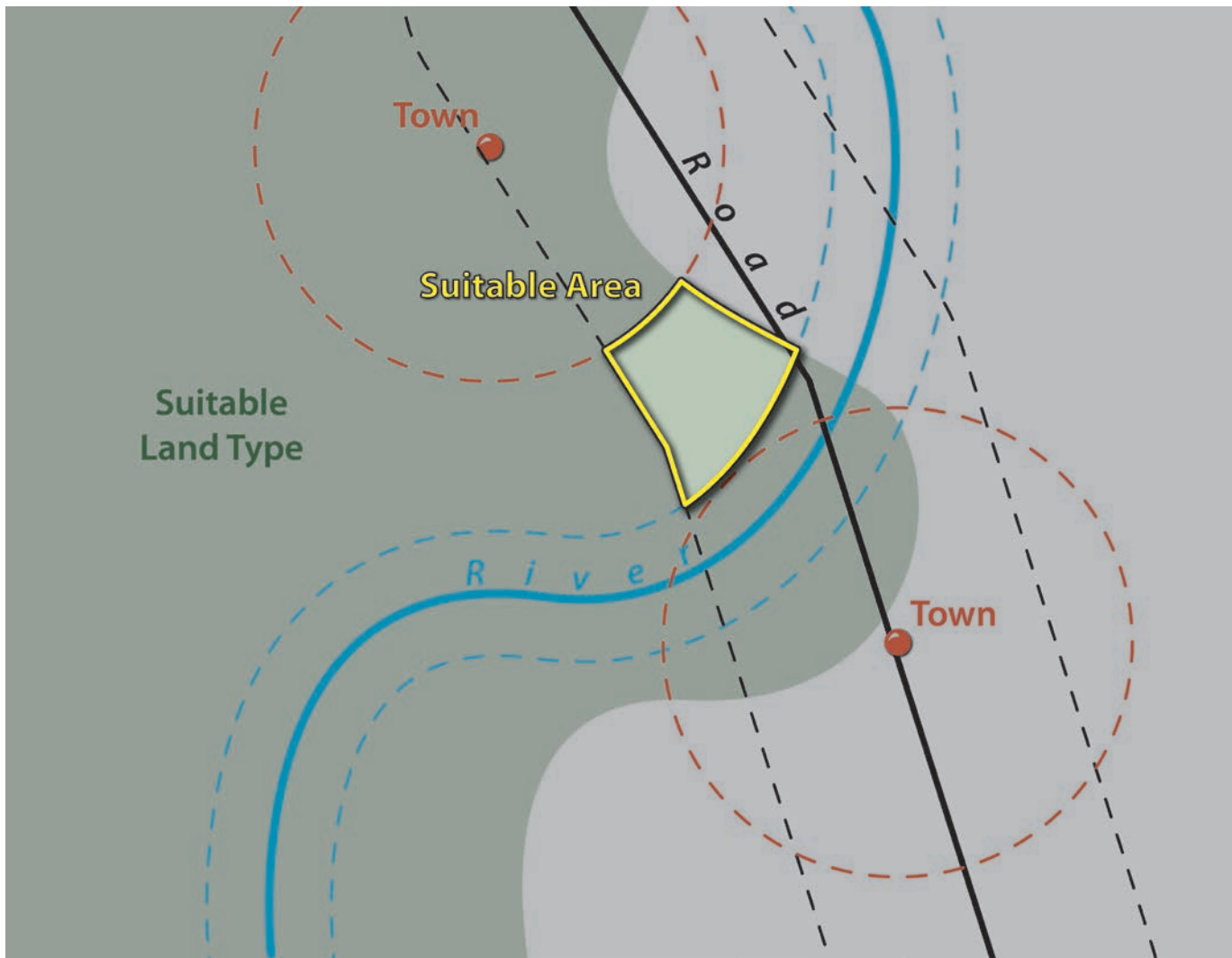
Initial Site Considerations - Rivers



Initial Site Considerations - Roads



Initial Site Considerations – Suitable Area

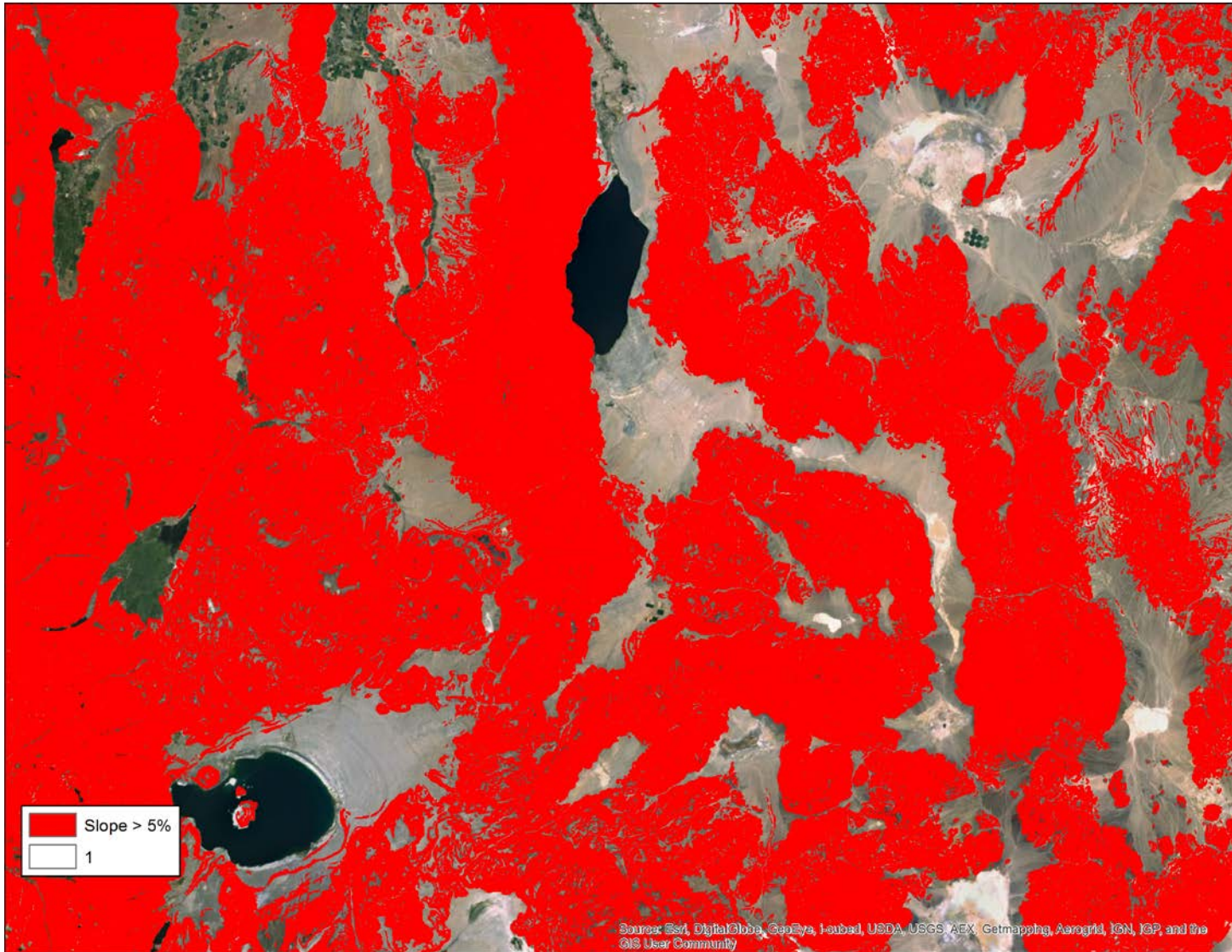




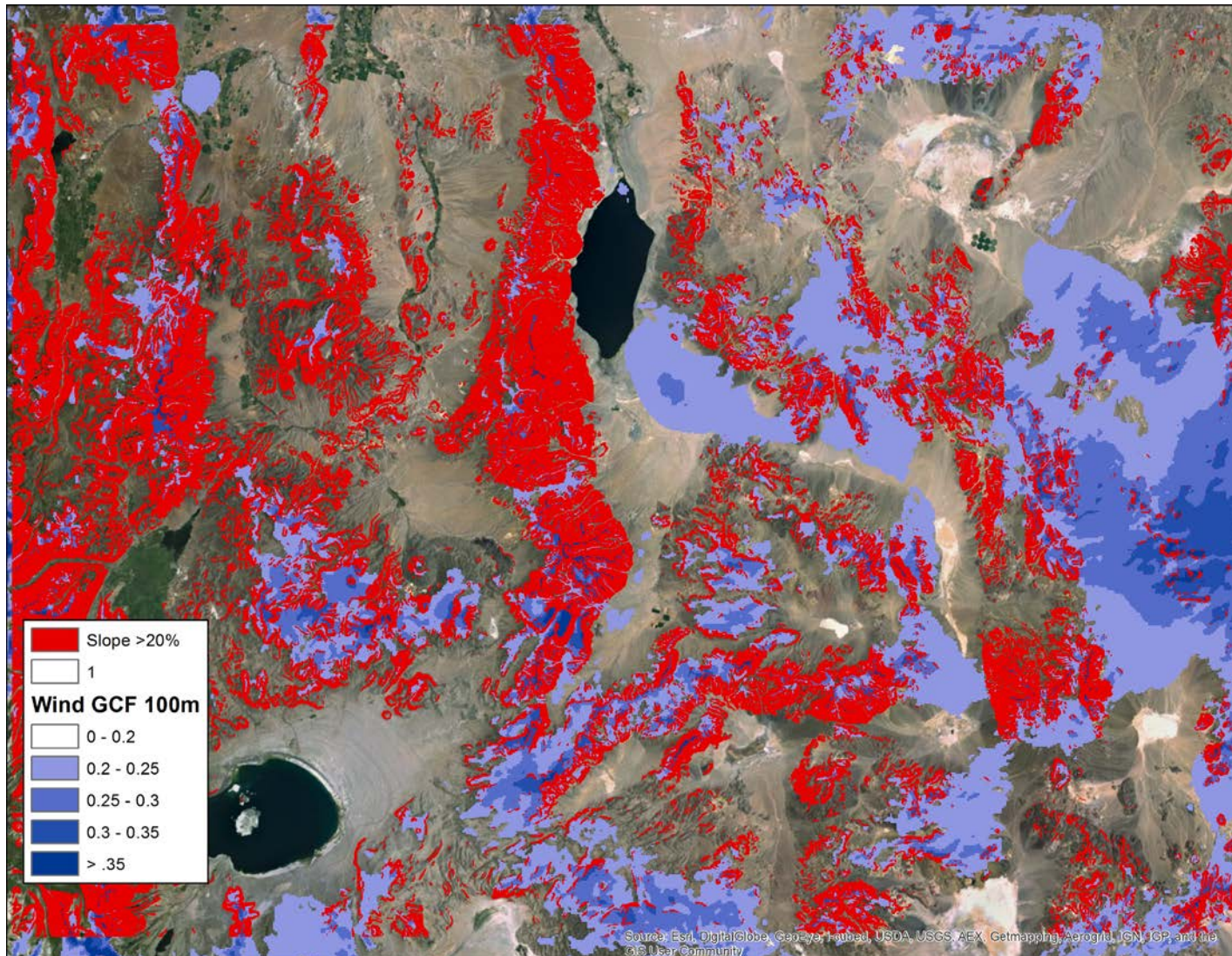
Initial Site Considerations – 1% Slope

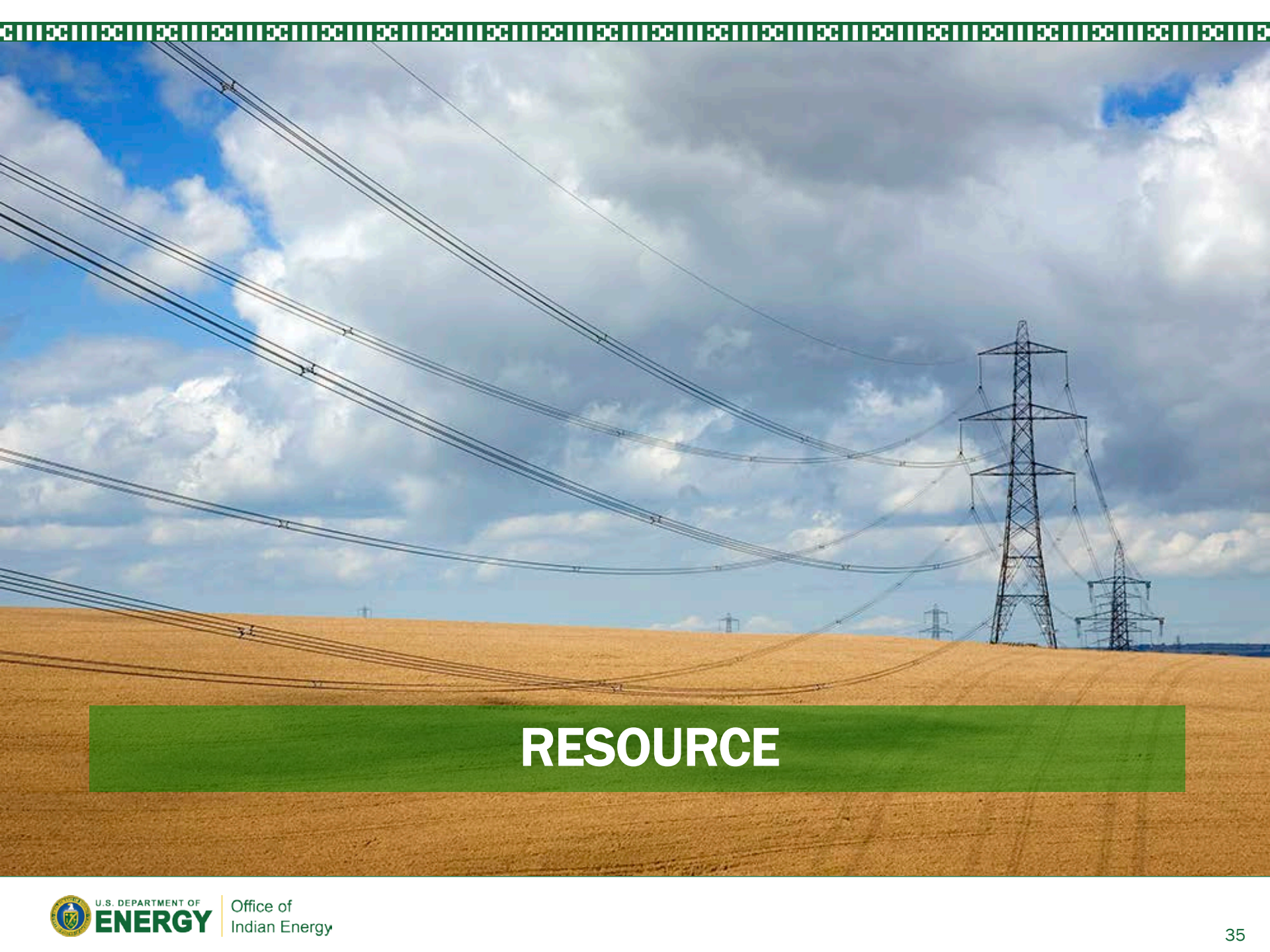


Initial Site Considerations – 5% Slope



Initial Site Considerations – 20% Slope

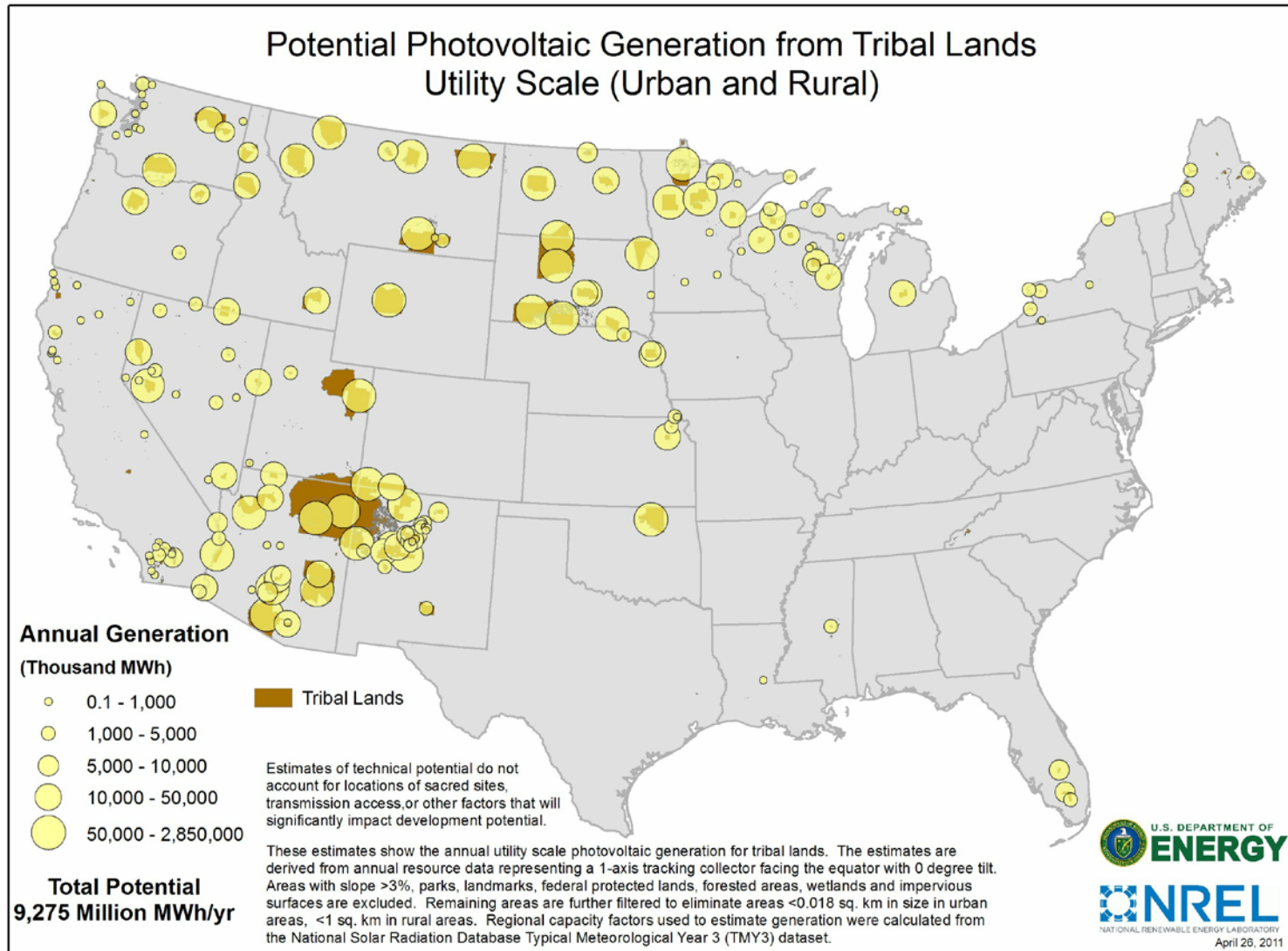




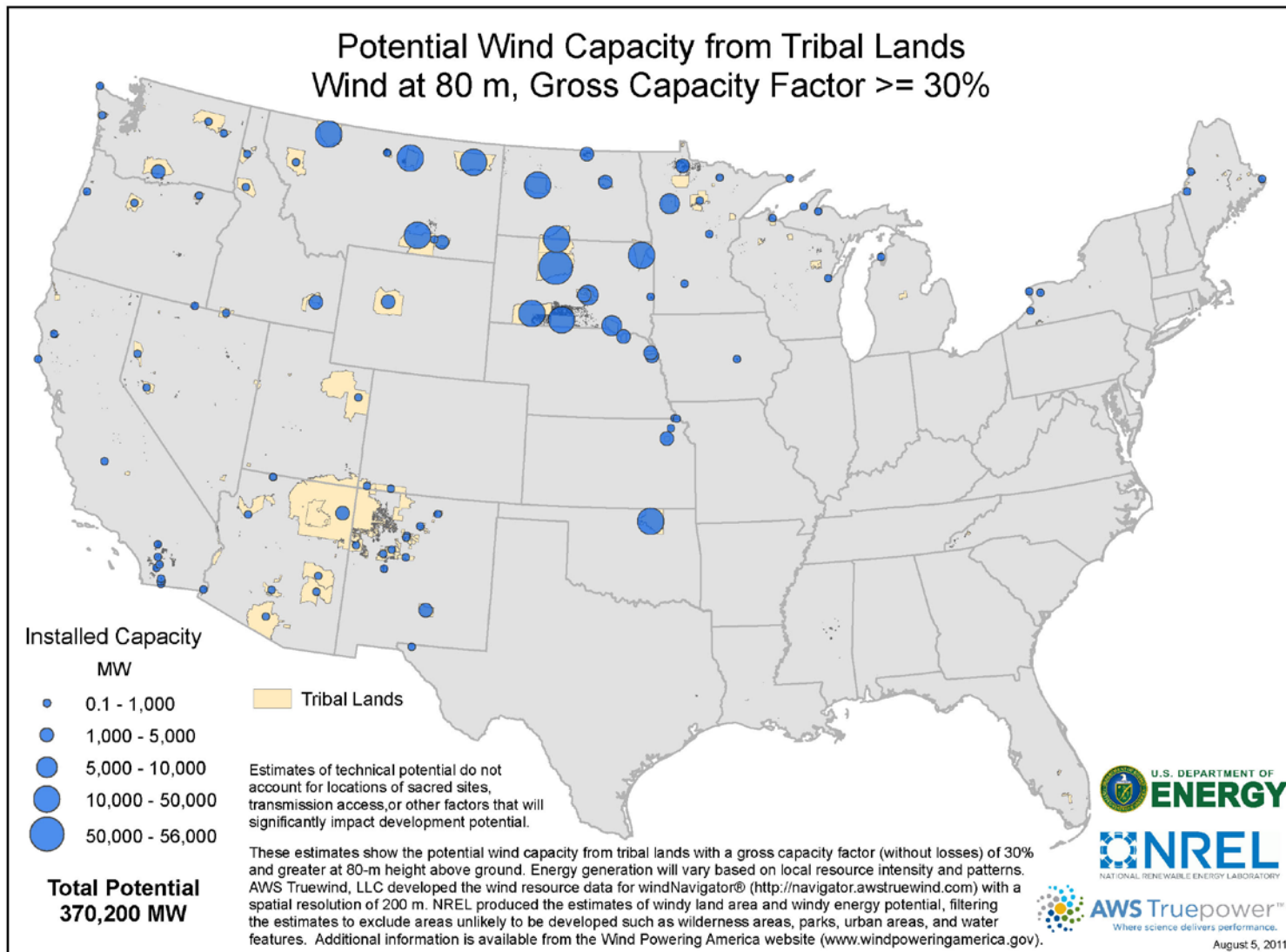
RESOURCE



Solar PV Energy Resource Mapping



Wind Energy Resource Mapping



Basic PV Modeling

The screenshot displays the PVWatts Viewer interface. At the top, it says "PVWatts Viewer" and "National Renewable Energy Laboratory". A map of the United States is shown with a yellow grid overlay. A "PVWatts Tool" dialog box is open, prompting the user to "Click on the map to identify a PVWatts (x2) grid cell:" or "Enter a zip code:". Below the map, there is a form with the following sections:

PV Walls
Click on **Calculate** if default values are acceptable, or after selecting your system specifications. Click on **Help** for information about system specifications. To use a DC to AC derate factor other than the default, click on **Derate Factor Help** for information.

Site Location:
Cell ID: 0221361
State: Nebraska
Latitude: 42.299
Longitude: -98.763

PV System Specifications:
DC Rating (kW): 4.0
DC to AC Derate Factor: 0.77 (DERATE FACTOR HELP)
Array Type: Fixed Tilt

Fixed Tilt or 1-Axis Tracking System:
Array Tilt (degrees): 42.299 (Default = Latitude)
Array Azimuth (degrees): 180.0 (Default = South)

Energy Data:
Cost of Electricity (cents/kWh): 7.693

Buttons: Calculate, HELP, Reset Form

Project Description

The PVWatts application is an interactive map-based interface to rapidly utilize the PVWatts calculator. The PVWatts calculator is a basic solar modeling tool developed at NREL to allow non-experts to quickly obtain performance estimates for grid-connected PV systems.

Project Impact

This project is focused on providing the general public with a basic solar performance modeling tool and is one of the most heavily visited page on the NREL website. Users can get an estimate of expected monthly and annual solar resource values for any location in the United States.

Users

Generally solar installers, but really anyone is able to use this to get a first cut of the potential output. Many national subsidy providers use PVWatts to determine the amount of subsidy a homeowner can receive.

Data Analysis and Visualization Group

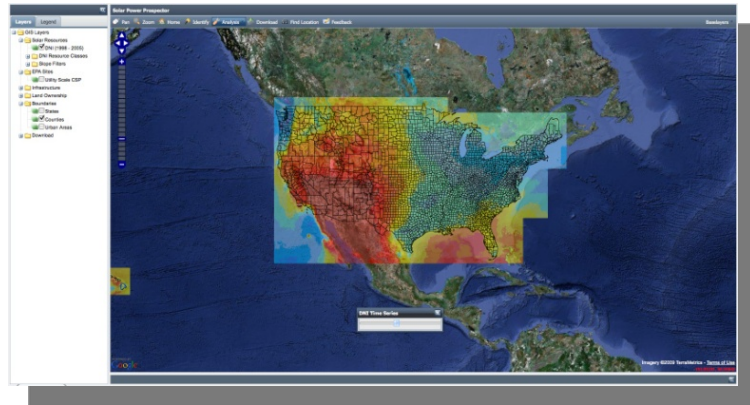
Project Lead: Dan Getman

Dan.getman@nrel.gov

The Solar Prospector

<http://maps.nrel.gov/prospector>

Citing Utility-Scale CSP



Project Description

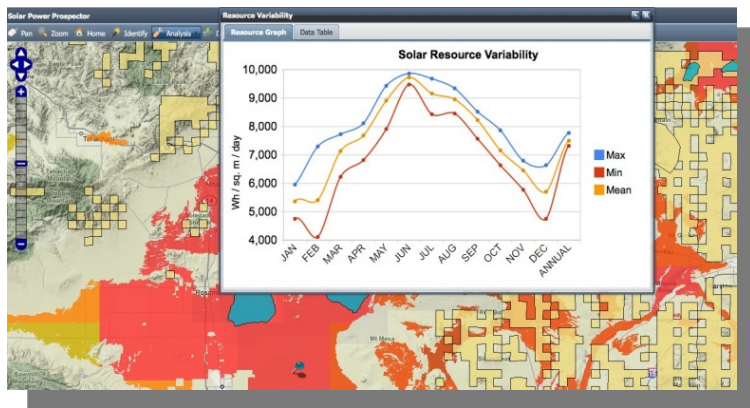
The Solar Prospector is a Web-based Geographic Information System (GIS) tool designed to assist industry professionals in the siting of utility-scale solar plants. The tool employs various GIS datasets to help identify areas that may have a high potential for solar plant development. Additionally, the Solar Prospector forms a platform to disseminate all solar related geospatial data to the larger industry and analysis community.

Project Impact

This project provides the location of solar resources, land ownership, and general infrastructure in an easy to use map format. Users can quickly download hourly solar resource data for specific locations and perform temporal analyses for any location in the United States and North Mexico.

Users

- Originally developed for CSP and expanded to PV; the CSP project development industry is a heavy user of the tool
- DOE/Lab analysts
- PV developers interested in information from the federal government



Data Analysis and Visualization Group

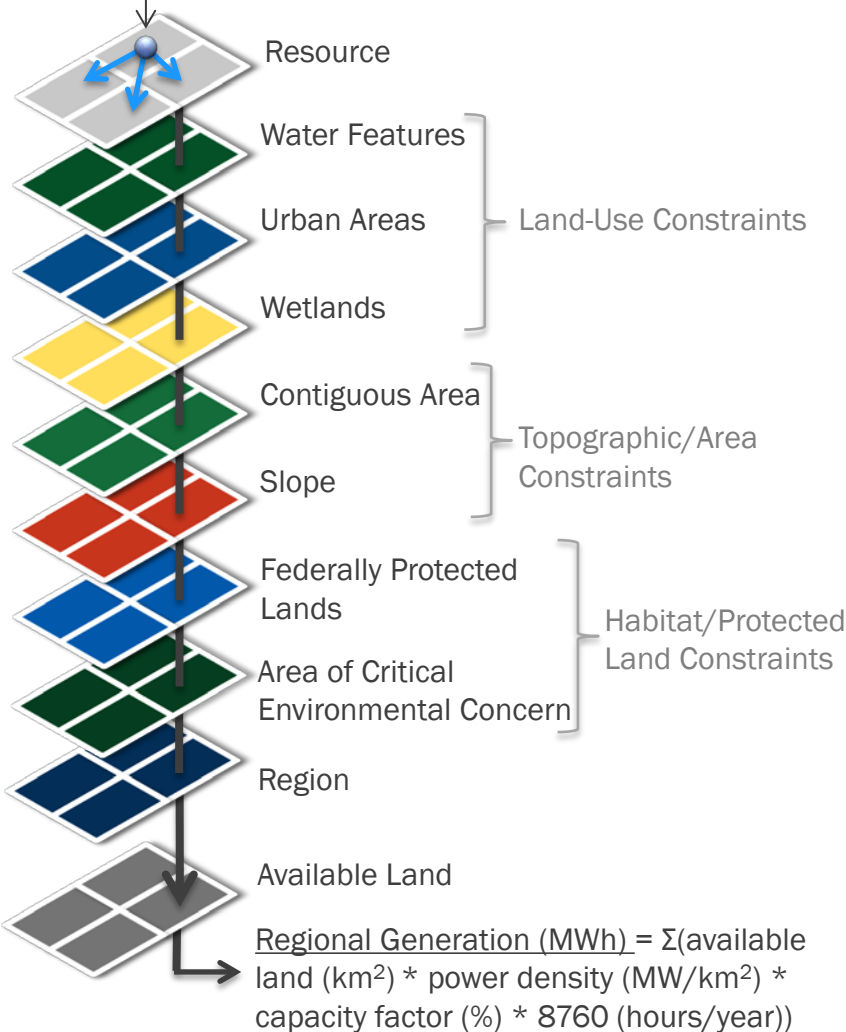
Project Lead: Ted Quinby

ted.quinby@nrel.gov

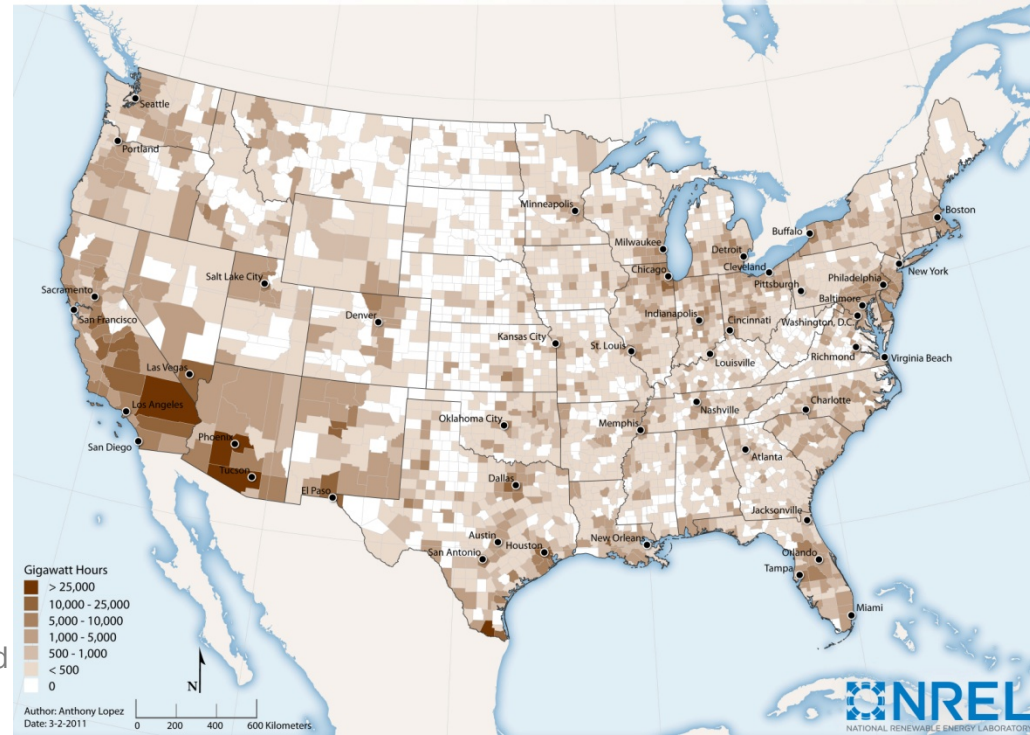
Renewable Resource Characterization & Technical Potential

Layer Stacking

Regional (or cell based) Capacity Factor



PV Utility (Urban) Technical Potential - U.S. Counties



Technical Potentials produced:

- Photovoltaic (PV) Utility – Urban & Rural
- PV Rooftop
- Concentrating Solar Power (CSP)
- Onshore Wind
- Offshore Wind
- Biopower – Gaseous and Solid Biomass
- Geothermal
- Hydropower

*See Technical Potential Worksheet for data sources, descriptions, and details

NREL Tools Links

Map Apps at NREL	http://maps.nrel.gov
MapSearch	http://www.nrel.gov/gis/mapsearch/
REAtlas	http://maps.nrel.gov/reatlas
IMBY	http://mercator.nrel.gov/imby
SAM	http://sam.nrel.gov
HyDRA	http://maps.nrel.gov/hydra
RE_Atlas	http://maps.nrel.gov/re_atlas
Solar Prospector	http://maps.nrel.gov/prospector
OpenPV	http://openpv.nrel.gov/gallery
PVDAQ	http://maps.nrel.gov/pvdaq
LCOE Calculator	http://www.nrel.gov/analysis/tech_lcoe.html
GeoREServ API	http://rpm.nrel.gov/docs/georeserv/
REEDS	http://www.nrel.gov/analysis/reeds/
PV JEDI	http://www.nrel.gov/analysis/jedi/
OpenEI	http://openei.org
Smartgrid.gov	http://smartgrid.gov



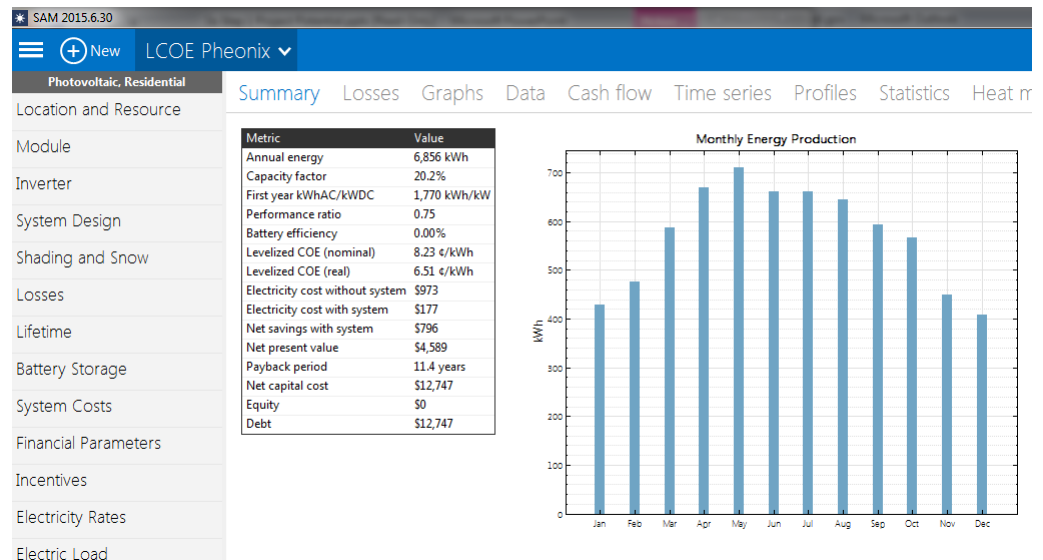
PROJECT SAVINGS AND PRODUCTION POTENTIAL

Advanced Tool: NREL's System Advisor Model

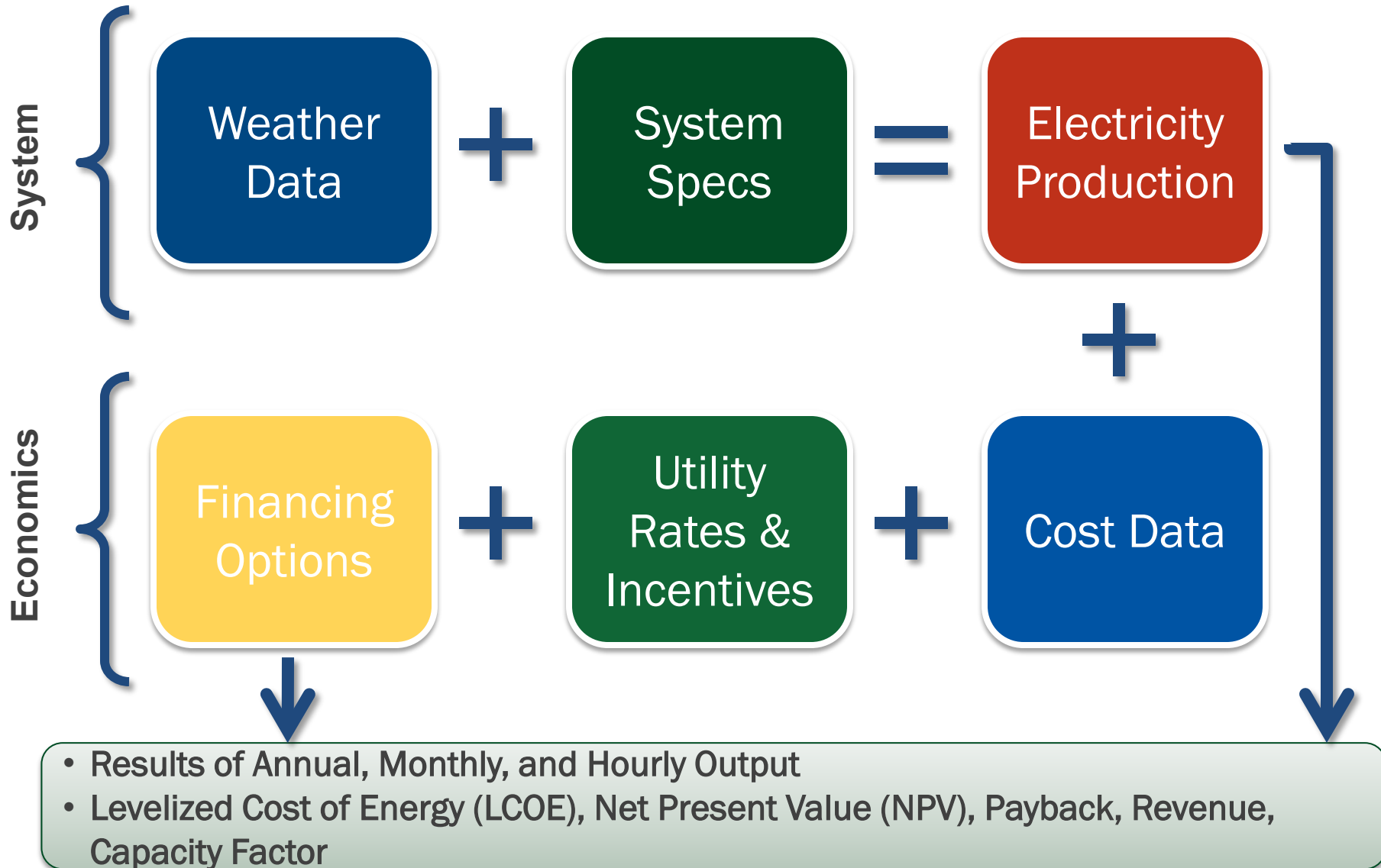
Available at: <https://sam.nrel.gov/>

NREL's System Advisor Model (SAM) is a free computer program that **calculates a renewable energy system's hourly energy output over a single year and calculates the cost of energy** for a renewable energy project over the life of the project.

- Solar, wind, geothermal, and other renewable and fossil technologies available
- These calculations are done using detailed performance models, a detailed cash flow finance model, and a library of reasonable default values for each technology and target market



General Modeling Workflow



Technologies in SAM



Photovoltaics



Concentrating PV



Solar Water Heating



Geothermal



Parabolic Trough



Power Tower



Linear Fresnel



Dish-Stirling



Small Wind



Utility-Scale Wind



Biomass Power



Conventional

Commercial-Scale Project Risks – Post Step 1

	Risks	Risk Assessment Post Step 1
Development	<ul style="list-style-type: none"> • Poor or no renewable energy resource assessment • Not identifying all possible costs • Unrealistic estimation of all costs • Community push-back and competing land use 	<p><u>Screened good sites</u></p> <p><u>Reduced</u></p> <p><u>Reduced</u></p> <p><u>Reduced</u></p>
Site	<ul style="list-style-type: none"> • Site access and right of way • Not in my backyard (NIMBY)/build absolutely nothing anywhere (BANANA) • Transmission constraints/siting new transmission 	<p>Unchanged; Critical to have site control and community support</p>
Permitting	<ul style="list-style-type: none"> • Tribe-adopted codes and permitting requirements • Utility interconnection requirements • Interconnection may require new transmission, possible NEPA 	<p><u>Reduced</u></p> <p><u>Reduced</u></p> <p><u>High risk, reduced</u></p>
Finance	<ul style="list-style-type: none"> • Capital availability • Incentive availability risk • Credit-worthy purchaser of generated energy 	<p>High risk, unchanged</p> <p><u>Reduced</u></p> <p>Unchanged</p>
Construction/ Completion	<ul style="list-style-type: none"> • Engineering, procurement, and construction (EPC) difficulties • Cost overruns • Schedule 	<p>Assumed low, mitigable, or allocatable</p>
Operating	<ul style="list-style-type: none"> • Output shortfall from expected • Technology O&M • Maintaining transmission access and possible curtailment 	<p>Assumed low, mitigable, or allocatable</p>

Small Group Exercise

- Evaluate pre-identified 10 sites on a map for potential development (considering what you just learned)