DOE OFFICE OF INDIAN ENERGY

Utility-Scale Energy Development

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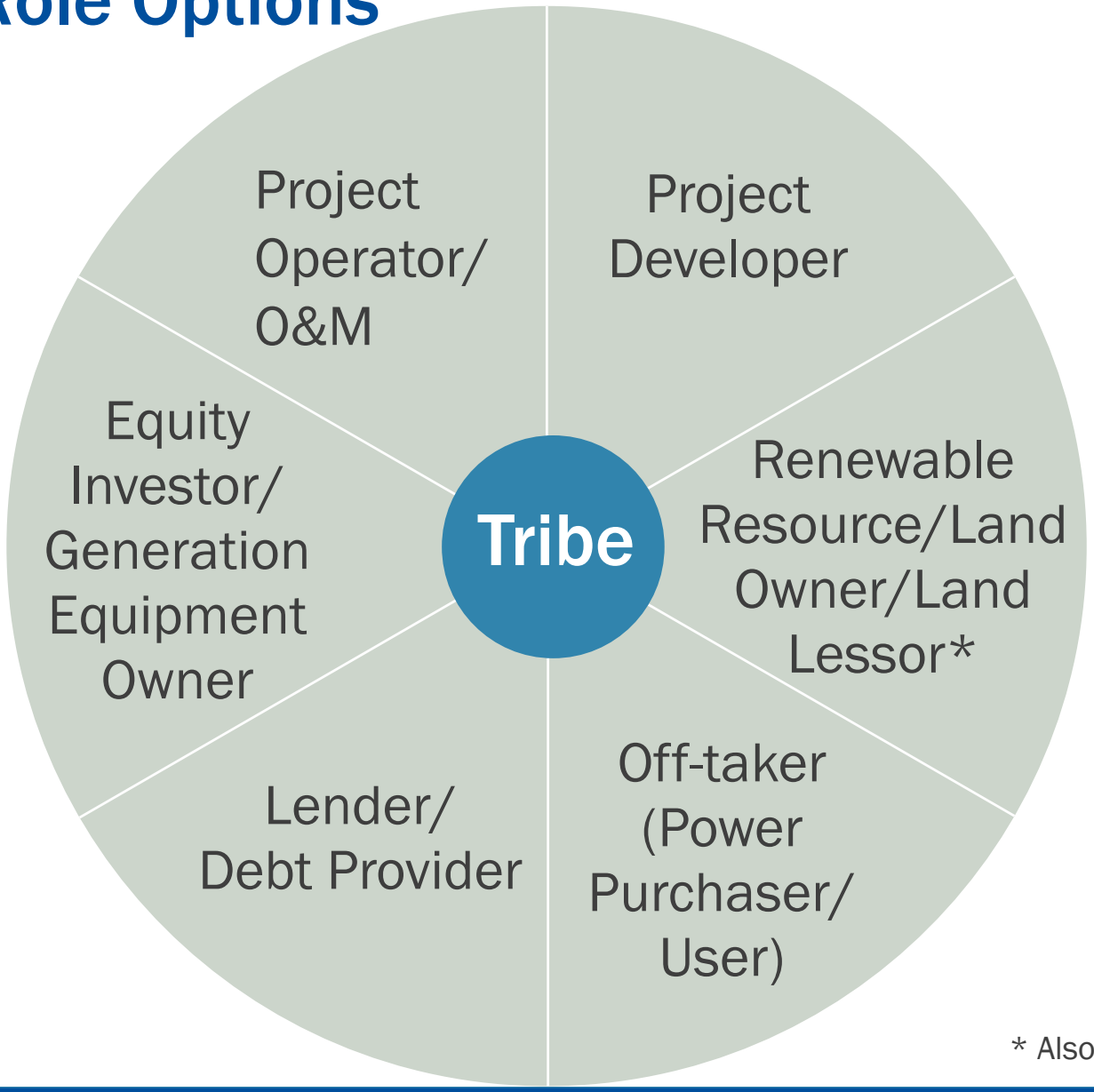
National Renewable Energy Laboratory (NREL)

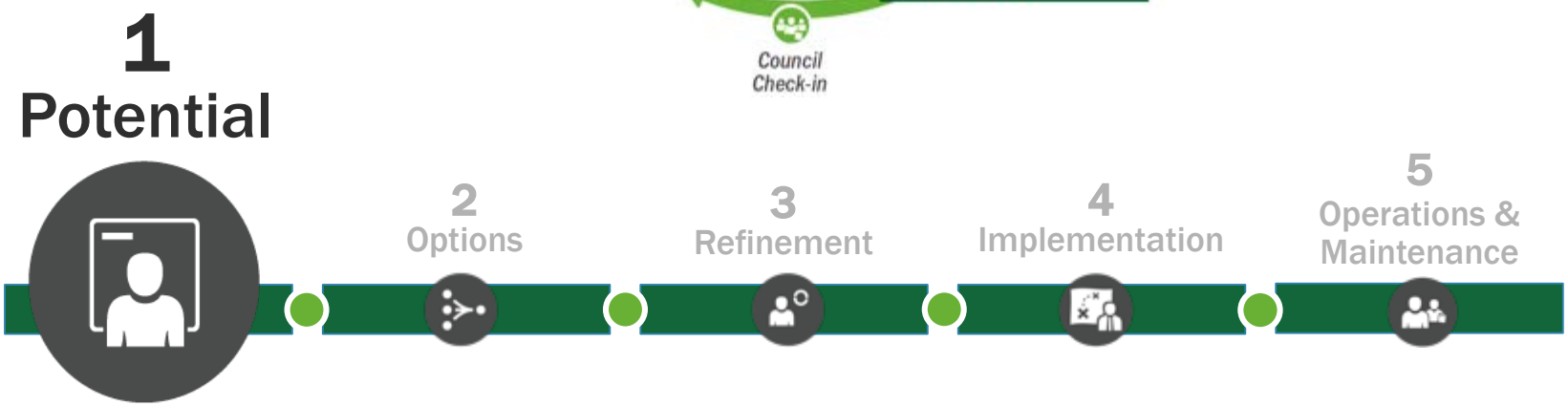
U.S. DEPARTMENT OF ENERGY | Office of Indian Energy

Tribal Role Options



* Also called Tribal Host

Project Development Steps



https://www.energy.gov/indianenergy/renewable-energy-online-learning

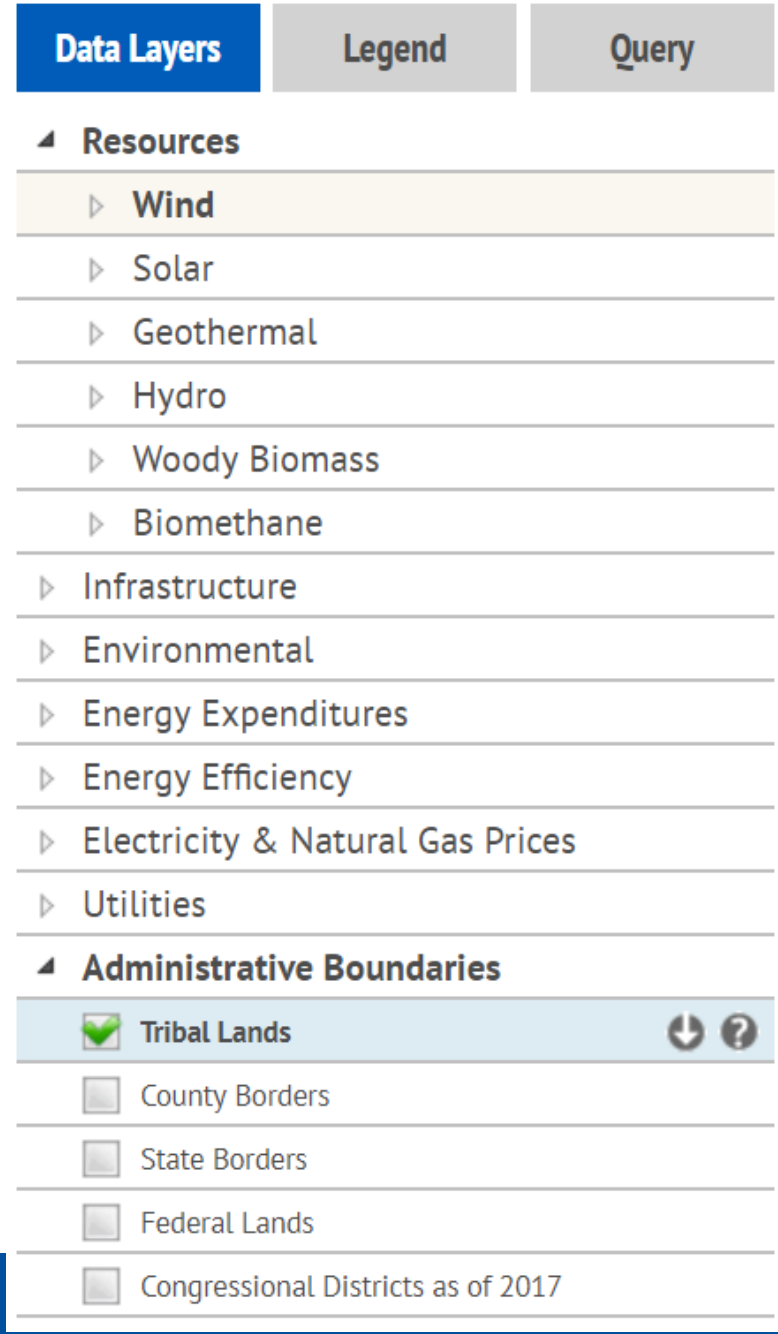
Agenda

- Resource
- Market and Offtakers
- Siting & Permitting
- Project Revenues and Production Potential


RESOURCE

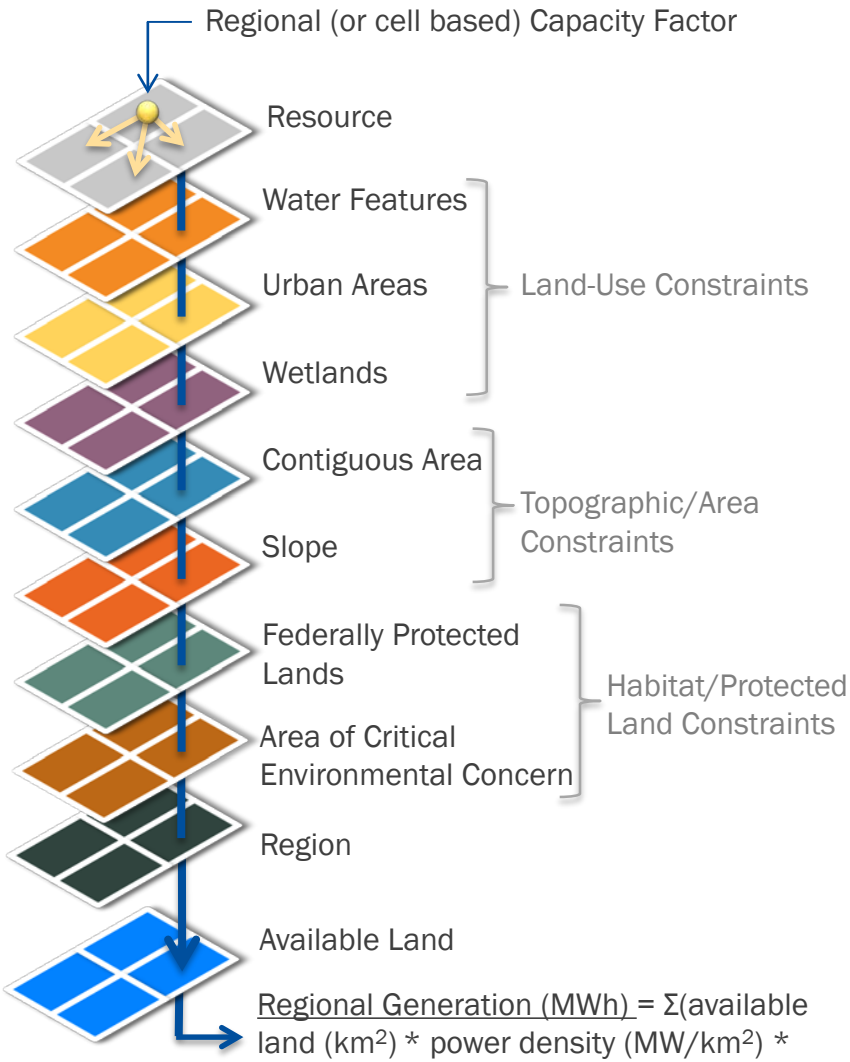
Tribal Energy Atlas

- Interactive, geospatial application
- Allows users to view resources, infrastructure, and other relevant data
- Allows users to query the data and conduct simple analyses
- Provides demographic, installed capacity, and utility-scale RE technical potential summaries by tribe
- Data download and feedback options
- https://maps.nrel.gov/tribal-energy-atlas

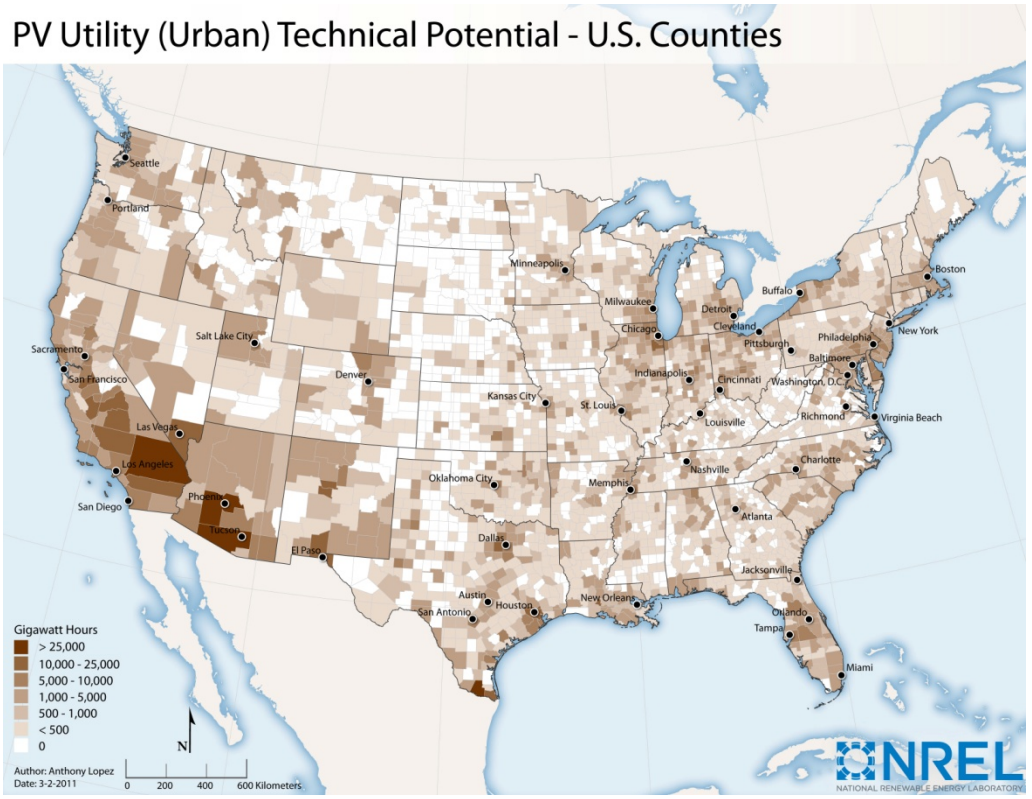


Renewable Resource Characterization & Technical Potential

Layer Stacking



Regional Generation (MWh) = Σ(available land (km^2) * power density (MW/km^2) * capacity factor (%) * 8760 (hours/year))

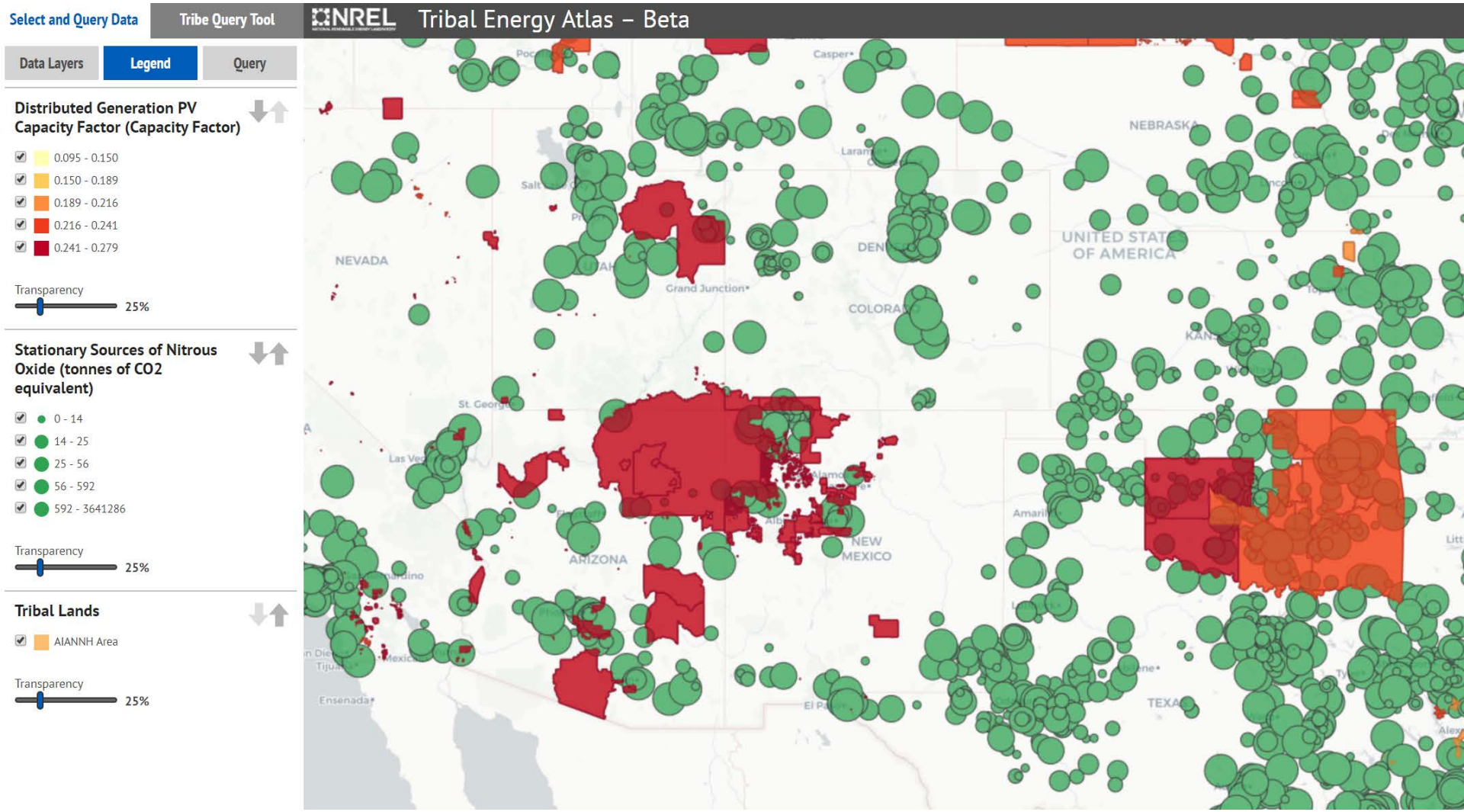


Technical Potentials produced:

- *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

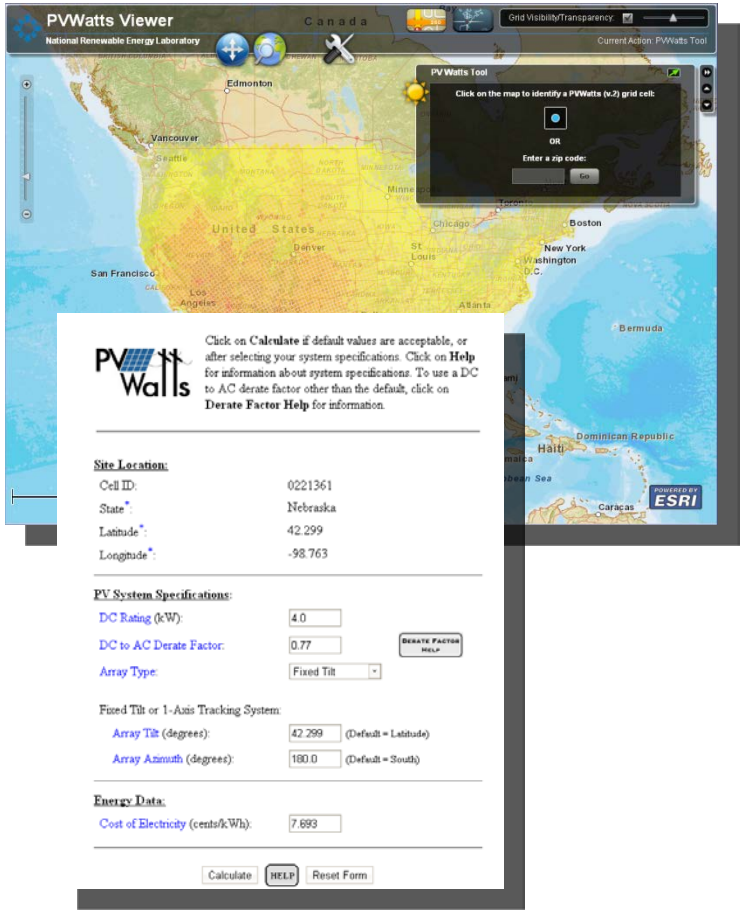
Tribal Energy Atlas



PVWatts

http://maps.nrel.gov/pvwatts

Basic PV Modeling



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
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MARKET & OFFTAKERS

Utility-Scale Considerations

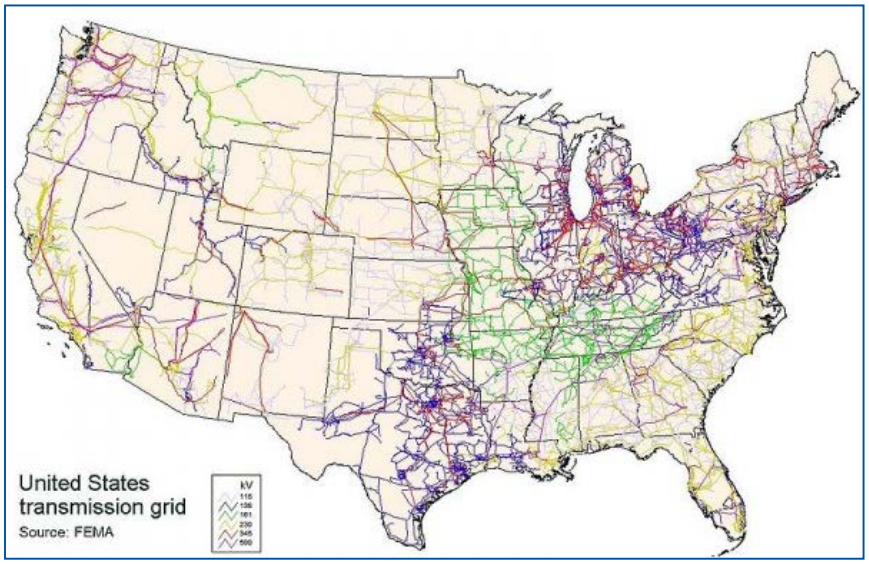
- Need an off-taker to buy electricity
  - A utility
  - A large corporation, industrial entity, or government agency (e.g., military base)
- Or, a developer who will work to find an off-taker and develop the project
- Utility motivated by Renewable Portfolio Standard (RPS) compliance, cost, etc.
- Non-utilities motivated for a number of reasons, including: cost savings, sustainability goals, and energy hedging

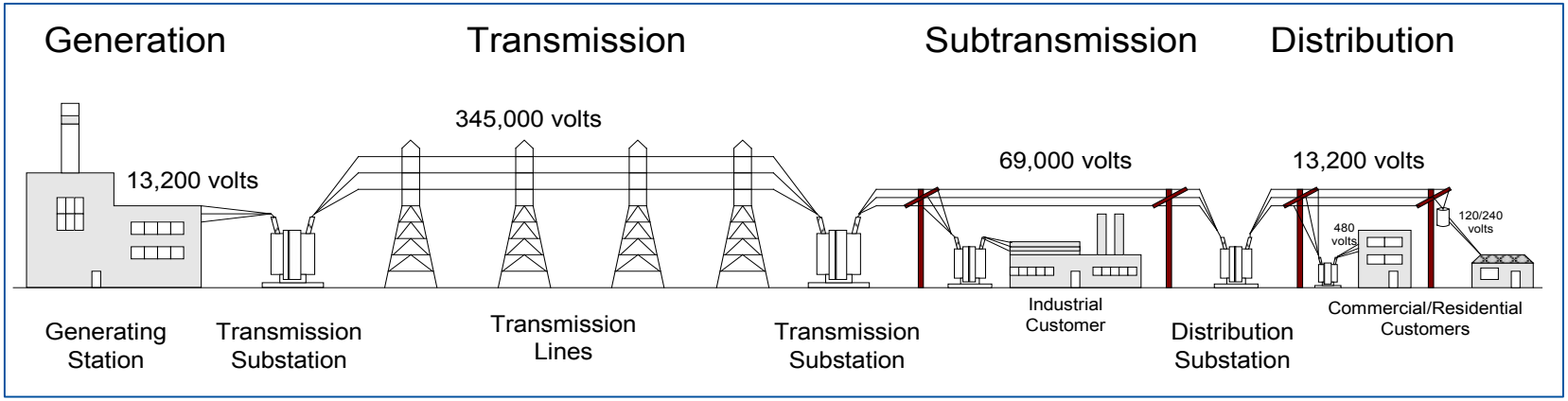
The Electricity Grid

It is not enough to identify a market for the electricity

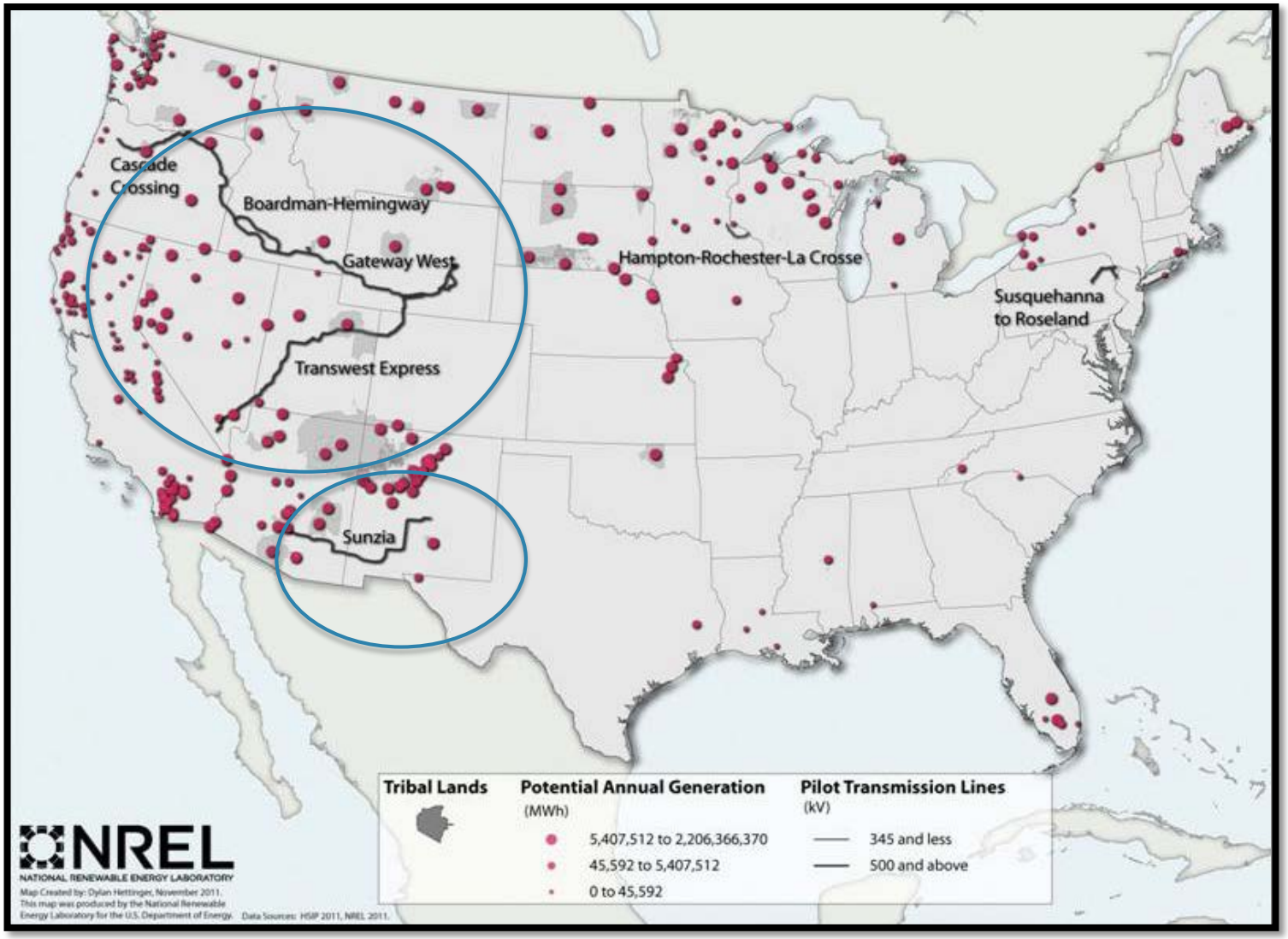
Can you get the electricity to market?

- Existing transmission lines?
- Capacity on those lines?





Projected Transmission



Project Agreements

Key Contracts:

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

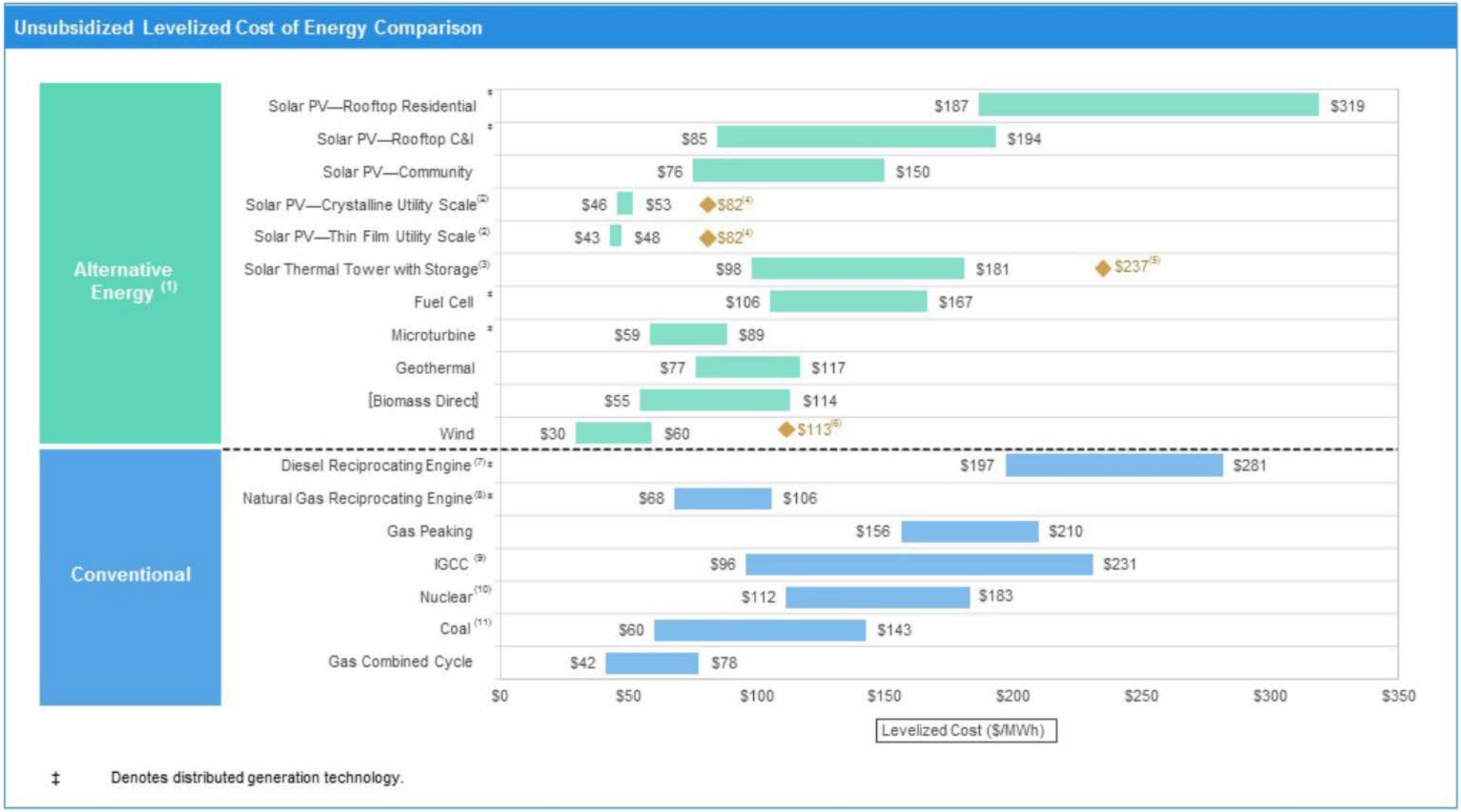
Interconnection agreement

- Allows electricity to flow into grid and dictates equipment and upgrades required to interconnect

Transmission agreement

- May be needed for access on third party controlled transmission lines

Market: Electricity Levelized Cost Comparison



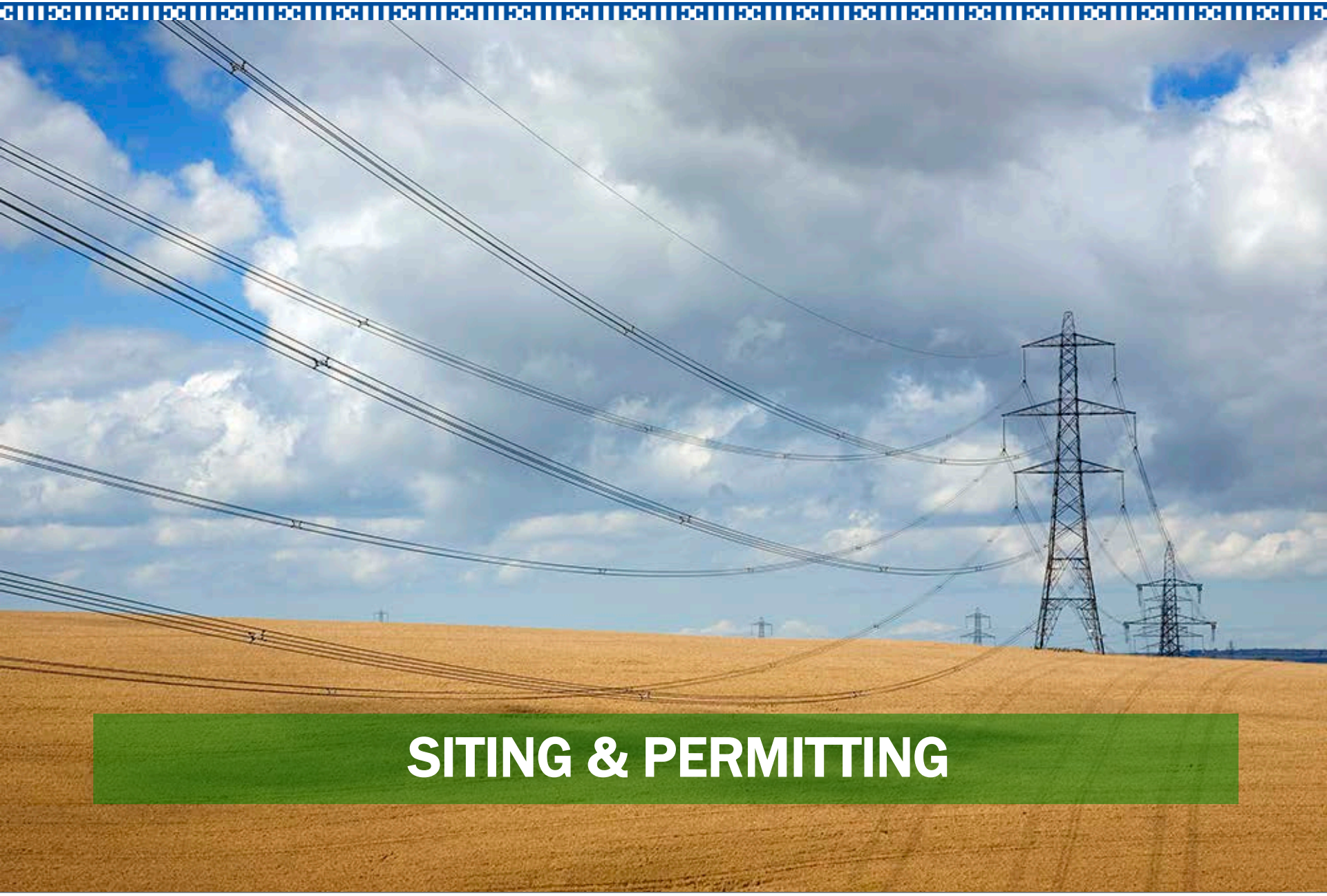
Source: Lazard's Levelized Cost of Energy Analysis Version 11.0; https://www.lazard.com/perspective/levelized-cost-of-energy-2017/

Utility-Scale Project Risks

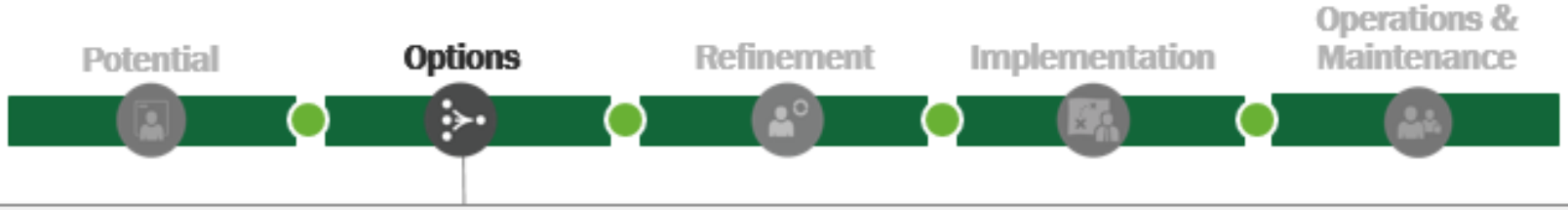
	Risks	Risk Assessment Post Step 1
Development	• Poor or no renewable energy resource assessment • Not identifying all possible costs • Unrealistic estimation of all costs • Community push-back and competing land use	Screened good sites Reduced Reduced Reduced
Site	• Site access and right of way • Not in my backyard (NIMBY)/build absolutely nothing anywhere (BANANA) • Transmission constraints/siting new transmission	Unchanged; Critical to have site control and community support
Permitting	• Tribe-adopted codes and permitting requirements • Utility interconnection requirements • Interconnection may require new transmission, possible NEPA	Reduced Reduced High risk, reduced
Finance	• Capital availability • Incentive availability risk • Credit-worthy purchaser of generated energy	High risk, unchanged Reduced Unchanged
Construction/ Completion	• Engineering, procurement, and construction (EPC) difficulties • Cost overruns • Schedule	Assumed low, mitigable, or allocatable
Operating	• Output shortfall from expected • Technology O&M • Maintaining transmission access and possible curtailment	Assumed low, mitigable, or allocatable

Sources: Adapted from Holland & Hart, RE Project Development & Finance & Infocast, Advanced RE Project Finance & Analysis

NOTE: Underlining signifies that the risk assessment outcome changes during the step at hand.


SITING & PERMITTING

Considerations for Permitting, Regulations, and Laws

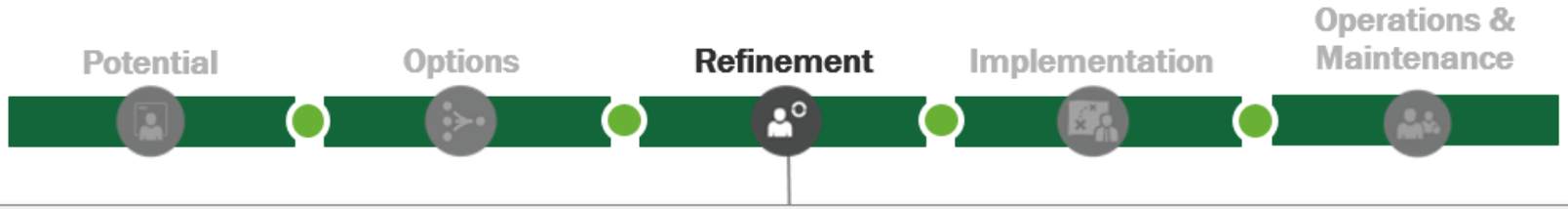


A. Determine ownership before applying for federal, tribal, and state laws and regulations. http://teeic.indianaffairs.gov/triballand/
   - Two types of **individually owned land**: (1)trust land and (2)restricted fee land
   - Three types of **tribally owned land**: (1)trust land, (2)restricted fee 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.

Determine Type of Permitting Necessary

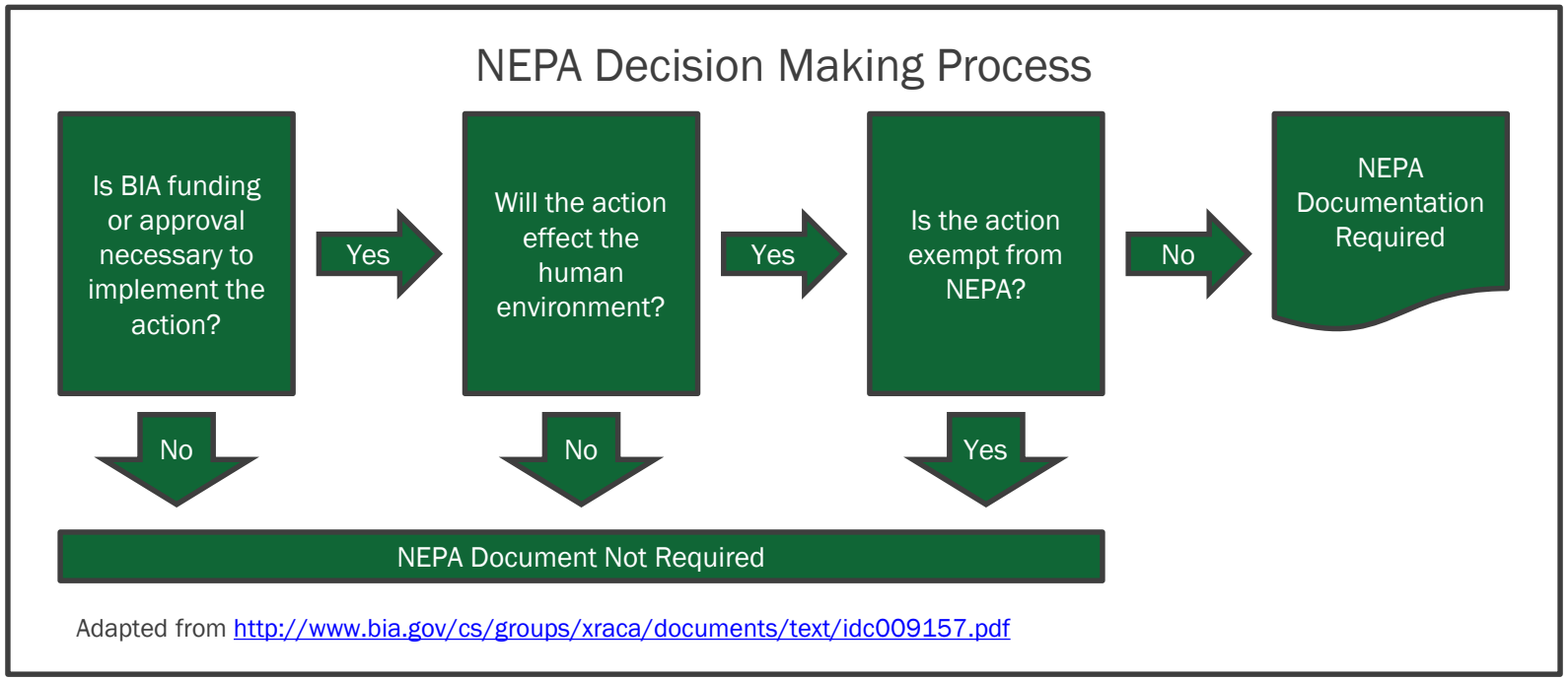


Key Types of Permitting at Tribal Community & Facility Level	Always	Sometimes	Rarely
Interconnection agreement	✓		
Environmental permitting		✓	
Transmission permitting		✓	
Off-take agreement	✓		
Local and State permitting			✓
Federal permitting		✓	
Local Tribal permitting	✓		

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



Adapted from http://www.bia.gov/cs/groups/xraca/documents/text/idc009157.pdf

Site Due Diligence

Consideration	Applicability	Resources
Wetlands/ Waterways	• 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	• Soil conditions impact structural design and site feasibility. • 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	• Check for critical habitat, riparian areas, and endangered species of flora or fauna that may be impacted.	http://ecos.fws.gov/crithab/flex/crithabMapper.jsp?
Driveway/access	• 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?	Check local, state, or federal department of transportation or equivalent

Site Due Diligence (cont.)

Consideration	Applicability	Resources
Easements/ Encumbrances/ Rights-of-way	• 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	• 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	• 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	• 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

Reducing Site Risks

For utility-scale projects on tribal lands to be competitive in the electricity market and attract investors, they must have a site with minimal development risks. Once a site is selected, actions to reduce development risk include:

- Documentation there are no cultural resources on the site through a phase I review or phase II transect study
- Documentation there are no threatened and endangered species impacts through a desktop review (at a minimum) and site visit
- BIA approval for land use/lease
- Letters of support for project development signed by tribal chair, village president, staff leaders
- Completed interconnection study for selected site(s)
- Exemptions from certain tribal taxes, clarity on how others will be assessed
- Attractive and clear lease terms and conditions
- Clarity on where legal disputes will be resolved – Requiring developers to resolve disputes in tribal courts may present too great of a risk to entice sufficient interest in an RFP.

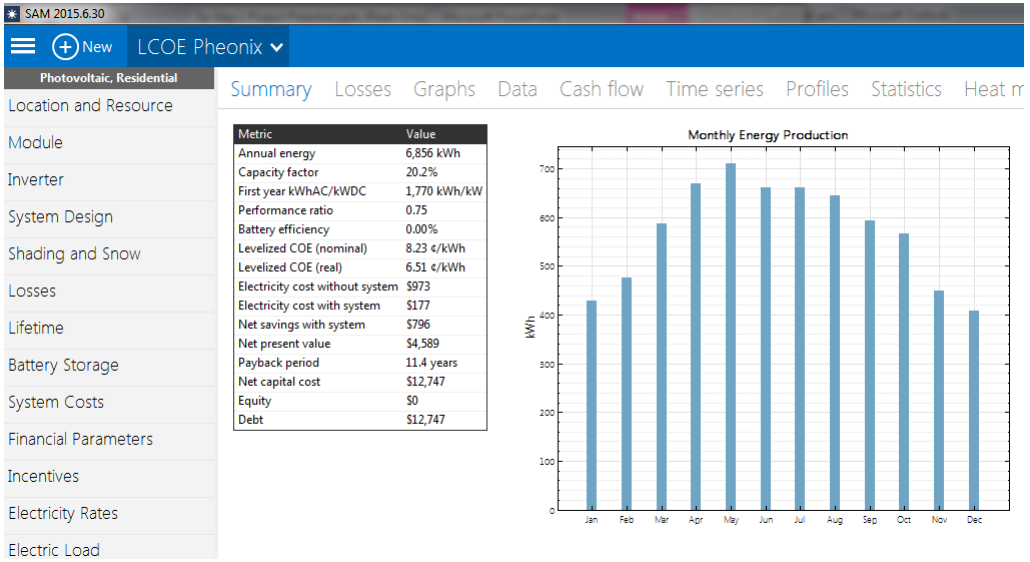
PROJECT REVENUES AND PRODUCTION POTENTIAL

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



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

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

Thank you

Questions?

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