DOE OFFICE OF INDIAN ENERGY

Utility-Scale Energy Development

Megan Day, AICP
National Renewable Energy Laboratory (NREL)
Tribal Role Options

- Project Operator/O&M
- Equity Investor/Generation Equipment Owner
- Lender/Debt Provider
- Off-taker (Power Purchaser/User)
- Project Developer
- Renewable Resource/Land Owner/Land Lessor*

* Also called Tribal Host
Project Development Steps

1. Potential

2. Options

3. Refinement

4. Implementation

5. Operations & Maintenance

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

• Resource
• Market and Offtakers
• Siting & Permitting
• Project Revenues and Production Potential
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](https://maps.nrel.gov/tribal-energy-atlas)
Renewable Resource Characterization & Technical Potential

Layer Stacking

Regional (or cell based) Capacity Factor

Resource

Photovoltaic (PV) Utility – Urban & Rural

PV Rooftop

Concentrating Solar Power (CSP)

Onshore Wind

Offshore Wind

Biopower – Gaseous and Solid Biomass

Geothermal

Hydropower

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

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

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

Select and Query Data

Data Layers

- Distributed Generation PV Capacity Factor (Capacity Factor)
  - 0.095 - 0.150
  - 0.150 - 0.389
  - 0.389 - 0.516
  - 0.516 - 0.241
  - 0.241 - 0.279

- Stationary Sources of Nitrous Oxide (tonnes of CO2 equivalent)
  - 0 - 14
  - 14 - 25
  - 25 - 56
  - 56 - 592
  - 592 - 3641286

- Tribal Lands
  - AIANIH Area

Legend

Query
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
Dan.getman@nrel.gov

http://maps.nrel.gov/pvwatts
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?

United States transmission grid
Source: FEMA
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

Unsubsidized Levelized Cost of Energy Comparison

- Solar PV—Rooftop Residential: $85, $187, $319
- Solar PV—Rooftop C&I: $76, $150
- Solar PV—Community: $76
- Solar PV—Crystalline Utility Scale: $46, $53, $82
- Solar PV—Thin Film Utility Scale: $43, $48, $82
- Solar Thermal Tower with Storage: $98, $181, $237
- Fuel Cell: $106, $167
- Microturbine: $59, $89
- Geothermal: $77, $117
- [Biomass Direct]: $55, $114
- Wind: $30, $60, $113
- Diesel Reciprocating Engine: $197, $281
- Natural Gas Reciprocating Engine: $68, $106
- Gas Peaking: $96, $156, $210
- IGCC: $112, $183
- Nuclear: $60, $143
- Coal: $42, $78

## Utility-Scale Project Risks

<table>
<thead>
<tr>
<th>Development</th>
<th>Risks</th>
<th>Risk Assessment Post Step 1</th>
</tr>
</thead>
</table>
|             | • 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  
| 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

- 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](http://www1.eere.energy.gov/tribalenergy/guide/legal_issues.html).
<table>
<thead>
<tr>
<th>Key Types of Permitting at Tribal Community &amp; Facility Level</th>
<th>Always</th>
<th>Sometimes</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interconnection agreement</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental permitting</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Transmission permitting</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Off-take agreement</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local and State permitting</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Federal permitting</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Local Tribal permitting</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 Decision Making Process

Is BIA funding or approval necessary to implement the action?  
Yes → Will the action effect the human environment?  
Yes → Is the action exempt from NEPA?  
No → NEPA Decision Making Process

No → NEPA Document Not Required

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Applicability</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetlands/Waterways</td>
<td>• Are there wetlands, water bodies, washes, arroyos, drainage considerations, or floodplain on site?</td>
<td><a href="http://www.fws.gov/wetlands/Data/Mapper.html">http://www.fws.gov/wetlands/Data/Mapper.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="https://msc.fema.gov/portal/search">https://msc.fema.gov/portal/search</a></td>
</tr>
<tr>
<td></td>
<td>• Caliche or bedrock may require costly drilling.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sandy soils may require deeper post embedment to meet wind and snow loading requirements.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Corrosive soils can require measures to protect embedded posts.</td>
<td></td>
</tr>
<tr>
<td>Wildlife/habitat/flora</td>
<td>• Check for critical habitat, riparian areas, and endangered species of flora or fauna that may be impacted.</td>
<td><a href="http://ecos.fws.gov/crithab/flex/crithabMapper.jsp">http://ecos.fws.gov/crithab/flex/crithabMapper.jsp</a>?</td>
</tr>
<tr>
<td>Driveway/access</td>
<td>• Is a new driveway required? If so, is access available? (Limited access highways may not allow a driveway.)</td>
<td>Check local, state, or federal department of transportation or equivalent</td>
</tr>
<tr>
<td></td>
<td>• Can equipment and materials be safely delivered to the site with no obstructions such as overhead utilities, trees, or vehicle weight limits?</td>
<td></td>
</tr>
<tr>
<td>Consideration</td>
<td>Applicability</td>
<td>Resources</td>
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<tr>
<td>Easements/Encumbrances/Rights-of-way</td>
<td>• 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?</td>
<td>Check with land management authorities, transportation plans, USGS maps</td>
</tr>
<tr>
<td>Cultural resources</td>
<td>• Are there known cultural resources on or near the site? If not, are further studies required?</td>
<td>Tribal Historic Preservation Office <a href="http://nrhp.focus.nps.gov/natreg/docs/Download.html">http://nrhp.focus.nps.gov/natreg/docs/Download.html</a> (Google Earth layer)</td>
</tr>
<tr>
<td>Land use and building permits</td>
<td>• 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</td>
<td>Local tribal government</td>
</tr>
<tr>
<td>Storm water</td>
<td>• 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?</td>
<td><a href="http://water.epa.gov/polwaste/npdes/stormwater/EPA-Construction-General-Permit.cfm">http://water.epa.gov/polwaste/npdes/stormwater/EPA-Construction-General-Permit.cfm</a></td>
</tr>
</tbody>
</table>
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
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?

Megan Day
Megan.day@nrel.gov
303-275-3261