DOE OFFICE OF INDIAN ENERGY

The Five-Step Development Process
Step 1: Identify Project Potential

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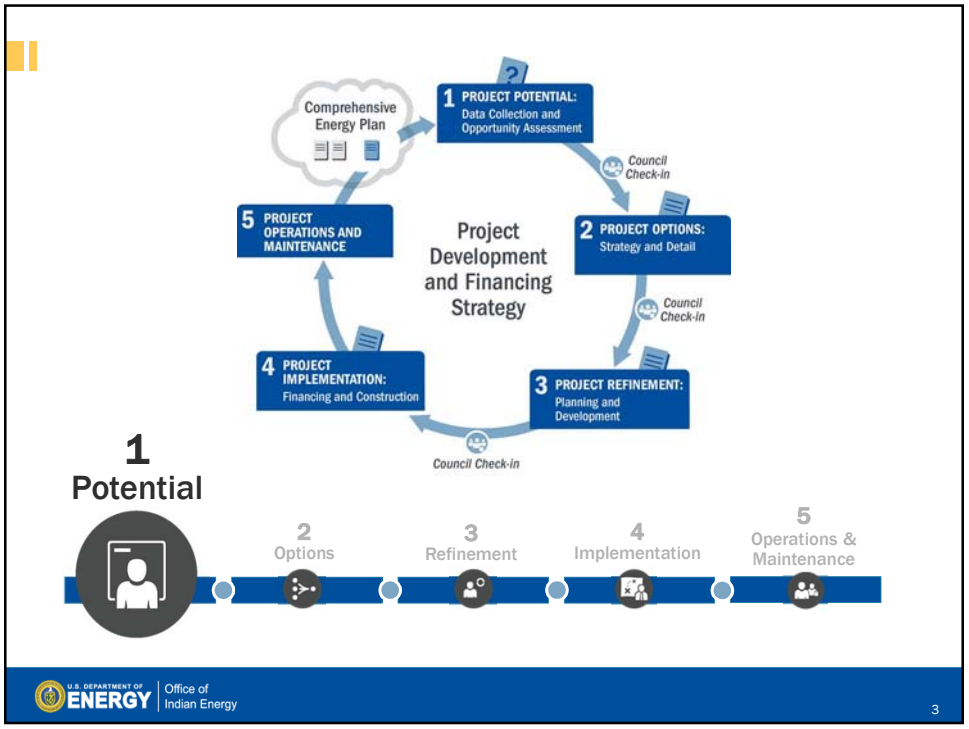
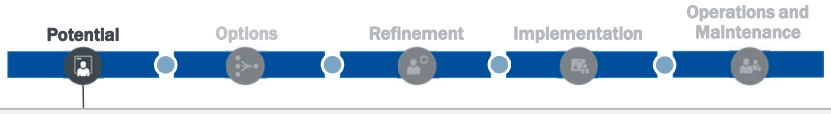
Presentation Agenda

- Brief Review of Day 1
- Step 1: Identifying Project Potential
  - Community Market Potential
  - Resource Potential
  - Initial Site Considerations
- Tools and Resources
- Small Group Exercise/Discussion



Step 1: Site, Scale, Resource, and Community Market Potential



Purpose: Determine whether basic elements for a successful project are in place

Tasks:

1. Identify possible **sites** for project locations
2. Determine the **energy load/demand** for these sites using past electric bills for these facilities
3. Confirm renewable energy **resource**
4. Review tribal facility electric cost data, regulations, and transmission and interconnection requirements
5. Evaluate community market potential for renewable sales. **Your community is the marketplace/energy –user.**
6. Assemble or communicate with the right team—those in positions or with knowledge to facilitate, approve, and champion the project

Understanding Community Market Potential

- Who is your market?
  - Tribal community
- What do you need to know?
  - Current energy loads and demand
  - Expected future energy loads and demand of the system
  - Condition of buildings and availability of roof space and land
  - Consider energy efficiency/weatherization first (typically the most cost-effective)

	2015	2016	2017
Energy (kWh)	#	#	#
Demand (avg kW)	#	#	#

Sizing Your Renewable Energy System

Current Load

- Use your past monthly energy bills to determine the demand. Start with your strategic energy plan
- Consider your scale: residential, commercial, or industrial
- Consider the current tariff structure (how the energy is metered and billed)

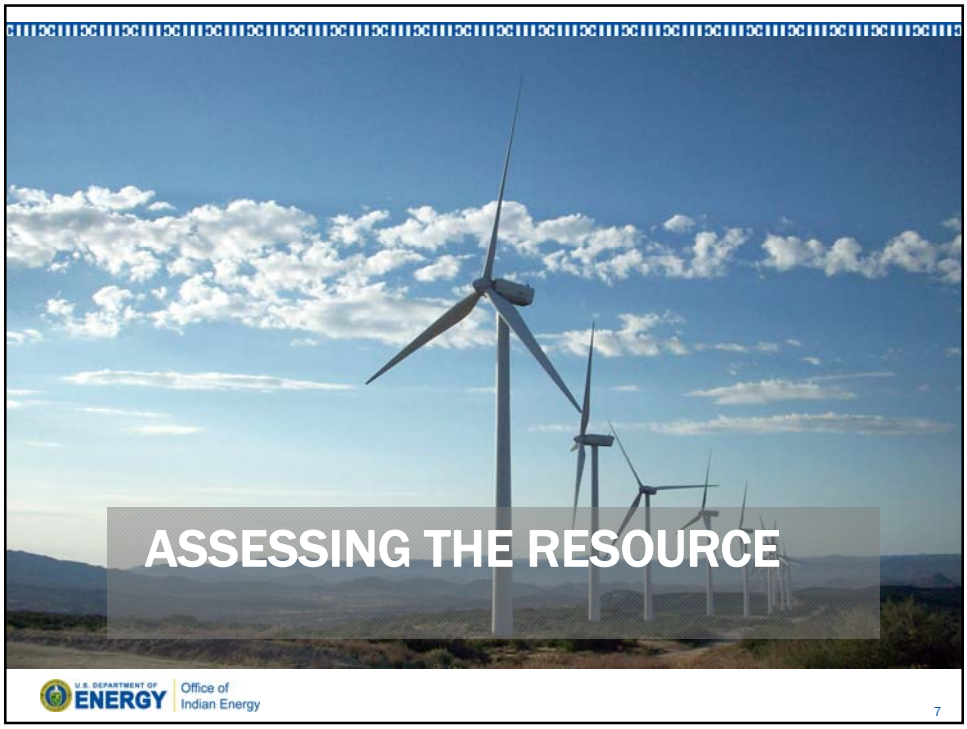
Future Load

- At which energy scale does your community expect the most growth in energy demand?
- How much will you need?

Other Limiting Factors

- Interconnection
- Net metering cap
- Rebate limits

	2015	2017	2019
Energy (kWh)	#	#	#
Demand (avg kW)	#	#	#

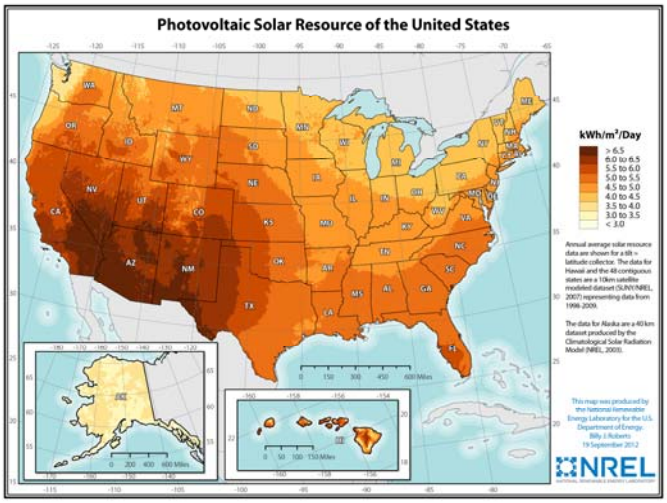


Resource, Production & Savings

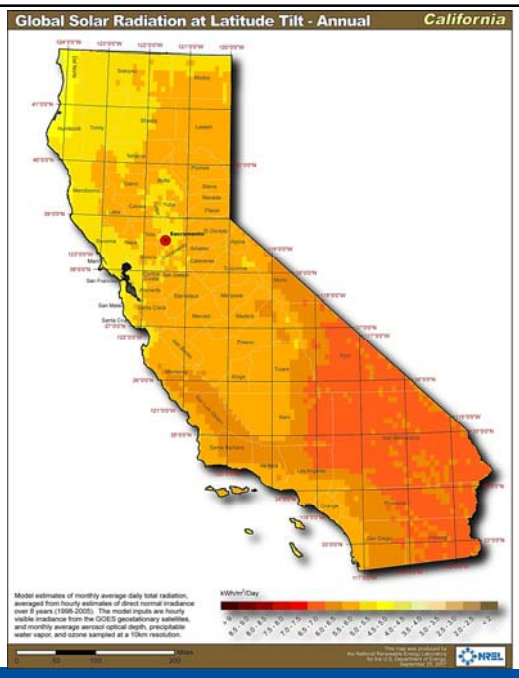
Assess available local energy resources

- Production
  - Online tools (PV Watts)
  - Field based measuring equipment
  - Resource maps

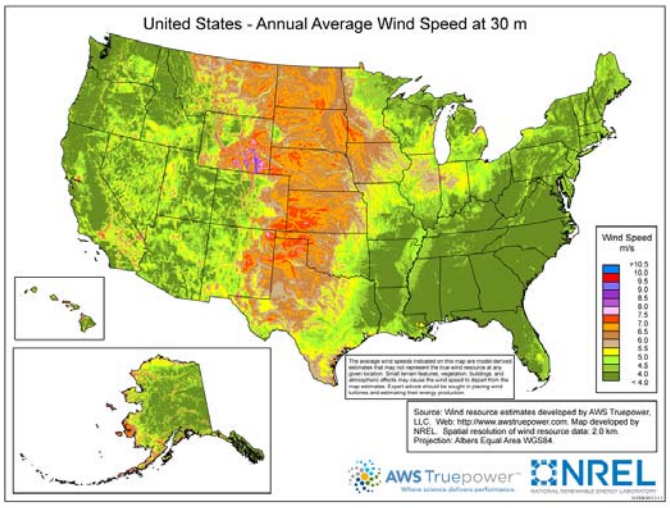
Solar PV Energy Resource Mapping



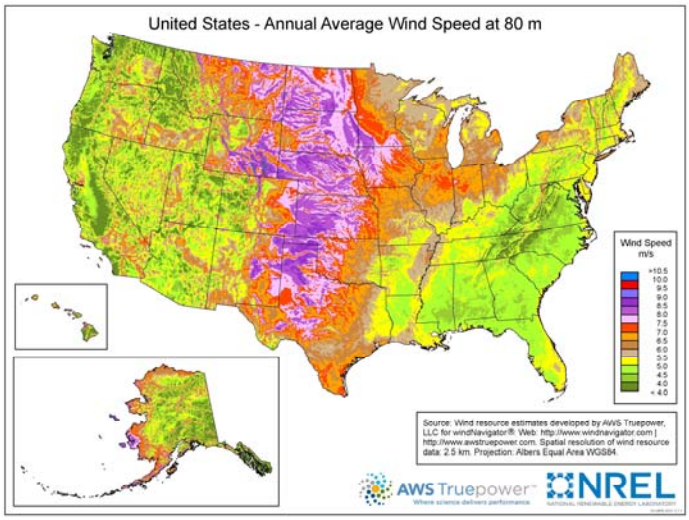
Solar Resources in California



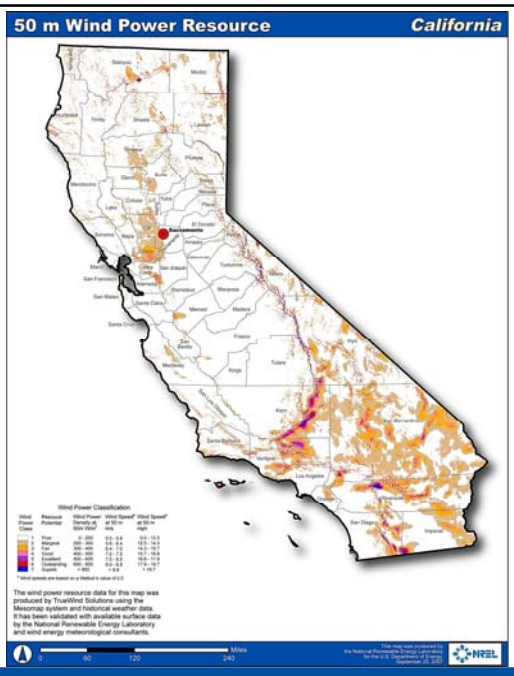
Wind Energy Resource Mapping: 30 Meter (m)



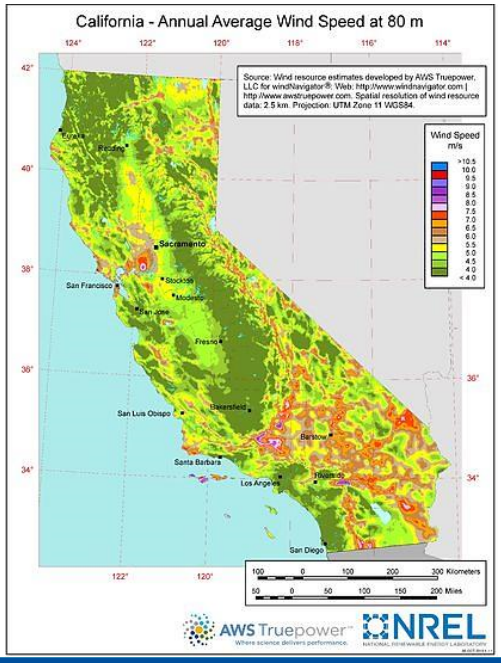
Wind Energy Resource Mapping: 80 m



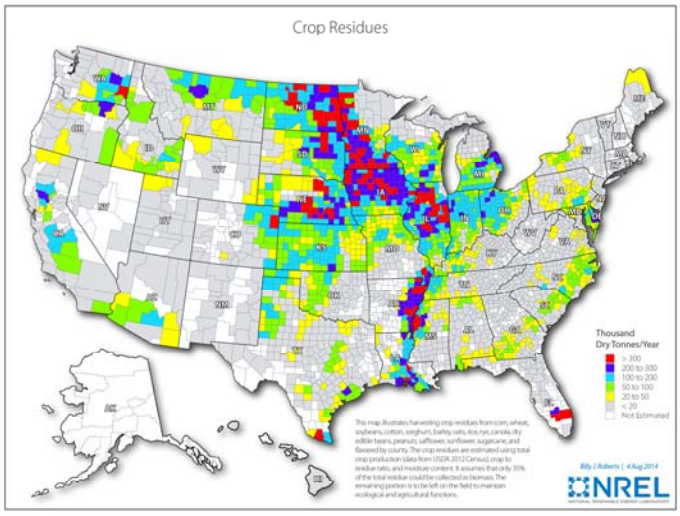
Wind Resources in California



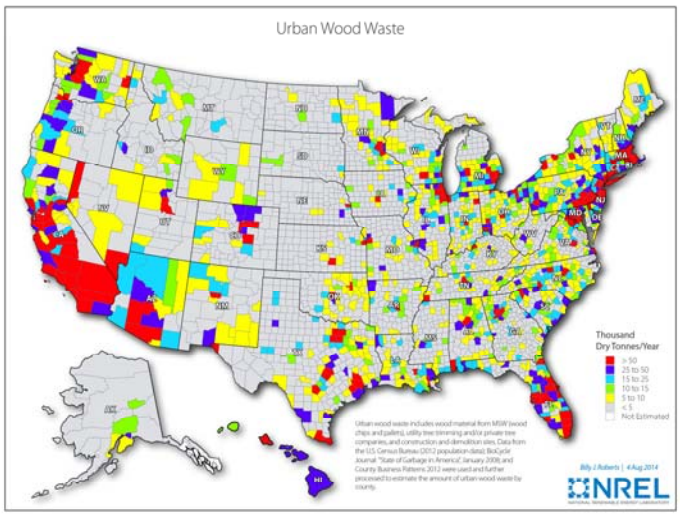
Average Wind Speed in California



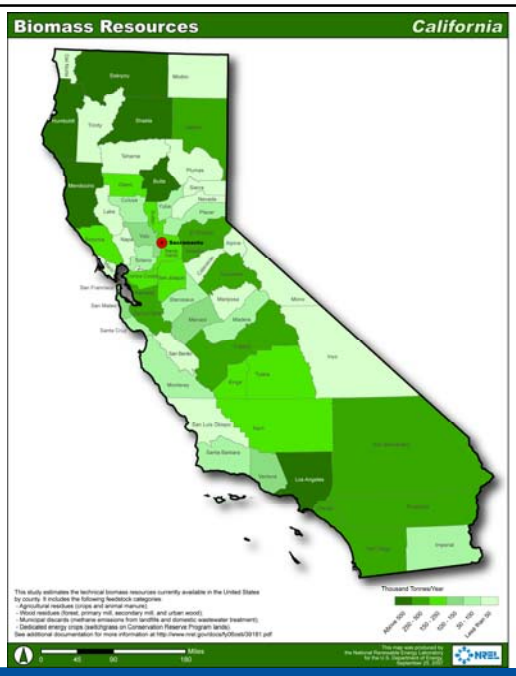
Biomass Energy Resource Mapping: Crop Residues



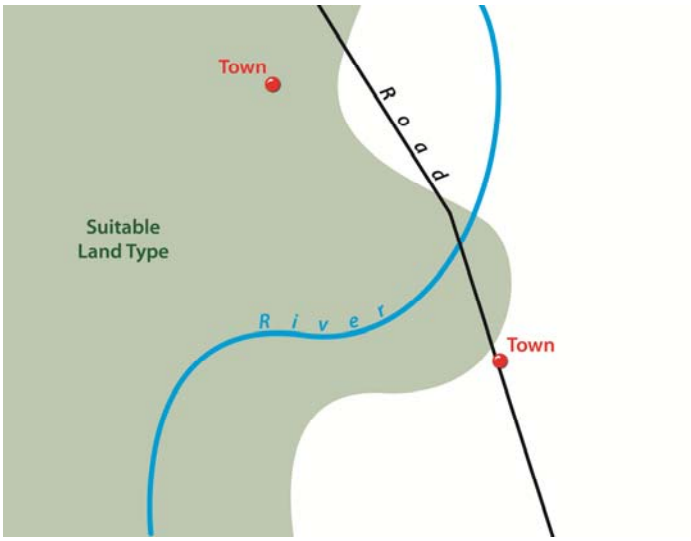
Biomass Energy Resource Mapping: Wood



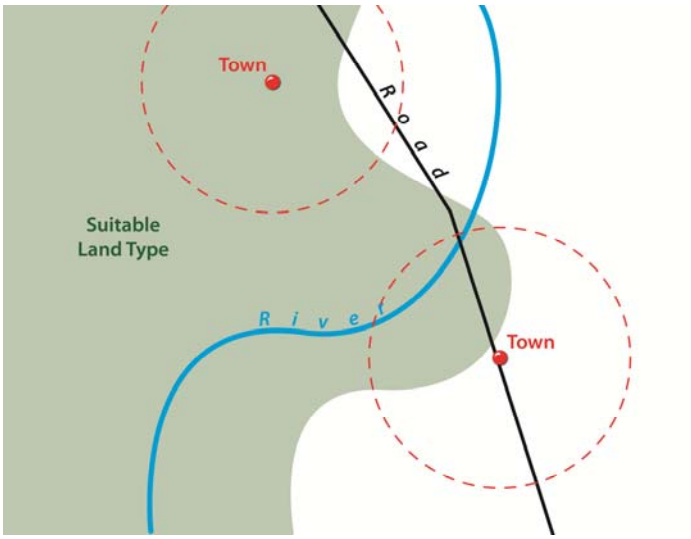
Biomass Resources in California



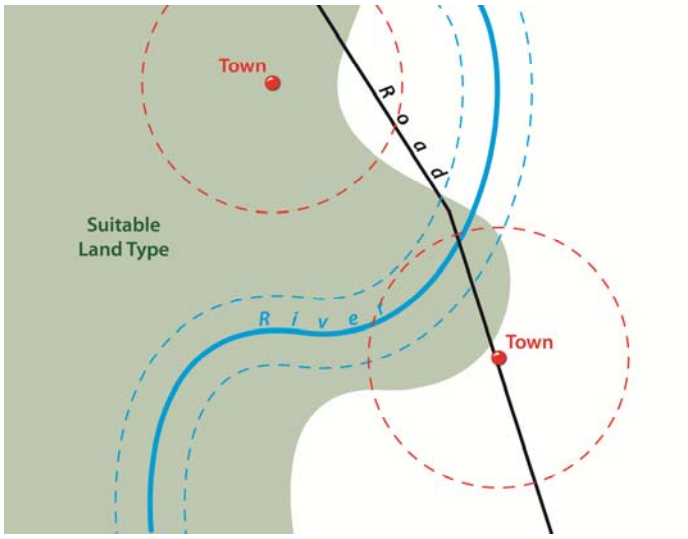
Local Site Considerations



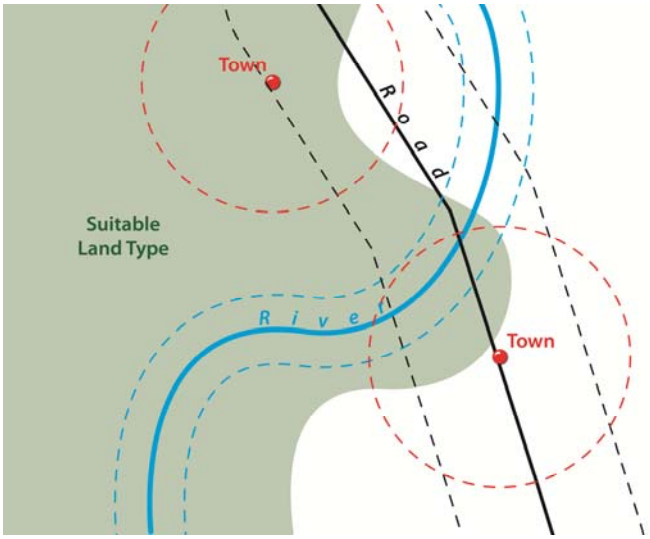
Local Site Considerations — Urban Centers



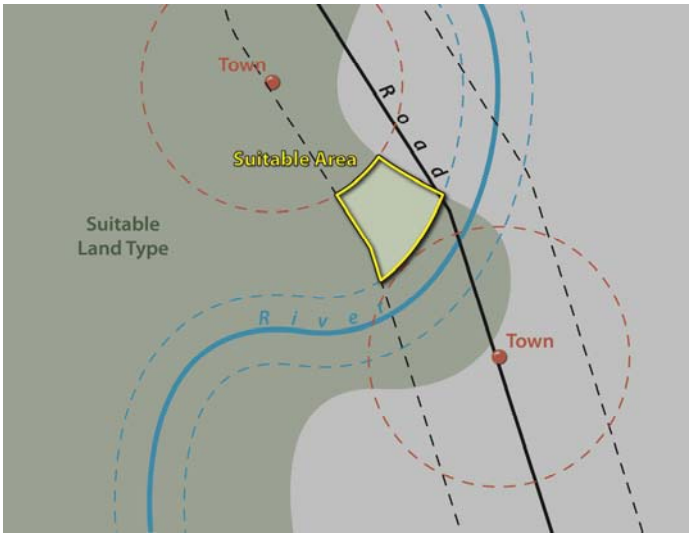
Local Site Considerations — Rivers



Local Site Considerations — Road Access



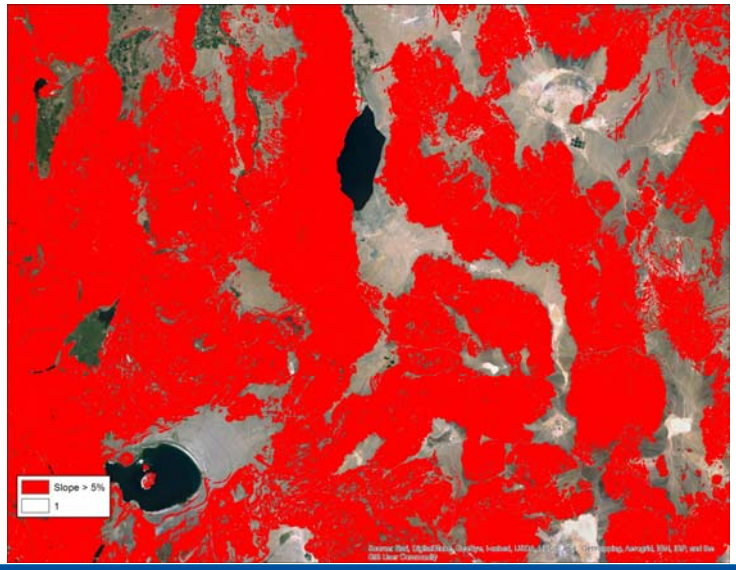
Local Site Considerations — Suitable Area



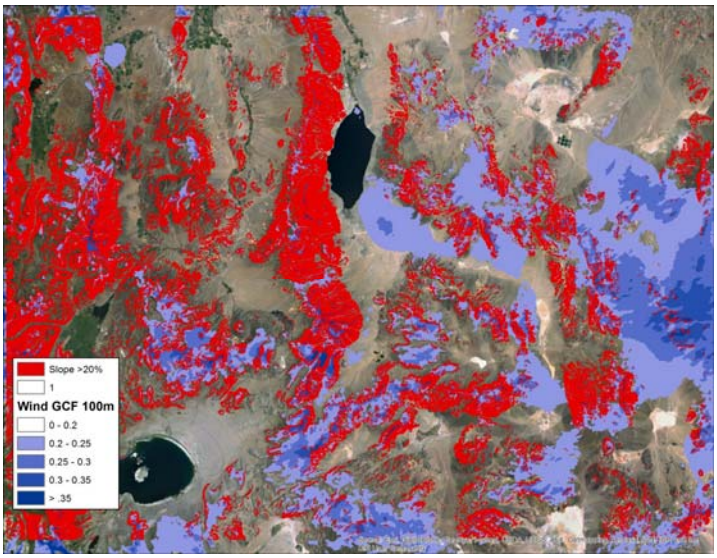
Initial Site Considerations — Example

Initial Solar Site Considerations — Slope>1%

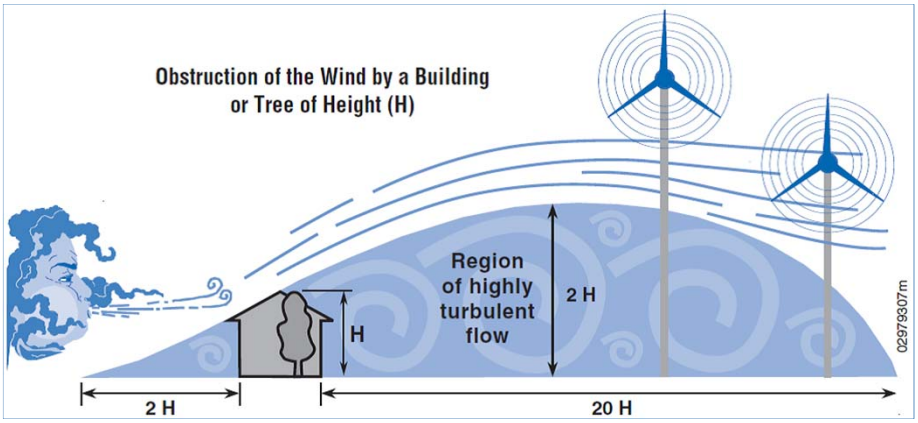
Initial Solar Site Considerations — Slope> 5%



Initial Wind Site Considerations — Slope>20%



Wind Siting Obstructions



Source: OpenEI, http://en.openei.org/wiki/File:ObstructionOfWindByBuilding.png

Initial Biomass Siting Considerations

Potential resource; determine:

- Local suppliers and equipment
- Quantities available (including long-term)
- Cost
- Quality
  - Sufficient volume
  - Future availability
  - Control (long-term purchase agreement)
- Distance (transportation cost)

Check permitting requirements:
- Air permits
- Ash disposal
- Fire permits

Photo from Mississippi Band of Choctaw Indians, NREL 26448

Photo from Randy Hunsberger, NREL

Initial Biomass Siting Considerations

Space requirements

- Ensure sufficient space for biomass boiler in boiler room
- Determine fuel requirements and storage space available
- Evaluate truck access, including space for maneuvering

Photo by Randy Hunsberger, NREL

Priorities: Where to Install Solar

- On the "built environment" where unshaded:
  - Existing building roofs that have an expected life of at least 15 more years and can accept added load - typically 2-4 pounds /ft^2. Reduces solar load on building
  - All new buildings – all new buildings should be "solar ready
    - See *Solar Ready Buildings Planning Guide*: http://www.nrel.gov/docs/fy10osti/46078.pdf
  - Over parking areas– energy generation and nice amenity
- On compromised lands such as landfills and brownfields
  - Saves green-fields for nature
  - If installed on green fields, minimize site disturbance; plant native low height vegetation as needed

Solar PV Placement

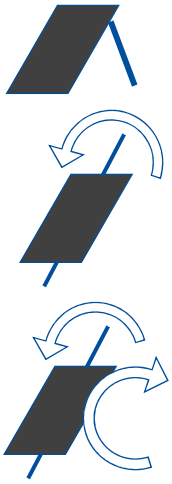
PV Panels on Grand Ronde Tribal Housing Authority carport. Photo by GRTHA, NREL 11659046

Photo by Michael Deru. NREL 10075381

Facility Scale Hybrid System, NPS Range Station, San Miguel Island, CA. Photo by Kent Bullard, NREL 6325496

Ballasted PV System on ESIF. Photo by Dennis Schroeder, NREL 13163640

Solar Photovoltaics (PV) Fixed Tilt/Tracking



Fixed Tilt Facing Equator
tilt=latitude
tilt<latitude for summer gain
tilt>latitude for winter gain

One Axis Tracking
around axis tilted or flat

Two Axis Tracking
both azimuth and altitude of sun around two axes

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Total Area Required for PV

- Varies by technology, tilt, and location
- Roof mount - sloped roof, flush-mounted power densities of 11 direct current (DC)-watt (W)/square foot (ft^2) crystalline
- Flat roof, slope panel = 8 DC-W/ft^2

Ground Mount		
System Type	Fixed Tilt Energy Density (DC-W/ft^2)	Single Axis Tracking Energy Density (DC-W/ft^2)
Crystalline Silicon	4	3.3
Thin Film	3.3	2.7
Hybrid High Efficiency	4.8	3.9

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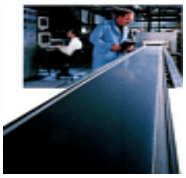
Types of PV Cells

Single Crystal * Multi-Crystal * Thin Film * Cadmium Telluride * CIGS

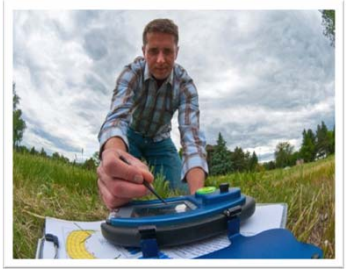




Efficiencies:

14 to 23% 13 to 17% 6 to 11% 10% to 11% 12% to 14%

Solar Assessment: PV is VERY Shade Sensitive



Shade Analyzer

Once preliminary site assessment has been completed, you want to know:

- Estimated system size
- Estimated production (kilowatt-hour [kWh]/yr)
- Estimated cost
- Some economic analysis

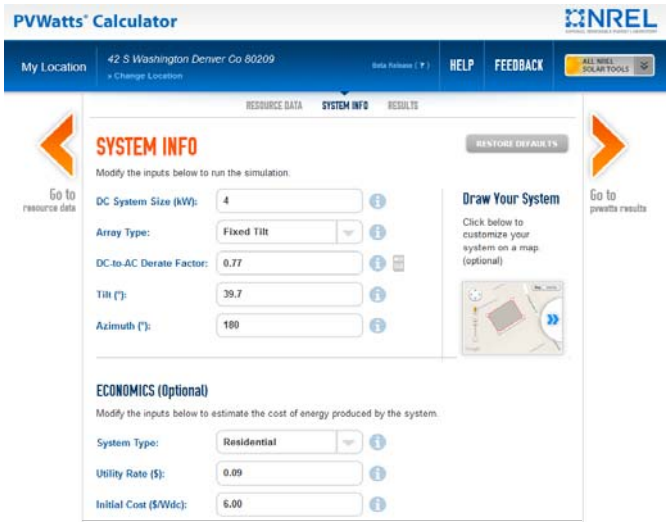
Photos top to bottom: NREL 10314 and 17509

PVWATTS Tool for Basic PV Modeling

Free interactive map-based tool allows you to:

- Estimate expected monthly and annual solar resource values
- Quickly obtain performance estimates for grid-connected PV systems
- Get a first cut of potential solar output
- Can identify potential incentives that a PV system in a particular area may be eligible for

PVWATTS Calculator



http://pvwatts.nrel.gov/

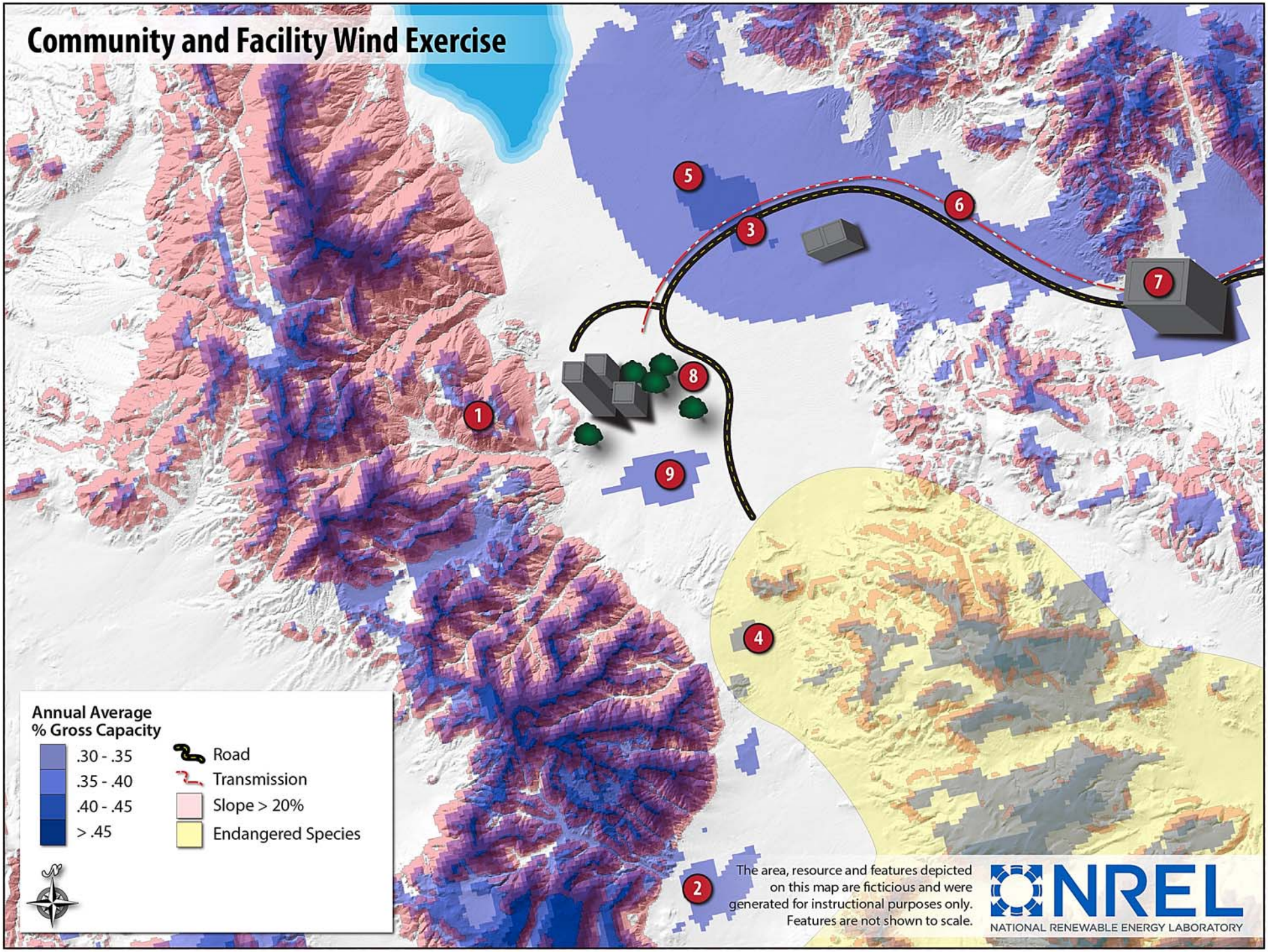
Project Risk: Facility/Community-Scale Post Step 1

	Risks	Risk Assessment Post Step 1	✓
Development	• Loss/waste of development resources	Low but rising; "calculated"	
Site	• Improper orientation or project affected by shade	Reduced	✓
	• Inadequate foundation or structural integrity	Assumed low	✓
	• Site control challenges for safety/security purposes	Assumed low	✓
Permitting	• Tribe-adopted codes and permitting requirements	Unchanged	
	• Utility interconnection requirements	Unchanged	
Finance	• Capital constraints	Assumed low	
	• Incentive unavailability or insufficiency	Reduced	
Construction/ Completion	• Engineering, procurement, and construction difficulties	Assumed low, mitigable, or allocatable	
	• Cost overruns	Assumed low, mitigable, or allocatable	
	• Schedule overruns	Assumed low, mitigable, or allocatable	
Operating	• Output shortfall from expected	Assumed low, mitigable, or allocatable	
	• Operations & maintenance (O&M) issues	Assumed low, mitigable, or allocatable	

NOTE: Underlining signifies that the risk assessment outcome changes during the step at hand.
Sources: Adapted from Holland & Hart, RE Project Development & Finance & Infocast, Advanced RE Project Finance & Analysis

Activity

- Resource Map/Siting


Community and Facility Wind Exercise
Annual Average
% Gross Capacity
.30 - .35
.35 - .40
.40 - .45
> .45
Road
Transmission
Slope > 20%
Endangered Species
1
2
3
4
5
6
7
8
9
The area, resource and features depicted on this map are ficticious and were generated for instructional purposes only. Features are not shown to scale.
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Site Dossiers: Community and Facility Wind

The following pages will provide a list of characteristics corresponding to the sites indicated on the map marked "**Community and Facility Wind Exercise.**" Some of these characteristics can be determined from the map; others, such as Tribal and cultural considerations, are available only in the following tables. Cross-reference these tables with the map to determine which **two (2)** sites/projects have the best potential for development.

Later in the training, we will calculate the project economics for the two wind sites that demonstrate the most potential using the System Advisor Model (SAM). The levelized cost of energy (LCOE) will be used to determine the winning wind project out of these final two.

Important: *In reality, when you compare multiple sites together, the size of the project at any location will depend on:*

1) *the available land at each site (the size, shape, slope and resource varies), and*
2) *the amount of capital you have available at your disposal.*

Note: projects that receive federal funds or are either fully or partially built upon federal lands are subject to the National Environmental Policy Act (NEPA) process. For the purposes of this exercise, it should be assumed that each project will require an EIS, or environmental impact statement. While most development projects will typically trigger NEPA, many small hardware or weatherization projects, and all paper projects such as feasibility studies, can usually be categorically excluded from a NEPA review.

Also, please note that the geographic areas assigned to the sites on this map are hypothetical and are not intended to represent a real geographic area in the U.S.

Site 1

Technology:	***Turbine:*** GE 1.5s ***Hub Height:*** 80m
Project Size:	3 MW (two turbines)
Resource:	Excellent (Montana – Northwestern - Canyon Lands)
Slope:	25%. Too steep for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 2

Technology:	***Turbine:*** Vestas V100 1.8 ***Hub Height:*** 60 m
Project Size:	3.6 MW (2 turbines)
Resource:	Good (Idaho Southeastern – Mountainous). Suitable for community-scale development
Slope:	3%. Suitable for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Distant. Sub-transmission build-outs to deliver power to load could impose significant costs
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 3

Technology:	***Turbine:*** Northern Power Northwind 100 ***Hub Height:*** 30m
Project Size:	200 kW (2 turbines)
Resource:	Excellent (Montana – Northwestern - Canyon Lands)
Slope:	1%. Suitable for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 4

Technology:	***Turbine:*** Gamesa G80 ***Hub Height:*** 60m
Project Size:	6 MW (3 turbines)
Resource:	Good (Idaho Southeastern – Mountainous). Suitable for wind development
Slope:	8%. Suitable for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Turbines will disrupt the territory of a local endangered species. This could lead to an extensive environmental review process, and impose significant costs to relocate the species.

Site 5

Technology:	***Turbine:*** GE 1.5s ***Hub Height:*** 60m
Project Size:	4.5 MW (3 turbines)
Resource:	Excellent (Montana – Northwestern - Canyon Lands). Suitable for wind development
Slope:	1%. Suitable for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 6

Technology:	***Turbine:*** Vestas V100 1.8 ***Hub Height:*** 85 m
Project Size:	3.6 MW (2 turbines)
Resource:	Good (Idaho Southeastern – Mountainous). Suitable for wind development
Slope:	1%. Suitable for wind development
Obstructions:	Insufficient "fall down distance" from the transmission line. If turbine collapses, it could cut the wires and knock out the power.
Proximity to Load/Distribution Grid:	Close to load and distribution line. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 7

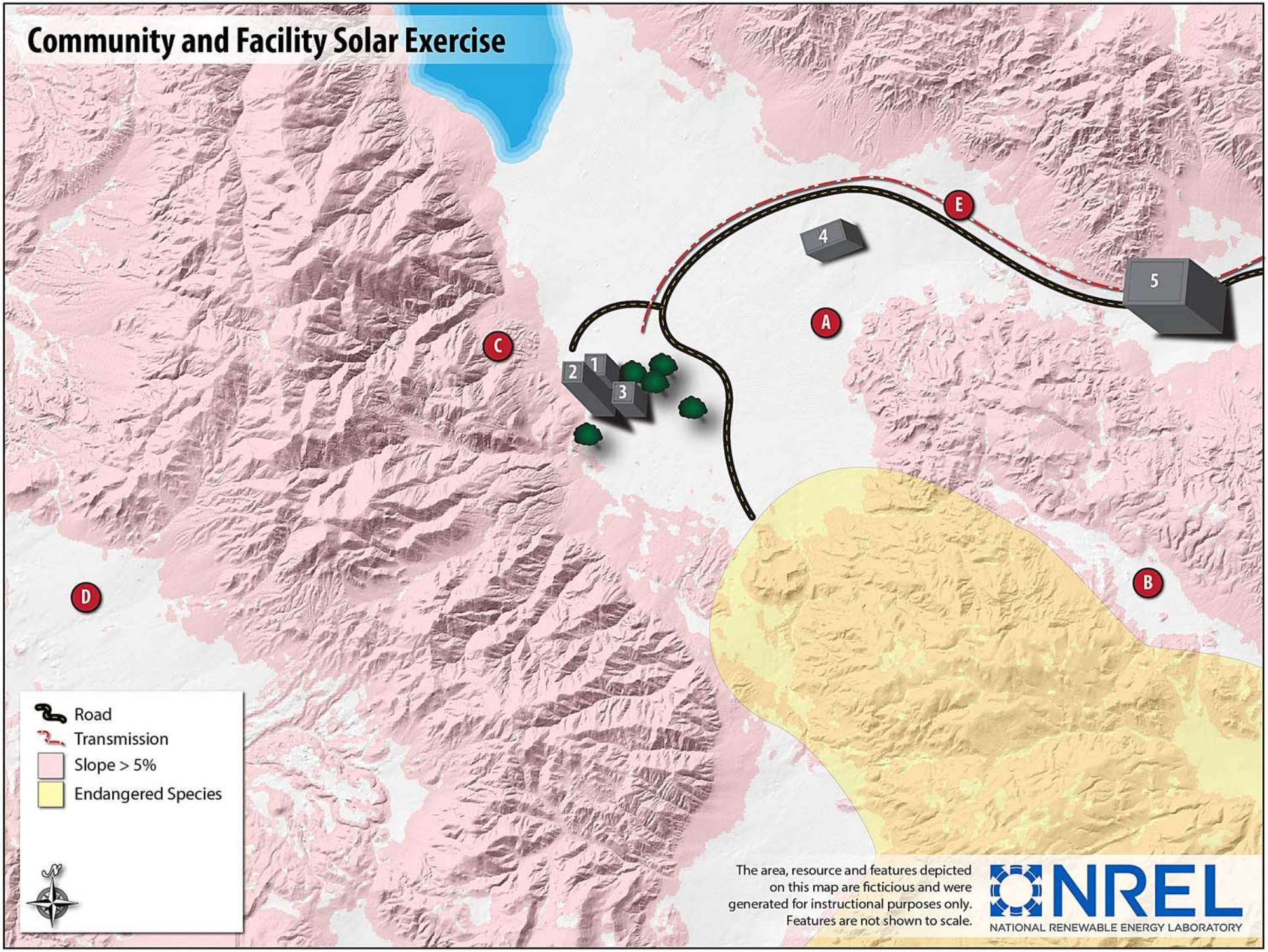
Technology:	***Turbine:*** Honeywell WT6500 (Roof-mounted turbine) ***Hub Height:*** 60m
Project Size:	30 kW (10 turbines)
Resource:	OK, but variable (Oregon – Northern Flat Lands). Presence of the building affects the resource
Slope:	NA
Obstructions:	Wind resource is heavily distrupted by presence of the building.
Proximity to Load/Distribution Grid:	Sited on load. No build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 8

Technology:	***Turbine:*** Nordex N-43 600 ***Hub Height:*** 40m
Project Size:	600 kW
Resource:	Poor (Florida – Southern Flat Lands). Wind resource blocked by natural and structural obstructions to the west.
Slope:	2%. Suitable for wind development
Obstructions:	Presence of trees and buildings blocks wind resource.
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site 9

Technology:	***Turbine:*** GE 1.5s ***Hub Height:*** 60m
Project Size:	3 MW
Resource:	Good (Idaho Southeastern – Mountainous). Suitable for wind development
Slope:	2%. Suitable for wind development
Obstructions:	No obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	Wind turbines will cause "blinking shadows" and create audible swooping noises for the building to the north.
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species


Community and Facility Solar Exercise
E
4
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Road
Transmission
Slope > 5%
Endangered Species
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Site Dossiers: Community and Facility Solar PV

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Later in the training, we will calculate the project economics for the two solar sites that demonstrate the most potential using the System Advisor Model (SAM). The levelized cost of energy (LCOE) will be used to determine the winning solar project out of the final two.

Important: *In reality, when you compare multiple sites together, the size of the project at any location will depend on:*

1) *the available land at each site (the size, shape, and slope varies), and*
2) *the amount of capital you have available at your disposal.*

Solar resources tend not to vary as greatly as wind resources within a given area. Accordingly, it is best to assume for the purposes of this exercise that all sites have suitable insolation/resource (except, of course, where there are shading issues related to natural or structural impositions).

Note: projects that receive federal funds or are either fully or partially built upon federal lands are subject to the National Environmnetal Policy Act (NEPA) process. For the purposes of this exercise, it should be assumed that each project will require an EIS, or environmental impact statement. While most development projects will typically trigger NEPA, many small hardware or weatherization projects, and all paper projects such as feasibility studies, can usually be categorically excluded from a NEPA review.

Also, please note that the geographic areas assigned to the sites on this map are hypothetical and are not intended to represent a real geographic area in the U.S.

Community Solar

Site A

Technology:	Solar PV
Project Size:	1 MW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Slope:	3%. Suitable for PV development
Obstructions:	No shading or other obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal and Cultural Considerations:	No Tribal land-use issues
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site B

Technology:	Solar PV
Project Size:	1 MW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Slope:	3%. Suitable for PV development
Obstructions:	Located in a ravine, which could create shading issues at certain times of day
Proximity to Load/Distribution Grid:	Distant. Sub-transmission and distribution build-outs to deliver power to load could impose significant costs
Tribal and Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site C

Technology:	Solar PV
Project Size:	700 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Slope:	8%. Building a solar farm on this site could impose significant costs
Obstructions:	No shading or other obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal and Cultural Considerations:	No Tribal land-use issues
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site D

Technology:	Solar PV
Project Size:	1.9 MW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Slope:	2%. Suitable for PV development
Obstructions:	No shading or other obstructions
Proximity to Load/Distribution Grid:	Distant. Sub-transmission and distribution build-outs to deliver power to load could impose significant costs.
Tribal/Cultural Considerations:	No Tribal land-use issues
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Site E

Technology:	Solar PV
Project Size:	500 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Slope:	3%. Suitable for PV development
Obstructions:	No shading or other obstructions
Proximity to Load/Distribution Grid:	Close to load. Minimal build out of distribution infrastructure
Tribal and Cultural Considerations:	No Tribal land-use issues
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")
Flora/Fauna Considerations:	Does not infringe on the territory of any endangered/threatened species

Facility Solar

Building 1: Office Building

Technology:	Rooftop solar
Project Size:	20 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Structural Issues:	Rooftop can accommodate panels without any costly structural upgrades
Obstructions:	Shadows cast by Building #2 would disrupt solar energy production for several hours during the day. The shadows would lengthen and the disruption intensify during the winter
Tribal/Cultural Considerations:	The buildings do no have significant cultural/historical value to the Tribe.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")

Building 2: Office Building

Technology:	Rooftop solar
Project Size:	40 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Structural Issues:	Rooftop can accommodate panels without any costly structural upgrades
Obstructions:	No shading or obstructions
Tribal/Cultural Considerations:	The buildings do no have significant cultural/historical value to the Tribe
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")

Building 3: Multi-Family Housing

Technology:	Rooftop solar
Project Size:	25 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Structural Issues:	Rooftop will require costly structural upgrades to accommodate panels or turbines
Obstructions:	No shading or obstructions
Tribal/Cultural Considerations:	The buildings do no have significant cultural/historical value to the Tribe
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")

Building 4: Cultural Center

Technology:	Rooftop and ground mounted solar
Project Size:	100 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Structural Issues:	Rooftop can accommodate panels without any costly structural upgrades
Obstructions:	No shading or obstructions
Tribal/Cultural Considerations:	The building is a historic site with high cultural value
Social Considerations:	Community is opposed to development of renewable energy technologies on the roof of this historic building

Building 5: Casino

Technology Choices:	Rooftop and ground mounted solar
Project Size:	500 kW
Resource:	Good (Albuquerque, NM). Suitable for community-scale development
Structural Issues:	Rooftop can accommodate panels without any costly structural upgrades
Obstructions:	No shading or obstructions
Tribal/Cultural Considerations:	No Tribal land-use issues.
Social Considerations:	No NIMBY/BANANA objections from local community (NIMBY = "Not In My Backyard" BANANA = "Build Absolutely Nothing Anywhere Near Anything")

Notes