Renewable Energy and Energy Efficiency for Tribal Community and Project Development

Project Development Steps for Community and Commercial Scale Projects

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Project Development Steps

See also:
http://www1.eere.energy.gov/tribalenergy/guide/assessing_energy_resources.html

- Phase I
  - Strategic plan completed
  - Champion identified and empowered
  - Initial project planning meeting(s)
  - Project team/company formed
  - Secure early stage funding (grant? equity investment?)
  - Feasibility assessment
  - Go/No-Go
- Phase II – Development
  - Permits, interconnect, PPA, finance
- Phase III - Construction

Feasibility study (FS) general steps

See also:
http://www1.eere.energy.gov/tribalenergy/guide/assessing_energy_resources.html

Last chance to spend a little money before you spend a lot

- Resource assessment
- Market analysis (community vs. commercial scale)
  - Load assessment if looking at community or small-scale
- Site analysis/site selection
  - interconnection, water, roads, host site, nat gas, rail
- Technology characterization
- Preliminary environmental review
- Economic and financial analysis
- Barriers and opportunities

The level of complexity of your project will dictate whether you do the FS in-house or hire a consultant.

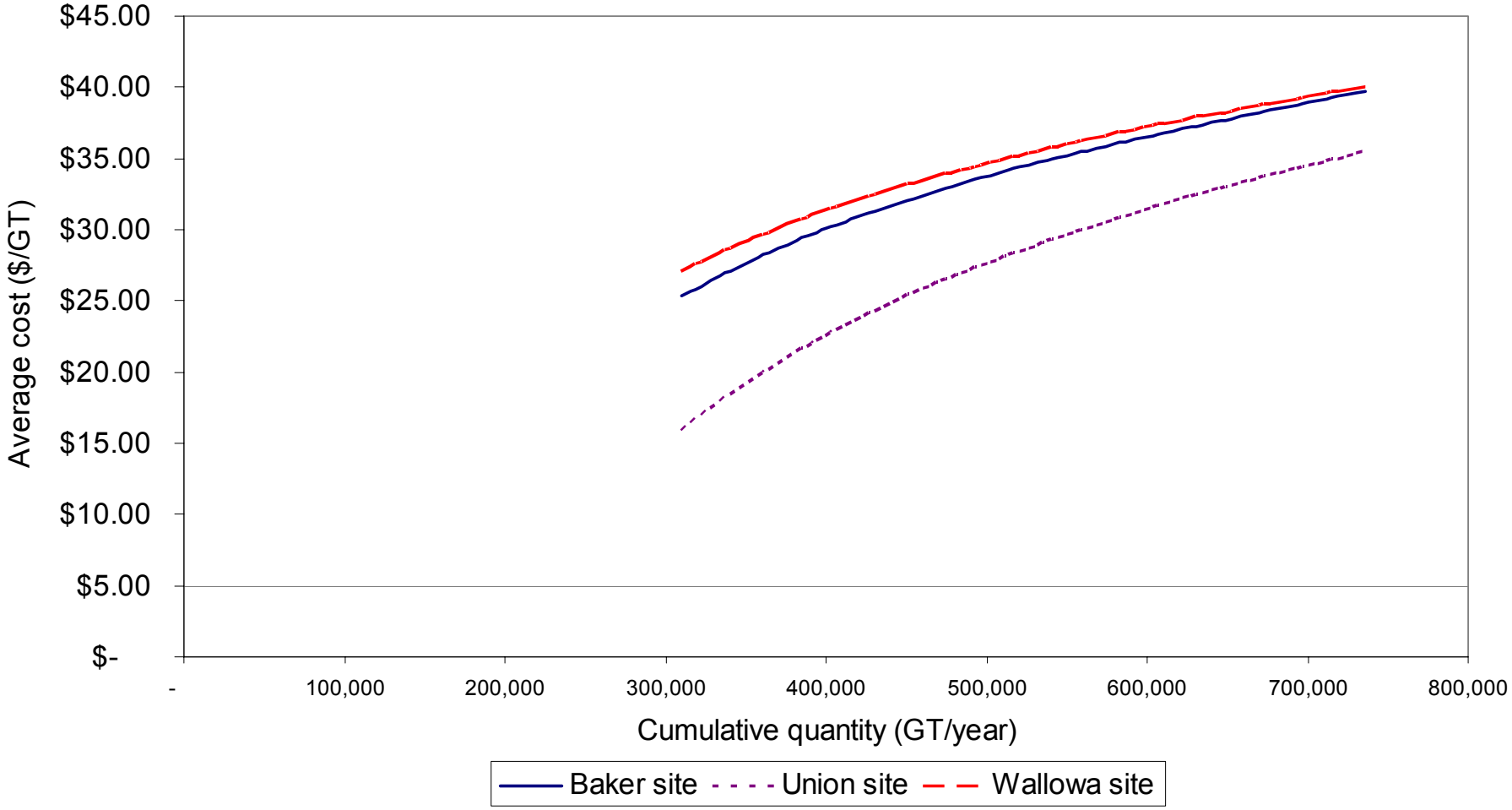
Resource assessment

- Resource specific information needs to be compiled
  - Wind
  - Biomass
  - Solar
  - Geothermal
  - Hydro

Biomass Resource Assessment

- Biomass supply is single most important issue for a biomass project
- Locate and quantify all potential sources of biomass
  - Forests: Tribal, state, local, private, urban
  - Residues: sawmill, construction, urban
  - Crops and crop residues
- How much is produced? How much can you actually collect? Sustainable?
- Competing uses (opportunity cost)
- Quality – chemical analyses
  - Moisture content, energy content, physical form, chemical composition
- Seasonality
- Collection, transport, storage: Cost? Who?

Biopower Supply Curve (Forest and Mill Residues)

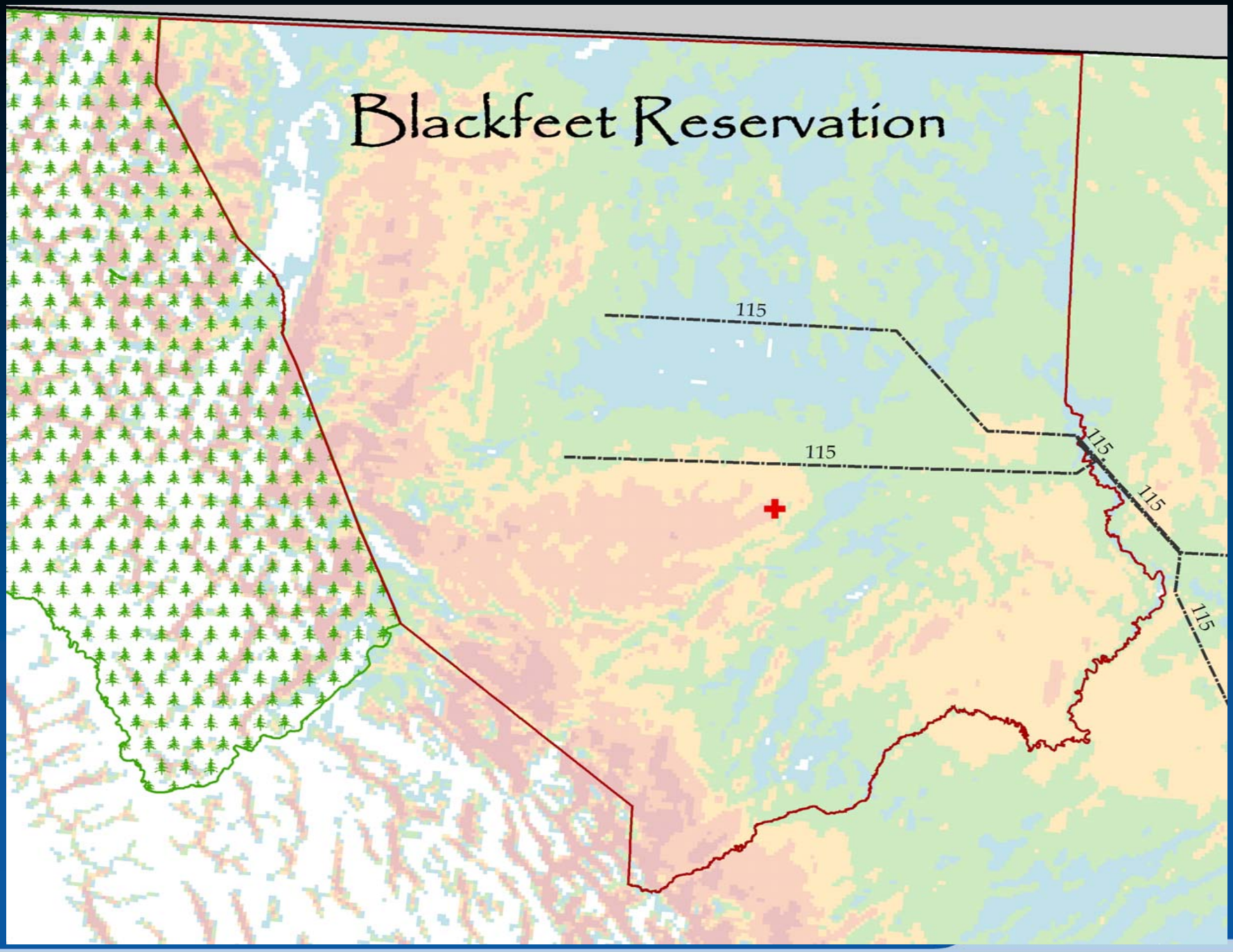


Wind Resource Assessment

- Site selection for anemometer(s)
- GIS overlays
  - Initial NREL wind data
  - Detailed meteorological models
  - Proximity to transmission lines
  - Ownership – tribal vs. allotted
- Preliminary cultural and environmental screening
- Categorical exclusion permit from BIA for met tower install
- Procure towers, use qualified installers
- Arrangements for data collection and analysis
  - Include other local data as available (weather stations, airports, DOT)

Wind Monitoring

- ~ $20,000 for met tower and install
- You will most likely need more than one tower
- You can do this step on your own,
- Or bring in a developer/partner
  - Be sure to negotiate major terms and conditions first
  - What will relationship be if a project gets developed?
    - Define the major terms before hand
  - Tribes must co-own the data
  - Annual payment to tribe in exchange for exclusive right to monitor and develop


Blackfeet Reservation
115
115
115
115
115

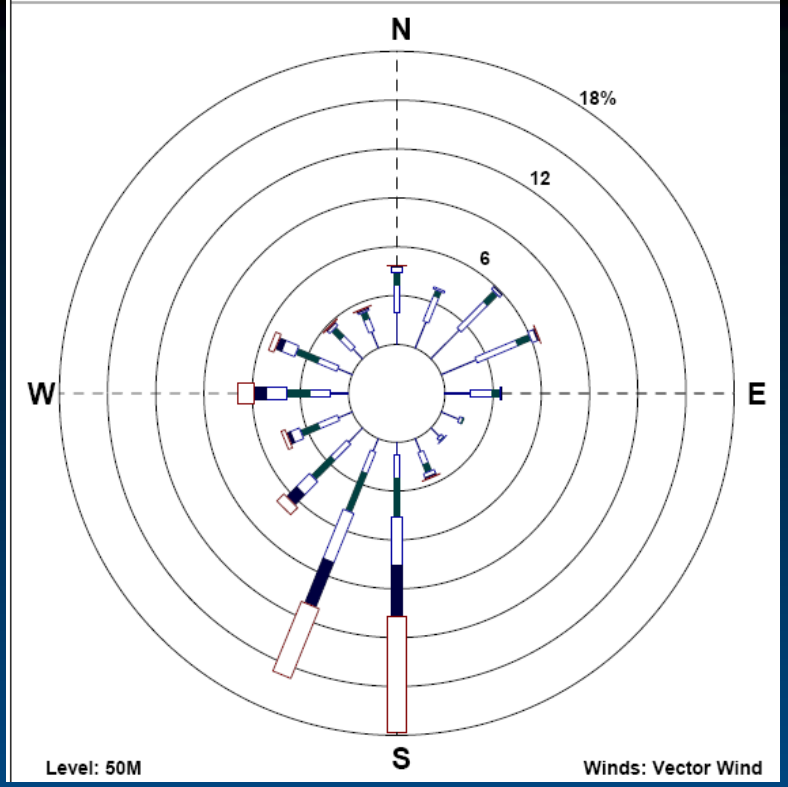
Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	19.6	19.5	21.3	17.7	13.4	12.2	14.9	12.7	14.8	16.5	23.9	26.1	17.9
02	19.9	19.5	21.0	18.6	15.3	12.5	15.3	12.6	13.7	17.0	24.2	26.4	18.2
03	18.9	20.0	21.7	18.2	17.6	12.9	15.9	12.7	13.2	16.9	24.8	27.5	18.5
04	19.4	19.6	21.2	19.0	17.4	14.2	16.0	12.4	15.4	17.3	25.2	27.9	18.9
05	21.4	21.3	20.7	19.0	18.0	15.0	16.3	13.9	15.4	17.9	25.6	27.6	19.4
06	21.0	21.9	21.1	18.7	17.5	15.0	16.5	13.8	13.7	17.1	24.7	29.1	19.3
07	21.9	20.0	21.3	17.3	17.7	15.0	17.0	14.1	13.4	17.8	24.4	30.2	19.3
08	21.9	19.7	21.4	17.5	18.0	15.3	17.2	15.0	13.3	16.9	25.2	29.2	19.4
09	21.4	19.3	21.1	17.3	16.4	15.1	14.8	13.4	14.1	17.0	24.1	29.9	18.8
10	22.0	20.0	20.6	16.2	16.2	15.0	15.1	12.3	15.2	17.5	24.4	28.9	18.7
11	21.6	20.3	20.3	15.9	16.0	13.0	13.8	13.1	15.3	16.4	23.8	29.5	18.4
12	21.6	20.5	20.3	15.0	16.5	13.1	13.5	15.2	14.1	16.1	23.0	30.1	18.3
13	20.5	20.4	20.3	14.8	15.9	12.3	12.4	13.7	13.3	14.9	22.3	30.0	17.7
14	20.0	21.1	20.8	14.5	17.3	11.8	11.7	14.8	12.2	14.0	21.1	28.8	17.5
15	18.2	18.9	20.1	13.6	16.4	12.5	12.1	14.9	12.7	14.4	19.6	30.1	17.1
16	17.7	17.2	19.1	14.0	15.7	12.5	12.2	14.2	13.1	14.5	19.3	28.1	16.6
17	17.1	17.0	20.1	15.3	16.4	14.0	12.6	13.7	13.8	13.7	18.5	27.6	16.9
18	16.0	16.8	19.3	17.0	14.4	13.9	12.8	15.2	13.2	13.5	17.6	25.6	16.5
19	16.2	16.3	19.5	16.1	16.9	14.1	13.1	15.4	12.6	12.7	18.6	26.7	16.7
20	17.8	15.9	18.7	14.7	15.5	13.7	11.4	12.7	12.4	13.0	19.1	26.8	16.2
21	18.1	16.5	18.3	13.9	15.2	13.7	12.6	13.5	12.3	14.3	20.4	27.8	16.5
22	17.4	17.3	18.7	13.5	16.0	11.7	12.6	13.3	12.8	15.2	21.5	25.9	16.5
23	19.3	18.6	19.9	15.5	15.4	12.2	14.0	14.9	14.2	15.9	21.3	26.5	17.5
24	20.3	18.8	20.6	14.9	12.9	11.9	14.4	14.2	15.1	17.0	22.9	26.2	17.7
Mean	19.5	19.0	20.3	16.2	16.2	13.4	14.1	13.8	13.7	15.7	22.3	28.0	17.9

Good Hours

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
737	669	1325	693	704	720	744	744	720	733	720	728

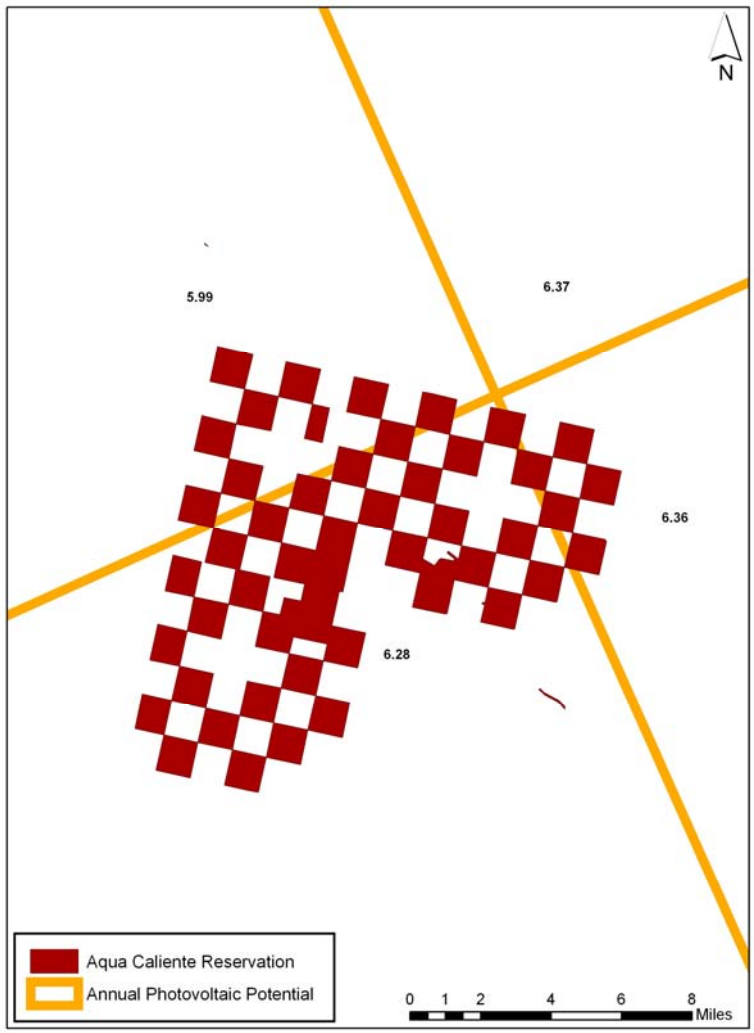
Missing Hours

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	3	163	747	40	0	0	0	0	11	0	16



Manufacturer	Model	Rating (kW)	Hub Height (m)	Gross Energy Output (kWh)	Gross Capacity Factor	Net Energy Output (kWh)	Net Capacity Factor	Wind Speed (mps)
Gamesa	G52	850	80	2,668,000	35.8%	2,348,000	31.5%	8.2
Gamesa	G87	2000	80	6,764,000	38.6%	5,952,000	34.0%	8.2
Vestas	V-80	1800	80	5,890,000	37.4%	5,183,000	32.9%	8.2
Vestas	V-90	3000	80	8,530,000	32.5%	7,506,000	28.6%	8.2
GE	70.5	1500	80	4,907,000	37.3%	4,318,000	32.9%	8.2
GE	77	1500	80	5,060,000	38.5%	4,453,000	33.9%	8.2

Solar



Map genrated by DEMD 2/7/07 using data from NREL and GDSC.

Meteorological Data Reviewed and Analyzed from the following sources:

- Renewable Resources Data Center
- National Solar Radiation Data Base (1,454 collection sites)
  - Hourly solar records for 8 years for 100,000 pixel locations (10 km x 10km)
- PVWatts (grid connected PV) and RETScreen are 2 tools that can help with the analysis

Sample Output from PVWatts

Station Identification

City:	Fresno
State:	CA
Latitude:	36.77° N
Longitude:	119.72° W
Elevation:	100 m

PV System Specifications

DC Rating:	4.00 kW
DC to AC Derate Factor:	0.770
AC Rating:	3.08 kW
Array Type:	Fixed Tilt
Array Tilt:	36.8°
Array Azimuth:	180.0°

Energy Specifications

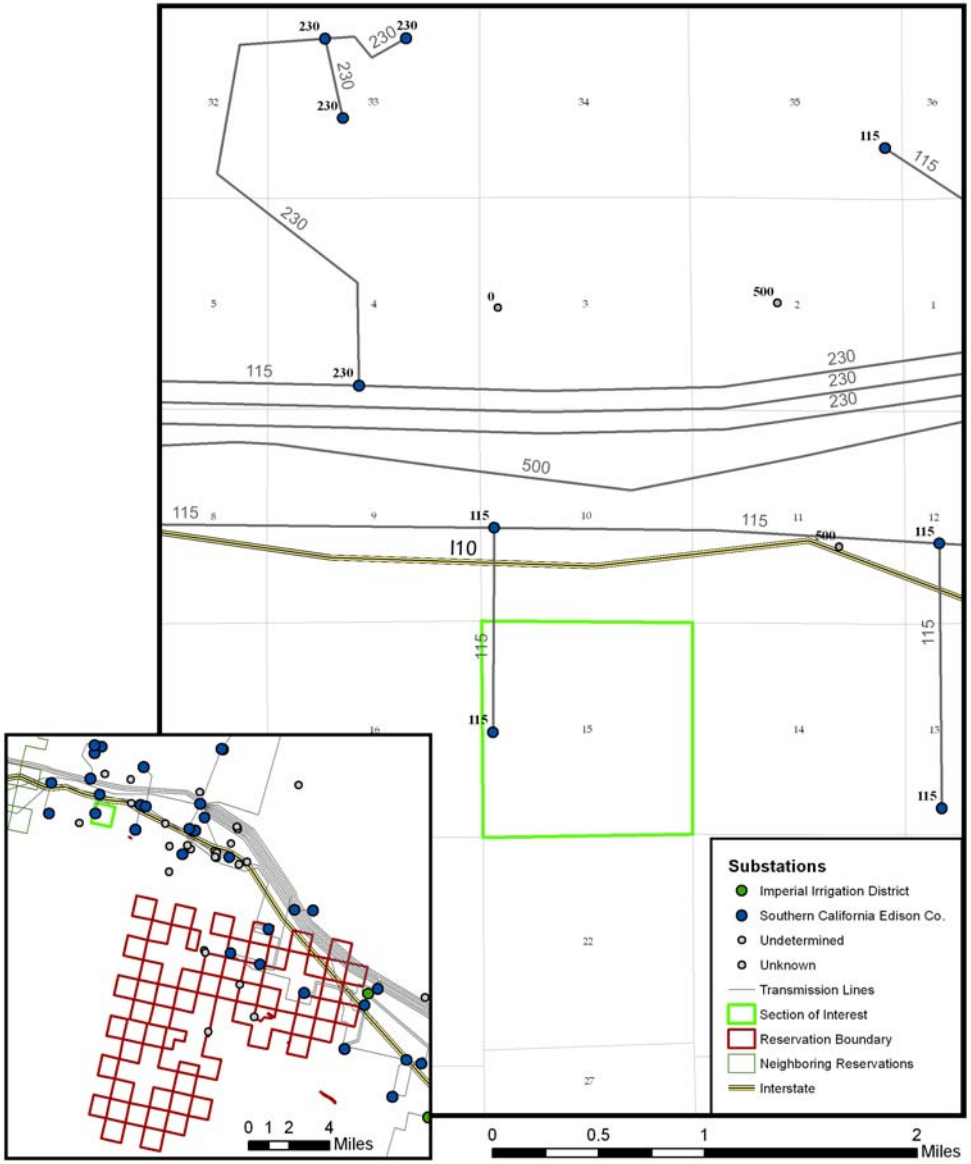
Cost of Electricity:	15.0 ¢/kWh

Results

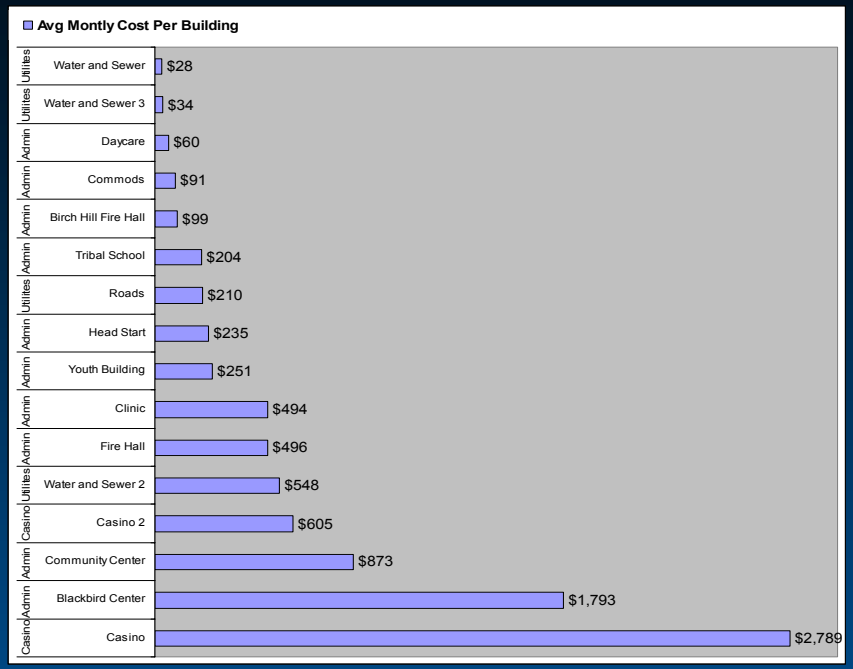
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.01	272	40.80
2	4.55	372	55.80
3	5.85	519	77.85
4	6.78	572	85.80
5	7.05	595	89.25
6	7.20	571	85.65
7	7.38	592	88.80
8	7.47	597	89.55
9	6.91	548	82.20
10	6.11	522	78.30
11	4.45	384	57.60
12	2.79	255	38.25
Year	5.80	5801	870.15

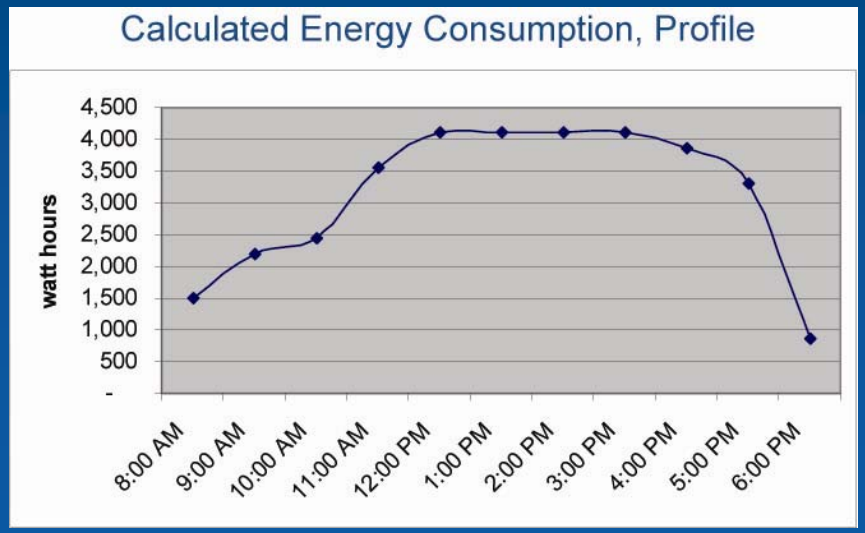
Market Analysis

- Define product(s)
  - Electricity, Renewable Energy Credits (RECs), heat
- Wholesale vs. offsetting your retail use (net metering) vs. off-grid
- Identify local, regional or national market outlets
  - Utilities, federal facilities, industry
- Identify opportunities for selling RECs separately or bundled
- Evaluate demand for renewable power by utilities
  - Quantity, type, price range
  - Mandated RPS? Growth?
- Preliminary interconnection discussions and transmission pathways


230
115
500
0
I10
Substations
Imperial Irrigation District
Southern California Edison Co.
Undetermined
Unknown
Transmission Lines
Section of Interest
Reservation Boundary
Neighboring Reservations
Interstate
0 1 2 4
Miles
0 0.5 1 2
Miles

Load Assessment





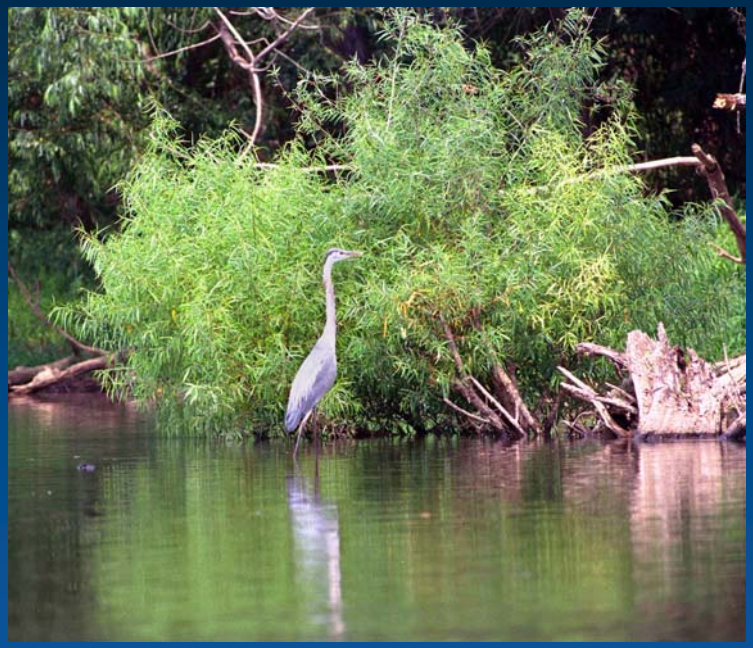
- Determine energy use (kWh), peak demand (kw) and cost ($) at candidate locations
  - Start with commercial and industrial loads
  - Multiple sites vs. single site (e.g. sawmill)
- Grid connected or off-grid
- Gather both electric and thermal
- Historical analysis (5-10 years back)
- Rate structures
- Obtain data from tribal records or utility
- Use results to identify opportunities and evaluate economics

Technology Characterization

- Match the available resource to the application (e.g. for biomass - heat, power or liquid fuels?)
- Size of system based on resource
  - For biomass, target 50% of total biomass
  - Area of tribal land available for wind?
  - Size PV system to meet building load
- Investigate various vendors, talk to other owners, independent reports
- Estimate expected performance (efficiencies, capacity factor, expected generation, steam flow, emissions)
- Capital costs? O&M costs?
- Ultimate goal is to feed data to the economic analysis on your output and costs

Category	Units	3-MW Stoker	3-MW STRPG	3-MW Chiptec
Capacity	kW	3,000	3,000	2,875
Capacity Factor	%	90%	90%	90%
Energy content	Btu/dry lb	8,640	8,640	8,640
MC	%	40%	40%	40%
Energy content	Btu/wet lb	5184	5184	5184
Consumption	wet lb/hr	12,153	6,000	11,213
Consumption	Btu/hr	63,001,152	31,104,000	58,128,192
Heat Rate	Btu/kWh	21,000	10,368	19,376
Efficiency	%	16%	33%	18%
Consumption	dry tons/hr	3.7	1.8	3.4
Consumption	dry tons/yr	28,744	14,016	25,048

Preliminary Environmental Review



- Determine the emissions limits for the project site if looking at biomass
- Preliminary contact with federal, state and local officials to discuss the project
- Hire experienced environmental consultant for quick screen, or use internal tribal staff
- Want to be sure there are no show stoppers
- Develop the process steps for development phase
- BIA is lead agency for NEPA process, so talk to RO early in the process

Economic Analysis

- Jack Whittier will give detailed talk tomorrow
- 20 year pro-forma model
- Use conservative cost assumptions
- Add 20% to capital cost estimates
- Labor, O&M, interest, discount rate, inflation, escalation
- Tax credits, green tags, loan guarantees
- Calculate levelized cost of energy over the 20 year period
- Net present value, IRR, debt service coverage ratio

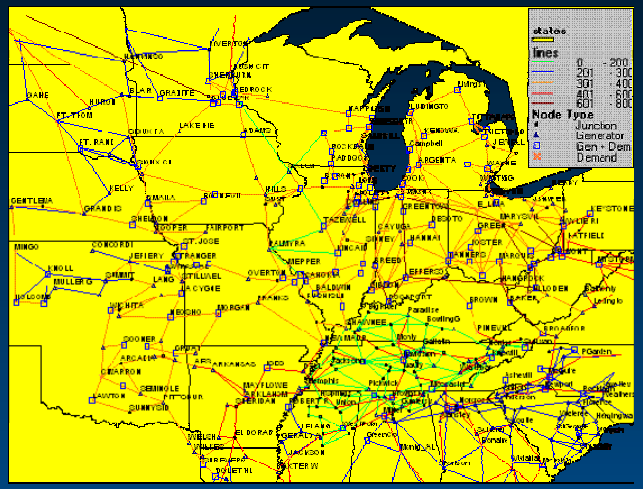
Results/Recommendations

- Resource potential?
- Market for product?
- Environmental showstoppers?
- Interconnection potential?
- Economically feasible?
  - What is the return on investment?
  - Simple payback?
  - Alternative investment options?
- Go/No-go decision

Phase II – Development Steps

- Get technical, legal, financial help
- 3 – 10 year process
- Interconnection application – follow FERC process
  - Small generator vs. large generator
  - **Get in the queue**
- Engineering
- Power Purchase Agreement
- NEPA process/permits
- FERC QF certification – make sure your generator is compliant with FERC rules
- REC certification
- Project structure/tax partners
- Financing strategy

Interconnection Procedures (After Filing Application)



- Pre-certified, less than 2 MW
  - Super expedited
  - UL listed, plug and play
  - Limited fees
- Small generator interconnection procedures (SGIP) (< 20 MW)
  - Expedited process
  - Follows LGIP steps but reduced fees
- Large generator interconnection procedures (LGIP)
  - Scoping meeting
  - Feasibility study ($10k)
  - Facilities study ($50k)
  - System impact study ($100k)

Engineering

- Hire an owner's engineer
  - Banks and lenders will do this as well
- Project implementation method?
  - Design-build
  - Design-bid-build
  - Construction management
- Design-build shown to have lowest cost overruns
- Delivery schedule
- Performance guarantees
- Capital cost risk

PPA Overview

- When developing a utility scale power plant, you (seller) must sign a power purchase agreement (PPA) with a buyer (utility)
- Competitive solicitation and/or bilateral negotiation
- PPA used to secure financing
- Either way, utilities will want you to provide certain information
- The better prepared you are, the greater your chances for success
  - Get help: legal, technical, financial

What are you selling?

- Selling two things:
  - Electricity
  - Green attributes (called RECs or Green Tags)
- Each commodity has value
  - Can be separated or bundled together
  - If bundled, the purchase price should be higher
- In RPS states, utilities will want RECs and power bundled together

The Process

- Identify potential purchasers
- Local as well as regional
  - To sell to regional utilities, must consider cost and availability of transmission
- Approach
  - Direct contact
  - Respond to Requests for Proposals (RFPs)

General Information Required by Buyers (and lenders, investors, vendors)

- Non-disclosure or confidentiality agreement
- Project location
- Site control
  - Site maps
  - Ownership
  - Evidence of legal agreements from tribe and/or landowners to use the land for the project
  - Aerial photos

Technical Description

- Technology description
  - Size and type of turbines
  - Manufacturer specs
  - Equipment performance guarantees
- Power production estimates (generation by hour for an entire year) and engineering calculations used
- Plant schematic and one line drawings showing layouts for generation equipment, buildings, roadways, interconnection
- Describe all interconnection equipment (transformers, switchgears, substations, new lines, delivery points)

Fuel Supply

- Biomass
  - Copy of supply study
    - quantity, availability, cost, location
  - Delivery arrangements, fuel supply contracts
  - On-site storage amount
  - Cost risk – who bears it?
  - Competing markets
- Wind
  - Copy of seller's wind resource report
  - Verified by third party meteorologist/ engineer

Evidence of Community Support

- Community meetings – plans for conducting, or results from completed ones
- Tribal Council resolutions
- Lease agreements from landowners
- Letters from local environmental groups

Interconnection

- Follow FERC process
- Usually, must be able to deliver power to purchasing utility system
  - Seller must arrange for third party service/wheeling
- Seller must file interconnection requests, or describe plans for filing
- Copies of any completed applications
- Copies of any agreements or completed Feasibility Studies, System Impact Studies or Facility Studies
- Copies of any agreements for network upgrades
- Copies of any executed interconnection agreements

Regulatory Permits and Compliance

- Seller is responsible for NEPA and obtaining all permits
- A written description of all applications, permits and approvals required to construct and operate the facility and all associated interconnecting utilities, including but not necessarily limited to:
  - Conditional Use Permit; Air Emission Permit; Authority to Construct; or Certificate of Public Convenience and Need.
  - A description of Seller's progress toward obtaining the necessary applications, permits and approvals.
- Copies of any permits and approvals that have already been received
- Copies of any applications filed with a state or local authority seeking authorization of the construction or operation of the facility
- A table which summarizes the air emission levels Seller anticipates will be established for the Generating Facility by the appropriate air permitting agency, if applicable, including:
  - Oxides of Nitrogen (NOx); Carbon Monoxide (CO); Volatile Organic Compounds (VOCs); and Particulate Matter (PM)
- A written description of the operating limitations that the permits have or expect to have which may constrain the operation of the facility including the maximum number of operating hours.

Schedule

- Milestone chart and schedule
- Show key activities
- Critical path items
  - Design
  - Engineering
  - Permits
  - Interconnection
  - Financing
  - Procurement
  - Construction
  - Commissioning

Team Qualifications

- Describe corporate structure of project entity (partners, ownership levels, managing partners)
- Fully describe roles and capabilities of each participant including
  - development team, management team, legal counsel, financial advisor
  - owner's engineer, construction contractor, transmission consultant, environmental consultant
  - construction period lender, operating period lender

Pricing Terms

- Prices are quoted in U.S. dollars and considered firm unless expressly stated otherwise
- Prices should be quoted as an all-in levelized cost, in terms of dollars per Megawatt-hour ($/MWh)
- The Seller will be responsible for compliance with all applicable existing and future environmental requirements during the term of a PPA
- If the Seller's pricing policy involves escalation or an index, the escalation terms and conditions or specific index must be included for evaluation
  - Indexes used should be published and publicly available

Financial Considerations

- Utilities want credit worthy sellers
- Provide annual financial reports and independent audits of each entity in the ownership group
- DUNS #, S&P, Moody's debt ratings
- Description of project financing plan and all arrangements for equity/debt financing of the project

Shortlist

- Begins the PPA negotiation process in earnest
  - This will be a long, complicated legal document (200 plus pages)
- Seller will be asked to sign exclusivity agreement with Buyer for a certain time period
- Buyer will usually have to post a deposit for negotiations ($500 - $3,000 per MW)
- Development security
- Performance assurance
  - If negotiations are successful, Seller may have to post guaranty of 6-12 months revenues by the commercial on-line date (COD)

Summary

- It is never too early to start
  - Project development can take 5-10 years
- Development/planning process for utilities is long
  - Looking out 5-10 years
- Even very early stage projects (e.g. wind resource assessments not complete) can begin the process