

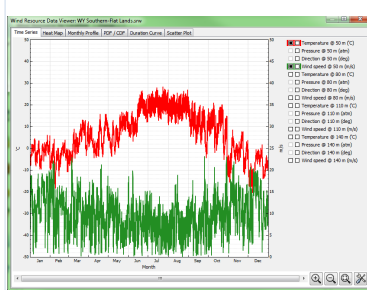
Model Basics

- Free software which is available for online download. <https://sam.nrel.gov/>
- Combination detailed hourly performance and economic modeling tool designed to facilitate decision making for people involved in the renewable energy industry.
- Includes a multitude of different technology and financial options.
- Default values for all inputs provided upon programs startup, so a simulation is always just a few clicks away.
- Models both distributed and utility-scale wind projects.
- Clean, easy to navigate interface.
- Can provide simple performance and financial metrics as well as perform advanced analysis through the use of GUI available tools.



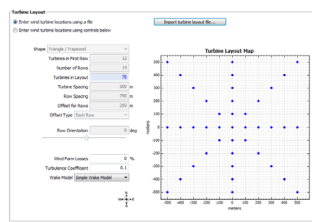
Setting up a Simulation

1. Weather File Specification



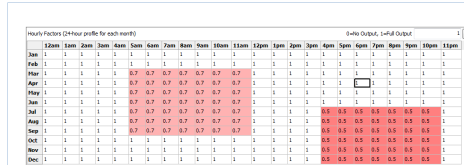
- 30 standard typical files included from AWS TruePower.
- Download weather files from the NREL wind integration studies: Files are available for most of the Western US and about 1300 Eastern US locations.
- Input your own weather files if measured data is available for your site.
- Link to Windographer.
- Future: Link to 3Tier-developed 7 years of gridded data for US.

4. Wind Farm Specification



- Can specify one or many turbines in multiple shapes and configurations to accurately portray any wind farms structure.
- 3 wake model options:
 - Simple Wake Model
 - Eddy Viscosity
 - Park (WASP)
- Does not do detailed topographic/GIS analysis.

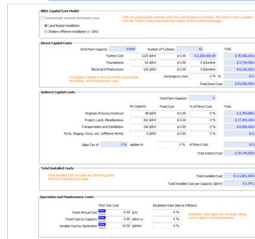
5. Performance Adjustments



Month	1	2	3	4	5	6	7	8	9	10	11	12
Jan	1	1	1	1	1	1	1	1	1	1	1	1
Feb	1	1	1	1	1	1	1	1	1	1	1	1
Mar	1	1	1	1	1	1	1	1	1	1	1	1
Apr	1	1	1	1	1	1	1	1	1	1	1	1
May	1	1	1	1	1	1	1	1	1	1	1	1
Jun	1	1	1	1	1	1	1	1	1	1	1	1
Jul	1	1	1	1	1	1	1	1	1	1	1	1
Aug	1	1	1	1	1	1	1	1	1	1	1	1
Sep	1	1	1	1	1	1	1	1	1	1	1	1
Oct	1	1	1	1	1	1	1	1	1	1	1	1
Nov	1	1	1	1	1	1	1	1	1	1	1	1
Dec	1	1	1	1	1	1	1	1	1	1	1	1

- Apply month by hour performance adjustments to account for known system curtailment, turbine degradation and availability.

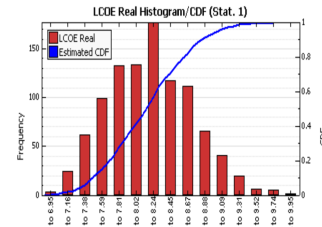
6. Wind System Costs



Category	Parameter	Value
Installation Costs	Foundation	\$100,000
	Tower	\$150,000
	Nacelle	\$200,000
	Hub	\$100,000
Operational Costs	Insurance	\$50,000
	Maintenance	\$100,000
	Repairs	\$50,000
	Other	\$50,000

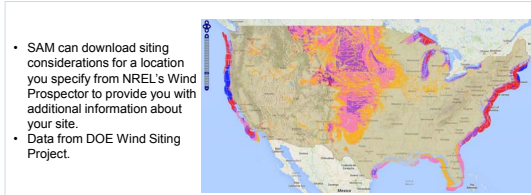
- Define installation costs by category in \$, \$/kW, or \$/turbine, and annual operating costs in \$, \$/kW, or \$/kWh.
- Specify offshore or onshore installations to change available cost parameters.

7. Financing



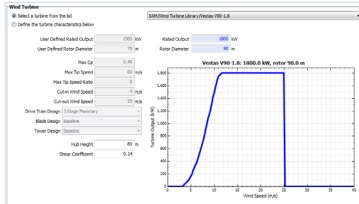
- Define complex system financing options allowing any financial situation to be modeled accurately.
- Allow SAM to optimize by debt fraction of PPA escalation rate to minimize LCOE.
- Solve by specifying PPA or IRR (specifying one forces SAM to solve for the other).
- List of financing options
 - Residential
 - Commercial
 - Utility IPP
 - Single Owner
 - All Equity Partnership Flip
 - Leverage Partnership Flip
 - Sale Leaseback

2. Siting Considerations



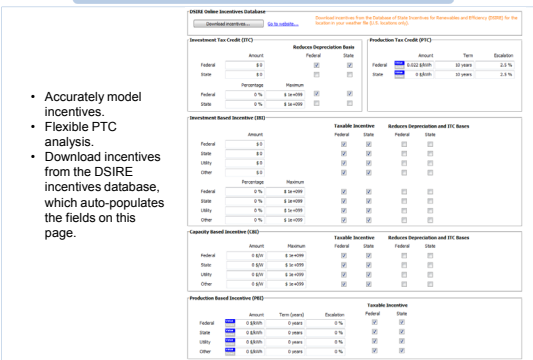
- SAM can download siting considerations for a location you specify from NREL's Wind Prospector to provide you with additional information about your site.
- Data from DOE Wind Siting Project.

3. Turbine Selection



- Select a turbine from a large database of available turbines.
- Define turbine characteristics if known.
- Use the library editor to define a power curve based on a pre-existing turbine's data.

8. Incentives



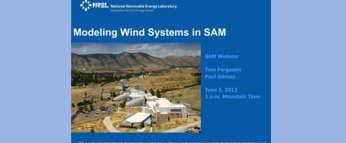
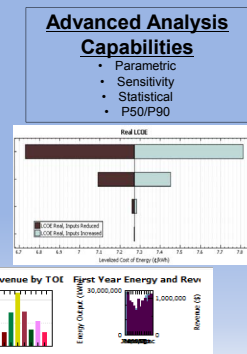
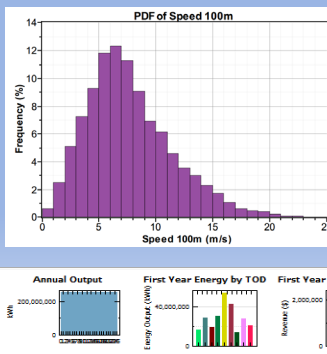
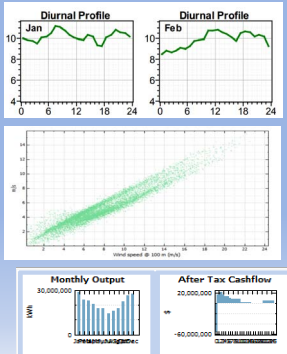
- Accurately model incentives.
- Flexible PTC analysis.
- Download incentives from the DSIRE incentives database, which auto-populates the fields on this page.

Outputs and Advanced Analysis

Outputs

- Metrics table which allows for quick analysis of performance and financial metrics.
- Hourly, monthly, or annual output metrics in exportable graphs and tables.
- Cash flow table with optional export to Excel with formulas.
- Choose from a series of available-by-default graphs, or make your own graph based on any of the hundreds of metrics output by SAM.

Metric	Value
Annual Energy	254,882,160 kWh
PPA price	4.50 ¢/kWh
LCOE Nominal	4.77 ¢/kWh
LCOE Real	3.85 ¢/kWh
Internal rate of return (%)	21.06 %
Minimum DSCR	1.52
Net present value (\$)	\$ 23,370,564.00
Calculated ppa escalation (%)	1.00 %
Calculated debt fraction (%)	50.00 %
Windfarm Capacity (MW)	57.60 MW
Capacity Factor	50.5 %
Approximate land use (m ²)	75400.0



SAM in Research

- Wind Technical Manual (Under Review)- NREL 2013
- New Features in SAM 2013.9.20- Webinar (NREL 2013)
- Ummel, K. "Planning for Large-Scale Wind and Solar Power in South Africa" (Center for Global Development, 2013)
- Modeling Wind Systems in SAM- Webinar (NREL 2013)
- Hermansson, H. "Assessment of Wind Energy Production Software" (University of Washington, 2013)