State-Federal RPS Collaborative

Clean Energy States Alliance

How SAM Can Be Useful to You and How to Use It

Hosted by
Todd Olinsky-Paul, Project Director, CESA

March 21, 2013

CleanEnergy States Alliance

CleanEnergyGroup
Innovation in Finance, Technology & Policy

Housekeeping

- All participants will be in listen-only mode throughout the broadcast.
- You can connect to the audio portion of the webinar using VOIP and your computer's speakers or USB-type headset. You can also connect by telephone. If by phone, please expand the Audio section of the webinar console to select "Telephone" to see and enter the PIN number shown on there onto your telephone keypad.
- You can enter questions for today's event by typing them into the "Question Box" on the webinar console. We will pose your questions, as time allows, following the presentation.
- This webinar is being recorded and will be made available after the event on the CESA website at

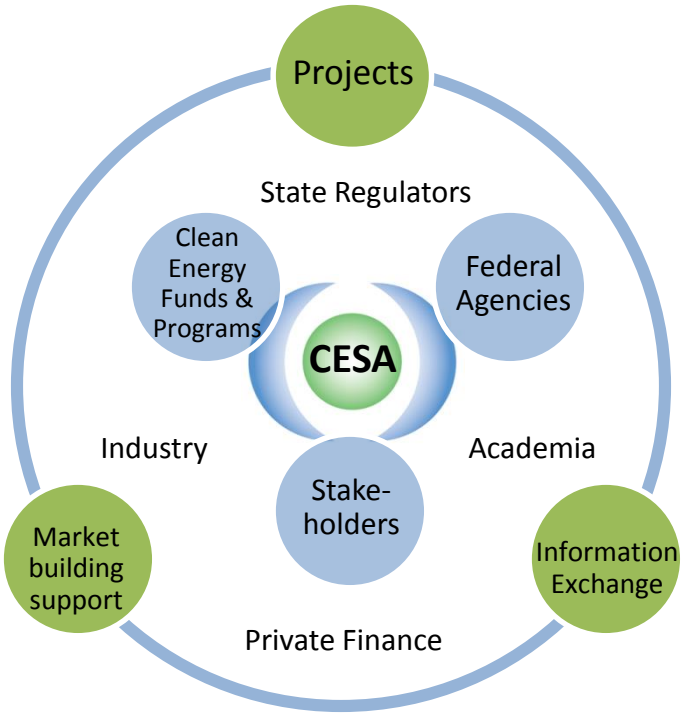
www.cleanenergystates.org/events/

About CESA

Clean Energy States Alliance (CESA) is a national nonprofit organization dedicated to advancing state and local efforts to implement smart clean energy policies, programs, technology innovation, and financing tools to drive increased investment and market making for clean energy technologies.

What We Do

- Multi-state coalition of clean energy programs cooperating and learning from each other, leveraging federal resources
- CESA state members have nearly $6 billion to invest in next 10 years
- Members have supported nearly 130,000 renewable energy projects from 1998-2011 with state-based dollars
- Nonpartisan, experimental, collaborative network
  - Information exchange & analysis
  - Partnership development
  - CESA projects: solar, wind, RPS, fuel cells, energy storage, program evaluation, national database



State-Federal RPS Collaborative

- With funding from the Energy Foundation and the US Department of Energy, the Clean Energy States Alliance (CESA) facilitates the **Collaborative**.
  - CESA is a national nonprofit organization dedicated to advancing state and local efforts to implement smart clean energy policies, programs, technology innovation, and financing tools. At its core is a multi-state coalition of clean energy programs cooperating and learning from each other, leveraging federal resources.
- Includes **state RPS administrators and regulators**, **federal agency representatives**, and other stakeholders.
- Advances dialogue and learning about RPS programs by **examining the challenges and potential solutions** for successful implementation of state RPS programs, including **identification of best practices**.
- To get the **monthly newsletter** and announcements of **upcoming events**, sign up for the listserv at: www.cleanenergystates.org/projects/state-federal-rps-collaborative

Today's Guest Speaker

Nate Blair, NREL

Nate.Blair@nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

National Renewable Energy Laboratory
Innovation for Our Energy Future

SAM Overview

CESA – RPS Webinar

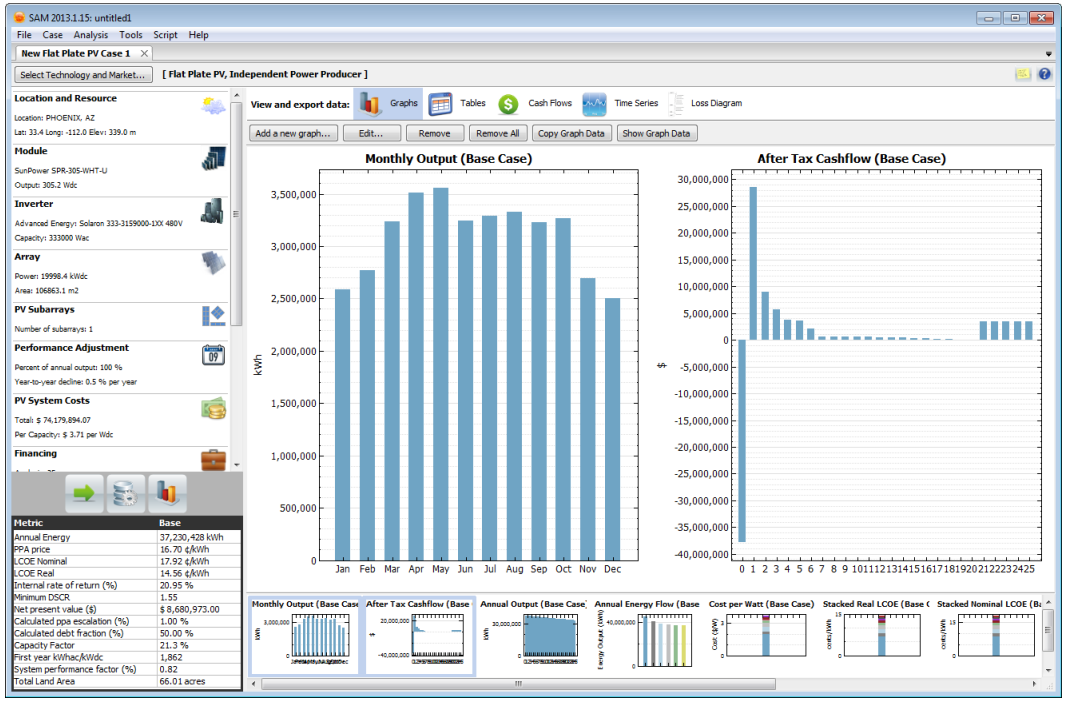
Nate Blair

March 21, 2013

NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy operated by the Alliance for Sustainable Energy, LLC

The System Advisor Model (SAM)

- Performance models calculate a renewable energy system's hourly energy output over a single year
- Financial models calculate the cost of energy for a renewable energy project over many years of operation



Find out more and download the software free at http://sam.nrel.gov

Background

Developed by the Department of Energy, National Renewable Energy Laboratory, and Sandia National Laboratories

Vision

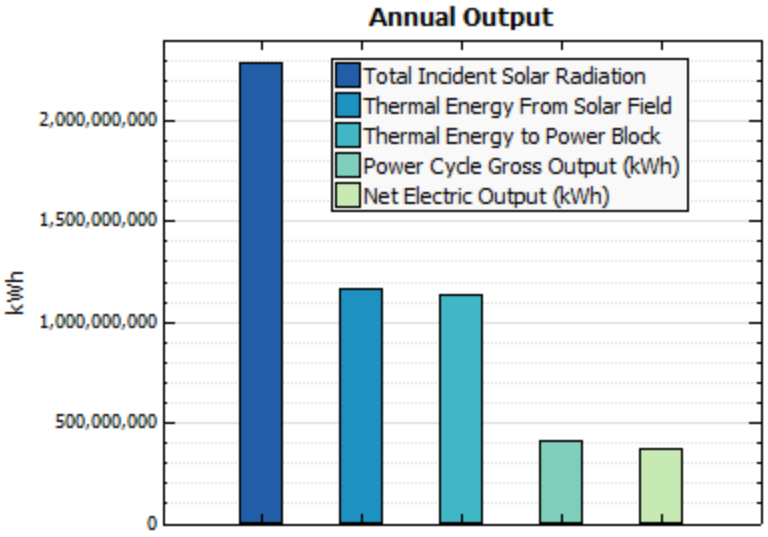
- Model different renewable energy projects in a single platform
- Facilitate technology comparison by handling performance, costs and financing consistently across technologies
- Make high-quality performance models developed by NREL, Sandia, and other partners available to the public

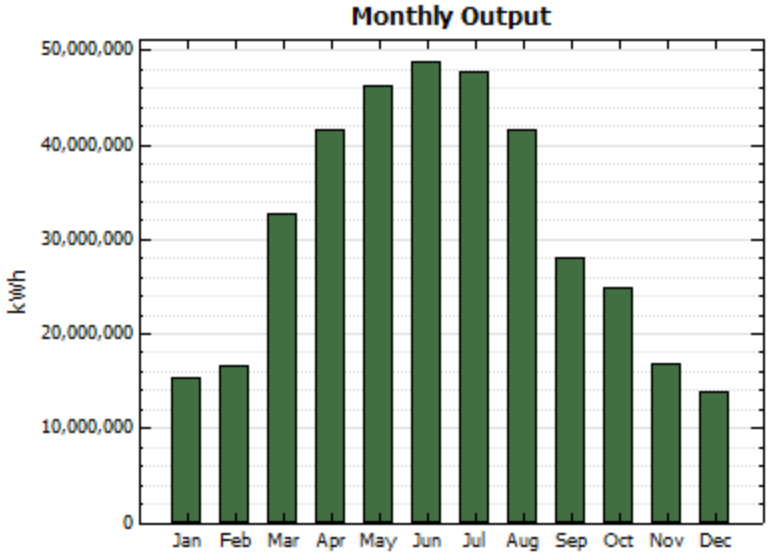
Applications

- Feasibility studies
  - Project developers, Federal Energy Management Program
- Use as benchmark for other models
  - System integrators and utilities
- Research projects
  - Universities and engineering firms
- Plant acceptance testing for parabolic trough systems
- Evaluate technology research opportunities and grant proposals
  - Department of Energy

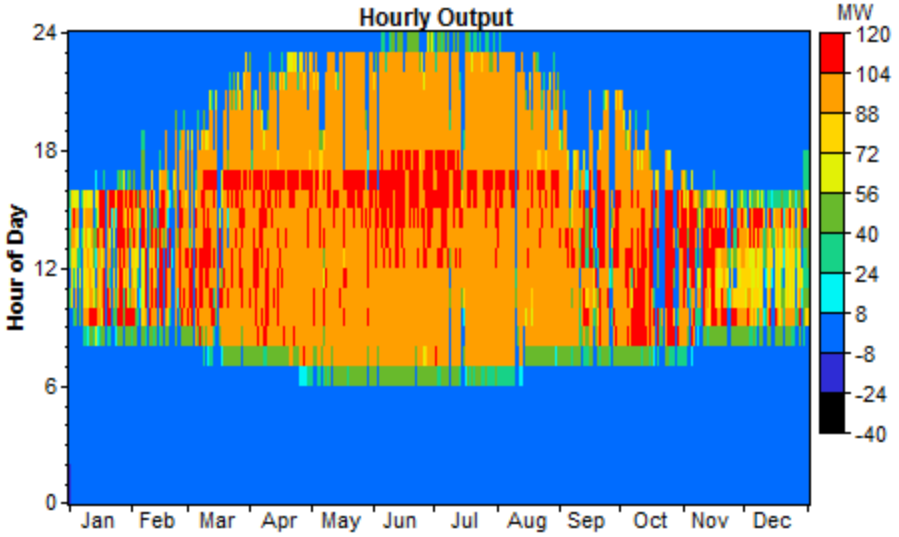
Over 35,000 downloads

Generate electric output predictions

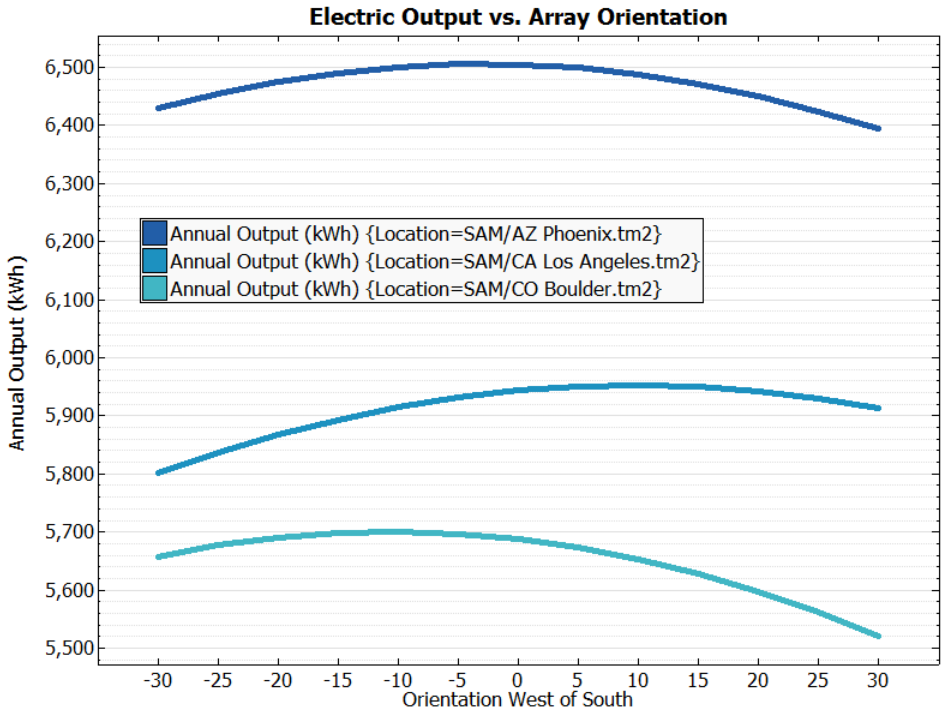




Example: 100 MW Parabolic trough system with 6 hours of storage



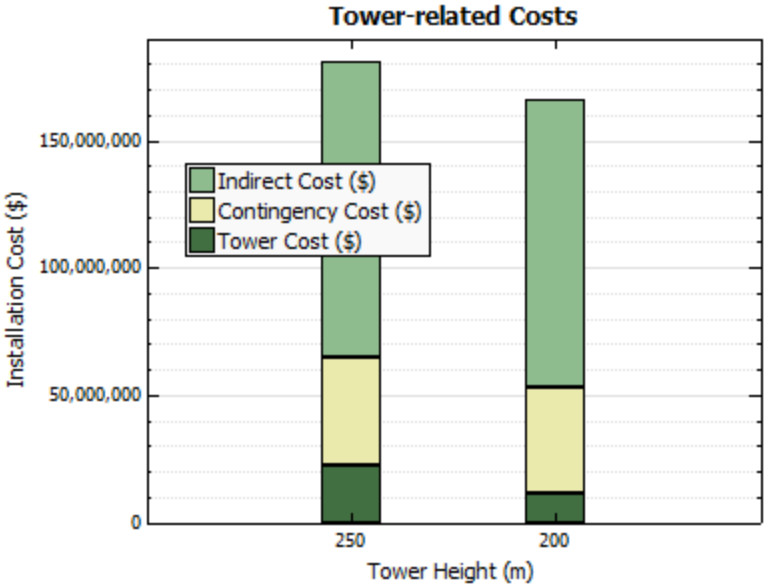
Optimize system design parameters



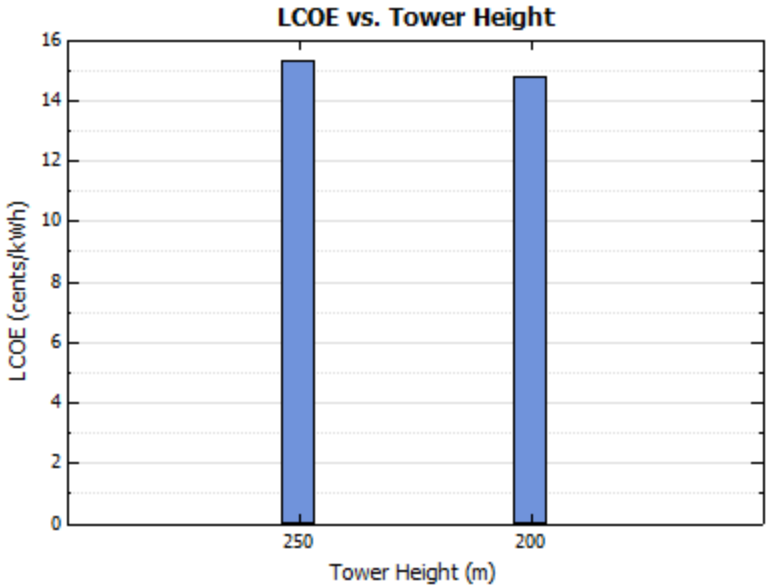
- For Boulder, CO, orient array slightly eastward to avoid summer afternoon thunderclouds over mountains
- For Los Angeles, CA, orient array slightly westward to avoid morning fog
- For Phoenix, AZ, orient array due south

Example: Explore optimal array tilt and azimuth angles for a 3 kW residential photovoltaic system in three different locations

Analyze project costs

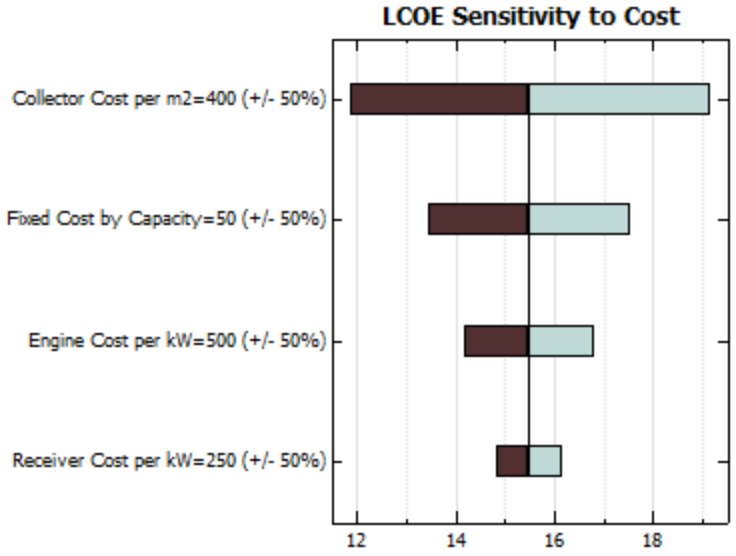


Decreasing tower height by 50 m decreases installation costs by 2.5% and levelized cost of energy (LCOE) by 4.0%



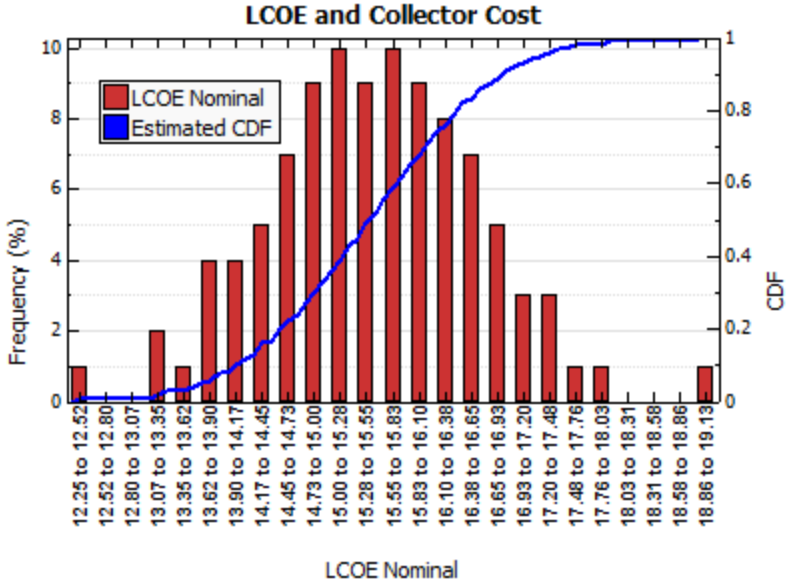
Example: 100 MW power tower system with 6 hours of storage

Explore uncertain assumptions



Sensitivity analysis: LCOE is most sensitive to collector cost

Statistical analysis: Shows degree of uncertainty



Example: 25 kW dish-stirling system

Advanced capabilities

- Excel Exchange: Populate inputs with data from an Excel workbook
- SamUL: Write scripts in the SAM user interface to automate repetitive or complex analyses
- Software Development Kit (SDK): Access the SAM API from programs written in C, C#, Java, Python, and MATLAB

Photovoltaic Residential

A new PV array system is installed on a home of a city employee who participated in the group buy pilot in 2010. (NREL PIX 19492)

- Buys and sells electricity at retail rates
- Meets a building load and sells excess electricity to the grid
  - –Grid meets load when PV output cannot meet load
- **Is project economically feasible given costs and energy production?**

Photovoltaic PPA

La Ola PV Plant in Hawaii. NREL PIX 19697

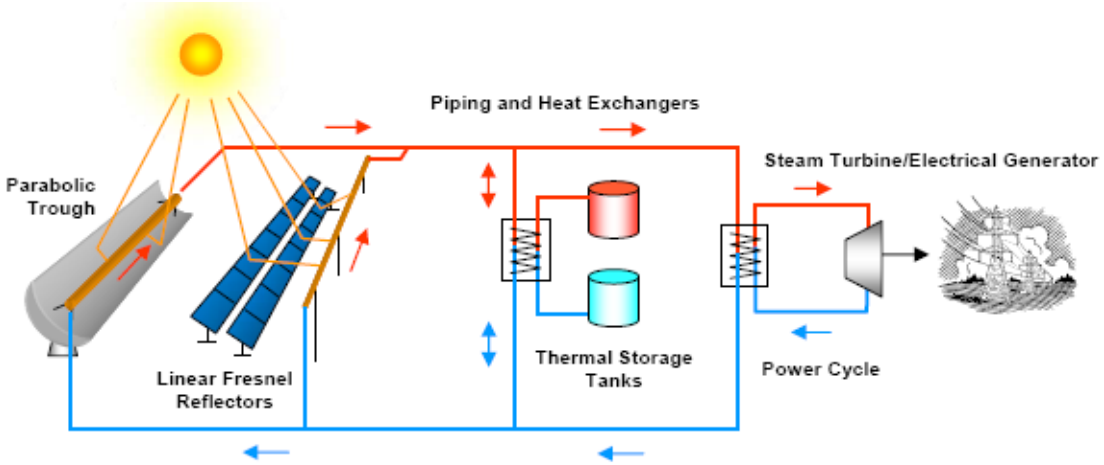
Installation in Philadelphia. NREL PIX 18064

Buys and sells electricity at a negotiated PPA price

Revenues must cover costs and IRR requirement

What PPA price is required to cover costs and meet IRR requirement?

Parabolic Trough

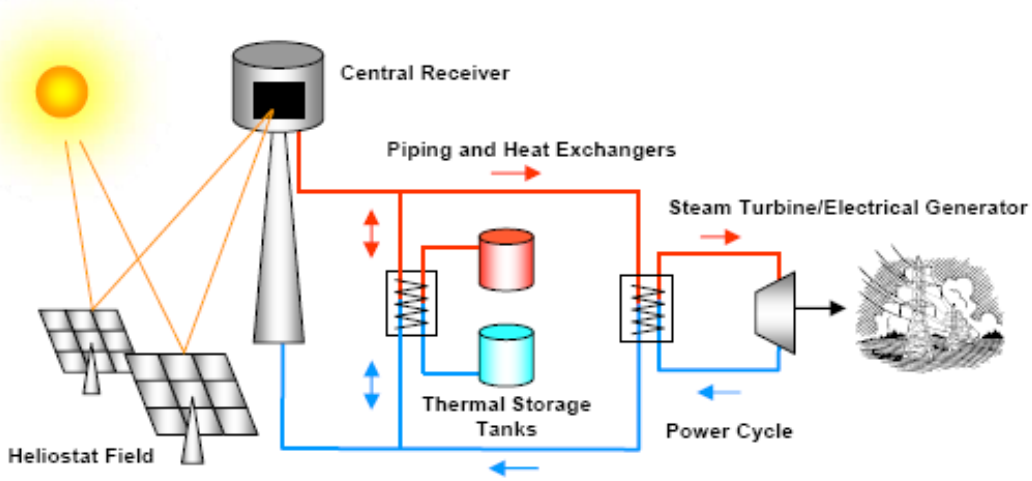


Solar field delivers thermal energy to a steam turbine, with optional thermal energy storage.

What is the optimal solar field size?

How much storage is most economical?

Power Tower



Field of heliostats focuses sunlight on receiver at top of tower, which delivers thermal energy to a steam turbine and optional storage.

What is the optional combination of heliostats and tower heights?

How much storage is most economical?

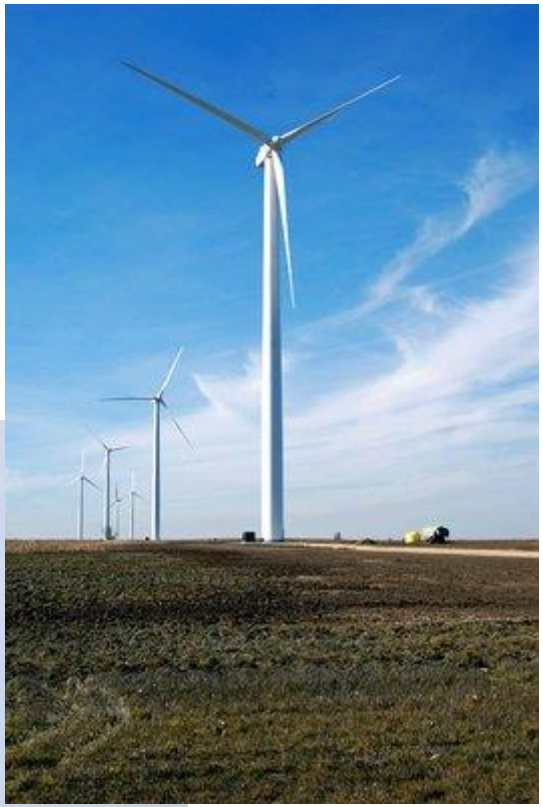
Solar Water Heating Systems

Collectors for solar water heating system on a school. NREL PIX 19690

Residential and commercial systems that displace electric water heating

What collector size is most cost effective?

Wind Power



Wind farm in Kansas. NREL PIX 17015

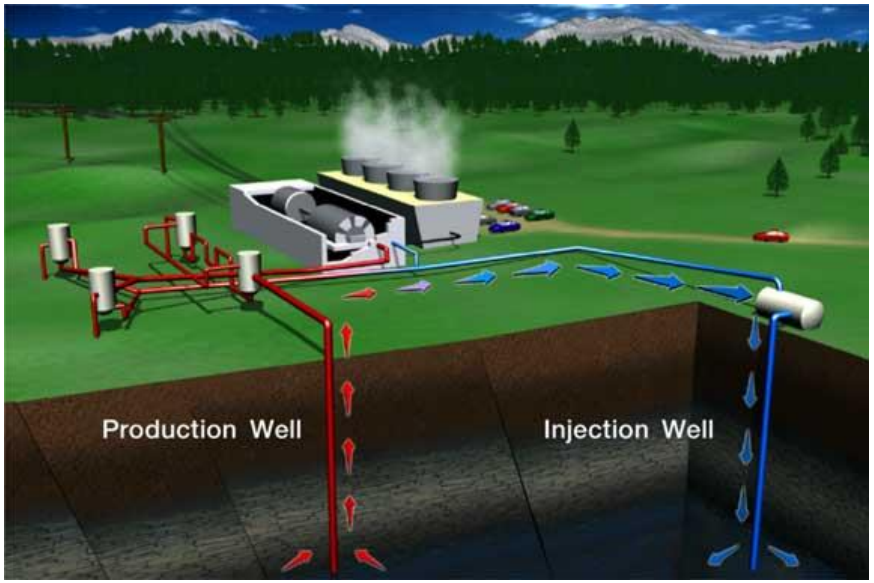
School in Iowa. NREL PIX 14661

Systems consisting of one or more wind turbines

Very basic wind farm layout analysis

What is the optimal hub height to minimize the project's levelized cost of energy?

Geothermal



Geothermal Education Office.
http://geothermal.marin.org/

Geothermal power plants that extract heat from below the earths surface

Geothermal co-production are smaller commercial projects that extract heat from a geothermal resource at an oil or gas well

Geothermal Power Plant in Iceland.
http://en.wikipedia.org/wiki/Geothermal_energy

Biomass Power

Biopower plant in Indiana.
NREL PIX 08927

- Burns biomass fuel to drive a steam turbine
- Download feedstock data from online databases

Contact Info

Todd Olinsky-Paul
Project Director
Clean Energy States Alliance
Todd@cleanegroup.org

www.cleanenergystates.org