

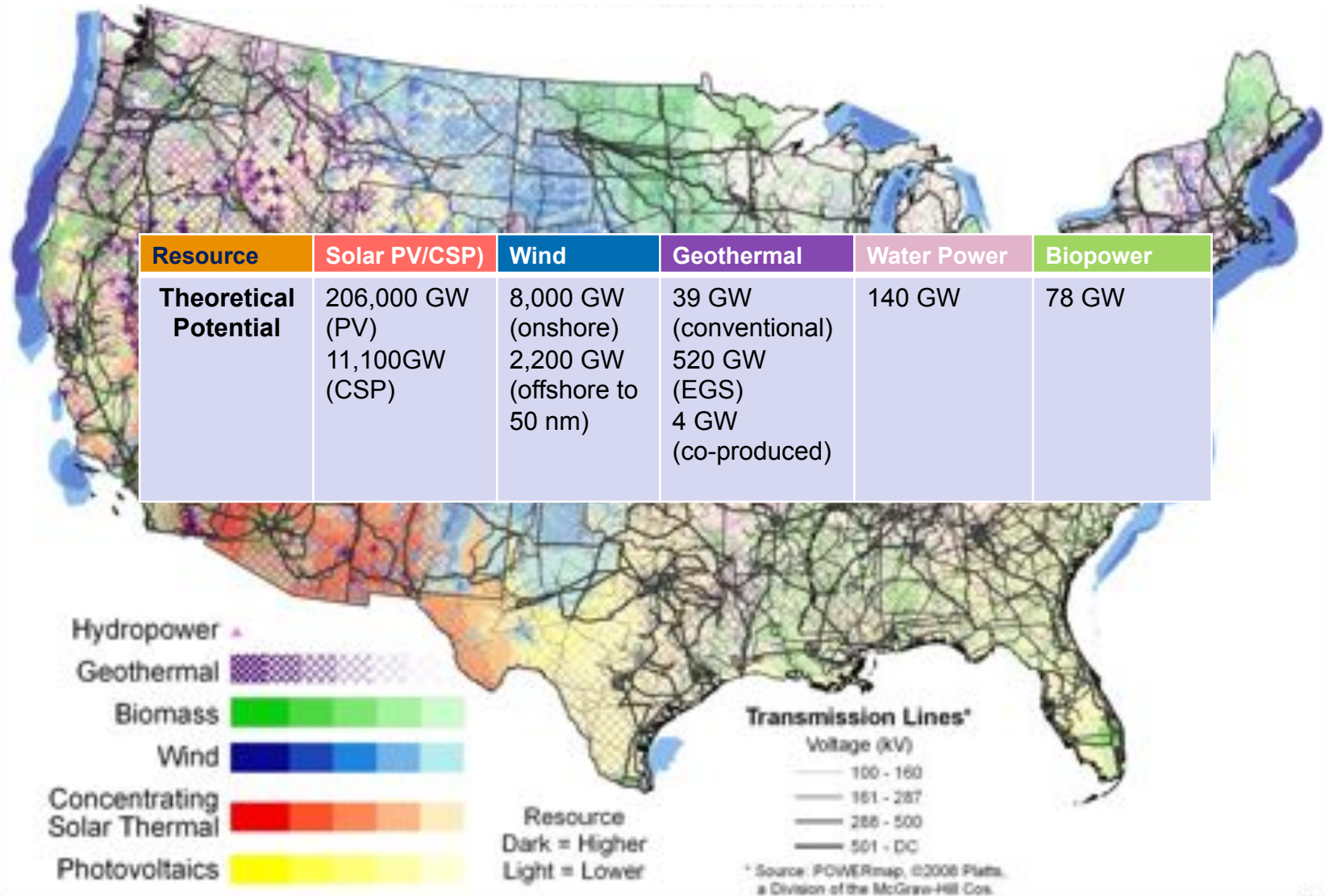


NREL Solar Data and Tools

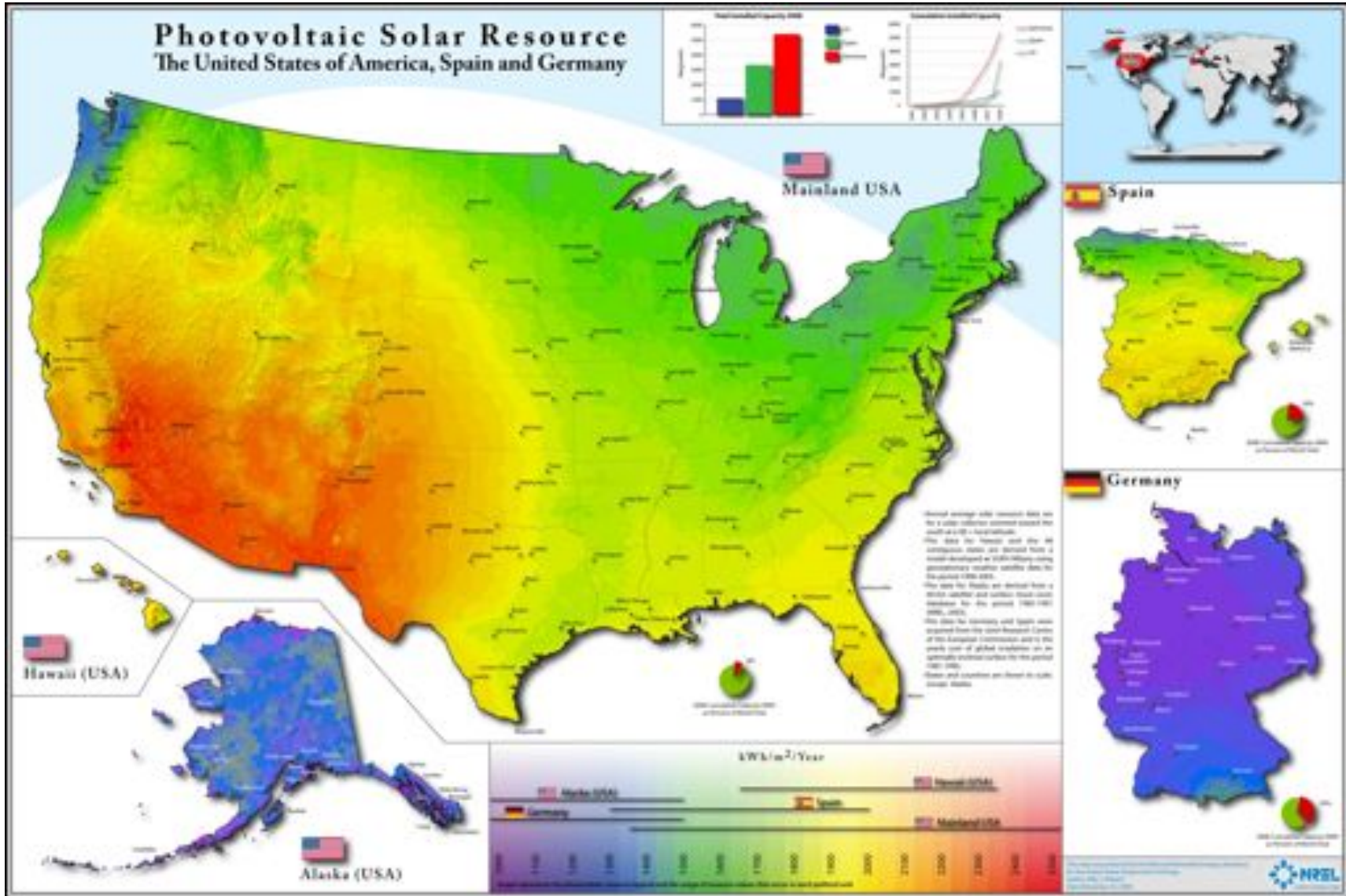


Nate Blair
NREL
Golden CO

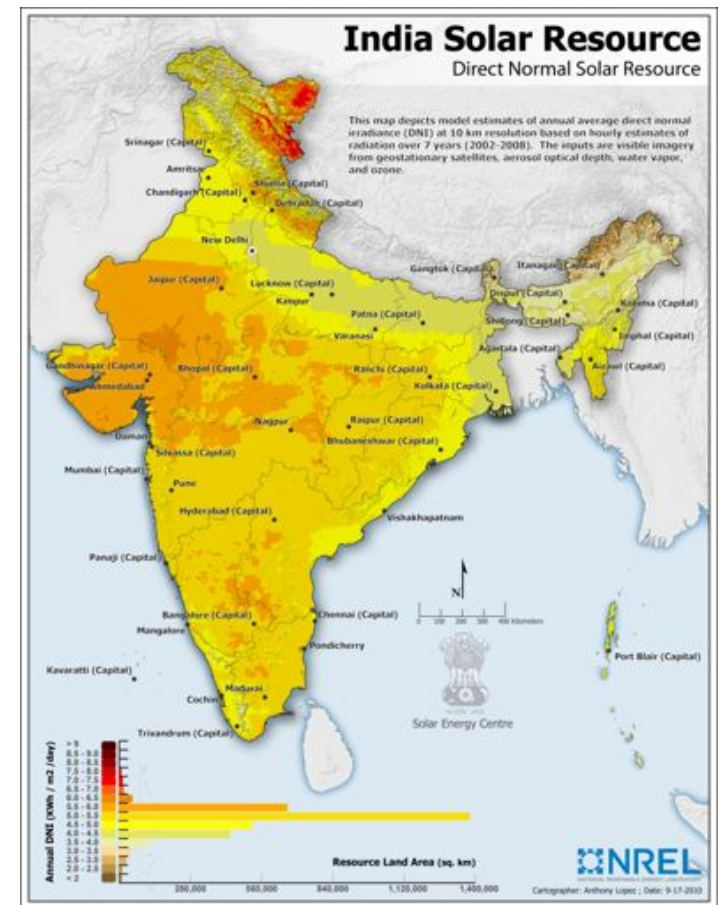
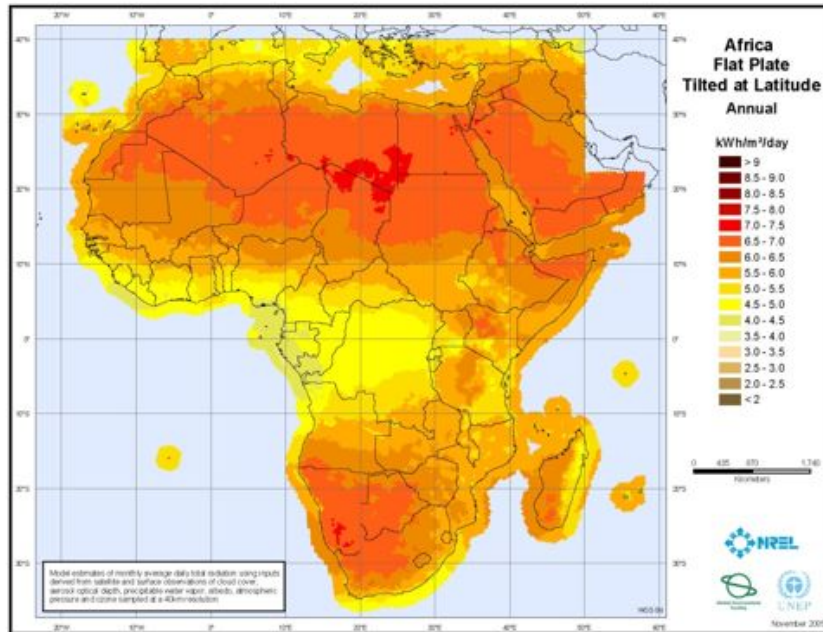
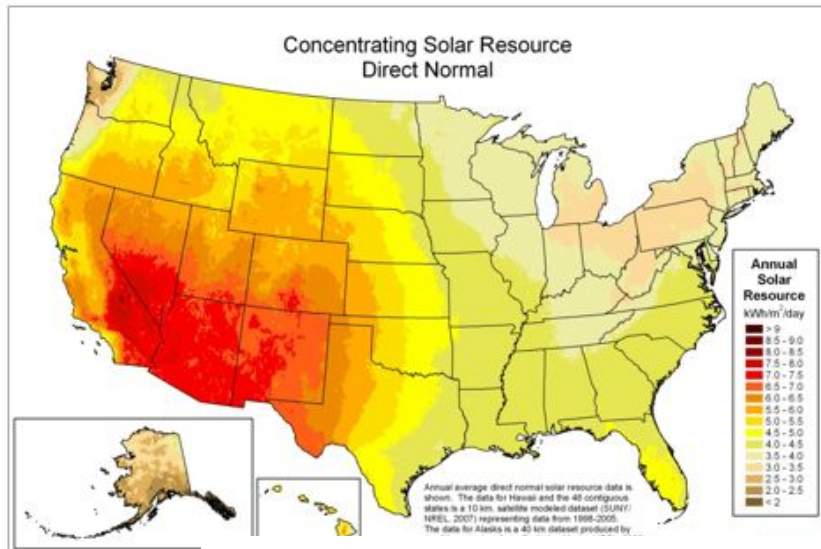
RE Resource Mapping



RE Resource Mapping



Solar Resource Mapping



GIS Analysis Example

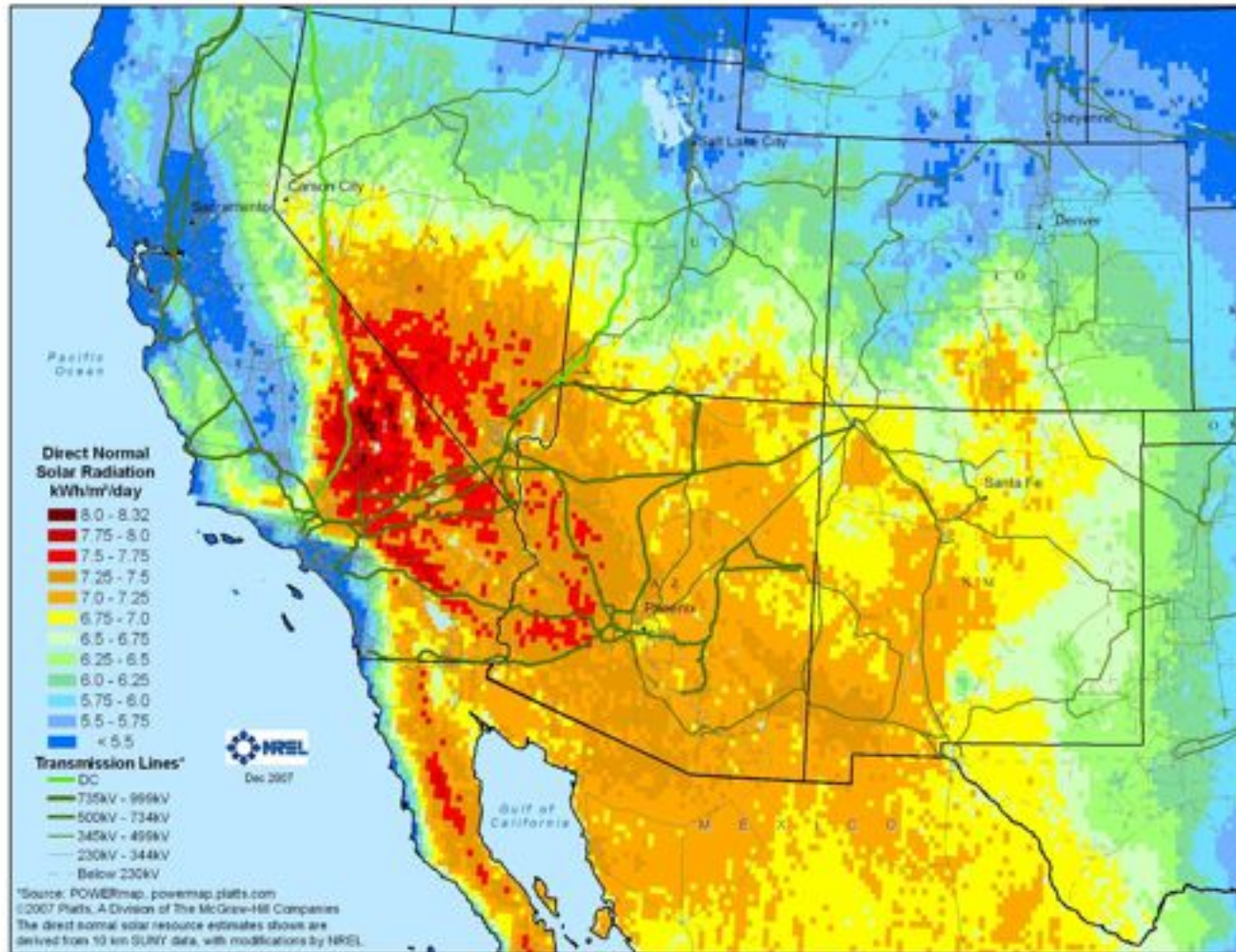
Analysis Question: What areas in the southwestern United States are best suited for development of concentrated solar power (CSP) technology?

Datasets:

- Solar Resource
- Elevation
- Protected Areas
- Unsuitable Areas
- Development Costs

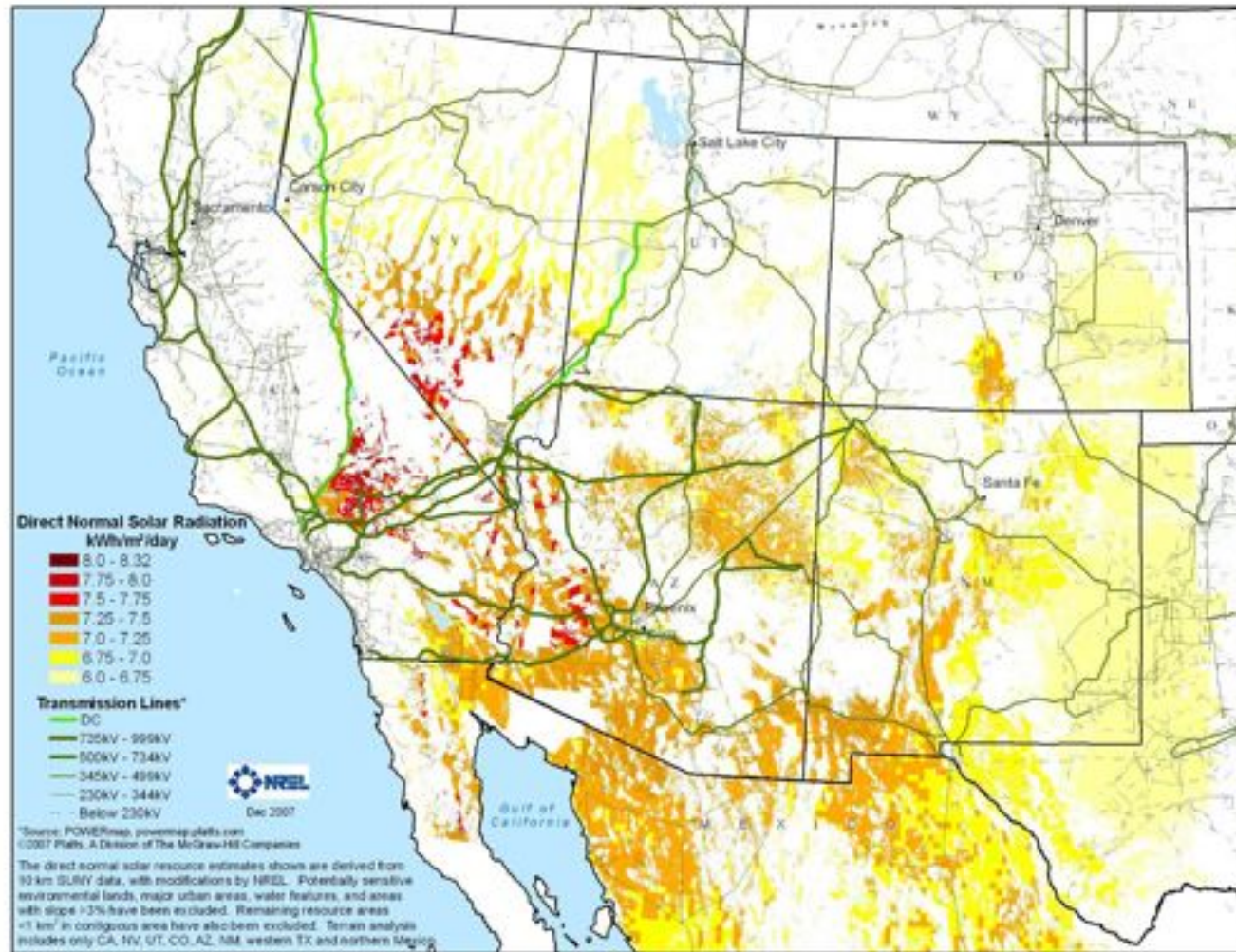
GIS Analysis - CSP Site Suitability Example

Southwest Solar Resources – Base Data



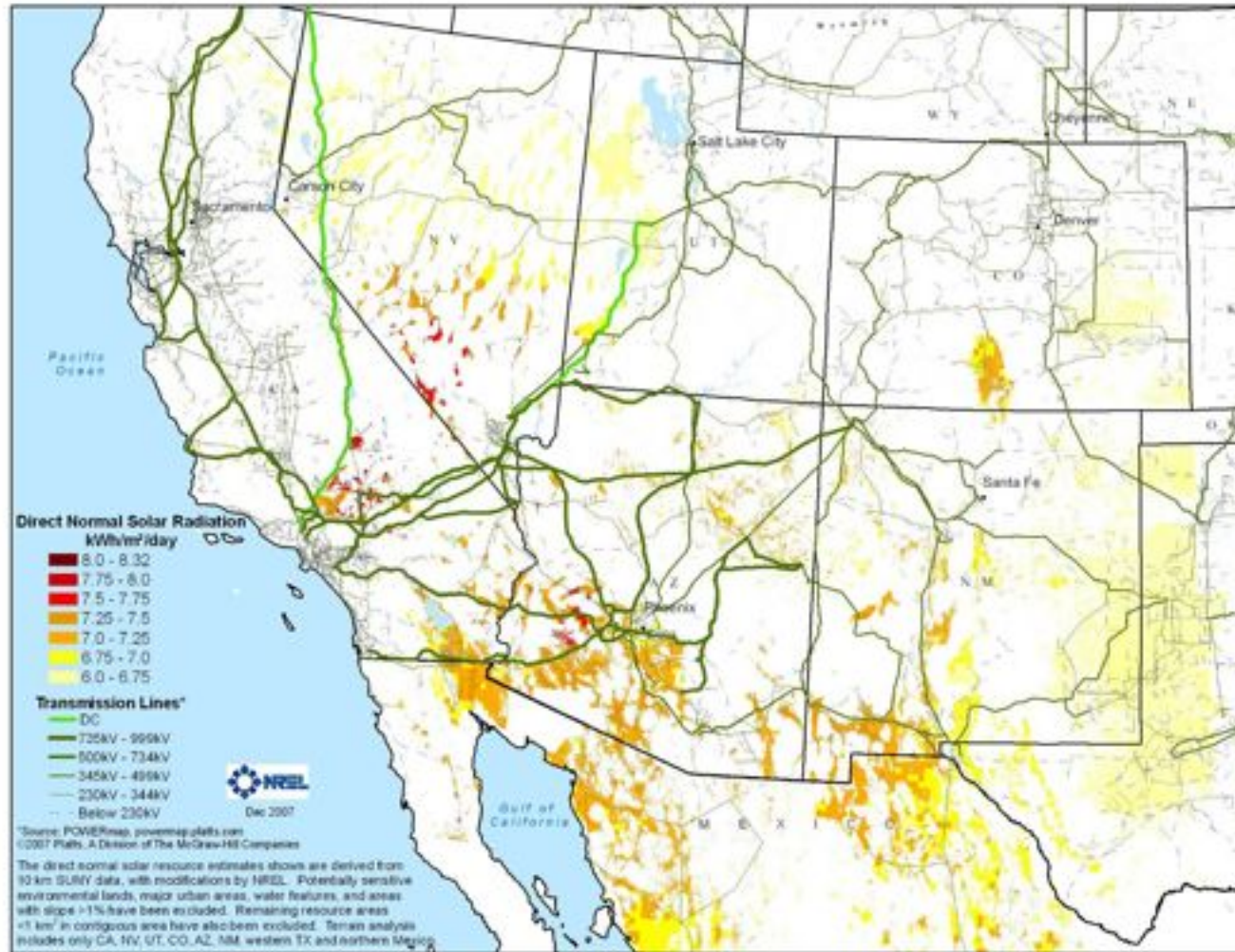
GIS Analysis - CSP Site Suitability Example

Southwest Solar Resources with Slope < 3%



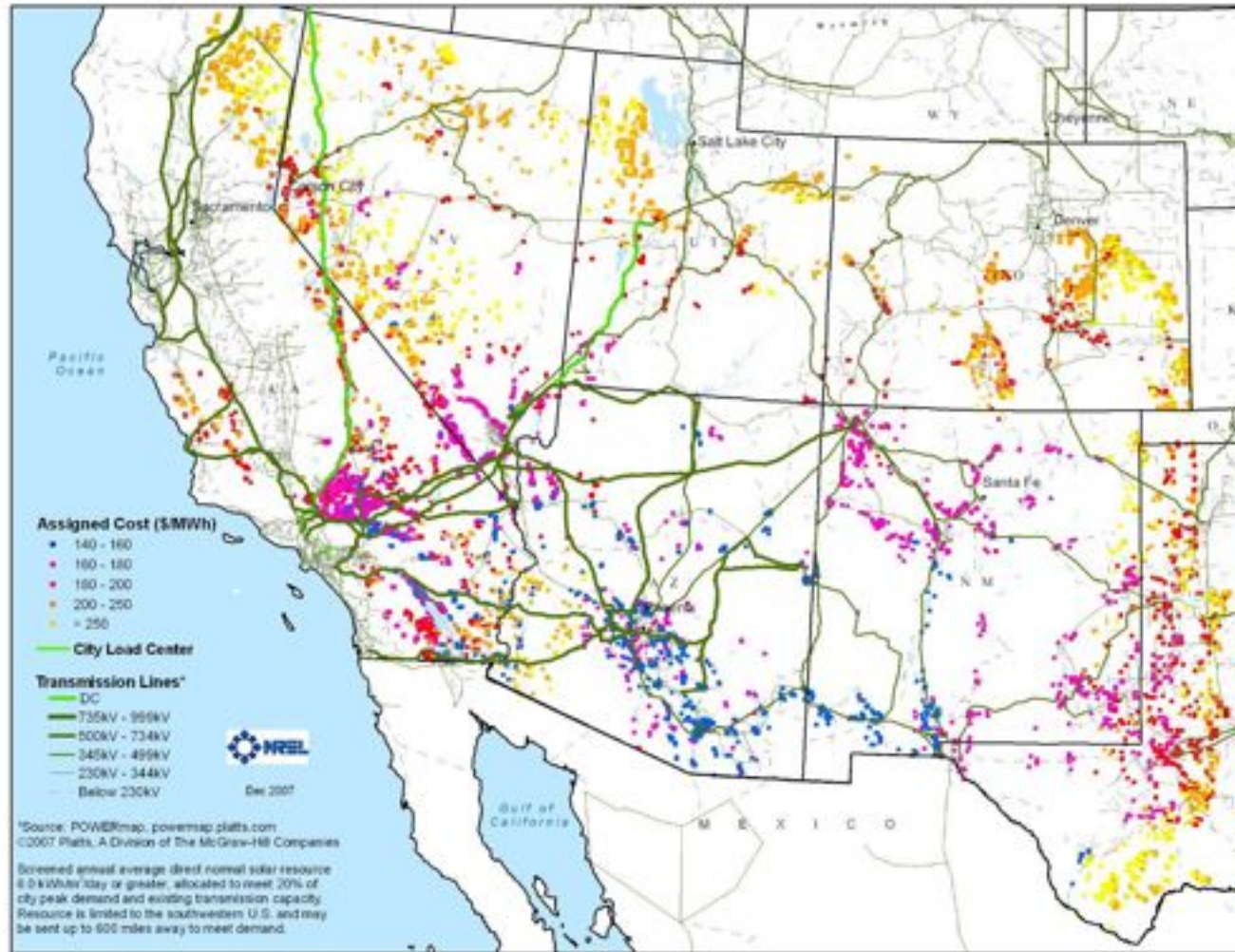
GIS Analysis - CSP Site Suitability Example

Southwest Solar Resources with Slope < 1%



GIS Analysis - CSP Site Suitability Example

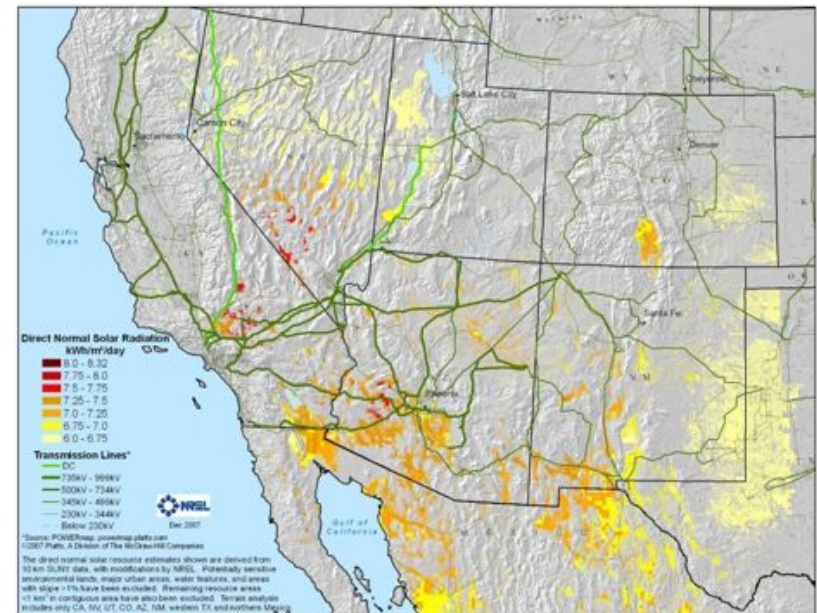
Optimal CSP Sites from CSP Capacity Supply Curves



GIS Analysis - CSP Site Suitability Example

Resulting CSP Resource Potential

State	Land Area (mi ²)	Solar Capacity (MW)	Solar Generation Capacity GWh
AZ	13,613	1,742,461	4,121,268
CA	6,278	803,647	1,900,786
CO	6,232	797,758	1,886,858
NV	11,090	1,419,480	3,357,355
NM	20,356	2,605,585	6,162,729
TX	6,374	815,880	1,929,719
UT	23,288	2,980,823	7,050,242
Total	87,232	11,165,633	26,408,956



The table and map represent land that has no primary use today, exclude land with slope > 1%, and do not count sensitive lands.

Solar Energy Resource ≥ 6.0

Capacity assumes 5 acres/MW

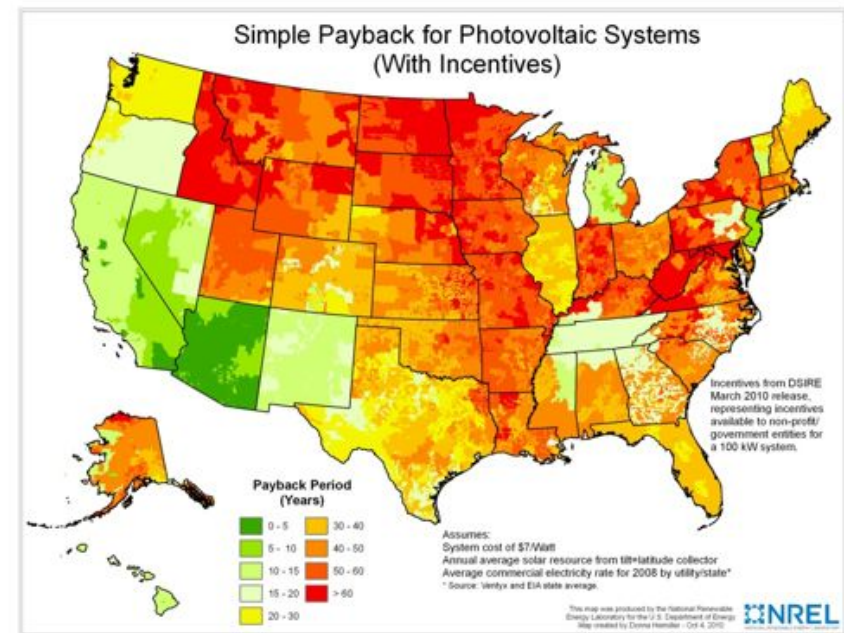
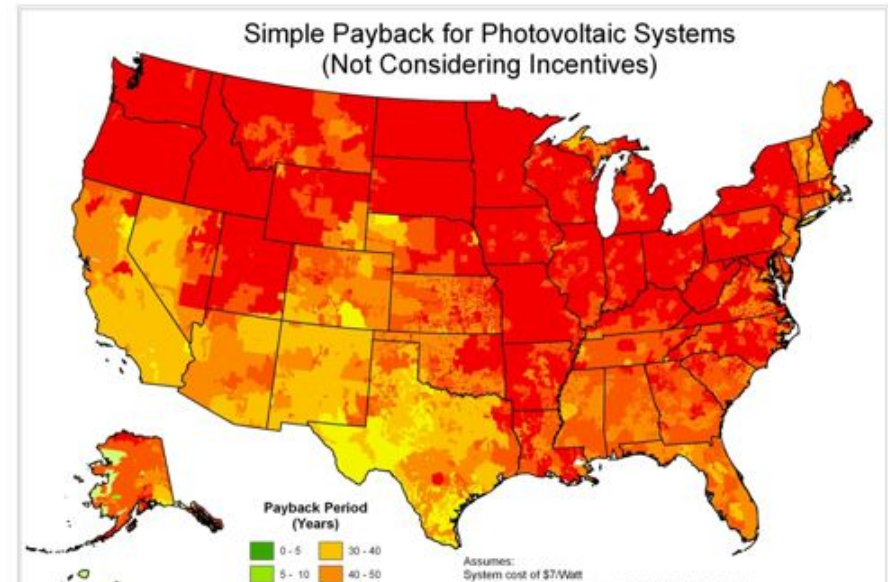
Generation assumes 27% annual capacity factor

Current total nameplate capacity in the U.S. is 1,000GW w/ resulting annual generation of 4,000,000 GWh

GIS Analysis: Solar Economic Analysis

Combine spatially variable data (solar resource and electricity rates) with other information to highlight opportunities

- where is it cost effective now?
- what can we do to make it cost effective?
- what happens if we change ...?



MapSearch

<http://www.nrel.gov/gis/mapsearch/>



New, collective approach for organizing and providing access to maps developed by the DAV group. Facilitates communication about which maps are available.

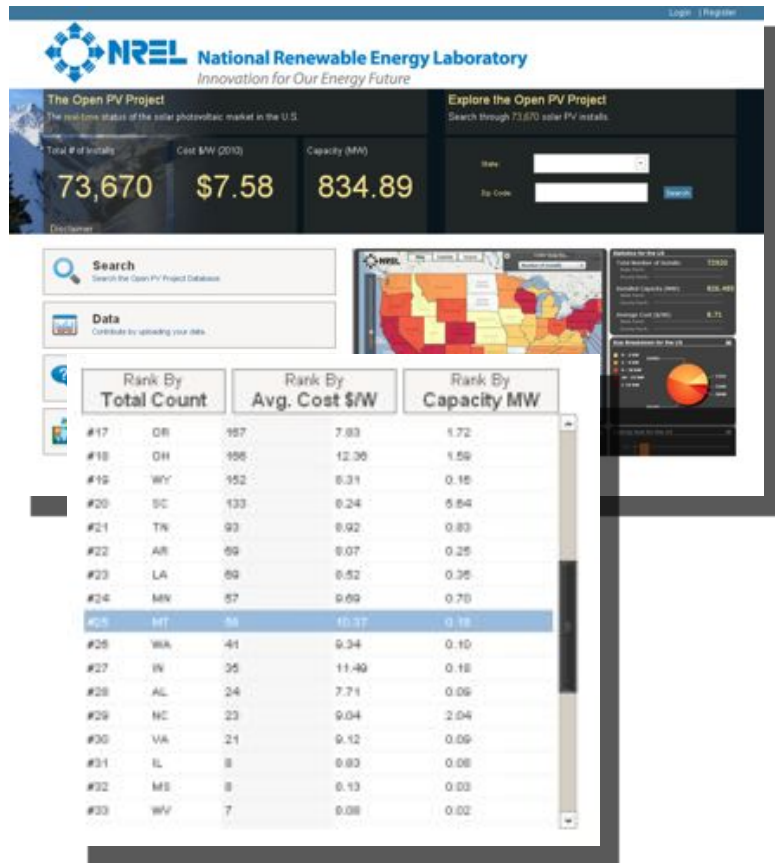


The screenshot displays the MapSearch web application interface. It features a search bar at the top right, a left sidebar with navigation and filtering options, and a main content area showing search results. The results are displayed as a grid of map thumbnails, each with a title and a brief description. The interface is annotated with several callout boxes:

- Topical Keyword One-Click Filtering:** Points to the 'Geographic Search' section in the left sidebar.
- Customize the Way Your Results Display:** Points to the 'Sort by' and 'Grouped by' options in the left sidebar.
- Search Using Your Own Terms:** Points to the search input field at the top right.
- Filter by File Type and Date:** Points to the 'File Type' and 'Date created' filters on the right side.
- Assess the Quantity of Maps Available:** Points to the '784 items' count displayed above the map thumbnails.

Applications

Tracking PV market



Data Analysis and Visualization Group
Project Lead:
Ted Quinby, NREL
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Project Description

The Open PV Mapping Project is a collaborative effort between government, industry, and the public that is compiling a comprehensive database of photovoltaic (PV) installation data for the United States. Data for the project are voluntarily contributed from a variety of sources including utilities, installers, and the general public.

Project Impact

The data collected is actively maintained by the contributors and are always changing to provide an evolving, up-to-date snapshot of the US solar power market

Project History and Timeline

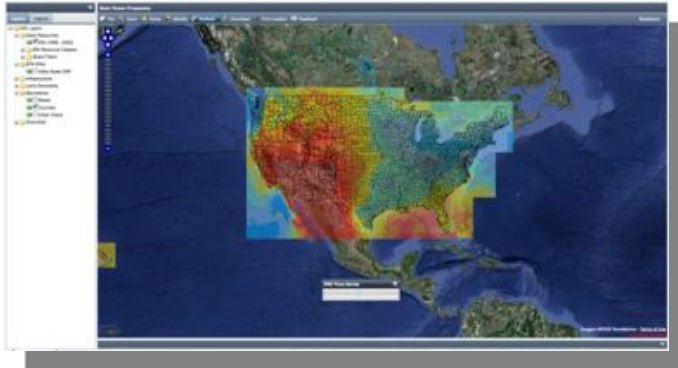
The OpenPV project was released in October of 2009. OpenPV is funded by the Market Transformation program of the DOE Solar Program.

October 2009
July 2010

Release of version 1.0
Release of version 2.0

The Solar Prospector

Citing utility scale CSP



Data Analysis and Visualization Group
Project Lead:
Ted Quinby, NREL
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Project Description

The Solar Prospector is a web-based GIS tool designed to assist industry professionals in the citing of utility-scale CSP plants. The tool employs various GIS datasets to help identify areas that may have a high potential for CSP plant development.

Project Impact

This project assists the CSP industry by providing critical information about location of solar resources, land ownership, and general infrastructure in an easy to use map format. Users can quickly download hourly solar resource data for specific locations and quickly perform temporal analyses for any location in the US and N. Mexico.

Project History and Timeline

Current work includes developing more customized analysis tools and adding more layers to the map. Additionally usability of the tool is primary concern moving forward (increasing usability in order to lead to higher use).

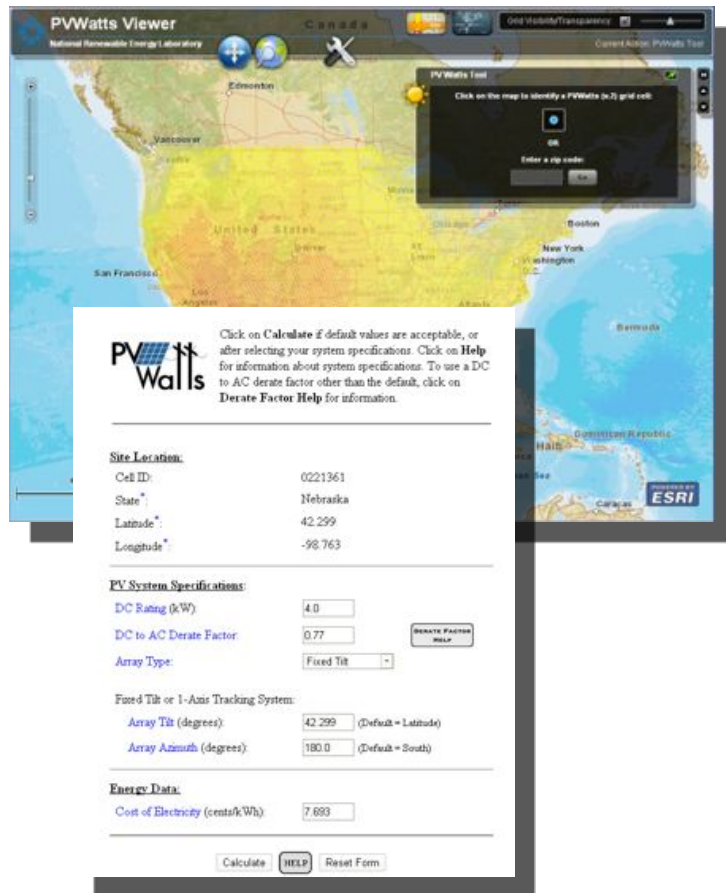
August 2010
September 2010
January 2011

Enhanced user documentation
Distance analysis tool
Spatial intersection analysis

PV Watts

http://mapserve3.nrel.gov/PVWatts_Viewer/index.html

Basic PV modeling



The screenshot shows the PVWatts Viewer interface. At the top, there's a map of the United States with a yellow grid overlay. A 'PV Watts Test' dialog box is open over the map, prompting the user to click on the map to identify a PV Watts v2 grid cell or enter a zip code. Below the map is a form with the following sections:

Site Location:
Cell ID: 0221361
State: Nebraska
Latitude: 42.299
Longitude: -98.763

PV System Specifications:
DC Rating (kW): 4.0
DC to AC Derate Factor: 0.77
Array Type: Fixed Tilt
Fixed Tilt or 1-Axis Tracking System:
Array Tilt (degrees): 42.299 (Default = Latitude)
Array Azimuth (degrees): 180.0 (Default = South)

Energy Data:
Cost of Electricity (cents/kWh): 7.683

Buttons: Calculate, HELP, Reset Form

Data Analysis and Visualization Group

Project Lead:

Ted Quinby, NREL
ted.quinby@nrel.gov

Project Description

The PVWatts v2 Viewer application is an interactive map based interface to rapidly utilize the PVWatts Version 2 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 pages on the NREL website. Users can get an estimate of expected monthly and annual solar resource values for any location in the United States.

Project History and Timeline

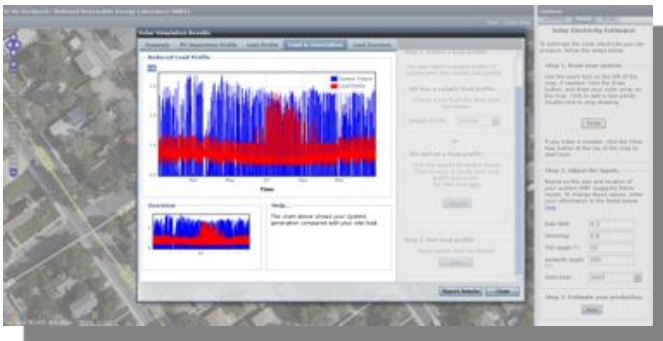
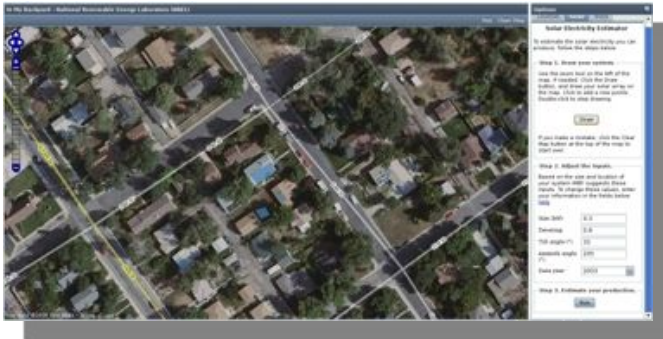
PVWatts was developed in two versions (Version 1 and Version 2). Version 1 is a modeling tool that provides PV performance estimates at a series of predefined point locations. In contrast to point based estimates, Version 2 provides PV performance estimates by interpolating values over a 40km grid for the United States.

July 2010
September 2010

Beta release of version 2.0
Official version 2.0 release

In My Backyard (IMBY)

Small scale PV & Wind



Data Analysis and Visualization Group
Project Lead:
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Dan.getman@nrel.gov

Project Description

In My Backyard, or IMBY, is a small scale PV and Wind simulation tool that provides a quick estimation of production potentials. Homeowners, business owners, and policy makers can use IMBY get a quick and easy estimate of whether PV or Wind makes sense at their location.

Project Impact

This project is focused on providing the general public with a tool that provides a slighter more complex analysis than PVWatts, but a more simple analysis than the Solar Advisor Model (SAM). IMBY is currently under active development on several updates & improvements meant to increase the tool usability and exposure.

Project History and Timeline

IMBY was originally conceived and developed under NREL internal LDRD funding. The project has since been funded by Solar America Cities initiative and with DOE/Solar Program Systems Integration funds.

August 2010
September 2010
September 2010

Beta release of version 2.0
Official version 2.0 release
Publicly available API

Solar Advisor Model (SAM)

Vision

- Combine PV, CSP, solar hot water technologies into a single model
- Make **high-quality performance models developed by NREL, Sandia, and other partners** available to a wider audience
- Facilitate comparison** by handling performance, costs and financing consistently across technologies
- Facilitate calculating the impact of R&D on LCOE, NPV, etc. in various markets.
- Sensitivity analysis and graphing capabilities
- High emphasis on GUI to promote greater usage of quality tools



Data Analysis and Visualization Group
Project Lead:
Nate Blair, NREL
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Download and use of recent solar satellite data

The screenshot shows a GIS application interface. On the left is a 'Layers' panel with a tree view containing categories like 'GIS Layers', 'Solar Resources', 'Infrastructure', 'Hydrology', and 'Download'. The 'Download' category is selected. The main map area displays a heatmap of solar radiation data with a red-to-yellow color scale. A 'Download Window' dialog is open on the right, showing options for '1. Select Format:' (TMY Format, CSV Format) and '2. Select Years:' (1998-2004). The 'TMY' format and '2005' year are selected. A 'Download' button is visible at the bottom of the dialog. A scale bar is located at the bottom center of the map area.

Layers

- GIS Layers
 - Solar Resources
 - Average DM (1998 - 2005)
 - Resource Classes
 - Slope Filters
- Infrastructure
 - Transportation
 - Inter states
 - US Highway
 - Fields
- Hydrology
- Land Ownership
- Boundaries
- Base Data
 - Shaded Relief
 - Satellite Imagery
- Download
 - Download Data

Map

Download Window

1. Select Format:

- TMY Format
- CSV Format

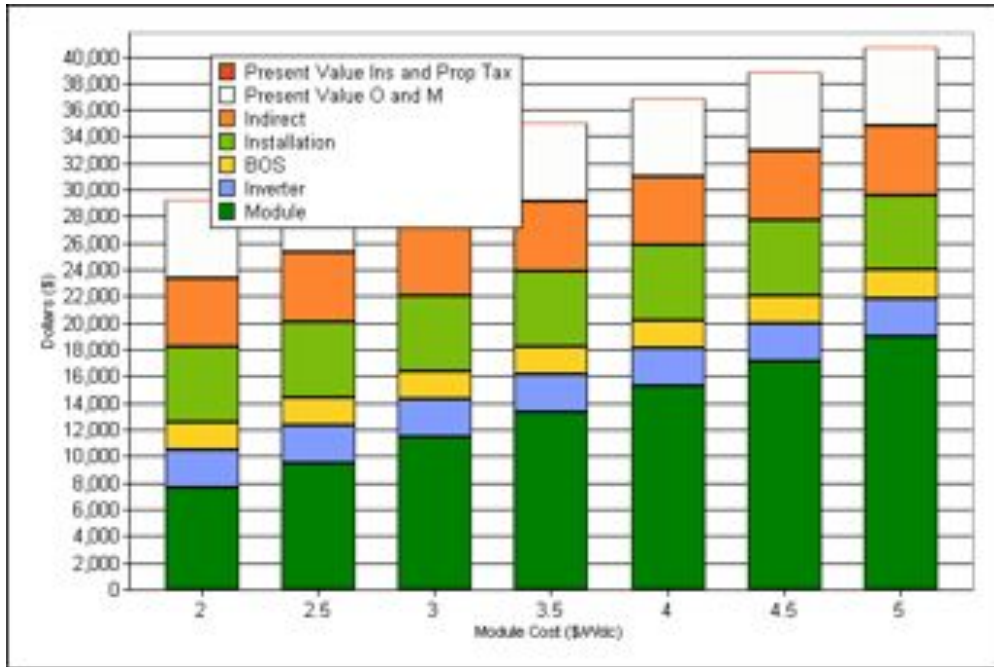
2. Select Years:

Available	Selected
1998	2005
1999	2005
2000	TMY
2002	
2003	
2004	

Download Close

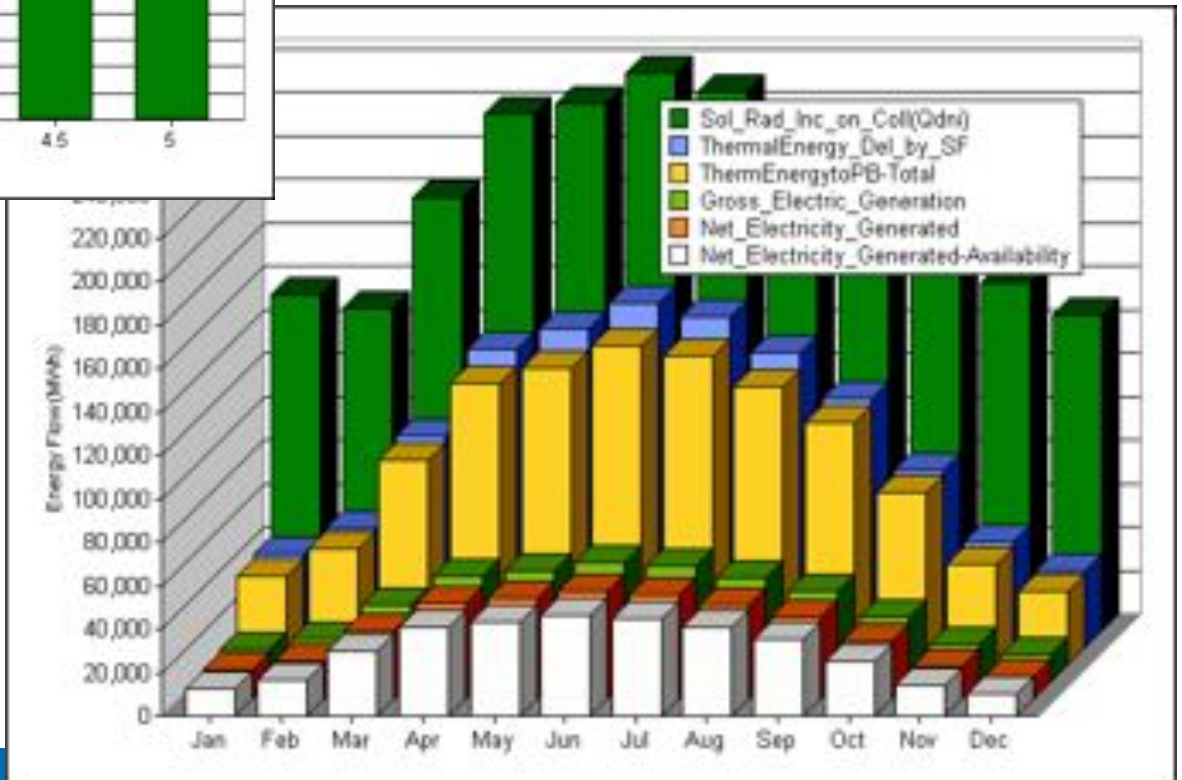
Scale: 1:100,000

Sample Output Graphics



PV System Cost vs. Module Cost Parametric

Monthly CSP System Energy Flow



Future Efforts

developer.nrel.gov

Making data and analysis tools available to developers via web services / APIs

1. Public access to data/models/tools via Web Services
2. Increased access to real-time/dynamic data
3. No need for repeated downloads of data snapshots
4. Shifts NREL application dev't to platform dev't



Connect data with those who will increase its visibility

Demonstration Links

- MapSearch, OpenPV, Solar Prospector, PV-Watts, and IMBY
 - Go to <http://maps.nrel.gov> and select “Launch” by the tool name
- SAM
 - Go to <https://www.nrel.gov/analysis/sam/download.html> to get a free copy
 - Go to <https://www.nrel.gov/analysis/sam/> to explore other pages related to SAM
- GIS Solar Information
 - <http://www.nrel.gov/gis/solar.html>
- General Energy Analysis links to solar data and tools
 - http://www.nrel.gov/analysis/analysis_tools_tech_sol.html