PVMapper 1.0

Concept of Operation and Functional Specifications

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# Introduction

This document provides an overview of the general operation and main features for a software product called “PVMapper.” Features included were obtained from discussions with existing solar development companies. In this document, descriptions are provided of the intended users of the system, high level user-oriented workflows, use cases, and a top-level design architecture. Constraints on operating systems, data interfaces, and use of commercial and open source software is discussed. Greater detail that describes the features implemented and their performance characteristics will be further elaborated at the project management level through task documentation that links code and feature requirements.

## Intended Use and Operational Concept

PVMapper will be a web-based Geographic Information System (GIS) project planning application designed to help solar energy developers better locate and plan large-scale solar utility projects. PVMapper will be an open-source application that will provide the open-source community with the flexibility and freedom to further develop and focus uses of the tool. Internally developed data sets and externally generated data sources or layers will be integrated into the tool. Specific, internally developed data layers may include environmental, military, land use, solar resource assessments, water resource assessments, and other factors collaboratively identified by the project team and steering committee. Connectivity to external data sources will be a critical element of the tool, to provide access to up-to-date data sources.

The application will integrate social criteria and constraints into the siting process. This functionality is expected to decrease overall project risk by avoiding potential delays in permitting and financing due to public/interest group opposition to high risk sites, or alternatively by identifying areas with higher social acceptance that are likely uncontroversial. Scientifically conducted surveys of public opinion that measure how much the public prefers a project to avoid or be placed near various types of land-based features will be incorporated.

## Target Users / Stakeholders

The intended audience for PVMapper includes solar power utility developers, Authorities Having Jurisdiction (AHJs), and other interested parties. Interfaces will also be provided for a special class of users to provide input data. These users include regional economic developers and power purchasers.

# High Level Operational Concept

## Main Use Case / Workflow Process

The PVMapper website will be available to anyone interested in solar energy development. However, there will be an option for users to establish their own projects, which will not be visible to the larger user community. For end-users interested in developing specific sites, a registration tool will be provided that will enable them to establish a user name and password. For users who are only interested in general information, a user name and password will not be required. The main use case and work flow described below are for users who have established a user name and password.

This use case begins when a user logs into the PVMapper website using their username and password. They are presented with a dashboard that contains information about the project(s) they have created. The user has the option to create new projects or work on one they have already created. Once they choose a project to work on, they open the project for editing, which presents them with potential utility-scale solar development sites.

If the user decides to create a new site for the project, they select the create new button on the sites selector screen. They are presented with a map where they can simply enter coordinates for a site they already have in mind, or they can choose to use the map to help them find a site. The user can change filter parameters (e.g., minimum solar insolation, slopes less than 5%, within 10 miles of a populated area, etc.) to find a site that matches their requirements. The map on the screen changes as the user manipulates the filter parameters. When the user has set up the filters, the on-screen map indicates the potential places in the US where the user could place a solar power plant that matches their requirements. The user can zoom into a smaller area of the map to refine the placement even more.

Once the user has decided on an area, they draw a polygon on the map that represents the possible solar farm. A site is created and the user is presented with the site analyzer screen where they can add further information about the site. The user can see the site’s detail in the detail screen where they can add parameters to the site that will be used by the PVMapper reporting engine to compare sites against each other. The user can also create GIS layers that can represent data that can be included in the reports. When the user is done with the site, they exit the edit screen.

After they exit, they are back to the project dashboard where they can see a list of potential sites. The user runs reports against the selected sites in the project to help them make business decisions. The user downloads and prints the reports. The user logs out of the system.

## High Level Design

The high level design for PVMapper is shown in Figure 1. PVMapper is web-based software that will deliver a unified framework and unique tools to analyze geographic and tabular information for the purpose of discovering feasibility of sites for utility scale solar energy development. Users will have a dashboard to manage projects that have been created and they will have the ability to find potential construction sites using a GIS enabled tool. They will be able to compare sites for feasibility using reports generated by PVMapper.

External data will be accessible to PVMapper through the use of a plug-in framework. External data sources and the method to fetch and use these sources will be definable as a plug-in. This will allow both open source and closed source data to be used. The same will be applied to the use of external calculation engines. PVMapper will also have internal storage and tightly integrated calculation functions that will be used for core operations. The internal engine will be subdivided into three parts: the Data Consumption and Analysis Engine, Site Profiler Engine, and Site Finder Engine.

The Data Consumption and Analysis Engine will be responsible for gathering layer data and creating meaningful base comparisons of that data. This engine will be responsible for utilizing the plug-in APIs and creating meaning from them. These functions will be used by the Site Profiler Engine and the Site Finder Engine.

The Site Finder Engine will be responsible for creating heat maps to allow the user to find broad areas that fit user supplied criteria. The site finder engine will deal with national scale data from many external sources.

The Site Profiler Engine will help a user compare specific defined sites. This engine will enable the user to input and store data that relates to the sites they have defined. It will also create comparison reports that will enable decision making. This engine will depend heavily on the Analysis and Reporting API plug-in framework for comparison calculations.

Already established GIS rendering engines will be allowed to render the layers on the tool. The Display Engine is responsible to tie all the GIS data into a layer and have a GIS engine render that layer. The Display Engine will also capture user data and have it stored in the user database.

The system will share its data through export functions including web services for easy access to reports and GIS layers.

Figure 1. High level design for PVMapper



## Terminology

|  |  |
| --- | --- |
| **PVMapper Term** | **Meaning** |
| User Workspace | A segmented secure memory space within PVMapper dedicated to the user for storage of multiple projects each of which includes input data, historical use, reports, and other information help private to the user. |
| Project | The highest level construct for a single development site containing all data, analysis, reports and history. Projects exist within at least one user’s workspace but can be shared among many users. |
| Site Selector | The “Site Selector” is a user interface that provides a high level map of the United States that provides expected GIS maneuverability and overlay capability in addition to specialized tools for finding solar development sites. |
| Site Analyzer | The “Site Analyzer” is a user interface that provides a map view of the development area and surrounding affected region. Expected GIS maneuverability, overlay capability and specialized tools for analyzing solar development sites are made available. |
| User | PVMapper has multiple users and associated user interfaces. These are designated as the follows; Developer, Economic Developer, Power Purchaser. |
| Developer | A PVMapper user that represents a company who is planning the development of utility scale solar electrical generation facilities. |
| Economic Developer | A PVMapper user that is employed by a regional economic development organization. |
| Power Purchaser | A PVMapper user that is employed by a utility or other utility-scale purchaser organization. |
| Contributed Data | Data contributed to PVMapper by a PVMapper user. |
| Offsets | Legal rules that govern how much undeveloped land must surround the developed area. Rules can vary by jurisdiction. |
| Buffer Zone or Buffer | Area surrounding the developed site that is undeveloped. |
| Development Area | Map polygon that represents the land area upon which development would occur. |
| Authoritative Data | Data from published Federal and State sources |
| Model Generated Data | Results derived from executing a set of calculations |

# Features and Functional Requirements

The mission of PVMapper is to help solar developers locate and analyze sites where profitable solar farms can be developed sustainably.

This section describes the main features available to users of PVMapper. Features are further decomposed into descriptions of use (use cases), functional, performance and non-functional requirements. The more detailed requirements will become the basis for developing and testing PVMapper.

For clarity, the definitions of the terms “Use Case”, as well as, “Functional”, “Non-functional” and “Performance” Requirements are listed here.[[1]](#footnote-2)

* A ***use case*** is a structure for documenting the functional requirements for a system. Each use case provides a set of *scenarios* that convey how the system should interact with a human user or another system, to achieve a specific business goal. Use cases typically avoid technical jargon, preferring instead the language of the end-user or *domain expert*.
* ***Functional*** ***Requirements*** explain **what has to be done** by identifying the necessary task, action or activity that must be accomplished. Functional requirements analysis will be used as the top-level functions for functional analysis.
* ***Performance Requirements*** describe the **extent to which a mission or function must be executed**; generally measured in terms of quantity, quality, coverage, timeliness or readiness. During requirements analysis, performance (how well does it have to be done) requirements will be interactively developed across all identified functions based on system life cycle factors; and characterized in terms of the degree of certainty in their estimate, the degree of criticality to system success, and their relationship to other requirements.”
* ***Non-functional Requirements*** are requirements that specify **criteria that can be used to judge the operation of a system**, rather than specific behaviors.

## Site Finder

A site finder function allows the user to look at a large scale US map and identify potential “hot spots” for utility scale solar power development.

**Required Data**: National level solar “insolation”, slope, public lands

**Pre-Condition**: User choses the “Site Locator” mode or large scale (USA) map.

**Use Case**:

* User activates the function/plugin
* Map highlights areas with the highest solar potential
* User zooms to areas of interest for higher detail views.

**Functional Requirements**:

* PVMapper will display a map of the United States with highlighted areas showing good potential for solar development.

**Performance Requirements**:

* We expect these data to be pre-computed and hence response should be very fast.

## Potential Power Purchaser (Power Purchase Agreements (PPA))

The highest priority issue for solar developers is whether they will be able to sell power once the site is developed. A list of available utilities and other utility-scale power purchasers, contact information and specifications associated with transmission will be provided to help developers make this determination. The functionality described here is contingent on availability of power purchaser data. The system will be constructed such that these data can be added as they become available.

### Power Company Service Territories

**Required Data:** A service territory is a region serviced by a particular power utility. The functionality described in this section is intended to help solar companies determine potential buyers in a region. A dataset of locations of service territories is required.

**Pre-Condition:** User is in the “Site Selector” mode or geographic scale.

**Use Cases**:

* User will select from a service territory map overly showing current energy regions and power marketer’s information.
* If data is missing, the user will be provided with any available information on local economic development agencies which can be contacted to retrieve data.

**Functional Requirements:**

* PVMapper will display a map of utility company’s service area.
* PVMapper will provide a user contributed database of utility service areas.

**Performance Requirements:**

* PVMapper will respond within 10 seconds from when the overlay is selected.

**Notes:**

* A function for uploading this data may be needed for obtaining this information from existing databases.

### Power Purchaser (Off-Takers) Demographics

**Required Data:** Database of locations of existing power purchasers.

**Pre-Condition:**

* User is in the “Site Analyzer” mode or geographic scale.

**Use Cases**:

* The user will activate the “Off-Taker” tool, select a search radius, and click a point on the map interface. PVMapper will query the appropriate data and will display a list of companies, addresses, contact names, phone numbers, URLs of existing power purchasers in the area. PVMapper may also display who is currently purchasing solar power in the region and who is physically connected to the grid in the area.

**Functional Requirements:**

* PVMapper will provide a list of available power purchasers within a given search radius of the map point selected by the user.

**Performance Requirements:**

* PVMapper will respond within 5 seconds from when the point is selected.

**Notes:**

* “User Defined Radius” is defined by a PVMapper configuration parameter. Default is 10 miles.

### Properties of Nearby Transmission

**Required Data:** Nearby transmission indicates all high voltage power lines used for transmission. Several commercial vendors of geospatial information provide this data in licensed format. We will need to negotiate licensing terms for use of the data.

**Pre-Condition:**

* User has selected a site and has drawn a polygon that delineates the proposed site boundary(s).

**Use Cases**:

* + User selects “Nearby Transmission” and PVMapper finds all transmission lines within a user defined search radius, forms a distance sorted list and presents the list to the user.
    - User right clicks an item on the list and PVMapper presents a dialog window containing data for the transmission line, including the following:
      * Company
      * Company Contact
      * Company Phone Number
      * Company URL
      * Transmission Capacity
      * Transmission Availability
      * Distance to Transmission
      * Development Cost to reach Transmission

**Functional Requirements:**

* PVMapper will calculate and present a list of nearby transmission line capacities and associated metadata.

**Performance Requirements:**

* PVMapper will rank and display power purchasers within 5 seconds.

**Notes:**

* “User Defined Transmission Cost” configuration parameter can be changed by the user. Default is $1M/mile.
* A more sophisticated calculation of transmission cost is provided in the Cost of Energy section.

## Cost of Energy

Balanced against the ability to sell power is the cost associated with developing the site, i.e., the total life cycle cost. Each developer has their own method for calculating life cycle costs. PVMapper will assist the developer by providing information that is often difficult to obtain, saving developers time and expense necessary to find this information. PVMapper helps ensure information is not ignored and provides overall improvement to the life cycle cost analysis estimate. PVMapper will provide information on local offset rules, transmission infrastructure, known social considerations, land use cost, and other information. PVMapper will also inform the user of missing data, so they can seek this information out by other means if necessary.

**Pre-Conditions for all Features in this Section:**

* User is in the “Site Analyzer” mode or geographic scale.
* User has drawn or selected a polygon that represents the land area (development area) to be studied.

**Fundamental Use Case**:

* + - User draws a polygon over the land area to be studied. User clicks a button to launch a particular kind of calculation. PVMapper responds by modifying the map and/or presenting the user with a list of information. As the user proceeds through a set of actions of their choosing. PVMapper records the user events and calculation results in a user log that can be downloaded, printed or saved to the user workspace.

### Local Offsets

**Required Data:** Database of local offset requirements for the study area of interest. If this data is not available for an area, the user will be able to add it.

**Use Cases**:

* + User clicks the “Offsets” button and PVMapper either draws a buffer based on distances in existing county/state level offsets, or presents the user with an opportunity to add an offset distance. PVMapper may reduce the size of the user drawn polygon if the buffer zone would impinge on any restricted or unavailable areas. PVMapper will calculate the buffer zone acquisition and maintenance cost based on a user defined land cost parameter.

**Functional Requirements:**

* PVMapper will automatically draw offset buffer zones surrounding user defined development sites.
* PVMapper will calculate the buffer zone cost based on a user defined land cost.

**Performance Requirements:**

* TBD

**Notes:**

### Cost to Deliver Power to Transmission Line

**Use Cases**:

* + User draws a segmented line from the development site to the transmission line or substation. The user can assign a cost to each segment based on easement differences. PVMapper will calculate the total transmission line cost and will record the cost of each segment and the user justification (i.e. why that segment was selected).

**Functional Requirements:**

* PVMapper will calculate the cost to develop transmission capability from the site to nearby transmission lines or substations identified by the user.

**Performance Requirements:**

* Performance will need to be assessed for digitizing, data search and data display.

**Notes:**

* The software will provide default power line costs. These need to be editable by the user.

### Incentives

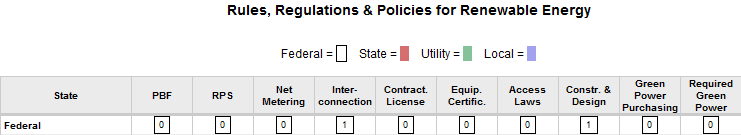
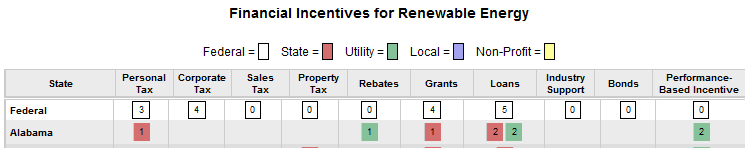
**Required data:** The DSIRE database/website provides incentive information for renewable energy. These data will be mined and brought into a dataset for PVMapper.

**Pre-condition:**

* + - User is in Site Selector or Site Analyzer mode

**Use Cases**:

* + User selects “Incentives” and PVMapper displays the row in the DSIRE database for the site in which the development site is located for both financial incentives, rules, regulations and policies for renewable energy. The user then chooses and reads the available information.



* + - User can bookmark information that appears useful for costing the development site.

**Functional Requirements:**

* PVMapper will provide access to the DSIRE state incentives database (NREL)

**Performance Requirements:**

* Will be dependent on DSIRE’s web site response.

**Notes:**

* + - See DSIRE at <http://dsireusa.org/> or at
    - North Carolina State University <http://www.mydsireusa.org/mydsire/index.php>

### Energy Forecast

**Required Data:** Modeled or simulated data from weather estimation tools.

**Pre-Condition:**

* User is in site analyzer mode

**Use Cases**:

* + User selects PVMapper Forecast Mode. User selects future time series sources that forecast available solar radiation, electrical energy demand and price, construction costs, etc. PVMapper then uses the site development costs as a starting value and forecasts future estimated balance sheets for the site.

**Functional Requirements:**

* PVMapper will provide a forecast of the potential energy output including confidence intervals.

**Performance Requirements:**

* We expect to run the SAM model via web services through the NREL system. This will have some performance implications that will need to be managed through appropriate user feedback.

**Notes:**

* The specific variables to be forecast, method for generating forecasts, and means by which forecasts are aggregated, displayed, and/or summarized will be determined upon consultation. The SAM model is a likely candidate for providing most/all of the functionality described here.

## Site Financial And Performance Analysis

PVMapper users will be able to conduct an integrated performance and financial analysis of the chosen site. This capability will be developed by integrating NREL’s System Advisor Model (SAM). “SAM makes performance predictions and cost of energy estimates for grid-connected power projects based on installation and operating costs and system design parameters that you specify as inputs to the model. SAM Projects can be either on the customer side of the utility meter, buying and selling electricity at retail rates, or on the utility side of the meter, selling electricity at a price negotiated through a power purchase agreement (PPA).”[[2]](#footnote-3)

**Required data**: Required SAM input data for the site.

**Pre-condition:**

* + - User is in Site Analyzer mode and has defined a site boundary.

**Use Cases**:

* + PVMapper selects the nearest SAM climate file based on the site location.
  + User selects the type of solar technology and financing option.
  + User defines the site technology by dragging objects from the PVMapper Site Definition pallet. Objects are provided for photovoltaic, parabolic trough systems, power tower, linear Fresnel, dish-stirling solar power systems, and shade objects. User parameterizes the specific vendor models.
  + User defines financial inputs including analysis period, inflation & discount rates, taxes and insurance, salvage values, construction periods, load parameters, tax credit incentives, payment incentives, direct and indirect capital costs, operation and maintenance costs.
  + PVMapper submits the SAM input file to the NREL SAM web service, NREL performs the calculations and returns the results to PVMapper.
  + User select site results in the form of tables and graphs to view either through PVMapper or to be downloaded for inclusion in the users balance sheets.

## Site Comparisons

The Site Comparisons feature provides the user with side-by-side comparisons of costs and benefits among sites that have been analyzed by PVMapper.

**Required data**: All summary data generated by PVMapper will be potentially used in this comparison tool .

**Pre-condition:**

* + - User is in Project Workspace mode and more than 1 site is available and has defined cost information.

**Use Cases**:

* + User selects multiple sites in the project browser and clicks the “Add to Comparison” button. PVMapper creates a table with costs (rows) vs. sites (columns), where the first column is an “include” check box, second the cost item name, third is a weight input field (integer 0-1), followed by a column for each site to be compared (user defined) and finally two columns for the mean and standard deviation of the row values across sites. The first row contains the site names and the second contains the site overall score.
  + User can select which cost items to compare row by row by selecting the first column check box. Note, this feature promotes fair comparisons among sites since some cost items may not have complete data.
  + User can define a weight (0 -1) for each cost item by editing the newly created table.
  + User can select “Scale Comparisons” and PVMapper will create a new table where site values are transformed by the formula (x – mean)/standard deviation. PVMapper will multiply each value by its row score, sum the column and put the resulting site score in the second row of the table immediately under the site name.
  + User can define a utility function for each cost (row).
  + User can select “Utility Comparison” and PVMapper will create a new table where site values are transformed by the user defined utility function. PVMapper will multiply each value by its row score, sum the column and put the resulting site score in the second row of the table immediately under the site name.
  + User selects “Rank Sites” and PVMapper will rearrange the table (Scale Comparisons or Utility Comparisons) columns from left to right in descending order by the site score.

**Functional Requirements:**

* PVMapper will allow the user to compare multiple sites based on estimated values, scaled estimates, and utility transformed estimates.
* PVMapper will calculate an overall site score
* PVMapper will calculate the buffer zone cost based on a user defined land cost.
* Additional metrics to include in the summary comparison table can be added by plugins.

**Performance Requirements:**

* This functionality should be relatively instantaneous because each cost value could be precalcualted by their respective plugins. Alternatively plugins could generate cost values for their respective cost metrics “on-the-fly” based on existing site information.

**Notes:**

## Site Suitability

Developers are interested in which sites to avoid as much as finding the best sites to develop. PVMapper will provide an overall site feasibility score that utilizes solar resources, geographical, political, environmental and social sensitivities, construction and industrial factors.  Developers are able to view maps nationally or locally.

### Social Political and Environmental Factors (Sites of Least Resistance)

**Pre-Condition:**

* User is in the “Site Analyzer” mode or geographic scale.

**Use Cases**:

* + With the selected sites from the Site Comparisons tool, the user can further evaluate suitability by viewing social, political, and environmental factors that can affect site suitability.
  + User is presented with a set of layers including:
    - Public Perception – measure of how much the public may oppose or favor specific areas for solar energy production
    - Threatened or endangered species (plants and animals)
    - Cultural resource sensitive areas
    - Zoning types (industrial, residential, commercial)
    - Soil – soils suitable for construction
    - Geology – bedrock near the surface
    - Water availability – adequate water available
    - Other relevant data sets identified through the social survey.

**Functional Requirements:**

* PVMapper will analyze overlapping polygons from the list above and produce a heat map based on acceptability. Each polygon in the layers above will be given a value based on the attributes of each and perceived acceptability of solar utility construction in each polygon type. For instance, zoning polygons with high acceptability will receive a high score, while areas with low acceptability will get a low score. PVMapper will then intersect all layers chosen by user and sum the values for each polygon into a single new polygon layer. That layer will be colored by the new value.

**Performance Requirements:**

* PVMapper will calculate and draw new polygons in 5 seconds.

**Notes:**

* If user has additional suitability information, they may add it to the tool as a new polygon layer provided there are values associated with each polygon similar to the layers mentioned above.

# Data Considerations

## Data Management Assumptions

The majority of data within PVMapper will come from pre-existing databases derived from trustworthy sources (Appendix A: Data Providers). Additionally, when valuable data is limited or does not currently exist, PVMapper will provide interfaces for the developers themselves or other users such as, regional economic developers, and companies that purchase power to enter data into PVMapper.

Use of contributed data will impose data quality restrictions that will be mediated in multiple ways, as follows:

* Users will be informed that publically contributed data is in use.
* Contributed data providers must first register and be a valid representative of their organization.
* Data will be version controlled.
* Data quality algorithms will be periodically run and reports made available.
* Data provided by developers will be only available privately to that developer.

The goal is to provide data to developers that are difficult and costly to obtain.

## Data Quality

Developers need to know the source and quality of the data provided by PVMapper. PVMapper uses data from three main sources; 1) Existing authoritative Federal and State data, 2) User contributed data, and 3) Model generated data. The main data quality approaches used will be transparency and reporting of extreme values.

**Pre-Condition:**

* None

**Use Cases**:

* + User selects “Data Quality Mode” PVMapper displays a table of data sources and includes an indication of data quality level.
  + The user can search the data source web site for information on data quality

**Functional Requirements:**

* PVMapper will provide user links to all authoritative data used.

**Performance Requirements:**

* TBD

**Notes:**

## Data Overlay

Developers must be allowed to combine map overlays in new ways to support their analysis. The following layers will be available within PVMapper

**Highest Priority Overlays**

* **Transmission availability**
  + Access to unconstrained transmission
  + Close to existing transmission w/ capacity
* **Legal / Economic / Social**
  + Incentives
  + Regulatory differences
  + Setback requirements (from roads, rivers, underground gas lines, military bases, etc.)
  + EIS data
  + Local zoning ordinances (industrial and ag lands, existing uses)
  + RPS, other incentives
  + Cost to ratepayers
  + NIMBY / Public Opinion
* **Land Use**
  + Agricultural overlay
    - High-value crops, ag-preservation designation/restrictions
    - Abandoned Ag Lands / Farms
    - Fallow lands / CRP
    - Land uses: Agricultural lands, disturbed lands
    - Previous ag land (include protected farmlands, other jurisdictional limitations)
  + Corridors of livestock/wildlife/protected species
  + Cultural resources – tribal lands, prior civilizations, dry lake beds
  + Disturbed lands
  + Private / state / federal lands
  + Non-pristine Desert / Lands
  + LR2000 data from BLM – Land ownership/easements/right of way
  + Land ownership/property boundaries/acreage
  + Tract Size
  + Property and Zoning (P&Z) Data
    - County Planning/Zoning Data
    - Solar Energy Zones on federal land (Depends on the Solar PEIS)
* **Geography** 
  + USGS Quadrangle Sheets (Topos)
  + Viewshed / Visual Impacts
  + Terrain (DEM) – shading
  + Shadows
  + Elevation
  + Imagery
* **Geological / Subsurface**
  + Soils
  + Subsurface geology conditions (is it shale, granite, or rock 6 in below the surface?)
  + Seismicity, and landslide susceptibility
* **Meteorological**
  + Solar radiance / insolation
* **Environmental**
  + Critical habitat corridors
  + Regional environmental concerns
  + Water (CSP technologies)
  + Wetlands
  + Fauna (Bugs & Bunnies, threatened & protected corridors, sanctuaries, wildlife corridors)
  + Flora (threatened & protected species, nature parks, wetlands, soils)
  + Cultural (nat’l parks, community interest, cultural heritage)
  + Wild and Scenic Rivers
  + Wilderness Areas
  + Previous Environmental Impact Analysis results (ANL)

# Constraints, Assumptions, and Dependencies

This section defines constraints, assumptions, and dependencies associated with PVMapper. These items include operating systems, databases, mapping software utilized to create and support PVMapper development and operation. These are not “requirements” since they do not describe what PVMapper will accomplish or do for the user and thus are not sources for testing whether PVMapper has achieved its mission.

## Constraints and Assumptions

PVMapper will be developed using industry standard tools such as Microsoft Visual Studio Integrated Development Environment. It will be written on the .Net Framework using C# and JavaScript. PVMapper will be developed as an open-source software product, and, as such, its source code will be made freely available according using an Open Source License approved by the Open Source Initiative (<http://www.opensource.org/licenses/index.html>).

PVMapper will be a web application and will not require any client software installed on the user’s computer besides a supported web browser.

### Operating System Support

PVMapper will run on a modern Windows IIS installation on commodity hardware (such as Windows Server 8 hosting Internet Information Services 8 and ASP.NET 4.5).

### Database Support

PVMapper will interoperate with Web Map Services hosted on a variety of platforms.

### Third Party Software Components

Rather than recreating specific functionality that can be obtained through free or inexpensive third party software development components, existing components will be reused where possible.

### Installation and Configuration

PVMapper will be hosted online as a service.

## Dependencies

The purpose of this section is to identify the interfaces between PVMapper, other software/applications, and any dependencies that must be in place to facilitate the full functionality describe above.

# Community Code Development System and Management

In addition to the core software design and development tasks that will be required in the development of PVMapper, a key activity and goal will be the development of an online community of users/developers who will jointly design, code, bug-test, and deploy the PVMapper software. The following section describes the functionality of components that will support the activities of this online community.

## PVMapper Web Site

A dedicated website will be developed to support community code development, bug tracking, and forum discussions related to PVMapper and related plug-ins, software, and tools. The website will serve as a workspace for individuals involved in the development of PVMapper and will be used to encourage external project participants including programmers, end-users, testers, and others. The site will include clear statements on the licensing under which the software is developed and instructions on how to participate in the development of PVMapper. The following collaborative software development tools will be available on the PVMapper website:

* Integrated Discussion Forum(s) – for sharing insights, questions, comments, and general discussion information.
* Source Code Repository – Subversion based code management repository for sharing source code. This will be set up such that anyone can read the code, but only authorized personnel can commit code.
* Coordinated Bug Management and Feature Identification – This will likely use the Mantis bug tracking system and will allow any user of PVMapper to post bug notices and feature requests.
* Downloadable Software – This will include a list of downloadable installation packages and plug-ins developed by the PVMapper project team as well as the open source community.

1. <http://en.wikipedia.org/wiki/Requirements_analysis> [↑](#footnote-ref-2)
2. https://sam.nrel.gov/ [↑](#footnote-ref-3)