Office of Legacy Management Decision Tree for Solar Photovoltaic Projects - 13317

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ABSTRACT

To support consideration of renewable energy power development as a land reuse option, the DOE Office of Legacy Management (LM) and the National Renewable Energy Laboratory (NREL) established a partnership to conduct an assessment of wind and solar renewable energy resources on LM lands. From a solar capacity perspective, the larger sites in the western United States present opportunities for constructing solar photovoltaic (PV) projects. A detailed analysis and preliminary plan was developed for three large sites in New Mexico, assessing the costs, the conceptual layout of a PV system, and the electric utility interconnection process. As a result of the study, a 1,214-hectare (3,000-acre) site near Grants, New Mexico, was chosen for further study. The state incentives, utility connection process, and transmission line capacity were key factors in assessing the feasibility of the project.

LM's Durango, Colorado, Disposal Site was also chosen for consideration because the uranium mill tailings disposal cell is on a hillside facing south, transmission lines cross the property, and the community was very supportive of the project. LM worked with the regulators to demonstrate that the disposal cell's long-term performance would not be impacted by the installation of a PV solar system. A number of LM-unique issues were resolved in making the site available for a private party to lease a portion of the site for a solar PV project. A lease was awarded in September 2012.

Using a solar decision tree that was developed and launched by the EPA and NREL, LM has modified and expanded the decision tree structure to address the unique aspects and challenges faced by LM on its multiple sites. The LM solar decision tree covers factors such as land ownership, usable acreage, financial viability of the project, stakeholder involvement, and transmission line capacity. As additional sites are transferred to LM in the future, the decision tree will assist in determining whether a solar PV project is feasible on the new sites.

INTRODUCTION

The DOE Office of Legacy Management (LM) maintains control and custody of land, structures, and facilities from private sector and federal nuclear weapons and materials production after remediation and regulatory closure of the sites. LM is responsible for maintaining protectiveness of these lands for their long-term use and for ensuring that the remedy remains effective. Additionally, LM is committed to the environmentally sound disposition, and the beneficial reuse, of property. LM conducts real property reuse activities at LM sites throughout the country

while also promoting installation of solar energy systems on its sites. LM manages 89 sites in 27 states and Puerto Rico. The sites range in size from several acres to several thousand acres, with an expected total of 129 sites transferred to LM from both DOE and private entities by 2022. Most of the 89 sites already have disposal cells containing radioactive wastes with land-use restrictions and are part of a long-term surveillance and maintenance program. With the primary responsibility of maintaining protectiveness of these lands and the accompanying regulatory oversight of that mission, there can be additional regulatory complexities for solar projects proposed on LM sites. Based upon factors that are unique to LM's sites, LM has developed lessons learned from its initiative to pursue solar energy projects on legacy sites.

NATIONAL RENEWABLE ENERGY LABORATORY STUDY

In partnership with the National Renewable Energy Laboratory (NREL), LM has screened its sites for wind and solar energy development potential. The report *Assessing the Potential for Renewable Energy Development on DOE Legacy Management Lands* (available to the public at http://www.nrel.gov/docs/fy08osti/41673.pdf) screened and scored LM sites for their renewable energy potential for concentrating solar photovoltaic (PV), solar PV, and wind. Based on a review of (1) GIS screening criteria developed with industry input and (2) NREL studies for the U.S. Bureau of Land Management and the U.S. Forest Service, LM produced tables that prioritized LM sites by renewable resource potential. Screening criteria included, but were not limited to, factors such as solar or wind capacity, slope of the land, and transmission line access.

Based upon the application of these criteria, wind energy appeared feasible on two sites in Wyoming, while solar PV systems appeared feasible in western states such as New Mexico, Colorado, Utah, Arizona, and Wyoming. Most of the LM sites in the west have uranium mill tailings disposal cells on the properties. The disposal cells were created to dispose of tailings and remediated soils. In most cases, more land was set aside than what was needed for just the disposal cell. Cells are constructed with flat tops (1 to 3 percent grades), while side slopes are steep and covered with large rock. The top of the cell and flat areas off the cell may be suitable for constructing a solar PV project. Three large sites near Grants, New Mexico (Ambrosia Lake, L-Bar, and Bluewater, shown in Figure 1), were chosen for additional evaluation of the practicality of constructing commercial-scale solar PV systems. The list of sites was then narrowed down, and LM decided to concentrate on only the Bluewater Disposal Site, the largest of the three sites.

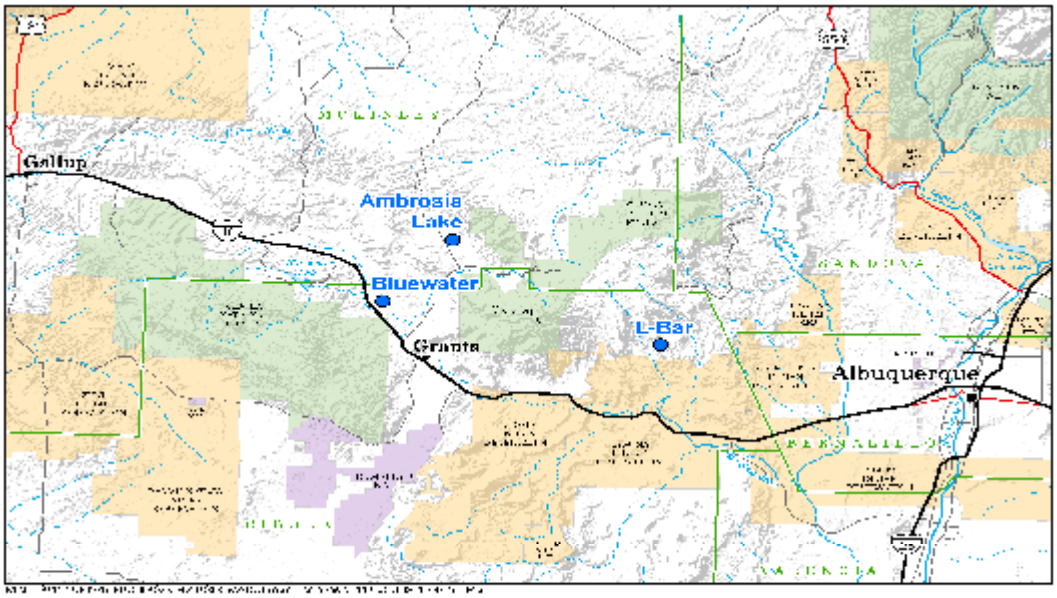

Figure 1. LM sites in New Mexico studied for a solar PV project.

BLUEWATER, NEW MEXICO

The Bluewater site near Grants was chosen for further study because of its proximity to transmission lines, good access, and sufficient flat land for siting a 20 MW PV system. The site comprises 1,214 hectares (3,000 acres) and has nearly 324 hectares (800 acres) of flat land with 1 to 3 percent grade. A Tri-State Generation and Transmission Association (Tri-State) substation is on the property and high-voltage transmission lines cross the property. The Bluewater site falls within the service area of Continental Divide Electric Cooperative (Continental Divide), which provides service to two counties and is one of the 44 members of the Tri-State family of power companies. Approval of a solar PV system and interconnection to the power grid would be required from both Continental Divide and Tri-State.

The Bluewater site has fairly good access from County Road 334, which connects to Interstate 40 and Highway 122. The open flat land has sparse grasses and shrubs and the site is not near any major waterway. The closest ranch house is 0.8 km (0.5 mile) to the south, so visual impacts were considered negligible.

Although the site has many of the attributes needed for building a large solar facility, major issues must be addressed before a solar PV project would be viable:

- The electric utility request for proposal (RFP) for solar power (typically utilities meet their requirement by purchasing solar power from developers in a bidding process)
- Interconnection studies and process
- Sufficient transmission line capacity

Approximately 40 hectares (100 acres) are required to construct a 20 MW fixed-tilt panel system. Power from a large system cannot be connected to the utility without a utility RFP bid

solicitation process, placement in the queue, and numerous studies to assess the impacts. Following communication with both Tri-State and the New Mexico-headquartered electric utility Public Service Company of New Mexico (PNM), LM personnel decided it would be better to connect the proposed system to PNM.

Despite the presence of high-voltage lines and an electrical substation on the site, excess capacity was not readily available in the transmission line. Previous renewable energy companies in the region have already submitted proposals to PNM and had tied up the remaining capacity. Although upgrades to transmission lines required to handle the increased load from the Bluewater PV system may cost a few million dollars, the utility company's policy is to upgrade in a larger increment. In the case of the Bluewater project, the cost of this upgrade would be tens of millions of dollars, making the project no longer feasible. LM will need to work with the utility companies to determine if there are other options available.

Regulatory requirements are another obstacle to projects because of additional costs. Although land is relatively inexpensive in New Mexico—its cost is less than 1 percent of the project cost—additional regulatory requirements would result in extra costs, making the site less attractive and the project less feasible. To attract potential bidders, LM must streamline processes as much as possible and minimize unnecessary regulatory impediments and the negative perceptions associated with having to work with government agencies.

Because constructing a PV system would result in a land use different from that originally considered in the site EIS, LM must consider its action under NEPA. Both a Categorical Exclusion and an Environmental Assessment (EA) will be evaluated to determine which is applicable. If an EA is developed, Native American tribes will be consulted, and a visual resource analysis, ethnographic study, and cultural resource survey will be performed. This process will take at least 8 months if no major issues are identified.

The disposal cell is under the NRC general license for custody and long-term care of uranium mill tailings disposal sites, which designates LM as the long-term custodian. Specific license conditions are contained in a Long-Term Surveillance Plan approved for the site. The license requires LM to notify NRC if a change in land use occurs. Since the PV system would not impact the disposal cell, the process to notify the NRC should not interfere with the schedule or feasibility of the project.

In PNM's 2008 RFP, the utility allowed parties to place descriptions of their land in the RFP to let bidders lease their land for a solar project. Initially, LM considered competitively bidding the lease, and the developer could go through the RFP and queue process (bids are reviewed in the order they are received). However, this results in two steps with the uncertainty and added costs if the developer doesn't make it into the queue. At the advice of PNM, LM would place a description of the property with the utility's next RFP and let PNM's evaluation process determine the successful project and lessee.

DURANGO, COLORADO

A local business approached LM about the possibility of installing a solar PV system at the Durango, Colorado, Disposal Site. The site looked favorable because the uranium mill tailings

disposal cell is on a hillside facing south, transmission lines cross a corner of the property, and the site is only 0.4 km (0.25 mile) from a substation. The largest flat area on the 49-hectare (120-acre) property is the top of the disposal cell. Since the disposal cell design was approved by NRC, and the site is under the NRC general license for long-term surveillance and maintenance, LM worked with NRC (and State of Colorado) to demonstrate that the cell's performance would not change if a PV system is built on the cover.

The top of the cover includes a 15 cm (6-inch) rock-soil matrix that supports vegetation. The surface was sloped at 1 to 2 percent to promote runoff but minimize erosion. The rock is sized to protect against the resulting runoff from large storms and provide protection to the underlying layers. Vegetation helps support a water balance and minimize infiltration. The challenge of using the cover for the PV system is to avoid impacts on the NRC-approved design. The installed system must not change the grade, disturb riprap, or affect the lower layers (radon barrier) of the cap.

The vegetated cover, as shown in Figure 2, provides an ideal area for solar panels because the grade is already flat—1 to 2 percent—and would not require regrading. The side slopes of the cell appear to be a better place for panels because they are already angled towards the sun. However, they are not at the ideal angle for optimal solar position for a fixed-tilt panel, which would result in adjustments in the framing or having a less efficient system. Additionally the large rock must not be disturbed, so it would be difficult to work on.

Figure 2. Photograph of the Durango Disposal Cell.

Panel systems typically use concrete foundations or metal anchors to withstand wind and other forces. However, rooftop systems have been developed that don't require foundations by building ballast into the frame or by designing unique panel configurations. These systems can also be used on the Durango cell to minimize disturbance of the cover. As much infrastructure as possible will be placed off the cell. The top of the cell and flat areas off the cell comprise 8.7 hectares (21.5acres), which has sufficient area for a 4.5 MW system (enough to power 900 homes).

The site is within the La Plata Electric Association (LPEA) service area. LPEA is a member of the Tri-State family of power companies. The high-voltage lines crossing the property belong to Tri-State, and a lower voltage line adjacent to the site belongs to LPEA. Initial indications from the utility companies were that it would be more practical to tie into La Plata's line, as it requires a smaller transformer.

Challenges for LM to use this site included how to minimize the obstacles for a developer to use the property, obtaining NRC (and State of Colorado) concurrence that the panels can be built on the cover without affecting the cell performance, and working with the local utility.

As with the Bluewater site, a lease must be used to outgrant the property to a developer, although the lease will have more restrictions than at Bluewater because the Durango system will be built on top of the disposal cell. The following technical restrictions were placed on building a system:

- The grade of the disposal cell cover can't change.
- Only minimal shallow trenching would be allowed for high voltage lines and a small concrete transformer pad.
- The storm-water channels can't be disturbed or modified.
- Panels cannot cause any new erosion.
- The site must be revegetated after panels and infrastructure are removed.
- DOE must have access at all times to perform maintenance (e.g., spraying noxious weeds) and to access settlement plates.

An EA was performed since the original EIS did not evaluate this type of land use. Since a PV system will be constructed in the area of the site that was disturbed for construction of the cell, only cultural resource and visual resource studies required updating. Several public hearings were held with most people providing positive comments for the project.

An initial attempt was made in 2011 to solicit developers interested in leasing the site. Although several proposals were received, DOE decided to cancel and reissue the solicitation to incorporate clarifications. Based on feedback from the bidders, the revised solicitation and lease captured several key revisions:

- Deletion of the minimum bid criteria and incorporation of the criteria into the evaluation
- Addition of an initial option period and extension of the lease to 25 years
- Starting of the lease period when electricity is ready to be generated; (this allows the developer to establish a power purchase agreement and optimizes the economic return for the project)

- Removal of emphasis on the size of the project as a major evaluation criterion

The solicitation for the new lease was reissued in June 2012. Five responses were evaluated and an award was made in September 2012. Although the company does not currently have an agreement with the utility or any other entity to purchase the power, they are confident that in the next year they will develop a power purchase agreement and begin construction on the project.

LM SOLAR DECISION TREE

To fulfill the mission of managing DOE's post-closure responsibilities, LM established five goals. Goal 4, pertinent to this paper, is to "manage legacy land and assets, emphasizing protective real and personal property reuse and disposition." To accomplish this goal, LM is actively reducing its "footprint" and placing as much land into beneficial reuse as is prudent and practicable. LM routinely screens its sites for disposal and reuse opportunities.

The LM solar decision tree was developed as a tool for screening LM sites for future solar PV projects. The tool was developed utilizing lessons learned from LM's previous studies and from the solar energy projects at Bluewater, New Mexico, and Durango, Colorado. The basis for the decision tree was a flowchart developed by NREL and the EPA. The EPA/NREL flowchart, *Screening Sites for Solar PV Potential,* can be found at the following address:

www.epa.gov/oswercpa/docs/solar_decision_tree

Additional information is available at EPA and NREL websites:

http://www.epa.gov/renewableenergyland
http://www.nrel.gov/learning/re_solar.html/

The LM solar decision tree is focused on solar PV projects but many of the factors could guide the decision for other reuse projects. The decision tree may require the use of subject matter experts to evaluate such factors as site restrictions, ownership, and NEPA compliance. If the solar panels are proposed for the top of a disposal cell, regulatory approval will likely be needed, and the project schedule will have to accommodate the time needed to obtain this approval. Many of the decision steps can be skipped if the solar panels will not be located on the disposal cell.

All of the steps and factors in the decision tree are listed in the outline below. Because of the limitations for placing figures into this paper, the flowcharts in the actual decision tree are not presented. A sample flowchart from the LM solar decision tree is shown in Figure 3.

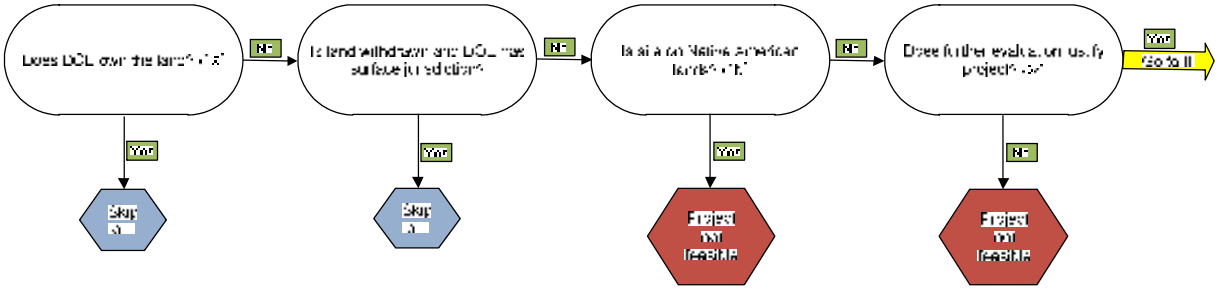

Figure 3. Sample portion of LM solar decision tree.

I. Prescreening Steps

- Review existing screening report (e.g., the NREL report).
- Meet with LM and contractor site leads to determine if there are issues that will prevent reuse on the site.
- Review known site restrictions and issues.
- Review NEPA and other environmental requirements that may affect the project.
- Discuss project with NREL, Western Area Power Administration, and the DOE Office of Energy Efficiency and Renewable Energy for their expertise in solar, utility distribution, and feasibility of projects.

II. Land Ownership

- Does DOE own the land?
- Is the land withdrawn and does DOE have surface jurisdiction?
- Is the site on Native American lands? (DOE typically has permanent access through a Custodial Access Agreement on tribal lands, but does not own the land.)
- Does the project justify further evaluation? (For example, if DOE retains the environmental cleanup liability but does not own the property, then the property would not be appropriate for a solar PV project.)

III. Usable Acreage

- Does the site have more than 0.8 hectares (2 acres)?
- Is the slope of site less than 3% and not shaded by buildings or trees? (A 1% to 2% slope is better.)
- Is the solar resource greater than 3.5 kWh/m^2/day? (Most LM sites exceed this except sites in Ohio, New York, West Virginia, and Pennsylvania, but incentives might make those states attractive.)

IV. Beneficial Reuse

- Has beneficial reuse credit already been taken for the property? (LM might have decided to choose a better long-term reuse option, such as grazing.)

- Does the project meet the requirements to qualify for reuse? (In an agreement with the Office of Management and Budget, LM has guidelines on how to take credit for a reuse project.)

V. Financial Viability

- Does the utility have the capacity to purchase the power and is it willing to pay at least 8 cents/kWh? (The amount varies by region.)
- Can the power be conveyed on transmission lines to another buyer? (States have different tax incentives and renewable energy portfolio goals.)
- Does DOE offer any other financial incentives to make the project viable?

VI. Land Use Restrictions

- Will a PV system interfere with the primary function of the site or impact access for long-term surveillance and maintenance?
- Does the site have institutional controls or land-use restrictions that will not allow a PV system?
- Does the site have institutional controls or land-use restrictions that can be modified in a reasonable time frame? (The Long-Term Surveillance Plans for most Uranium Mill Tailings Radiation Control Act sites have to be modified. Some sites would require an administrative or other legal order that would allow use of the site [e.g., Rocky Flats].)

VII. NEPA

- Did the original NEPA analysis cover the scope and impacts of a PV project? (Most studies are over 5 years old and didn't contemplate reuse of the site.)
- Does the project involve less than 4 hectares (10 acres) and will it qualify for a Categorical Exclusion?
- Does DOE want to spend the resources to conduct an EA? (DOE could require the solar developer to conduct an EA, but that adds uncertainty and cost to the developer.)
- Are there impacts to threatened and endangered species or cultural resource properties that cannot be mitigated?

VIII. Stakeholders

- If a local land-use authority has jurisdiction, can approvals/permits be obtained? (Federal property is typically exempt from local land-use authority.)
- Is an unfavorable reaction to the project expected? (Solar projects usually have strong support, unless nearby neighbors consider it a visual eyesore.)
- Can public relations be improved enough to let the project proceed?

IX. Power Transmission Line

- Is the distance to the power transmission line less than 0.8 km (0.5 mile), resulting in a reasonable cost to the developer?

- Does the transmission line have enough capacity to accommodate power generated from the proposed system?
- Can insufficient transmission lines be upgraded by the developer at a reasonable cost?

X. Disposal Cell Restrictions

- Will panels be placed on the cell cover?
- Can any new erosion caused by the PV panels be mitigated?
- Can settlement/other factors be mitigated? (This is more of a factor on solid waste landfills where settlement will be ongoing.)
- Will the surface of the cell be penetrated by panel foundations?
- Can ballasted foundations be placed on top of the cell?

XI. Secondary Considerations

- Is the distance to a road less than 0.8 km (0.5 mile)?
- Is site security sufficient to attract developers? (Theft of copper wire is a common problem.)
- Can DOE commit to a 20-year minimum lease?
- Can real property lease terms be defined to attract developers?
- Will contaminated soil be disturbed, and can that disturbance be mitigated? (Most sites, such as Fernald Preserve, Ohio, have a waste management plan in case contaminated soils or debris are discovered.)

Although any one item in the decision tree can make a project not feasible, experience shows that the primary considerations for a site typically involve economics and capacity and/or the location of transmission lines. Because solar PV continues to require some subsidies to make it economical, the subsidy available in each state and from each utility plays a critical role in the project's feasibility. Many states have mandated that investor-owned utilities purchase a certain percent of their power from renewable energy sources in an established time frame. Utilities might be willing to purchase the power at higher rates to make the project feasible until they reach the mandated goal. Many utilities in states such as Colorado and New Mexico have reached their mandated goals.

CONCLUSIONS

Positioning renewable energy on sites can provide a sustainable land reuse option, create local jobs, and provide clean energy for onsite use or for the utility grid. As additional sites are transferred to LM in the future, the LM solar decision tree will assist in determining whether a solar PV project is feasible on the new sites. More detailed site-specific analysis should follow the screening, if the PV project is found to be feasible. Many factors can be mitigated with additional research and efforts.