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PPRP

SmartDG+

A Screening Tool for 1-10 MW Distributed Generation and Renewable Energy Projects

A joint effort by the Maryland Energy Administration and the Power Plant Research Program

DRAFT Final Report

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Abstract

SmartDG+ is a free, online, map-based screening tool. It is intended to help developers and officials identify promising areas for the location of new distributed generation and renewable energy projects in Maryland. The tool focuses on screening factors of relevance to wind and solar projects between one and ten megawatts in size—i.e., bigger than rooftop solar. In order to create SmartDG+, the Maryland Department of Natural Resources' Power Plant Research Program evaluated electrical lines throughout Maryland, gathered publically available data on numerous barriers to project construction, and met with county and utility officials to discuss local priorities and policies of relevance. This input is reflected in individual layers of the tool, as are the results of 16 static screening scenarios, which are intended to reflect differing preferences among developers. This report explains the development process for SmartDG+. It acts as a supplement to instructions for using SmartDG+, which are integrated into the online tool.

SmartDG+
A Screening Tool for 1-10 MW Distributed Generation and Renewable Energy Projects

Executive Summary

During 2014 and 2015, the Maryland Energy Administration (MEA) and the Power Plant Research Program (PPRP), a division of the Maryland Department of Natural Resources, sponsored the creation of SmartDG+, a tool to help developers and officials identify promising areas for the location of new distributed generation (DG) and renewable energy (RE) projects in Maryland.

SmartDG+ is a free, online, map-based screening tool. It focuses on wind and solar projects between one and ten megawatts (MW) in size—i.e., bigger than rooftop solar.[1] The tool also addresses siting factors of relevance to combined heat and power (CHP) projects, which are typically located in buildings with large electrical and thermal loads, such as larger commercial, institutional, and industrial facilities.

The linchpin of SmartDG+ is a statewide map of one- to four-mile-wide corridors surrounding electrical distribution and transmission lines that appear capable of accommodating the output of new 1-10 MW generation projects. Within these corridors, the tool shows areas that remain promising after various static screening scenarios—involving resource availability, land use, protected areas, county zoning, and more—have been applied. The screening results are shown as three technology-specific data layers:

1. Possible areas for solar;
2. Possible areas for wind; and
3. Possible areas for CHP.

SmartDG+ combines field-gathered infrastructure assessments with state- and county-level screens, in order to help those involved in planning projects (developers, state agencies, and local leaders) save time and make better informed decisions about where to focus further research.

This report provides an overview of SmartDG+, explains the purpose of the tool's data layers and siting scenarios, and describes how each was developed. It acts as a supplement to instructions for using SmartDG+, which are integrated into the online tool.

[1] One MW of solar requires ~five acres of land; one MW of wind requires ~two acres of land.

1.0 Introduction and Project Description

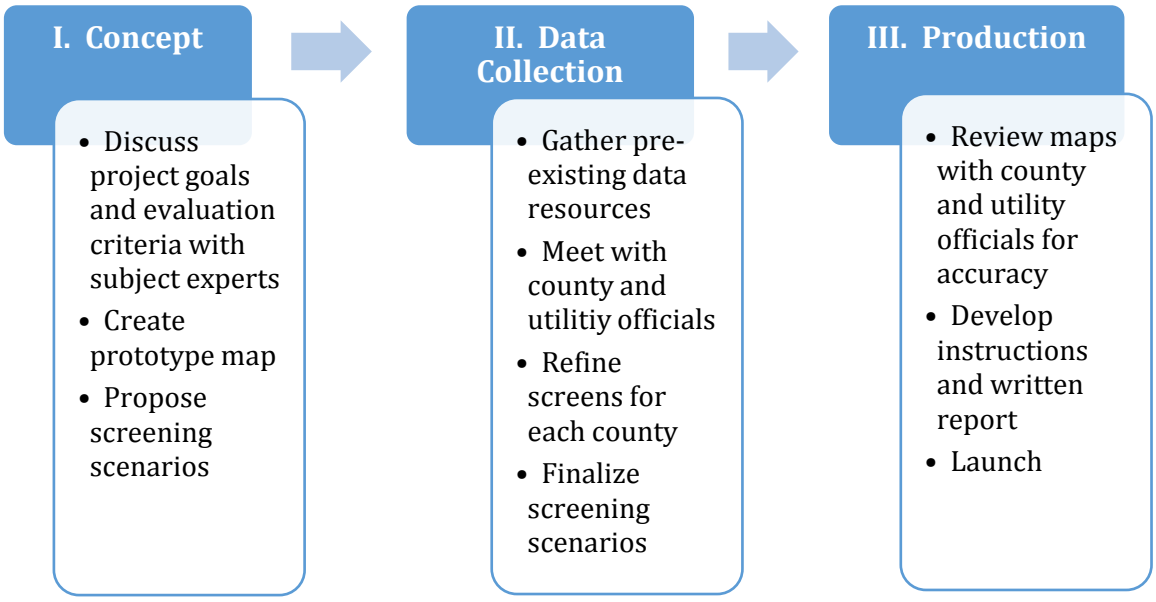
Over the past few years, many wind and solar project developers have approached MEA, as well as county planning and zoning representatives, seeking guidance on where new generation projects would be most feasible throughout Maryland and within individual counties. The goal of SmartDG+ is to provide a neutral platform for information that is often siloed, thus facilitating initial research by DG and RE project developers, future dialogue about specific projects, and proactive planning by communities. Some of this information has been generated specifically for the tool. Other information has been translated into a graphical format for the first time.

SmartDG+ has two objectives: (1) to compile and develop statewide information for several basic factors considered for 1-10 MW project siting; and (2) to develop a tool to facilitate "desktop-level" screening of regions of the State that are more favorable for future 1-10 MW project development.

SmartDG+ is designed to help identify potential areas for development, rather than specific sites. Any areas identified as potentially suitable would have to be evaluated further with respect to critical environmental and socioeconomic factors. In addition, coordination with local utilities and government entities would be required.

PPRP took the lead in developing SmartDG+, in close consultation with MEA. The project was split into three phases, summarized in Figure 1 and described in further detail below.

Figure 1. SmartDG+'s Development Phases



1.1 Phase I. – Concept

In order to identify appropriate screening criteria, PPRP reviewed a wide range of sources, including: technology-specific guidebooks and fact sheets; studies of CHP/wind/solar technical potential; and prior siting suitability studies. PPRP vetted its draft criteria with subject experts at the Maryland Department of Business and Economic Development (DBED), the Maryland-District of Columbia-Virginia division of the Solar Energy Industries Association (MDV-SEIA), MEA, and PPRP. As a result of these discussions, PPRP made changes to the screening criteria to reflect advances in wind turbine design, incorporate defense-related restrictions on wind turbine or solar panel placement, and protect landowners from unwanted solicitation. The revised screening criteria can be grouped as follows:

- Electrical line proximity (and, for CHP, natural gas pipeline proximity);
- Renewable resource availability (only applies to wind; solar insolation is viable throughout the State and CHP typically uses natural gas);
- Protected lands (environmental, historic, and some federal) and road accessibility; and
- Incompatible land use or zoning.

PPRP developed a prototype map focused on the four counties of the southern Eastern Shore (Dorchester, Somerset, Wicomico, and Worcester) in order

to test the screening methodology and receive early input from officials in a region where interest in solar development has been rapidly increasing.

Simultaneously, PPRP developed a set of 16 possible screening scenarios intended to capture differing preferences among DG and RE project developers. For example, developers of larger generation projects might have a higher tolerance for construction-related expenses, such as land-clearing and project interconnection.

1.2 Phase II. – Data Collection

PPRP conducted extensive fieldwork by electric transmission and distribution system engineers to assess electrical line infrastructure throughout the State. The information for SmartDG+'s other state-level screens was gathered primarily from pre-existing, publically available Geographic Information System (GIS) files hosted by: DNR (http://dnrweb.dnr.state.md.us/gis/data/); the Maryland Department of Planning (MDP) (http://www.mdp.state.md.us/OurProducts/downloadFiles.shtml); and Maryland's Mapping and GIS data portal (MD *iMap*) (http://data.imap.maryland.gov/).

Next, PPRP met with staff from county planning and economic development offices throughout the State, as well as several of the State's electric utilities including Pepco Holdings International (the parent company of Pepco and Delmarva Power), Southern Maryland Electric Cooperative, and Choptank Electric Cooperative. During these meetings, PPRP demonstrated the prototype tool and offered to incorporate county- or utility-specific information (e.g., local solar or wind ordinances, local protected areas, utility substation constraints, etc.) that could provide additional guidance to developers and other interested parties. This information was later gathered through follow-up correspondence and research. PPRP also gathered feedback on its proposed screening scenarios, which led to the addition of two scenarios related to Maryland Agricultural Land Preservation Foundation easements.

1.3 Phase III. – Production

After incorporating county- and utility-specific data, PPRP vetted the revised maps with its contacts to ensure that their input had been accurately reflected. It should be noted, however, that county regulations and zoning, infrastructure availability, and other factors can change over time. SmartDG+ may not reflect the current status of these factors. While annual updates to SmartDG+ are anticipated, the tool will not be continuously updated.

2.0 Data Layers

Each of the screens utilized in SmartDG+ corresponds to a data layer in the tool, as does each type of "bonus" information that can be superimposed on the screening results. These data layers are static. Viewers can make them visible, invisible, or transparent. They can also click on points of interest (POI) within a layer to pull up further information, such as the name, type, and size of a building; historic landmark; environmental easement, etc. Table 1 below provides an overview of the data layers in SmartDG+. The rest of this section provides specific discussions of how and why each data layer was developed.

Table 1. SmartDG+ Data Layers

Type of Layer	Brief Description
Infrastructure Corridors	
Electrical Transmission and Distribution Line Corridors	Shows areas within one-half to two miles of robust transmission or distribution lines
Natural Gas Pipeline Corridors	Shows areas within one-half to two miles of robust natural gas pipelines (only relevant to CHP projects)
Barriers to Construction	
Standard – applied in all SmartDG+ screening scenarios	
Environmental/Historic	Shows areas of strong cultural or environmental importance
Radar/Aviation	Shows areas near airports where wind turbines are discouraged or prohibited
Resource Potential	Shows areas where wind speeds are not strong enough for large-scale wind turbines to be economical
Land Use	Shows high-density residential areas, which are considered incompatible 1+ MW wind or solar projects
Additional – can be added voluntarily by users	
County Zoning	Shows areas where county zoning ordinances explicitly prohibit 1+ MW wind or solar projects
County Protected Areas	Shows areas that may protected from development by county-level regulations
Naval Air Station Patuxent River Protected Areas	Shows areas near NAS Patuxent River where 1+ MW wind or solar projects may interfere with DOD activities
Forested Areas	Shows forested lands, which may be incompatible with 1+ MW wind or solar projects
MALPF Easements	Shows areas that have been designated as Maryland Agricultural Land Preservation Foundation easements

Table 1. SmartDG+ Data Layers (cont'd)	
Type of Layer	**Brief Description**
Positive Attributes	
Industrial Areas	Shows industrial areas where DG and RE projects may avoid disturbing residences
Landfills, Brownfields, Wastewater Treatment Plants	Shows areas where DG and RE projects can often complement other activity or revitalize land that is not in use
CHP-type Buildings	Shows types of buildings (e.g., hospitals and universities) that often have large enough thermal and electrical loads to make CHP projects economical

2.1 Infrastructure

2.1.1 Electrical Transmission and Distribution Line Corridors

Description and Importance – As noted earlier, SmartDG+ shows corridors surrounding high-voltage electric distribution and transmission lines that PPRP judged robust enough to absorb up to a 10-MW generation project.[2] Transmission and/or distribution lines are important to projects of between 1 and 10 MW because developers usually intend to contribute power to the grid. In general, developers prefer to limit the length of interconnection lines to two miles or less. Within these distances, developers are better able to recoup the cost of necessary energy infrastructure build-outs and deal with right-of-way issues.[3]

Data Source(s) and Tasks Conducted to Develop Layer – PPRP based its depiction of electric utility corridors on publically available maps, aerial photography files, and extensive fieldwork to ascertain the location, voltage, and type of utility lines throughout the State. (SmartDG+ only shows 3-phase lines.) The population centers near Washington, D.C. and Baltimore, however, were not assessed. While these areas have ample electrical infrastructure, small lot sizes and high land values functionally preclude wind or solar projects of between 1 and 10 MW, except in brownfield locations.

2.1.2 Natural Gas Pipeline Corridors

Description and Importance – The map shows a two-mile-wide corridor surrounding gas transmission lines, which PPRP judged to be robust enough to provide fuel for CHP projects as large as 10 MW. As with electric lines, developers

[2] Further discussion of each corridor is found in Section 3.0, which describes SmartDG+'s siting scenarios.
[3] Sometimes, substation upgrades are needed before a new project can be added to a particular substation. Since substation capabilities are very site-specific, it is best to seek up-to-date information directly from utilities.

typically limit the length of gas interconnection lines to not more than two miles, due to construction costs and right-of-way issues.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP based its corridors on pre-existing gas transmission line maps furnished by Platts.

2.2 Barriers to Construction – Standard

2.2.1 Environmental/Historical

Description and Importance – This layer identifies three types of protected lands: (1) environmental (includes: Maryland Environmental Trust easements; Maryland Forest Conservation easements; Maryland Rural Legacy Areas; private conservation properties, federally-owned protected areas, and county-owned parks); (2) historic (includes Maryland Historical Trust preservation easements and sites on either the National Register of Historic Places or the Maryland Inventory of Historic Properties); (3) wetlands (includes Wetlands of Special State Concern (WSSC)). Collectively, the contents of this layer provide information about areas to potentially avoid due to heightened environmental, recreational, or historic importance.[4]

Data Source(s) and Tasks Conducted to Develop Layer – The lands protected for environmental purposes are available as a combined data set from DNR, which also provides the data set for WSSC. The data sets for historic areas are available from MD *iMap*. PPRP projected all these data sets into the appropriate coordinate system.[5] In addition, PPRP added a 100-foot buffer around the WSSC to reflect prohibitions against development near these areas.

2.2.2 Radar/Aviation

Description and Importance – This layer shows all regional airports, including fields with landing strips. Each of these sites is surrounded by a circular "buffer zone" with a three-mile radius. Since commercial-scale wind turbines can interfere with radar activity at airports, wind farms are discouraged within three miles of an airport. In addition, Patuxent River Naval Air Station (Pax River) is surrounded by a buffer zone with a 46-mile radius. Pax River serves as a testing center for naval aviation systems, including radar systems. Numerous state and

[4] DNR-managed lands are not included in this layer, since DNR is open to considering power generation projects on lands managed by the Department. Maryland Agricultural Land Preservation (MALP) easements are also not included in this layer since DG projects are permissible on these easements, under certain circumstances. A clickable layer in SmartDG+ permits viewers to see where MALP easements are located.
[5] There are two common types of coordinate systems used in GIS: (1) spherical coordinate systems such as latitude-longitude; and (2) projected coordinate systems which translate the Earth's surface into a two-dimensional Cartesian coordinate plane. Any data set with a well-defined coordinate system can be automatically integrated with other data sets by being projected into one consistent coordinate system.

federal laws have been passed in recent years to prevent wind turbines from interfering with Pax River activities.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP obtained the airport data set from the Maryland Department of Transportation (MDOT) State Highway Administration's (SHA's) Points of Interest database, projected it into the appropriate coordinate system, and created the buffer zones representations using GIS editing tools.

2.2.3 Resource Potential

Description and Importance – This layer is based on average annual wind speeds at 100 meters, the height at which many commercial-scale wind turbine blades are now mounted. Areas with wind speeds under 5.5 meters/second were judged to be unsuitable for large wind turbines.[6]

Data Source(s) and Tasks Conducted to Develop Layer – The data for this layer was developed by AWS Truepower, a renewable energy consulting firm that works in partnership with the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). PPRP obtained the data from AWS, and used a GIS-based editing function to identify areas with wind speeds under 5.5 meters/second from the entire spectrum of wind speeds.

2.2.4 Land Use

Description and Importance – This layer was derived from the Maryland Department of Planning's (MDP's) Statewide Land Use/Land Cover map, which classifies land areas into 13 distinct types of land use (e.g., low- to high-density residential, commercial, industrial) or land cover (e.g., agriculture, forest). High-density residential areas are shown because such areas present significant barriers to wind or solar projects between 1 and 10 MW. Specifically, high-density residential areas rarely have open land plots that are larger than two acres. Moreover, the high cost of such plots, where they exist, makes higher-revenue uses more attractive than generation projects.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP obtained the Land Use/Land Cover map from the MDP, projected it into the appropriate coordinate plane, and extracted the relevant type of land use.

[6] No screen for solar insolation was created because, barring local shading, average annual solar insolation is strong enough for PV projects to be economically viable throughout Maryland.

2.3 Barriers to Construction – Additional

2.3.1 County Zoning

Description and Importance – These layers show county zoning districts where 1- to 10-MW wind or solar projects are explicitly discouraged. Many of Maryland's counties have passed regulations to guide the siting of 1-10 MW wind and/or solar projects. Usually, this guidance lists zoning districts where such projects would be permitted, and notes any special requirements that must be met. SmartDG+ simplifies matters by excluding areas where county zoning prohibits all 1-10 MW projects wind or solar projects. Beyond this, further research will be needed to understand the specific nature of each county's regulations. Also, within municipalities, additional/other rules may apply.

Data Source(s) and Tasks Conducted to Develop Layer – Data sets for these layers were provided by the county officials with whom PPRP met or sourced from a given county's web portal for GIS data sets. PPRP collected any wind- or solar-specific zoning language that could be located in a county's zoning ordinance, imported each county's entire zoning district data set, and then extracted the relevant districts in GIS. In order to ensure the accuracy of these layers, PPRP vetted its interpretation of each county's zoning language with its county contacts and provided early access to SmartDG+ to county contacts, so they could review the corresponding zoning layer in its visual format.

2.3.2 County Protected Areas

Description and Importance – These layers show areas identified by county officials as potentially posing a barrier to 1-10 MW wind or solar projects. These areas are typically protected at the county level due to their environmental importance.

Data Source(s) and Tasks Conducted to Develop Layer – Data sets for these layers were provided by the county officials. PPRP included all areas that were recommended for inclusion by county officials.

2.3.3 NAS Patuxent River Protected Areas

Description and Importance – These layers show areas where 1+ MW wind or solar projects would potentially pose a barrier to DOD activities at Naval Air Station Patuxent River. One layer represents the Atlantic Test Range (ATR) High Risk of Adverse Impact Zone (HRAIZ) for wind energy development. (This HRAIZ is being revised based on findings from the Massachusetts Institute of Technology. An updated version should be completed in 2016.) The second layer shows two smaller, circular Areas of Concern for solar projects around NAS Patuxent River and

nearby Webster Field. Anyone considering development in these areas should contact the ATR office at (301) 757-4822/christopher.jarboe@navy.mil or the DOD Siting Clearinghouse at osd.dod-siting-clearinghouse@mail.mil.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP had a phone conversation with NAS Patuxent River officials, who then provided the data sets for these layers via email.

2.3.4 Forested Areas

Description and Importance – This layer was derived from the Maryland Department of Planning's (MDP's) Statewide Land Use/Land Cover map, which classifies land areas into 13 distinct types of land use. Forested areas are shown because such areas present significant barriers to wind or solar projects between 1-10 MW. Specifically, many RE developers avoid forested areas, given the expense of cutting, clearing, and in some cases planting substitute trees, as required by Maryland's Forest Conservation Act.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP obtained the Land Use/Land Cover map from the MDP, projected it into the appropriate coordinate plane, and extracted the relevant type of land cover.

2.3.5 MALPF Easements

Description and Importance – This layer was derived from the Maryland Department of Information Technology's Open Data Portal, *iMap*. Maryland Agricultural Land Preservation Foundation (MALPF) easements present significant barriers to wind or solar projects between 1-10 MW. Specifically, a developer must seek permission to build RE projects, based on special requirements issued by the MALPF.

Data Source(s) and Tasks Conducted to Develop Layer – PPRP obtained the MALPF Easements data set *iMap* and projected it into the appropriate coordinate plane.

2.4 Positive Attributes

2.4.1 Industrial Areas

Description and Importance – This data layer was derived from MDP's Land Use/Land Cover map, described earlier. It shows all land categorized as an industrial area. This data layer is potentially useful for two reasons: (1) it may help the user to identify areas where DG projects are more easily located due to prior

disturbance and lack of nearby residential impacts; and (2) it may serve to indicate the presence of potential steam hosts for a CHP facility.

Data Source(s) and Tasks Conducted to Develop Layer – As described earlier, PPRP obtained the Land Use/Land Cover map from MDP, projected it into the appropriate coordinate plane, and integrated the relevant types of land use/land cover into GIS.

2.4.2 Landfills, Brownfields, Wastewater Treatment Plants

Description and Importance – This data layer shows three types of sites that are often well-suited to DG and RE projects: landfills, brownfields, and wastewater treatment plants (WWTPs). Each of these sites commonly has large open areas that may not be suitable for commercial or residential development. Brownfields often have the added advantage of nearby substations that are already equipped to handle large power flows.

Data Source(s) and Tasks Conducted to Develop Layer – The data for this layer was derived from the MD Department of the Environment. PPRP projected the data set into the appropriate coordinate system and, in certain cases, PPRP added specific sites, based on input (the name of a facility, its address, and its type) from county officials.

2.4.3 CHP-type Buildings

Description and Importance – This layer shows buildings that often have large electrical and thermal loads: hospitals, higher education facilities, federal government buildings, and correctional facilities. CHP systems can be cost-effective in such buildings, especially in the context of a building expansion or rehabilitation. Note: this layer is illustrative, not comprehensive. For example, it does not include large office buildings (i.e., office buildings larger than 100,000 square feet), even though they are the most common, potentially suitable sites for CHP systems in the State.

Data Source(s) and Tasks Conducted to Develop Layer – The data for this layer were provided by MDOT SHA's POI database. PPRP projected the data set into the appropriate coordinate system and maintained POIs that are relevant for CHP. In certain cases, PPRP added specific sites, based on input from county officials, which included the name of a facility, its address, and its building type.

3.0 Screening Scenarios

Early on in the development of SmartDG+, MEA and PPRP realized that certain screens were important to include but not necessarily applicable in the same

manner to every potential user. MEA and PPRP decided to offer users four screening options related to infrastructure proximity and several additional screens that can be applied—individually or collectively—to any of the four primary scenarios. The rationale behind each set of options is further discussed below.

3.1 Infrastructure Corridors

To reflect DG and RE projects of different sizes and provide a measure of flexibility to accommodate developers with different tolerances for interconnection costs, PPRP created four screening options for infrastructure proximity:

1. Areas within one-half mile of a ≤35 kV line (for 1-3 MW projects)
2. Areas within one mile of a ≤35 kV line (for 1-3 MW projects)
3. Areas within one mile of a ≥69 kV line (for 3-10 MW projects)
4. Areas within two miles of a ≥69 kV line (for 3-10 MW projects)

3.2 Forested Areas

To enhance the usefulness of SmartDG+ to developers with different tolerances for construction costs and for communities with different priorities for forested areas, PPRP created two screening options related to land cover:

1. With forested areas (i.e., designated as forested in MDP's Land Use/Land Cover data set)
2. Without forested areas

As discussed in Section 2.2.3, projects in forested areas must compensate for tree losses, and doing so can significantly increase the project's total cost.

3.3 County-Level Zoning and Protected Areas

Neither county officials nor developers view county regulations as entirely inflexible or immutable. Changes to county regulations may take place at the county level as the result of dialogue about a specific project. Also, the Maryland Public Service Commission (Commission) can authorize the construction of generation projects larger than 2 MW by issuing a Certificate of Public Convenience and Necessity (CPCN) to a developer. When developers apply for CPCNs, the Commission takes into consideration local zoning ordinances and protected areas, among many factors. The Commission, however, may grant a CPCN to an applicant whose proposed project is in conflict with county regulations.

Given the influential, yet somewhat flexible, role that county-level exclusions play in DG and RE project siting, PPRP created four screening options related to county regulations:

1. With all zoning districts
2. Without zoning districts where 1-10 MW wind or solar projects are prohibited by county zoning
3. With county-level protected areas
4. Without county-level protected areas

3.4 MALPF Easements

In 2014, the Maryland General Assembly passed SB 259, which enables MALPF to grant permission for renewable generation projects on easement properties. MALPF is still in the process of developing detailed regulations for this approval process.

Given the additional hurdles involved with siting generation projects on MALPF easement lands, PPRP created two screening options:

1. With MALPF easements properties
2. Without MALPF easement properties