



A Survey of Federal and State-Level Solar System Decommissioning Policies in the United States

Taylor L. Curtis, Ligia E.P. Smith, Heather Buchanan,
and Garvin Heath

National Renewable Energy Laboratory

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List of Acronyms

AESL	Alternative Energy Source Lease
BLM	Bureau of Land Management
BOS	Balance-of-system
CSP	Concentrated Solar Power
EOl	End-of-life
FLPMA	Federal Land Policy and Management Act
FS	Forest Service
FWS	U.S. Fish and Wildlife Service
GW	Gigawatt
kW	Kilowatt
MW	Megawatt
NPS	National Park Service
NREL	National Renewable Energy Laboratory
PSC	Public Service Commission
PUC	Public Utilities Commission
PV	Photovoltaic
PV ICE	PV in the Circular Economy
RCE	Reclamation Cost Estimate
ROW	Right-of-way

Executive Summary

In the United States, cumulative installed utility-scale solar photovoltaic (PV) capacity reached more than 60 gigawatts (GW)_{dc} at the end of 2020 (Davis et al. 2021b). Federal and state renewable energy and net-zero emissions policies will continue to drive solar development in the United States with installed utility-scale PV projected to quadruple (240 GW_{dc}) by 2030 (Davis et al. 2021a; Heeter 2014).

Although more than 75% of all U.S. installed utility-scale PV came online in the last 5 years, federal, state, and local governments are planning for system decommissioning (Davis et al. 2021b). Our research found that as of April 2021, one federal agency, the Bureau of Land Management (BLM), and 15 U.S. states have solar decommissioning policies in place. North Carolina is also in the process of drafting solar decommissioning regulations, and at least 4 states (Maine, Pennsylvania, West Virginia, Texas) proposed solar decommissioning bills in the 2021 legislative session.¹

Decommissioning a PV system typically includes removing the PV array; removing all balance-of-system (BOS) equipment (i.e., other parts of the PV system, excluding modules, which can include wiring, inverters, and the mounting system); and restoring the land or infrastructure (e.g., roofs and irrigation canals) to its original condition or for a new use (Curtis et al. 2021a; Barbosa 2020).

Federal and state solar decommissioning policies² in the United States typically apply to utility-scale projects and mandate compliance with regulatory requirements over the lifetime of the project (not only during system decommissioning). Most U.S. solar decommissioning policies are tied to a permit or approval required for initial project development – typically as a condition or term of the approval. Some jurisdictions require a decommissioning cost estimate and/or the submission of a decommissioning plan prior to project construction. Solar decommissioning policies may also require a financial assurance for decommissioning, and compliance with reporting and records requirements over the lifetime of the project. Most decommissioning policies also require compliance with specific performance activities, including removal of all solar system equipment, site restoration, and reclamation (e.g., soil regrading, revegetation, reseeding, removal of access roads). A project owner may also be subject to civil penalties for noncompliance under some U.S. state solar decommissioning policies.

A calculation using the National Renewable Energy Laboratory's (NREL) PV in the Circular Economy (PViCE) tool predicts at least 27 GW of all nonresidential (commercial and utility-scale) PV capacity installed as of 2020 will be decommissioned in the U.S. by 2030 (Ayala et al. 2021).³

¹ 2019 N.C. Sess. Laws 132, S.P. 113, 130th Leg., Reg. Sess. (Me. 2021), H.B. 1555, 205th Gen. Assemb., Reg. Sess. (Pa. 2021), S.B. 492, 2021 Leg., Reg. Sess. (W. Va. 2021), S.B. 760, 2021 Leg., Reg. Sess. (Tex. 2021).

² We use “policy” in this report broadly to include not only mandated federal and state regulatory and legal requirements but also guidance, programs, and initiatives.

³ The PViCE calculation only considers known nonresidential (commercial and utility-scale) installations of crystalline silicon PV through 2020; thin film is excluded, and no estimates of future installations are made. PV module technology evolutions and dynamic lifetime assumptions are drawn from data derived PViCE baselines (Ovaatt et al. forthcoming). This analysis can be explored in the Jupyter Journal “14 - Historical US Installs Waste Projection” on the PViCE GitHub.

Solar decommissioning policies in the United States vary by federal, state, and local jurisdiction. The BLM requires a solar facility right-of-way (ROW) holder to submit a decommissioning plan and proof of financial security to support decommissioning costs. Fifteen states have also enacted statewide decommissioning policies that require solar developers to comply with specific decommissioning performance activities, submit decommissioning plans, estimate costs of decommissioning, and/or provide proof of financial assurance to state and/or local jurisdictions. The remaining 35 states and the District of Columbia leave solar decommissioning policies completely to local governments. Of those 35 states, 9 states⁴ have model ordinances, templates, or other resources that local governments may—but are not required—to use in developing their local solar decommissioning policies. Table ES-1 provides an overview of federal and statewide solar decommissioning policies in the United States.

The 15 states with statewide solar decommissioning policies have diverse regulatory frameworks that vary by jurisdiction. Six states (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont) have enacted *state-level* policies that require solar project owners to submit decommissioning plans and proof of financial assurance. Eight states (California, Hawaii, Illinois, Nebraska, New Jersey, Oklahoma, Virginia, and Wyoming) have enacted *hybrid* state and local solar decommissioning policies. In states with *hybrid* policies, localities must follow state decommissioning requirements enacted through statute and/or regulation but may prescribe additional requirements, which in some cases are more stringent than the state requirements. Washington state has an optional statewide solar decommissioning program, which allows solar project owners to comply with a state certification process in lieu of obtaining local city and county government approvals. In addition to jurisdictional mandates, a landowner may also prescribe additional solar decommissioning requirements (e.g., site restoration and reclamation) as a condition to a land or building lease agreement for a solar facility located on private land (Pivot Energy 2017).

**Table ES-1. Federal and State Solar Decommissioning Policies in the United States:
Selected Attributes**

Jurisdiction	Decommissioning Plan Required by Federal or State Policy	Financial Assurance Required by Federal or State Policy
Federal		
BLM	Yes	Yes
State-Level Only		
Louisiana	Yes	Yes
Minnesota	Yes	Yes
Montana	Yes	Yes
New Hampshire	Yes	Yes
North Dakota	Yes	Yes
Vermont	Yes	Yes

⁴ Georgia, Iowa, Massachusetts, New York, North Carolina, Oregon, Rhode Island, Texas, Wisconsin

Jurisdiction	Decommissioning Plan Required by Federal or State Policy	Financial Assurance Required by Federal or State Policy
Hybrid State/Local		
California	Yes	Yes
Hawaii	No	Yes
Illinois	Yes	Yes
Nebraska ⁵	No	No
New Jersey	Yes	No
Oklahoma ⁶	No	No
Virginia	Yes	Yes
Wyoming	Yes	No
State-Level/Optional		
Washington	Yes	Yes

We found that BLM and 12 of the 15 state policies in the United States tie their decommissioning requirements to an approval required for initial project development (e.g., site license, right-of-way). These jurisdictions require a solar project developer submit a decommissioning plan and/or proof of financial assurance as a pre-requisite or condition of approval needed for project construction or operation. We also found that BLM and 11 of the 15 statewide solar decommissioning policies in the United States require owners to issue a financial assurance instrument (e.g., bond, guarantee, or escrow fund) to cover the cost of system decommissioning prior to project construction or at some point in time after project operation (Maamari 2018; NYSERDA 2020).⁷

Anecdotal evidence suggests that compliance with decommissioning policies can impact utility-scale solar project construction timelines, project economics, and overall project viability (Maamari 2018; NYSERDA 2020).⁸ For example, jurisdictions that require submission of decommissioning plans and/or financial assurance as a pre-requisite or condition of approval prior to project construction or operation can impact construction timelines and capital costs associated with project development (Wyatt 2020).⁹ Policies that require financial assurance at

⁵ In Nebraska, there is a state-level solar decommissioning policy in place; however, the state does not require a decommissioning plan or financial assurance, but delegates authority to local government which may prescribe decommissioning requirements including a decommissioning plan and/or financial assurance.

⁶ In Oklahoma, there is a state-level solar decommissioning policy in place; however, the state does not require a decommissioning plan or financial assurance, but delegates authority to local government which may prescribe decommissioning requirements including a decommissioning plan and/or financial assurance.

⁷ Mont. Admin. R. 17.86.102, 106, 115; Vt. PUC Rule 5.904; La. Admin. Code tit. 43:V, §§ 953, 955; Minn. R. 7854.0500; N.H. Admin. R. Site 301.08(d)(2).

⁸ Megan Day, National Renewable Energy Laboratory, email, October 19, 2020.

⁹ The Bureau of Land Management (BLM) as well as several states including Hawaii, California, Louisiana, Montana, New Hampshire, Louisiana, Minnesota, North Dakota, Wyoming, and Vermont require compliance with decommissioning policies as a condition of approval prior to solar project construction or operation. In addition, Virginia's policy requires localities to tie site license approval for solar facilities to decommissioning requirements.

the outset of a project prior to construction or operation¹⁰ (e.g., Louisiana, Vermont) increase capital costs, which may prolong construction timelines and discourage project development (NYSERDA 2020). By contrast, policies that allow project owners to use an incremental bond schedule (e.g., North Dakota, Illinois) or issue financial assurance after project operations (e.g., Montana) allow financial assurance to be incurred as an operating cost rather than a capital cost.

Moreover, the calculation method and/or amount of financial assurance mandated by solar decommissioning policies varies by jurisdiction and may raise or lower overall project costs depending on what the policy includes. For example, policies that mandate that financial assurance amounts include site restoration and reclamation costs to return land to its preconstruction condition (e.g., Vermont) may raise costs of decommissioning depending on the size of the facility and the preconstruction uses of the land. By contrast, some solar decommissioning policies allow facility owners to offset the costs of decommissioning with the estimated salvage value of the facility equipment (e.g., Montana), which may lower overall project costs.

Solar decommissioning policies can also impact project operations, solar equipment end-of-life (EoL) management decisions, and system repowering evaluations. For example, some state solar decommissioning policies mandate compliance with reporting and records keeping requirements during project operation. Solar decommissioning policies may also impact equipment retirement and EoL decisions by requiring project owners to submit plans and detailed cost estimates accounting for transportation, salvage (e.g., reuse, recycling), and/or disposal of decommissioned system equipment (Maamari 2018; NYSEDA 2020).

This report provides a survey and brief overview of both BLM and U.S. statewide solar decommissioning policies, and a discussion of some of the potential impacts different policy designs may have on utility-scale solar development, including impacts that might influence construction timelines and over project costs.

Our results are based on legal and literature-based research, as well as a 50-state survey to identify enacted statewide solar decommissioning policies. We also conducted a survey of the four major federal land management agencies (BLM, Forest Service, Fish and Wildlife Service, and National Park Service) and determined that BLM is currently the only major federal land management agency with a solar decommissioning policy. Accordingly, our analysis of federal decommissioning policies is limited to BLM. Decommissioning policies developed by other federal agencies, which may have solar installations on property or land under their jurisdiction (e.g., the Department of Defense, the Bureau of Indian Affairs) were not addressed within this report. Local and municipal ordinances addressing solar decommissioning requirements are also outside the scope of this report. In addition, this report does not provide an in-depth analysis or comparison of cost-estimate calculations by jurisdiction or the impacts solar decommissioning requirements, such as financial assurance instruments, have on solar project development, project operations, EoL equipment management decisions, or system repowering evaluations.

¹⁰ New Hampshire, Minnesota, Vermont, Louisiana, California, Hawaii, and Virginia all require proof of financial assurance prior to solar project construction or operation.

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1 Introduction

In the United States, cumulative installed utility-scale solar photovoltaic (PV) capacity reached more than 60 gigawatts (GW)_{dc} at the end of 2020 (Davis et al. 2021b). Federal and state renewable energy and net-zero emissions policies will continue to drive solar development in the United States with installed utility-scale PV projected to quadruple (240 GW_{dc}) by 2030 (Davis et al. 2021a; Heeter 2014).

Although more than 75% of all U.S. installed utility-scale PV came online in the last 5 years, federal, state, and local governments are planning for system decommissioning (Davis et al. 2021b). Our research found that as of April 2021, one federal agency, the Bureau of Land Management (BLM), and 15 U.S. states have solar decommissioning policies in place. North Carolina is also in the process of drafting solar decommissioning regulations, and at least 4 states (Maine, Pennsylvania, West Virginia, Texas) proposed solar decommissioning bills in the 2021 legislative session.¹¹

Decommissioning a PV system typically includes removing the PV array; removing all balance-of-system (BOS) equipment (i.e., other parts of the PV system, excluding modules, which can include wiring, inverters, and the mounting system); and restoring the land or infrastructure (e.g., roofs and irrigation canals) to its original condition or for a new use (Curtis et al. 2021a; Barbosa 2020).

Legislative momentum for solar decommissioning policies in the United States is expected to continue as system assets age, extreme weather events become more prevalent, and large-scale PV deployment increases. A calculation using the National Renewable Energy Laboratory's (NREL) PV in the Circular Economy (PViCE) tool predicts approximately 27 GW of all nonresidential (commercial and utility-scale) PV capacity installed as of 2020 will be decommissioned in the U.S. by 2030 (Ayala et al. 2021).¹²

Federal and state solar decommissioning policies¹³ in the United States typically apply to utility-scale projects and mandate compliance with regulatory requirements over the lifetime of the project (not only during system decommissioning). Most U.S. solar decommissioning policies are tied to a permit or approval required for initial project development – typically as a condition or term of the approval. Some jurisdictions require a decommissioning cost estimate and/or the submission of a decommissioning plan prior to project construction. Solar decommissioning policies may also require financial assurance for decommissioning, and compliance with reporting and records requirements over the lifetime of the project. Most decommissioning policies also require compliance with specific performance activities, including removal of all

¹¹ 2019 N.C. Sess. Laws 132, S.P. 113, 130th Leg., Reg. Sess. (Me. 2021), H.B. 1555, 205th Gen. Assemb., Reg. Sess. (Pa. 2021), S.B. 492, 2021 Leg., Reg. Sess. (W. Va. 2021), S.B. 760, 2021 Leg., Reg. Sess. (Tex. 2021).

¹² The PViCE analysis only considers known installations of nonresidential (commercial and utility-scale) crystalline silicon PV through 2020; thin film is excluded, and no estimates of future installations are made. PV module technology evolutions and dynamic lifetime assumptions are drawn from data derived PViCE baselines (Ovaatt et al. forthcoming). This analysis can be explored in the Jupyter Journal “14 - Historical US Installs Waste Projection” on the PViCE GitHub.

¹³ We use “policy” in this report broadly to include not only mandated federal and state regulatory and legal requirements but also guidance, programs, and initiatives.

solar system equipment, site restoration, and reclamation (e.g., soil regrading, revegetation, reseeding, removal of access roads). A project owner may also be subject to civil penalties for noncompliance under some U.S. state solar decommissioning policies.

Solar decommissioning policies in the United States vary by federal, state, and local jurisdiction. The BLM requires a solar facility right-of-way (ROW) holder¹⁴ to submit a decommissioning plan and proof of financial security to support decommissioning costs. Fifteen states have also enacted statewide decommissioning policies with varying requirements that may mandate solar facility developers comply with specific decommissioning performance activities, submit decommissioning plans, decommissioning cost estimates, and/or provide proof of financial assurance to state and/or local jurisdictions. The remaining 35 states and the District of Columbia leave solar decommissioning policies completely to local governments. Of those 35 states, 9 states¹⁵ have model ordinances, templates, or other resources that local governments may—but are not required—to use in developing their local solar decommissioning policies.

Fifteen U.S. states¹⁶ have enacted various types of statewide solar decommissioning policies that include:

- *State-level* regulatory frameworks in which mandatory decommissioning requirements are overseen by state regulatory authorities and may require solar project developers to submit a decommissioning plan and proof of financial assurance depending on the project location or operating capacity (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, Vermont).
- *Hybrid* regulatory frameworks in which mandatory decommissioning requirements are overseen by state and/or local regulatory authorities and may require solar project developers to submit decommissioning plans and/or proof of financial assurance depending on the project location or operating capacity (California, Hawaii, Illinois, New Jersey, Nebraska, Oklahoma, Virginia, and Wyoming).
- *Optional* state-level decommissioning program, which allow solar developers to submit decommissioning plans and proof of financial assurance to state entities in lieu of obtaining local city and county government permits and approvals (Washington).

For a summary of the 15 state solar decommissioning policies analyzed in this report, see Appendix A.1. In addition, Figure 1 maps the state-level, hybrid, and optional statewide solar decommissioning policies in the United States.

¹⁴ Any person may apply to the BLM to obtain a right-of-way (ROW) to develop a solar energy facility on BLM managed land. The BLM is authorized to grant, issue, and renew ROWs upon, under, or through BLM managed public lands for electric energy generation, transmission, and distribution systems pursuant to the Federal Land Policy and Management Act (FLPMA) (43 U.S.C. 1761(a)(4)). The term “ROW” includes easements, leases, permits, or licenses to occupy, use, or traverse public lands (43 U.S.C. 1702(f)). A BLM solar ROW includes solar collector, towers, turbine generators, generators, thermal storage, access, roads, electrical and transmission facilities, transmission lines, and interconnection and support facilities (BLM 2018).

¹⁵ Georgia, Iowa, Massachusetts, New York, North Carolina, Oregon, Rhode Island, Texas, Wisconsin

¹⁶ California, Hawaii, Louisiana, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, North Dakota, Oklahoma, Vermont, Virginia, Washington, and Wyoming

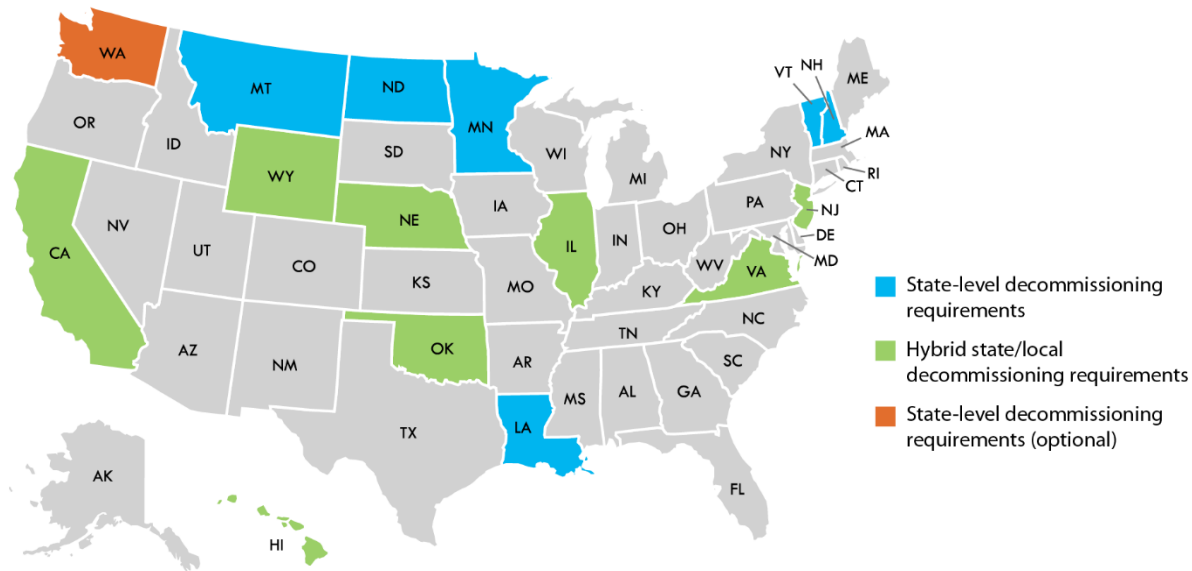


Figure 1. Map of state solar decommissioning policies in the United States

Solar decommissioning policies in the United States often require a project developer draft and submit a decommissioning plan to federal, state and/or local authorities. Solar decommissioning plans typically include the following information:

- The projected lifespan of the solar project
- A site reclamation plan, a restoration plan, or both
- Plans for transportation, salvage, and disposal of the solar project equipment and infrastructure (e.g., modules, inverters, supports, and cables)
- Cost estimates for solar system decommissioning (e.g., costs for removal of solar project equipment and infrastructure, land restoration and reclamation, and insurance requirements)
- Estimates of the salvage value for solar project equipment and infrastructure (e.g., modules, inverters, supports, and cables)
- A description of any expected impacts on natural resources
- Estimated timelines for completion of decommissioning activities (NYSERDA 2020).¹⁷

Solar decommissioning policies in the United States also often require owners to issue a financial assurance instrument (e.g., bond, guarantee, or escrow fund) to cover the cost of system decommissioning prior to project construction or at some point in time after project operation (Maamari 2018; NYSERDA 2020).¹⁸ The financial assurance typically must cover the estimated costs of labor, infrastructure removal and transportation, recycling and/or disposal, and site restoration and reclamation for system decommissioning. Table 1 provides an overview types of

¹⁷ N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06; Mont. Admin. R. 17.86.105; La. Admin. Code tit. 43:V, §§ 953, 955; N.H. Admin. R. Site 301.08(d)(2); Vt. PUC Rule 5.904; Cal. Code Regs. tit. 14 § 3108; N.J. Admin Code §§ 2:76-2A.12N; 7:50-5.36; Wyo. Stat. Ann. § 18-5-503

¹⁸ Mont. Admin. R. 17.86.102, 106, 115; Vt. PUC Rule 5.904; La. Admin. Code tit. 43:V, §§ 953, 955; Minn. R. 7854.0500; N.H. Admin. R. Site 301.08(d)(2).

financial assurance instruments typically used to ensure solar project decommissioning requirements are met.

Table 1. Financial Assurance Instruments

Instrument Type	Instrument Description	Instrument Form and/or Funding Mechanism
Surety Bonds and Letters of Credit	An agreement in which a third party (e.g., bank, insurance company) agrees to uphold the financial obligations of the developer for the benefit of the landowner and/or state or local entity with jurisdiction if the developer defaults or abandons the project. ¹⁹	A surety bond may be paid as a lump capital sum, as a percentage of the total cost of the bond, or incrementally over time. ²⁰ State policies may vary in mandating when bonds must be fully funded (e.g., prior to project construction, during operation, prior to decommissioning).
Parent Guarantees	A contractual promise given by a parent company for the benefit of the landowner and/or state or local entity with jurisdiction to secure the performance of a subsidiary company's (i.e., the developer) financial and legal obligations (e.g., financial assurance and solar project decommissioning requirements) if the subsidiary company defaults or abandons the project. ²¹	A parent guarantee takes the form of a negotiated contract and may be executed as a deed. State policies may vary in mandating when guarantees must be executed (e.g., prior to project construction, during project operation, prior to decommissioning).
Escrow Accounts	A trust account held by a lender (e.g., bank, title company) that holds funds necessary to complete solar project decommissioning until the end of the project. ²²	Although state policies may vary typically escrow accounts must be fully funded prior to project construction and remain fully funded for the duration of project operation. ²³

Figure 2 shows jurisdictions that have statewide financial assurance requirements for solar project decommissioning and states that leave financial assurance requirements to local and municipal governments.

¹⁹ *Surety Bond*. Black's Law Dictionary (11th ed. 2019); *Performance Bond*. Black's Law Dictionary (11th ed. 2019).

²⁰ Maamari 2018.

²¹ *Guarantee*. Black's Law Dictionary (11th ed. 2019).

²² *Escrow*. Black's Law Dictionary (11th ed. 2019).

²³ Maamari 2018.

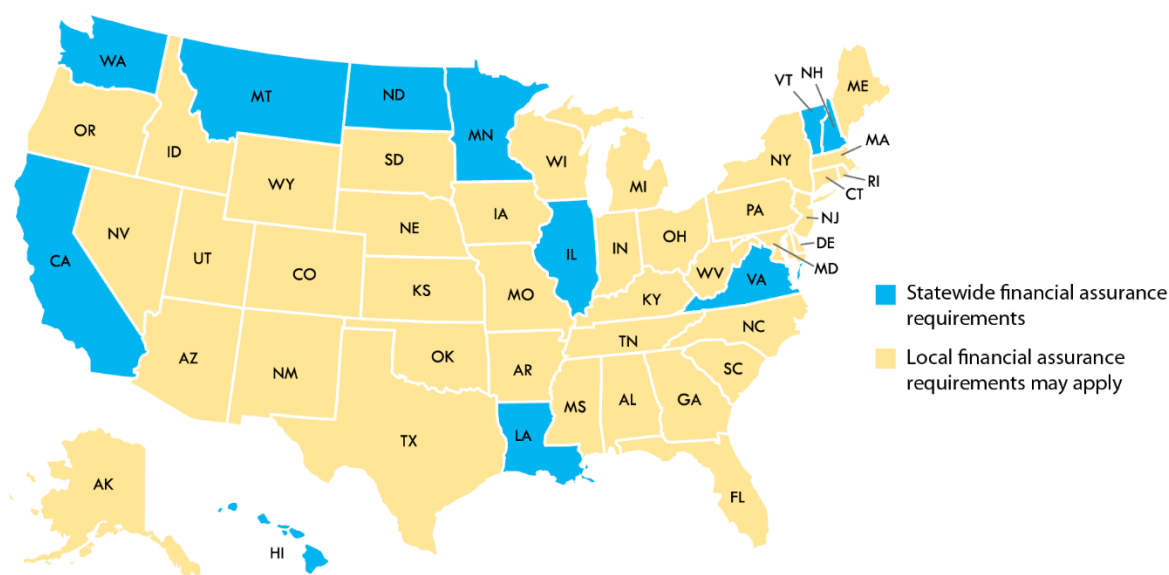


Figure 2. Map of statewide solar decommissioning financial assurance policies in the United States

In addition, solar decommissioning policies in the United States are often tied to an approval required for initial project development (e.g., site license, right-of-way). These policies typically mandate compliance with solar decommissioning requirements like the submission of a plan and/or proof of financial assurance as a pre-requisite or condition of approval needed for project construction or operation.

In this report, we provide a survey and analysis of U.S. federal and state solar decommissioning policies. Section 2 provides an overview of the one U.S. federal land management agency (BLM) with a solar decommissioning policy. Section 3 summarizes mandatory *state-level* solar decommissioning policies, Section 4 summarizes mandatory *hybrid* state/local solar decommissioning policies, and Section 5 summarizes the *optional* solar decommissioning policy enacted in the state of Washington. In Section 6, we discuss some potential impacts of solar decommissioning policies on construction timelines, project development, project operations, and EoL equipment management decisions, and ideas for future study.

Our results are based on legal and literature-based research, as well as a 50-state survey to identify enacted statewide solar decommissioning policies. We also conducted a survey of the four federal land management agencies (BLM, Forest Service, Fish and Wildlife Service, and National Park Service) and determined that BLM is currently the only major federal land management agency with a solar decommissioning policy. Accordingly, our analysis of federal decommissioning policies is limited to BLM. Decommissioning policies developed by other federal agencies, which may have solar installations on property or land under their jurisdiction (e.g., the Department of Defense, the Bureau of Indian Affairs) were not addressed within this report. Local and municipal ordinances addressing solar decommissioning requirements are also outside the scope of this report. In addition, this report does not provide an in-depth analysis or comparison of cost-estimate calculations by jurisdiction or the impacts solar decommissioning requirements, such as financial assurance instruments, have on solar project development, project operations, EoL equipment management decisions, or system repowering evaluations.

2 Bureau of Land Management Solar Decommissioning Policy

The Bureau of Land Management (BLM) is the only federal land management agency (that the authors found) that has a decommissioning policy for solar projects located on public lands.²⁴ A developer must submit a decommissioning plan and proof of financial assurance to BLM prior to approval for a solar right-of-way (ROW) to use BLM land (BLM 2017).

The BLM approved its first solar project in October 2010, and as of May 2021, has permitted 37 utility-scale projects totaling more than 7,000 MW_{dc} (BLM nd). BLM-approved solar projects are predominately PV projects but also include concentrated solar power projects. Of the 37 BLM-permitted solar projects, 2 have been decommissioned, 22 are in operation, and 13 are pending construction (BLM 2021). Table 2 analyzes the size and land acreage of BLM-approved solar projects. The 37 solar projects analyzed have a median capacity size of 175 MW utilizing 1,077 acres of BLM land.

Table 2. Solar Projects with a BLM Solar Right-of-Way

	Range	Mean	Median	Mode
Potential Capacity Size (MW_{dc})²⁵	0.05 MW – 690 MW	212.57 MW	175 MW	250 MW
BLM Land Acreage²⁶	0.13 acres – 7,063 acres	1,506.89 acres	1,077 acres	1,661 acres

Decommissioning Requirements

A solar facility owner must submit a decommissioning plan to BLM prior to project construction as a prerequisite to approval for a solar ROW. The decommissioning plan must include a description of the reclamation and restoration activities as well as a reclamation cost estimate (RCE) (BLM 2017).²⁷ The RCE must take into account environmental liabilities such as “those from the use of hazardous materials waste, costs of decommissioning, disposal of the facility and equipment, and land restoration (e.g., revegetation, recontouring, and soil stabilization)” (BLM

²⁴ There are four federal land management agencies that manage 95% of all public lands (approximately 606 million acres) in the United States including the BLM, the Forest Service (FS), U.S. Fish and Wildlife Service (FWS), and National Park Service (NPS) (CRS 2021).²⁴ The BLM manages 244 million acres, the FS manages 193 million acres, the FWS manages 89 million acres, and the NPS manages 80 million acres (CRS 2021). The BLM has determined that more than 19 million acres of the land it administers in California, Nevada, Arizona, New Mexico, Colorado, and Utah has excellent solar energy development potential (BLM 2021). However, the FS, FWS, and NPS do not appear to have formal guidance, directives, or regulations addressing utility-scale solar energy project decommissioning requirements. Accordingly, the scope of federal decommissioning policies analyzed in this report is limited to the BLM.

²⁵ This calculation includes the 2 projects that were approved and have since been decommissioned, and excludes 2 maintenance facility projects, which have no potential generating capacity.

²⁶ This calculation includes all 37 BLM-approved solar projects.

²⁷ 43 C.F.R. § 2805.20(a)(3), (5)

2017).²⁸ However, the RCE may not include the estimated salvage value for structures, equipment, or materials (i.e., cost offsets) (BLM 2015).

Financial Assurance

A solar facility owner must also provide proof of financial assurance through a bond, which is due prior to project construction as part of the decommissioning plan (BLM 2017).²⁹ The amount of financial assurance must be based on the RCE, which is currently set to at least \$10,000/acre.^{30, 31} The BLM adjusts the RCE bond requirement for inflation every 10 years (BLM 2017).³²

Historically, utility-scale solar projects on BLM land are large developments with an average operating capacity of more than 200 MW_{dc} utilizing more than 1,500 acres of land (BLM 2021) (see Table 2 above). At \$10,000/acre a 1,500-acre project would require a \$15,000,000 decommissioning assurance bond (EIA 2019; SEIA 2021; BLM 2020).³³ Anecdotal evidence indicates that BLM's financial assurance requirement for solar project decommissioning (a capital cost due prior to project construction) is a financial barrier for large, utility-scale solar projects which has led to project delays and project cancellations.³⁴

In 2020, the Department of Interior approved the Gemini Solar Project for development on BLM managed land – the largest solar project in U.S history (BLM 2020). The 690 MW proposed solar project will be located on approximately 7,100 acres of BLM land in Nevada and required at least a \$71,000,000 decommissioning bond prior to project development pursuant to BLM regulations (BLM 2020).

Table 3 provides a list of BLM permitted solar projects that are pending construction – one of which has been pending construction for approximately 8.5 years (BLM 2021).³⁵ For a full list of all BLM solar projects, see Appendix A.2.

²⁸ 43 C.F.R. § 2805.20(a)(3), (5)

²⁹ 43 C.F.R. § 2805.20(b)

³⁰ In 2016, the BLM published final rules establishing minimum bonding amounts for solar project decommissioning (\$10,000/acre) and wind project decommissioning (\$10,000/turbine) (43 C.F.R. §§ 2800, 2880). Notably, a 2012 Office of the Inspector General (OIG) Report stated that “BLM field personnel did not know how the \$10,000 minimum bond amount was developed” (OIG 2012). The OIG report also noted that at the time the report was published in 2012, the BLM was still in the process of developing a method to determine a minimum bonding amount for solar projects (OIG 2012).

³¹ 43 C.F.R. § 2805.20(a)(3), (b)

³² 43 C.F.R. § 2805.20(b)

³³ Megan Day, National Renewable Energy Laboratory, personal communication, 2021.

³⁴ Megan Day, National Renewable Energy Laboratory, email, October 19, 2020.

³⁵ The authors do not have insight as to the reason these projects are pending construction, nor does this report speculate on a particular reason for project construction delay.

Table 3. Pending Construction – Solar Projects with a BLM Solar Right-of-Way

Project Name	Potential MW Capacity	BLM Acreage	Right-of-Way Issuance Date	Time from Right-of-Way Issuance³⁶
Sonoran Solar Energy Solar Project	300 MW	2,335.60 acres	October 2012	8 years, 7 months
Desert Harvest	150 MW	1,412 acres	September 2013	7 years, 8 months
McCoy Solar Unit	500 MW	2,180 acres	August 2014	6 years, 9 months
Moapa Sola Energy Center	200 MW	119 acres	August 2015	5 years, 9 months
Harry Allen	130 MW	640 acres	April 2018	3 years, 1 month
Palen	500 MW	3,140 acres	March 2019	2 years, 2 months
Dodge Flat	200 MW	3,500 acres	November 2019	1 year, 6 months
Dry Lake Solar Energy Center	130 MW	660 acres	December 2019	1 year, 5 months
Eagle Shadow Mountain	420 MW	144 acres	April 2020	1 year, 1 month
Yellow Pine	500 MW	2,987 acres	January 2021	4 months
Crimson Solar	350 MW	2,489 acres	May 2021	0 months

³⁶ This data was collected in May 2021, therefore the time from right-of-way issuance was calculated up to May 2021.

3 States with Mandatory State-Level Solar Decommissioning Policies

This section analyzes 6 *state-level* solar decommissioning policies in the United States that require a project developer to submit a decommissioning plan and financial assurance to a state entity that has the authority to review, approve, and enforce the requirements. Notably, these state-level decommissioning policies are often inclusive of other technologies (e.g., oil and gas refineries, wind, geothermal, and hydropower technologies) and may not be narrowly tailored to solar or renewable energy facilities. Six states (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont) have enacted state-level policies that require project developers to submit decommissioning plans and proof of financial assurance to the state regulatory authority depending on the proposed project operating capacity or facility location. In 5 of those states (Louisiana, Minnesota, New Hampshire, North Dakota, and Vermont) compliance with decommissioning requirements is a condition of approval for a permit/license necessary for site access, project construction, or project operation. Louisiana, Montana, North Dakota, and Vermont also require solar facility owners to provide periodic updates to decommissioning plans, cost estimates, and/or financial assurance instruments after project construction or operation. Table 4 describes the threshold for state-level solar decommissioning policies and provides a summary of the requirements.

Table 4. Regulatory Threshold for State-Level Solar Decommissioning Policies and Summary of Requirements

State	Regulatory Threshold and Summary of Requirements
Louisiana	In Louisiana, as a condition of approval for an Alternative Energy Source Lease (AESL), the owner of an alternative energy source facility ³⁷ located on state land must submit a decommissioning plan and financial assurance to the Louisiana Department of Natural Resources prior to commencing decommissioning activities. Within 60 days of completing decommissioning activities, the facility owner must notify the department and submit a decommissioning report that includes a summary of decommissioning activities and a description of any mitigation measures used during decommissioning. ³⁸
Minnesota	In Minnesota, as a condition of a Site License, the owner of a large electric power generating plant ³⁹ with a capacity of 50 MW or greater must submit a decommissioning plan and financial assurance to the Minnesota Public Utilities Commission (PUC). ^{40, 41}

³⁷ In Louisiana, an “alternative energy source” includes wind energy, geothermal energy, geothermal energy, solar energy, and hydrokinetic energy (La. Admin. Code tit. 43:V, § 909). Although the Louisiana decommissioning regulations refer to “alternative energy source facilities,” that term is not defined within the regulations.

³⁸ La. Admin. Code tit. 43:V, §§ 921, 961, 967

³⁹ In Minnesota, “large electric power generating plants” means electric power generating equipment and associated facilities designed for or capable of operation at a capacity of 50 MW or greater (Minn. Stat. § 216E.01).

⁴⁰ Minn. Stat. §§ 216E.01, 216E.02; Minn. R. 7854.0500

⁴¹ By statute, the Minnesota PUC has authority to issue Site Licenses for large solar facilities with a capacity of 50 MW or greater (Minn. Stat. §§ 216E.01, 216E.02). However, the Minnesota PUC has not drafted administrative rules addressing site licenses specific to solar facilities. Rather, in applications for Site Licenses for large solar facilities, the Minnesota PUC cites to administrative rules related to site permit requirements for large wind facilities (PUC Docket No. E-6928/GS-14-515).

State	Regulatory Threshold and Summary of Requirements
Montana	In Montana, the owner of a facility ⁴² with a capacity of 2 MW or greater must submit (1) a decommissioning plan within 12 months prior to operation of the facility and (2) financial assurance at any time prior to 15 th year of the facility's operation to the Montana Department of Environmental Quality. Decommissioning plans must be updated every 5 years after the facility is bonded. ⁴³
New Hampshire	In New Hampshire, as a condition of approval for a Certificate of Site and Facility Application, the owner of an energy facility ⁴⁴ larger than 30 MW must submit a decommissioning plan and proof of financial assurance to the New Hampshire Site Evaluation Committee prior to construction of the facility. ⁴⁵
North Dakota	In North Dakota, as a condition of approval for a Certificate of Operation, the owner of a facility ⁴⁶ with a capacity of 500 kilowatts (kW) or greater must submit a decommissioning plan and proof of financial assurance to the North Dakota Public Service Commission (PSC) prior to the operation of the facility. The facility owner must file an updated decommissioning cost estimate with the PSC 10 years after the decommissioning cost estimate is initially approved and then every 5 years after until decommissioning is complete. ⁴⁷
Vermont	In Vermont, as a condition of approval for a Certificate of Public Good the owner of a facility ⁴⁸ with a capacity of greater than 500 kW must submit a decommissioning plan and financial assurance to the Vermont Public Utility Commission (PUC) prior to construction. Facility owners must adjust the financial assurance instrument every 3 years to account for inflation and then file a report with the PUC and the Vermont Department of Public Service describing any adjustments. ⁴⁹

⁴² In Montana, “facility” means a wind generation facility or a solar facility (Mont. Admin. R. 17.86.101).

⁴³ Mont. Admin. R. 17.86.102, 17.86.105

⁴⁴ In New Hampshire, an “energy facility” includes oil refineries, gas plants, electric generating stations, electric transmissions lines, and renewable energy facilities (N.H. Rev. Stat. Ann. § 162-H:2 (VII)). A “renewable energy facility” is defined as electric generating station equipment and associated facilities with a capacity of greater than 30 megawatts and powered by wind energy, geothermal energy, hydrogen, ocean energy, methane gas, biomass technologies, solar technologies, or hydroelectric energy (N.H. Rev. Stat. Ann. § 162-H:2 (XII)).

⁴⁵ N.H. Rev. Stat. Ann. § 162-H:2, 7

⁴⁶ In North Dakota, a “facility” means a commercial solar energy conversion facility, including solar modules, racking, anchors, bolts, foundations, bases, transformers, cables, lines, substations, concrete fences, facility access roads, towers, and all areas disturbed by the construction, operation, maintenance, or decommissioning activities (N.D. Admin. Code § 69-09-10-01).

⁴⁷ N.D. Admin. Code § 69-09-10-01, 06

⁴⁸ In Vermont, “facility” means an electric generation, transmission, or natural gas facility (Vt. PUC Rule 5.904).

⁴⁹ 30 V.S.A. § 248; Vt. PUC Rule 5.904

3.1 State-Level Solar Decommissioning Plan Requirements

State-level solar decommissioning policies vary by jurisdiction but often require the submission of a decommissioning plan that incorporates site reclamation and restoration details, as well as a cost estimate. Six states (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont) require solar developers to submit decommissioning plans to a state regulatory entity. Five of those six states (Minnesota, Montana, New Hampshire, North Dakota, and Vermont) require a decommissioning cost estimate as part of the plan submission. Three states (Montana,⁵⁰ New Hampshire,⁵¹ and North Dakota)⁵² require decommissioning plans, and/or the cost estimate be prepared by a qualified third party at the facility owner's expense. Table 5 summarizes state-level decommissioning plan requirements for Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont.

Table 5. State-level Solar Decommissioning Plan Requirements

State	Requirements
Louisiana	Decommissioning plans must include: • A proposed decommissioning schedule • A description of facilities that will be removed or kept in place • A description of removal methods and site clearance activities • Transportation, disposal, or salvage plans • A description of resources, conditions, or activities potentially affected by decommissioning • Results of recent biological surveys conducted in the site area • Mitigation measures secured to protect sensitive biological and archaeological features during decommissioning.⁵³
Minnesota	Decommissioning plans must include information about the anticipated manner in which the project will be decommissioned, and the site restored. The decommissioning plan must also include a detailed cost estimate. ⁵⁴
Montana	Decommissioning plans must include: • A proposed decommissioning schedule • Information about site restoration and reclamation to preconstruction topography • Information about dismantling, removal, and regrading of all aboveground and underground infrastructure, including access roads • Information about repair and reconstruction of public roads, culverts, and natural drainage damaged by decommissioning activities • A detailed cost estimate

⁵⁰ In Montana, a detailed estimate of the salvageable value of the facility must be prepared by an independent evaluator and included as part of the decommissioning plan (Mont. Admin. R. 17.86.105).

⁵¹ In New Hampshire, decommissioning plans must be prepared by a qualified, independent individual who has demonstrated knowledge and experience in solar energy facility projects and cost estimates (N.H. Rev. Stat. Ann. § 162-H:2, 7).

⁵² In North Dakota, decommissioning plans must be prepared by a professional licensed engineer (N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06).

⁵³ La. Admin. Code tit. 43:V, § 965

⁵⁴ Minn. R. 7854.0500

State	Requirements
	A detailed estimate of the salvageable value of the facility.⁵⁵
New Hampshire	Decommissioning plans must include information about removal of all underground infrastructure less than four feet below ground surface and must also include a detailed cost estimate. ⁵⁶ Decommissioning plans must be prepared by a qualified, third-party. ⁵⁷
North Dakota	Decommissioning plans must address: - Site restoration and reclamation to preconstruction topography - Dismantling and removal of all aboveground infrastructure (e.g., modules, supports, and inverters) and underground infrastructure (e.g., foundations, cables, and equipment) - Expected effects of decommissioning on natural resources⁵⁸ - A detailed decommissioning cost estimate Decommissioning plans must be prepared by a qualified, third-party. ⁵⁹
Vermont	Decommissioning plans must address: - Labor, equipment, transportation, and disposal costs associated with facility removal (e.g., infrastructure including modules, supports, and inverters) - Site restoration and reclamation to preconstruction condition, including removal of non-native soils, fences, and access roads - A detailed decommissioning cost estimate.⁶⁰

As noted above, Minnesota, Montana, New Hampshire, North Dakota, and Vermont mandate that decommissioning plans include a cost estimate for decommissioning the solar facility. The state specifications regarding costs estimate calculation methods and what must be included or excluded within the cost estimate vary by jurisdiction. Louisiana does not mandate that decommissioning plans include a cost estimate. Table 6 summarizes cost estimate requirements.

Table 6. State-level Solar Decommissioning Cost Requirements

State	Cost Requirements	Calculation Method
Louisiana	N/A	N/A
Minnesota	No requirements are articulated within the regulations other than that the owner must provide a cost estimate. ⁶¹	Not specified

⁵⁵ Mont. Admin. R. 17.86.105

⁵⁶ N.H. Admin. R. Site 301.08(d)(2))

⁵⁷ N.H. Rev. Stat. Ann. § 162-H:2, 7

⁵⁸ N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06

⁵⁹ N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06

⁶⁰ Vt. PUC Rule 5.90

State	Cost Requirements	Calculation Method
Montana	A cost estimate must include: • A detailed estimate of the anticipated salvage value of the facility (e.g., infrastructure including modules, supports, and inverters) prepared by an independent evaluator • Any other expenses related to decommissioning, which are the responsibility of the solar facility owner.⁶²	Current machinery production handbooks, publications, or other substantiated methods approved by the Montana Department of Environmental Quality ⁶³
New Hampshire	Cost estimates must exclude the anticipated salvage value (i.e., potential cost offsets) of the facility. ⁶⁴	Not specified
North Dakota	Cost estimates must exclude the anticipated salvage value (i.e., potential cost offsets) of the facility. It must be updated 10 years after initial approval and every 5 years after that until decommissioning is complete ⁶⁵	Not specified; however, a facility owner must include a description of the cost estimate calculation method used ⁶⁶
Vermont	A cost estimate must include: • Labor, equipment, transportation, and disposal costs associated with facility removal (e.g., infrastructure including modules, supports, inverters) • Costs of site reclamation to preconstruction condition • Costs of applicable federal, state, and local permits • Costs associated with decommissioning activity management, supervision, and safety⁶⁷ A cost estimate must exclude the anticipated salvage value (i.e., potential cost offsets) of the facility⁶⁸	Not specified

⁶² Mont. Admin. R. 17.86.105

⁶³ Mont. Admin. R. 17.86.105

⁶⁴ N.H. Admin. R. Site 301.08(d)(2)).

⁶⁵ N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06

⁶⁶ N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06

⁶⁷ Vt. PUC Rule 5.904

⁶⁸ Vt. PUC Rule 5.904

3.2 State-level Solar Decommissioning Financial Assurance Requirements

State-level solar decommissioning policies vary by jurisdiction but often require financial assurance to guarantee funds will be available for system decommissioning activities and site restoration. These policies may mandate a preferred financial assurance instrument (e.g., surety or performance bond), an issuance date for when the financial assurance is due (e.g., prior to facility construction, at a specified point during facility operation, along with the decommissioning plan), and a specific calculation method (e.g., using a cost estimate, liability insurance, or salvage value of the facility infrastructure). Six states (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont) require solar facility owners to submit financial assurance to a state entity to ensure funds will be available for decommissioning and site restoration. Four of those six states (Louisiana, Minnesota, New Hampshire, and Vermont) all require submittal of financial assurance prior to project construction (i.e., financial assurance is a capital cost). North Dakota requires that a project developer submit two installments of financial assurance, the first installment must be submitted prior to project construction, and the second after construction is complete but before project operation (i.e., financial assurance is a capital cost). Montana allows project developers to submit financial assurance at any time prior to the fifteenth year of project operation (i.e., financial assurance is an operating cost). Table 7 summarizes these financial assurance requirements.

Table 7. State-level Solar Decommissioning Financial Assurance Requirements

State	Financial Assurance Required	Issuance Dates	Instrument Type	Calculation Methods, Contents, and Amounts
Louisiana ⁶⁹	Yes	Prior to receiving an AESL (see Table 1)	Bond	The Louisiana Department of Natural Resources determines the amount, which can be no less than \$500,000, and it may base the amount on: • Estimated costs of decommissioning • Past due rent and payments incurred by the owner • Any other monetary obligations, including insurance⁷⁰ that the owner is required to maintain for the duration of the AESL
Minnesota ⁷¹	Yes	Prior to issuance of the site license	Not specified	Not specified

⁶⁹ La. Admin. Code tit. 43:V, §§ 953, 955

⁷⁰ The energy facility owner is required to purchase and maintain insurance for the duration of the AESL including workers' compensation insurance with a minimum limit of \$500,000 per/accident and Commercial General Liability Insurance with a minimum limit of \$1,000,000 (La. Admin. Code tit. 43:V § 953).

⁷¹ Minn. R. 7854.0500

State	Financial Assurance Required	Issuance Dates	Instrument Type	Calculation Methods, Contents, and Amounts
		and project construction		
Montana ⁷²	Yes	Any time prior to the 15 th year of operation	Surety bond Collateral bond	The Montana Department of Environmental Quality (DEQ) determines the amount, and it may base the amount on: • The cost estimate submitted by the owner (see Table 2) • Character and nature of the site • Costs of managing, maintaining, and/or decommissioning the facility in the event of owner abandonment • Current salvage value of the facility infrastructure (e.g., modules, supports, inverters, and other ancillary equipment). Reviewed by the DEQ every 5 years.
New Hampshire ⁷³	Yes	Prior to issuance of the site license and project construction	• Letter of credit • Performance bond • Surety bond • Guarantee	Not specified
North Dakota ⁷⁴	Yes	Owner must issue the first installment prior to construction. Owner must issue the second installment after construction is complete but prior to facility operation. When the second installment is received, the first	• Letter of credit • Performance bond • Surety bond • Guarantee • Cash escrow • Incremental bond schedule	The first installment must be in an amount equal to 5% of the estimated costs of construction. The second installment must be sufficient to cover the costs of decommissioning.

⁷² Mont. Admin. R. 17.86.102, 106, 115

⁷³ N.H. Admin. R. Site 301.08(d)(2)

⁷⁴ N.D. Admin. Code § 69-09-10-08

State	Financial Assurance Required	Issuance Dates	Instrument Type	Calculation Methods, Contents, and Amounts
		installment is returned.		
Vermont ⁷⁵	Yes	Prior to issuance of the Certificate for Public Good and project construction	Letter of credit	Must cover the costs of decommissioning and site restoration as set forth in the cost estimate submitted by the owner (see Table 2) Must be adjusted every 3 years to account for inflation

3.3 State-level Solar Decommissioning Policies Oversight Authority and Penalties

State-level solar decommissioning policies often delegate oversight authority to state entities that stipulate penalties for noncompliance (e.g., enforcement actions, civil or criminal monetary penalties). Six states (Louisiana, Minnesota, Montana, New Hampshire, North Dakota, and Vermont) delegate oversight authority of decommissioning policies to state entities that may assess penalties for noncompliance. State authorities in Louisiana, Minnesota, Montana, New Hampshire, and Vermont may assess civil penalties ranging from \$100 to \$10,000 per day for noncompliance with state decommissioning policies. In Louisiana and North Dakota, noncompliance with state decommissioning policies may result in forfeiture of financial assurance. In New Hampshire, noncompliance with state decommissioning policies may result in revocation or suspension of the Certificate of Site and Facility approval required for project operation. Table 8 summarizes state solar decommissioning policy oversight authority and penalties.

Table 8. State-level Solar Decommissioning Policies Oversight Authority and Penalties

State Authority	Penalties for Noncompliance
Louisiana Department of Natural Resources	- Forfeiture of financial assurance - Owner liability for facility removal and costs - Civil penalty up to \$300/day⁷⁶
Minnesota PUC	- Civil action to compel performance - Civil penalty of up to \$10,000/day⁷⁷
Montana Department of Environmental Quality	Civil penalty of up to \$1,500/day⁷⁸

⁷⁵ Vt. PUC Rule 5.904

⁷⁶ La. Admin. Code tit. 43:V, § 969

⁷⁷ Minn. Stat. §§ 216E.17

⁷⁸ Mont. Admin. R. 17.86.110; 75-26-304

State Authority	Penalties for Noncompliance
New Hampshire Site Evaluation Committee	• Revocation or suspension of Certificate of Site and Facility Application • Civil penalty of up to \$10,000/day or criminal charges⁷⁹
North Dakota Public Service Commission	• Forfeiture of financial assurance⁸⁰
Vermont PUC	• Civil penalty of up to \$100 • Imprisonment up to 60 days⁸¹

⁷⁹ N.H. Rev. Stat. Ann. §§ 162-H:12, 162-H:19

⁸⁰ N.D. Admin. Code § 69-09-10-09

⁸¹ 30 V.S.A. § 247

4 States with Hybrid State/Local Solar Decommissioning Policies

This section analyzes eight hybrid state/local solar decommissioning policies in the United States that require project developers comply with specific performance requirements and/or submit decommissioning plans and financial assurance to state and local entities that have authority to review, approve, and enforce the requirements. Typically, in jurisdictions with hybrid state/local decommissioning policies, the state mandates decommissioning requirements overseen by local city or county governments. Oversight and enforcement authority may be delegated to local government entities or shared between state and local government. Localities must follow state decommissioning policies enacted through statute or regulation; however, they may prescribe additional decommissioning requirements that are more stringent than the state requirements. California and Illinois require solar facility owners to submit decommissioning plans and proof of financial assurance to local jurisdictional entities based on facility location. By contrast, Hawaii mandates solar facility owners comply with state decommissioning requirements (e.g., removal of system equipment) and submit proof of financial assurance to local jurisdictions based on facility location, but the state policy does not mandate the submission of a decommissioning plan. New Jersey and Wyoming require solar facility owners to submit decommissioning plans, without financial assurance to local entities based on the facility location or operating capacity. Nebraska and Oklahoma state policies require solar facility owners to provide a description of local decommissioning and financial assurance requirements within solar easements. Virginia has a statewide requirement that local jurisdictional solar facility siting ordinances include decommissioning and financial assurance requirements. Table 9 describes the threshold for hybrid state/local solar decommissioning policies and provides a summary of the requirements.

Table 9. Regulatory Threshold for Hybrid State/Local Solar Decommissioning Policies and Summary of Requirements

State	Regulatory Threshold and Summary of Requirements
California	In California, as a condition for a self-renewing Solar Use Easement, ⁸² the owner of a solar use easement project ⁸³ located on land subject to the Williamson Act or farmland

⁸² Solar-use easement means any right or interest acquired by a county, or city in perpetuity, for a term of years, or annually self-renewing as provided in Section 51191.2, in a parcel or parcels determined by the Department of Conservation pursuant to Section 51191 to be eligible, where the deed or other instrument granting the right or interest imposes restrictions that, through limitation of future use, will effectively restrict the use of the land to photovoltaic solar facilities for the purpose of providing for the collection and distribution of solar energy for the generation of electricity, and any other incidental or subordinate agricultural, open-space uses, or other alternative renewable energy facilities. A solar-use easement shall not permit any land located in the easement to be used for any other use allowed in commercial, industrial, or residential zones. A solar-use easement shall contain a covenant with the county, or city running with the land, either in perpetuity or for a term of years, that the landowner shall not construct or permit the construction of improvements except those for which the right is expressly reserved in the instrument provided that those reservations would not be inconsistent with the purposes of this chapter and which would not be incompatible with the sole use of the property for solar photovoltaic facilities (Cal. Gov. Code §51190(c)).

⁸³ In California, a “solar use easement project” means all land and photovoltaic panels and foundations, and other installations, facilities, buildings, accessory structures, or other improvements to the land that are related to the

State	Regulatory Threshold and Summary of Requirements
	security zone contract must submit a decommissioning plan and financial assurance to the local city or county government with jurisdiction prior to construction. The local city or county government submits the solar use easement application, decommissioning plan, and financial assurance documents to the California Department of Conservation for final review and approval. The owner must review and resubmit the financial assurance instrument to the local government every 5 years. ⁸⁴
Hawaii	In Hawaii, as a condition of a Special Use Permit, the owner of a solar energy facility ⁸⁵ located on agricultural lands with a soil productivity rating of B or C must comply with state decommissioning requirements and submit proof of financial assurance to the local county planning commission with jurisdiction prior to construction. The local county planning commission must submit all special use permit application documents, including financial assurance documents, to the Hawaii Land Use Commission. ⁸⁶
Illinois	In Illinois, the owner of a commercial renewable energy facility ⁸⁷ located on agricultural land owned by a third party must enter into an Agricultural Impact Mitigation Agreement with the Department of Agriculture outlining facility construction and deconstruction plans and submit a deconstruction plan and financial assurance to the county government with jurisdiction prior to construction. The owner must review and resubmit the decommissioning plan, including the cost estimate and financial assurance instrument to the county with jurisdiction 10 years after commercial operation commences. ⁸⁸
Nebraska	In Nebraska, the owner of a solar energy system ⁸⁹ who executes a Solar Agreement (e.g., easement) to secure a land right for a solar energy system must include within the solar agreement instrument a description of any decommissioning plans or financial assurance instruments required by the local jurisdiction where the solar energy system is located. ⁹⁰

photovoltaic generation of electricity on land that is or has been proposed to be placed in a solar-use easement (Cal. Code Regs. tit. 14 § 3101).

⁸⁴ Cal. Code Regs. tit. 14 §§ 3102, 3108, 3111

⁸⁵ In Hawaii, the Land Use Commission's regulations use the term "solar energy facility;" however, that term is undefined within the regulations.

⁸⁶ Haw. Rev. Stat. 205-4.5(21); 205-6

⁸⁷ In Illinois, "commercial renewable energy facility" means a commercial solar energy conversion facility with a capacity equal to or greater than 500 kW or a wind energy facility conversion facility with a capacity equal to or greater than 500 kW (505 Ill. Comp. Stat. 147/10 (2018)).

⁸⁸ 505 Ill. Comp. Stat. 147/15 (2018).

⁸⁹ In Nebraska, "solar energy system" means a complete design or assembly consisting of a device used primarily to transform solar energy into thermal, chemical, or electrical energy, an energy storage facility, and components for the distribution of transformed energy to the extent that they cannot be used jointly with a conventional energy system (Neb. Rev. Stat. § 66.905).

⁹⁰ Neb. Rev. Stat. § 66.911-01

State	Regulatory Threshold and Summary of Requirements
New Jersey	In New Jersey, as a condition of approval for a Site Plan, an owner of a solar energy generation facility ⁹¹ located on commercial farmland subject to the Right to Farm Act ⁹² must submit a conservation plan that addresses the impacts of decommissioning to the local soil conservation district with jurisdiction. The Site Plan is subject to approval from the New Jersey State Agriculture Development Committee. ⁹³ In addition, an owner of a solar energy generation facility located in a Pinelands Management Area must submit a landscaping plan to the New Jersey Pinelands Commission that addresses the impacts of decommissioning. ⁹⁴ New Jersey does not require proof of financial assurance at a state level for solar facility decommissioning, but localities may impose financial assurance requirements.
Oklahoma	In Oklahoma, a solar energy conversion system owner ⁹⁵ who executes a Solar Agreement (e.g., easement) to secure a land right for a solar energy conversion system must include within the solar agreement instrument, a description of any decommissioning plans or financial assurance instruments required by the local jurisdiction where the energy facility is located. ⁹⁶
Virginia	In Virginia, the state legislature requires local governments with solar facility siting ordinances to include solar decommissioning requirements within their regulations. Local governments must require owners of solar energy equipment, facilities, or devices ⁹⁷ to submit decommissioning plans and proof of financial assurance to the local entity with jurisdiction. ⁹⁸
Wyoming	In Wyoming, as a condition of approval for an Operating Permit, the owner of a solar energy facility ⁹⁹ with a capacity of greater than 500 kW must submit a decommissioning plan to the county board of commissioners with jurisdiction prior to construction of the facility. The solar facility owner must submit updated decommissioning plans every 5 years until site reclamation and decommissioning is complete. Wyoming does not require proof of financial assurance for energy facility decommissioning. ¹⁰⁰

⁹¹ In New Jersey, “solar energy generation facility” means all the components of a solar generation system, including but not limited to structures and equipment, photovoltaic panels and films, arrays, collectors, piping, footings, supports, mounting and stabilization devices, inverters, pumps, transformers, electrical distribution and transmission wires, utility poles and other on-farm infrastructure necessary to operate and maintain the system for the generation of power or heat (N.J. Admin Code § 2:76-2A.12).

⁹² Commercial farmland means a “farm management unit of no less than five acres producing agricultural or horticultural products worth \$ 2,500 or more annually, and satisfying the eligibility criteria for differential property taxation pursuant to the Farmland Assessment Act of 1964” or a “farm management unit less than five acres, producing agricultural or horticultural products worth \$ 50,000 or more annually and otherwise satisfying the eligibility criteria for differential property taxation pursuant to the Farmland Assessment Act of 1964” (N.J. Admin Code § 2:76-2A.12(a)).

⁹³ N.J. Admin Code § 2:76-2A.12

⁹⁴ N.J. Admin Code § 7:50-5.36

⁹⁵ In Oklahoma, the Airspace Severance Restriction Act (Act), which governs conditions of solar agreements, refers to “solar energy conversion systems;” however, this term is not defined within the act (Okla. Stat. tit. 60, § 820.1).

⁹⁶ Okla. Stat. tit. 60, § 820.1

⁹⁷ In Virginia, “solar energy equipment, facilities, or devices” means any personal property designed and used primarily for the purpose of collecting, generating, or transferring electric energy from sunlight (Va. Code Ann. §15.2-2241.2).

⁹⁸ Va. Code Ann. §15.2-2241.2; Va. Admin. Code § 67-103

⁹⁹ In Wyoming, a “solar energy facility” means a commercial facility with a rated power capacity of more than one-half megawatt of electricity from solar power that includes all lands where the owner or developer has rights to erect solar energy facilities (Wyo. Stat. Ann. § 18-5-501).

¹⁰⁰ Wyo. Stat. Ann. §§ 18-5-501, 18-5-503

4.1 Hybrid State/Local Solar Decommissioning Plan and/or Performance Requirements

Hybrid state/local solar decommissioning policies vary by jurisdiction but often require the submission of a decommissioning plan, that incorporates site reclamation and restoration details, as well as a cost estimate to a state or local regulatory entity. By contrast, a few hybrid state/local solar decommissioning policies only mandate performance of specified decommissioning activities (e.g., removal of all solar system equipment) but do not require submission of a plan to state or local regulatory entities. Four states (California, Hawaii, New Jersey, and Wyoming) have hybrid state/local solar decommissioning policies that mandate decommissioning plans and/or performance requirements. One state, Virginia, has a hybrid state/local solar decommissioning policy that mandates solar facility owners enter into an agreement regarding decommissioning performance requirements with local entities with jurisdiction. Only Illinois and Virginia require facility owners provide cost estimates to local entities with jurisdiction. Notably, three of the jurisdictions with hybrid state/local decommissioning policies (Hawaii, Illinois, and New Jersey) impose timeframes on facility owners that dictate when decommissioning activities must be complete. Nebraska and Oklahoma do not have specific statewide decommissioning plan requirements but instead require compliance with local government rules and regulations. Table 10 summarizes hybrid state/local decommissioning plan and performance requirements in California, Hawaii, Illinois, Nebraska, New Jersey, Oklahoma, Virginia, and Wyoming.

Table 10. Hybrid State/Local Solar Decommissioning Plan and Performance Requirements

State	Plan and Performance Requirements
California	State law requires that an owner submit a decommissioning plan to the local city or county government with jurisdiction that includes the following information: • Soil management plan • Site restoration plan • Description of regrading and removal of structures and equipment.¹⁰¹
Hawaii	State law requires removal all equipment within 12 months after operations cease and restore the land to its preconstruction condition. ¹⁰² State law does not require submittal of a decommissioning plan; however, local regulations may apply.
Illinois	State law requires that an owner submit a decommissioning plan to the local city or county government with jurisdiction addressing the following: • Restoration of agricultural land to pre-construction state • Removal of aboveground structures (supports, facilities, wires, anchors, access roads) • Removal of underground structures (cabling) • Topsoil removal and replacement • A detailed decommissioning cost estimate.¹⁰³

¹⁰¹ Cal. Code Regs. tit. 14 § 3108

¹⁰² Haw. Rev. Stat. 205-4.5(21)

¹⁰³ Illinois Department of Agriculture. 2019. "Standard Agricultural Mitigation Agreement Form." <https://www2.illinois.gov/sites/agr/Resources/AIMA/Documents/Std%20Solar%20AIMA.pdf>.

State	Plan and Performance Requirements
Nebraska	State law requires that an owner describe any decommissioning plan required by the local government with jurisdiction within the solar easement. ¹⁰⁴
New Jersey	State law requires the owner of a solar facility on commercial farmland submit a conservation plan to the local soil conservation district with jurisdiction addressing: • Removal of the solar facility within 18 months after operations have ceased • Restoration of the land to achieve agricultural productivity.¹⁰⁵ State law requires the owner of a solar facility located in a Pinelands Management Area must submit a landscaping or revegetation plan to the New Jersey Pinelands Commission addressing removal of all solar facility structures and equipment within 12 months after operations cease. ¹⁰⁶
Oklahoma	State law requires that an owner describe any decommissioning plan required by the local government with jurisdiction within the solar easement. ¹⁰⁷
Virginia	State law requires the owner enter into a written agreement with the locality with jurisdiction to decommission the solar energy equipment, facilities, and devices within a specified timeframe as well as detailed cost estimate prepared by a professional engineer licensed in Virginia. ¹⁰⁸
Wyoming	State law requires the owner submit a decommissioning plan to the county board of commissioners with jurisdiction addressing how the solar facility will be decommissioned and reclaimed at the end of the facility's life. ¹⁰⁹

As noted above, only 2 of the 8 states with hybrid state/local solar decommissioning policies, Illinois and Virginia, mandate that solar project developers submit a cost estimate for decommissioning the solar facility to local entities with jurisdiction. The specifications regarding what must be included or excluded within the cost estimate vary by state and neither Illinois nor Virginia requires a specific calculation method at the state level; however, local regulations may mandate specific cost estimate calculation methods. California, Hawaii, Nebraska, New Jersey, Oklahoma, and Wyoming do not mandate that decommissioning plans include a cost estimate at the state level; however, local regulations may mandate that facility owners provide decommissioning cost estimates. Table 11 summarizes cost estimate requirements in California, Hawaii, Illinois, Nebraska, New Jersey, Oklahoma, Virginia, and Wyoming.

Table 11. Hybrid State/Local Solar Decommissioning Cost Requirements

State	Cost Requirements
California	Not prescribed by state statute or regulation but local requirements may apply.
Hawaii	Not prescribed by state statute or regulation but local requirements may apply.

¹⁰⁴ Neb. Rev. Stat. § 66.911-01

¹⁰⁵ N.J. Admin Code § 2:76-2A.12

¹⁰⁶ N.J. Admin Code § 7:50-5.36

¹⁰⁷ Okla. Stat. tit. 60, § 820.1

¹⁰⁸ Va. Code Ann. §15.2-2241.2; Va. Admin. Code § 67-103

¹⁰⁹ Wyo. Stat. Ann. § 18-5-503

State	Cost Requirements
Illinois	Owner must submit a cost estimate prepared by a professional engineer licensed in Illinois. The cost estimate must consider: • The number of solar panels, racking, and related facilities • The original construction costs • Size and capacity of the facility • Salvage value of the facility¹¹⁰
Nebraska	Not prescribed by state statute or regulation but local requirements may apply.
New Jersey	Not prescribed by state statute or regulation but local requirements may apply.
Oklahoma	Not prescribed by state statute or regulation but local requirements may apply.
Virginia	Owner must submit a cost estimate prepared by a professional engineer licensed in Virginia. The cost estimate: • Must not exceed the total projected cost of decommissioning • May include the salvage value of equipment, facilities, or devices • May include an annual inflation factor. Check local regulations for additional requirements. ¹¹¹
Wyoming	Not prescribed by state statute or regulation but local requirements may apply.

4.2 Financial Assurance Requirements

Four states (California, Hawaii, Illinois, and Virginia) have hybrid state/local policies that mandate that solar developers submit financial assurance to a state and/or local entities to ensure funds will be available for decommissioning and site restoration. In addition, California requires facility owners to review and resubmit financial assurance to the local jurisdiction with authority every 5 years. Nebraska and Oklahoma do not have statewide financial assurance requirements, but they do require compliance with local financial assurance requirements. New Jersey and Wyoming do not require proof of financial assurance. Local and municipal governments may have financial assurance requirements in addition to state requirements. Table 12 summarizes hybrid state/local financial assurance requirements in California, Hawaii, New Jersey, Wyoming, Nebraska, Oklahoma, and Virginia.

Table 12. Hybrid State/Local Financial Assurance Requirements

State	Financial Assurance	Date Due	Instrument Type	Calculation Methods, Contents, and Amounts
California ¹¹²	Yes	Prior to receiving a self-renewing easement/prior to construction	Performance bond	The amount is based on:

¹¹⁰ Illinois Department of Agriculture. 2019. "Standard Agricultural Mitigation Agreement Form." <https://www2.illinois.gov/sites/agr/Resources/AIMA/Documents/Std%20Solar%20AIMA.pdf>.

¹¹¹ Va. Code Ann. §15.2-2241.2; Va. Admin. Code § 67-103

¹¹² Cal. Code Regs. tit. 14 § 3111

State	Financial Assurance	Date Due	Instrument Type	Calculation Methods, Contents, and Amounts
				- Costs of site restoration and reclamation as set forth in the decommissioning plan (see Table 6) - Costs of equipment, transportation, and labor necessary for infrastructure removal - Liability insurance the owner is required to maintain for the duration of decommissioning and restoration work - Contingency amount not to exceed 10% of the costs of site restoration, which does not include construction and operation costs The amount must be reviewed and resubmitted to the local government for approval every 5 years.
Hawaii ¹¹³	Yes	Prior to operation	Not prescribed by state statute or regulation; check local regulations	Not prescribed by state statute or regulation; check local regulations
Illinois ¹¹⁴	Yes	Owner must submit: 10% before the end of the first year of operation	Reclamation or surety bond, or other financial instrument acceptable to the	The financial assurance must be based on the cost estimate as set forth within the

¹¹³ Haw. Rev. Stat. 205-4.5(21)

¹¹⁴ 505 Ill. Comp. Stat. 147/15; Illinois Department of Agriculture. 2019. "Standard Agricultural Mitigation Agreement Form." <https://www2.illinois.gov/sites/agr/Resources/AIMA/Documents/Std%20Solar%20AIMA.pdf>.

State	Financial Assurance	Date Due	Instrument Type	Calculation Methods, Contents, and Amounts
		• 50% before the end of the sixth year of operation • 100% before the eleventh year of operation.	county with jurisdiction	decommissioning plan (see Table 9)
Nebraska	State law mandates compliance with local financial assurance requirements ¹¹⁵	N/A	N/A	N/A
New Jersey	No state-level requirements but local regulations may apply	N/A	N/A	N/A
Oklahoma	State law mandates compliance with local financial assurance requirements ¹¹⁶	N/A	N/A	N/A
Virginia ¹¹⁷	Yes	Prior to construction	• Bond • Letter of credit • Guarantee • Certified fund • Cash Escrow	The financial assurance must be based on the cost estimate as set forth within the decommissioning plan (see Table 9).
Wyoming	No state-level requirements but local regulations may apply	N/A	N/A	N/A

¹¹⁵ The solar facility owner must describe any financial assurance instrument required by the local government where the facility is located as a condition of a solar agreement (easement) (Neb. Rev. Stat. § 66.911-01).

¹¹⁶ The solar facility owner must describe any financial assurance instrument required by the local government where the facility is located as a condition of a solar agreement (easement) (Okla. Stat. tit. 60, § 820.1).

¹¹⁷ Va. Code Ann. §15.2-2241.2

4.3 Hybrid State/Local Solar Decommissioning Policies Oversight Authority and Penalties

California, Hawaii, Illinois, Nebraska, Oklahoma, Virginia, and Wyoming delegate oversight authority of solar decommissioning policies to local entities that may have the authority to assess penalties for noncompliance. In New Jersey, state regulatory entities retain authority to enforce decommissioning policies. Penalties vary by jurisdiction; however, in Hawaii and Wyoming, local authorities have the right to assess fines for noncompliance with state and local decommissioning policies. In addition, in California, noncompliance with decommissioning policies may result in forfeiture of financial assistance. In Virginia, local authorities have the right to enter property without consent and begin decommissioning in the event of noncompliance with decommissioning policies. Table 13 summarizes oversight authority and penalties.

Table 13. Oversight Authority and Penalties

State	Enforcement Authority	Penalties for Noncompliance
California	Local city or county government ¹¹⁸	Forfeiture of financial assurance ¹¹⁹
Hawaii	Local county planning board ¹²⁰	Fine of up to \$5,000 ¹²¹
Illinois	Local jurisdiction ¹²²	Determined by the jurisdiction/variable
Nebraska	Local jurisdiction ¹²³	Determined by the jurisdiction/variable
New Jersey	State Agriculture Development Committee ¹²⁴ or Pinelands Commission ¹²⁵	Civil action ¹²⁶
Oklahoma	Local jurisdiction ¹²⁷	Determined by the jurisdiction/variable
Virginia	Local jurisdiction ¹²⁸	Local jurisdictional entity may enter property without consent and begin decommissioning ¹²⁹
Wyoming	County board of commissioners ¹³⁰	Fine of up to \$10,000/day ¹³¹

¹¹⁸ Cal. Code Regs. tit. 14 § 3111

¹¹⁹ Cal. Code Regs. tit. 14 § 3111

¹²⁰ Haw. Rev. Stat. 205-12

¹²¹ Haw. Rev. Stat. 205-12

¹²² 505 Ill. Comp. Stat. 147/15.

¹²³ Neb. Rev. Stat. § 66.911-01

¹²⁴ The State Agriculture Development Committee has authority and oversight over site plans for commercial farmland subject to the Right to Farm Act (N.J. Admin Code §§ 2:76-2A.12(d)).

¹²⁵ The New Jersey Pinelands Commission has authority and oversight over the construction, maintenance, and decommissioning of energy facilities on land designated as a Pinelands Management Area (N.J. Admin Code § 7:50-8.1).

¹²⁶ N.J. Admin Code §§ 2:76-2A.12; N.J. Admin Code § 7:50-8.1

¹²⁷ Okla. Stat. tit. 60, § 820.1

¹²⁸ Va. Code Ann. §15.2-2241.2

¹²⁹ Va. Code Ann. §15.2-2241.2

¹³⁰ Wyo. Stat. Ann. § 18-5-503

¹³¹ Wyo. Stat. Ann. § 18-5-512

5 Optional State-level Decommissioning Requirements in Washington

One state, Washington has enacted a voluntary state-level decommissioning policy. Washington's policy allows solar facility developers to submit a decommissioning plan and proof of financial assurance to the State of Washington Energy Facility Site Evaluation Council (Council) in lieu of obtaining local and county government permits and approvals. In Washington, as a condition of approval to enroll in the *optional* certification program, an energy facility owner must submit a site restoration plan and financial assurance to the Council prior to construction.¹³²

5.1 Decommissioning Requirements

An energy facility owner must submit a restoration plan to the Council 90 days prior to construction that:

- Identifies, evaluates, and resolves all major environmental, public health, and public safety issues relevant to the site
- Describes the facility owner's methodology in choosing measures to be used to restore or preserve the site
- Compares economic factors of costs and benefits for different restoration options against any risks to the public.¹³³

5.2 Financial Assurance Requirements

As part of the restoration plan, the facility owner must provide proof of financial security that (1) is sufficient to manage the restoration of the site and (2) includes evidence of pollution liability insurance coverage, and a site closure bond, sinking fund, or other financial instrument or security. The facility owner must also provide justifications for the amounts of the financial securities as proof that they will be sufficient to fund decommissioning and site restoration.¹³⁴

5.3 Oversight Authority and Penalties

The Council has oversight and authority over decommissioning and financial assurance requirements. At least once every 5 years, an energy facility owner must review and submit an updated restoration plan that accounts for new conditions, technologies, and knowledge that could be relevant to facility decommissioning.¹³⁵ Violations of the certification requirements may include penalties of \$1,000–\$25,000 per day.¹³⁶

¹³² Wash. Rev. Code §§ 80.50.020; 80.50.060; Wash. Admin. Code § 463-72-020

¹³³ Wash. Admin. Code § 463-72-040

¹³⁴ Wash. Admin. Code § 463-72-020

¹³⁵ Wash. Admin. Code § 463-72-080

¹³⁶ Wash. Rev. Code § 80.50.150

6 Conclusion

Our analysis found that U.S. solar decommissioning policies typically apply to utility-scale solar projects and can impact initial project development, system operations, system decommissioning and may influence equipment end-of-life management decisions. One federal agency, BLM, and 15 U.S. states have decommissioning policies in place that mandate compliance with requirements over the lifetime of the project. The development of solar decommissioning policies in the United States is expected to gain momentum as the call for utility-scale solar is projected to quadruple by 2030 to meet renewable energy and decarbonization goals. As of April 2021, five states (North Carolina, Maine, Pennsylvania, West Virginia, and Texas) have pending (not yet enacted) solar decommissioning regulations or legislation.¹³⁷

The design of solar decommissioning policies is an important consideration for enabling responsible decommissioning practices and for solar deployment, project operations, and the overall U.S. solar market. Solar decommissioning policies can enable responsible system decommissioning practices but may also have unintended impacts on project development and project operations. These policies may include compliance with requirements that impact construction, pre-operation project timelines, and project operational costs that may affect project economics and/or initial project development decisions. Anecdotal evidence suggest that solar decommissioning policies can impact a project's initial development timelines and costs by mandating compliance with decommissioning requirements (e.g., submittal of decommissioning plans, cost estimates, and financial assurance) prior to approval of construction and siting applications, permits, and licenses. For instance, the complexity¹³⁸ associated with decommissioning policy compliance may increase capital costs and extend construction timelines in jurisdictions that condition construction and site related approvals on submittal of decommissioning plans, financial assurance, and/or conformance with decommissioning performance requirements.

Some of the decommissioning policy designs we analyzed are arguably more favorable to solar project development than others (Maamari 2018; NYSERDA 2020).¹³⁹ For example, our research found that solar decommissioning policies may dictate whether financial assurance must be provided at the outset of a project as a capital cost or may be provided later during project operation (Wyatt 2020; Maamari 2018; NYSERDA 2020). BLM, California, Hawaii, Louisiana, Minnesota, New Hampshire, North Dakota, Vermont, and Virginia all require submittal of financial assurance prior to project operation, increasing the capital costs to a solar project, which evidence suggests has led to prolonged construction timelines, delays, and even project cancellation (Maamari 2018; NYSERDA 2020).¹⁴⁰ By contrast, some jurisdictions have enacted decommissioning policies that allow developers to submit financial assurance during project operation (e.g., in Montana, financial assurance must be provided before the end of the 15th year

¹³⁷ 2019 N.C. Sess. Laws 132, S.P. 113, 130th Leg., Reg. Sess. (Me. 2021), H.B. 1555, 205th Gen. Assemb., Reg. Sess. (Pa. 2021), S.B. 492, 2021 Leg., Reg. Sess. (W. Va. 2021), S.B. 760, 2021 Leg., Reg. Sess. (Tex. 2021).

¹³⁸ New Hampshire and North Dakota require decommissioning plans are prepared by a qualified, independent third party at the facility owner's expense (N.H. Rev. Stat. Ann. § 162-H:2, 7; N.D. Admin. Code §§ 69-09-10-01, 69-09-10-06).

¹³⁹ Megan Day, National Renewable Energy Laboratory, email, October 19, 2020.

¹⁴⁰ Megan Day, National Renewable Energy Laboratory, email, October 19, 2020.

of project operation) or in phases (e.g., in Illinois, 10% of the entire financial assurance amount must be provided before operation begins, 50% before the end of the 6th year of operation, and 100% before the end of the 11th year of operation). Accordingly, in these jurisdictions, financial assurance may be absorbed as an operating cost rather than an upfront capital cost.

Solar decommissioning policies that require a decommissioning cost estimate vary by jurisdiction and may also impact capital costs and/or operational costs of projects. For example, policies may mandate that certain costs be included or excluded in the overall decommissioning cost estimate. Three states – Montana, Illinois, and Virginia – allow project owners to offset the costs of decommissioning (e.g., costs of infrastructure removal, transportation and labor, disposal, liability insurance, site restoration and reclamation) with an estimated salvage value (e.g., recycling), which may lower the projected costs of decommissioning. By contrast, BLM, New Hampshire, North Dakota, and Vermont specify that the salvage value of solar facility infrastructure must be excluded from the cost estimate.¹⁴¹ In jurisdictions that do not allow for salvage value to be included in the overall solar decommissioning cost estimate, the result may be higher decommissioning estimates and therefore higher financial assurance amounts for the project (Curtis et al. Forthcoming). For example, a 200 MW project in the United States required a decommissioning bond of approximately \$16 million, because the permitting authority did not allow salvage value to be considered in setting the financial assurance level to cover decommissioning costs.¹⁴² Assuming an annual bond rate of 1%, bond payments for the example project would be \$160,000 per year, or \$4.8 million over 30 years.¹⁴³ The debate around allowing salvage to be calculated in a cost estimate boils down to concerns about over-estimating the future value of recycled PV system materials and resale of PV equipment versus underestimating the cost to properly decommission and dispose of PV equipment in lieu of reuse and recycling options (Hawley 2017). Future study is needed to determine whether financial assurance requirements which are typically based on a cost estimate are adequate to support solar decommissioning activities or whether they exceed the costs and place an undue burden on developers. Moreover, future research could analyze whether decommissioning policies that allow solar developers to offset decommissioning costs with the estimated salvage value of EoL system equipment influence EoL management decisions (e.g., provide an incentive for recycling rather than landfill disposal).

State policies also vary in terms of calculation methods prescribed for determining the decommissioning cost estimate amount, which are typically used to calculate financial assurance. Four states – Illinois, New Hampshire, North Dakota, and Virginia – require that cost estimates are prepared by a qualified third-party (e.g., state licensed engineer). In addition, Montana and North Dakota require project owners provide a description of the cost estimate calculation method used, but do not prescribe a specific methodology. We did not find any guidance, studies, or publicly available cost models related to cost estimate calculation methods; however, evidence suggests that the calculation method used is an important factor in determining cost estimates, and that the lack of a consistent calculation method has resulted in highly variable net

¹⁴¹ Some jurisdictions (e.g., Louisiana, Montana, Minnesota, Hawaii, Nebraska, New Jersey, Oklahoma, and Wyoming) do not address cost estimate calculation methods.

¹⁴² Parikhith Sinha, First Solar, personal communication, 2018.

¹⁴³ Parikhith Sinha, First Solar, personal communication, 2018.

decommissioning cost estimates (\$/MW) (Curtis et al. Forthcoming). Development of a publicly available decommissioning cost model as well as further study of decommissioning cost estimates and decommissioning best practices could provide guidance to asset owners and operators to adequately plan and prepare for system decommissioning. Study of decommissioning cost estimates compared to actual costs could provide guidance to enable accurate and consistent cost estimates that are sufficient to cover the costs of decommissioning and do not exceed actual costs. Qualitative study has also found that there is a need for guidance and best practices for system decommissioning and EoL equipment management, which could, for example, aid developers in accurately determining salvage value for recycled and reused equipment and may enable sustainable EoL equipment management.

Penalties for violating solar decommissioning requirements, which provide a mechanism to ensure decommissioning is carried out in accordance with state policies and that land will be returned to its pre-construction uses and value also vary widely by jurisdiction. Some U.S. states that we analyzed require the forfeiture of financial assurance (e.g., California, North Dakota, and Louisiana), allow state agencies to enter property and begin decommissioning the project (i.e., Virginia), or impose fines that can range from \$100 per day (e.g., Vermont) to \$10,000 per day (e.g., Minnesota, New Hampshire, Washington, and Wyoming) for violations. By contrast, Oklahoma, Illinois, and Nebraska leave penalties for violating decommissioning requirements entirely to local government. Additional research could analyze how penalties associated with violations of decommissioning policies may impact stakeholder interests. For example, whether creditors are more confident in investing and providing financing in jurisdictions that impose penalties. In addition, new research could study whether penalties imposed for violations of decommissioning policies are protecting state and landowner interests and ensuring system decommissioning as well as land restoration and remediation.

Many of the solar decommissioning policies analyzed in this report were not designed with solar technologies in mind, or even for renewable energy technologies, but instead they have been adopted from—or adapted in whole or in part for inclusion in—decommissioning policies for fossil fuel generating technologies such as oil and gas. Future research could also examine whether decommissioning policies, which are not specifically tailored to solar energy facilities accurately reflect the risks associated with solar decommissioning. Decommissioning policies that are designed to consider solar project development, operations, and EoL considerations unique to solar technologies and those that balance development objectives with responsible decommissioning practices may be best suited to facilitate sustainable EoL management practices as well as solar energy development in the United States.

Decommissioning policies may also provide a framework for enabling a circular economy for solar materials. Although we found no U.S. federal or state solar decommissioning policy that dictates a particular EoL disposition for system equipment (e.g., recycling or disposal), solar decommissioning policies could include language that mandates or incentivizes the recycling of decommissioned solar equipment. Some solar industry experts have also indicated that decommissioning policies may be a preferred policy mechanism to encourage sustainable EoL management practices over other policy frameworks like manufacturer takeback requirements or universal solid waste designations for EoL solar PV modules (Curtis et al. 2021b, Curtis et al. 2021c). One reason that decommissioning policies may be favored to encourage recycling-based resource recovery of solar equipment is because the requirements of these policies are known at

the outset of the project, prior to project construction or operation, allowing project owners time to plan well in advance for project decommissioning activities which could include a requirement to recycle EoL system equipment (Curtis et al. 2021b, Curtis et al. 2021c).

Although the scope of this report is limited to analysis of U.S. statewide and BLM solar decommissioning policies,¹⁴⁴ future research could review other federal non-land management agencies that may have solar installations located on property or land under their jurisdiction (e.g., Bureau of Indian Affairs, Department of Defense) to identify decommissioning policies and provide an analysis of their requirements. In addition, future research could review local county and municipal regulations and ordinances in states that leave decommissioning requirements to local government. This additional solar decommissioning policy research could be coupled with analysis and predictive modeling that provides insight on how certain policy requirements influence project development, operations, system decommissioning, EoL management, and repowering decisions. For example, future research could analyze whether financial assurance and cost estimate requirements that lead to higher operating costs may also lead to higher insurance costs. In addition, future research could look at international PV system decommissioning policies to inform efforts in the United States.

¹⁴⁴ We also conducted a survey of the four major federal land management agencies (BLM, FS, FWS, and NPS) and determined that the BLM is currently the only major federal land management agency with a decommissioning policy. Accordingly, our analysis of federal decommissioning policies is limited to the BLM.

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7.1 Federal and State Statutes and Legislative Materials

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Wash. Rev. Code § 80.50.060.

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Wyo. Stat. Ann. § 18-5-503.

7.2 Federal and State Regulations

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43 C.F.R. §§ 2800, 2805, 2880.

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A.1 Summary of BLM and State Policies Analyzed

Table A-1 summarizes the BLM and 15 state decommissioning policies analyzed within the report.

Table A-1. Summary of BLM and State Policies Analyzed

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
BLM	Federal	BLM	Requirement under BLM's right-of-way (ROW) program (43 C.F.R. § 2801.2 - 2809.19)	A Performance and Reclamation Bond for a solar energy ROW covers the decommissioning, removal, and disposal of the facility and equipment as well as site reclamation, revegetation, and restoration costs (43 C.F.R. § 2801.2 - 2809.19).	Yes	Yes	Yes; no less than \$10,000/acre
California	Hybrid state/local	California Department of Conservation and local city or county government	Condition of approval for a solar-use easement (Cal. Gov. Code § 51191.3)	In California, as a condition for a self-renewing Solar Use Easement, the owner of a solar use easement project on land subject to the Williamson Act or farmland security zone contract must submit a decommissioning plan and financial assurance to the local city or county government with jurisdiction prior to construction. The local city or county government submits the solar use easement application documents, decommissioning plan, and financial assurance documents, to the California Department of Conservation (Department) for final review and approval (Cal. Code Regs. tit. 14 § 3101).	Yes	Yes	No

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
Hawaii	Hybrid state/local	County Planning Commission	Condition of approval for a special use permit to operate a solar facility on Class B or C agricultural land (HRS § 205-4.5)	In Hawaii, as a condition of a Special Use Permit, the owner of a solar energy facility on agricultural lands with a soil productivity rating of B or C must comply with state decommissioning requirements and submit proof of financial assurance to the local county planning commission with jurisdiction prior to construction. The local county planning commission must submit all special use permit application documents, including financial assurance documents, to the Hawaii State Land Use Commission (Haw. Rev. Stat. 205-4.5(21)).	No	Yes	No
Illinois	Hybrid state/local	County government	Required element of an Agricultural Impact Mitigation Agreement (505 Ill. Comp. Stat. 147/15 (2018)).	In Illinois, the owner of a commercial renewable energy facility located on agricultural land owned by a third party must enter into an Agricultural Impact Mitigation Agreement with the Department of Agriculture outlining facility construction and deconstruction plans and submit a deconstruction plan and financial assurance to the county government with jurisdiction prior to construction. The owner must review and resubmit the	Yes	Yes	Yes

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
				decommissioning plan, including the cost estimate and financial assurance instrument to the county with jurisdiction 10 years after commercial operation commences (505 Ill. Comp. Stat. 147/15 (2018)).			
Louisiana	State-level	Louisiana Department of Natural Resources	Condition of approval for an Alternative Energy Source Lease (AESL) to operate a solar facility on state land	In Louisiana, as a condition of approval for an AESL, the owner of an alternative energy source facility on state land must submit a decommissioning plan and financial assurance to the Louisiana Department of Natural Resources (Department) prior to commencing decommissioning activities. Within 60 days of completing decommissioning activities, the facility owner must notify the Department and submit a decommissioning report that includes a summary of decommissioning activities and a description of any mitigation measures utilized during decommissioning (La. Admin. Code tit. 43:V, §§ 921, 961, 967).	Yes	Yes; no less than \$500,000	No
New Jersey	Hybrid state/local	Local soil conservation district and New Jersey	Required for solar energy facilities on commercial farmland seeking the benefits and protections of the	In New Jersey, as a condition of approval for a Site Plan, an owner of a solar energy generation facility on commercial	Yes	No	No

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
		Pinelands Commission a	Right to Farm Act or located in a Pinelands Management Area (N.J. Admin Code § 2:76-2A.12(m))	farmland subject to the Right to Farm Act must submit a conservation plan that addresses the impacts of decommissioning to the soil conservation district with jurisdiction. The site plan is subject to approval from the New Jersey State Agriculture Development Committee (N.J. Admin Code § 2:76-2A.12). In addition, an owner of a solar energy generation facility located in a Pinelands Management Area must submit a landscaping plan that addresses the impacts of decommissioning to the Pinelands Commission (N.J. Admin Code § 7:50-5.36)			
Minnesota	State-level	Minnesota Public Utilities Commission	Condition of a Site License	In Minnesota, as a condition of a site license, the owner of a large electric power generating plant with a capacity of 50 MW or more must submit a decommissioning plan and financial assurance to the Minnesota PUC (Minn. Stat. §§ 216E.01, 216E.02; Minn. R. 7854.0500).	Yes	Yes	Yes

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
Montana	State-level	Montana Department of Environmental Quality	N/A	In Montana, the owner of a facility with a capacity of 2 MW or greater must submit (1) a decommissioning plan within 12 months prior to operation of the facility and (2) financial assurance at any time prior to 15 th year of the facility's operation to the Montana Department of Environmental Quality (Mont. Admin. R. 17.86.102, 17.86.105).	Yes	Yes	Yes
Nebraska	Hybrid state/local	Delegated to local government	An owner of a solar energy facility subject to a solar easement is required to submit a description of decommissioning plans that address any local regulations/requirements.	In Nebraska, the owner of a solar energy system who executes a solar agreement (e.g., easement) to secure a land right for a solar energy system must include within the solar agreement instrument, a description of any decommissioning plans or financial assurance instruments required by the local jurisdiction where the solar energy system is located (Neb. Rev. Stat. § 66.911-01).	No; check local ordinances	No; check local ordinances	No; check local ordinances
New Hampshire	State-level	New Hampshire Site Evaluation Committee	Condition of approval to a Certificate of Site and Facility Application	In New Hampshire, as a condition of approval for a Certificate of Site and Facility Application, the owner of an energy facility larger than 30 MW must submit a decommissioning plan and proof of financial assurance to the New Hampshire Site Evaluation	Yes	Yes	Yes

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
				Committee prior to construction of the facility (N.H. Rev. Stat. Ann. § 162-H:2, 7).			
North Dakota	State-level	North Dakota Public Service Commission	N/A	In North Dakota, as a condition of approval for a Certificate of Operation, the owner of a facility with a capacity of 500 kilowatts (kW) or greater must submit a decommissioning plan and proof of financial assurance to the North Dakota Public Service Commission prior to the operation of the facility (N.D. Admin. Code § 69-09-10-01, 06).	Yes	Yes	Yes
Oklahoma	Hybrid state/local	Delegated to local government	An owner of a solar energy facility subject to a solar easement is required to submit a description of decommissioning plans that address any local regulations/requirements.	In Oklahoma, a solar energy conversion system owner who executes a solar agreement (e.g., easement) to secure a land right for a solar energy conversion system must include within the solar agreement instrument, a description of any decommissioning plans or financial assurance instruments required by the local jurisdiction where the energy facility is located (Okla. Stat. tit. 60, § 820.1).	No; check local ordinances	No; check local ordinances	No; check local ordinances

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
Vermont	State-level	Vermont Public Utility Commission	Condition of approval for Certificate of Public Good.	In Vermont, as a condition of approval for a Certificate of Public Good, the owner of a facility with a capacity of greater than 500 kW must submit a decommissioning plan and financial assurance to the Vermont PUC prior to construction (30 V.S.A. § 248; Vt. PUC Rule 5.904).	Yes	Yes	Yes
Virginia	Hybrid state/local	Delegated to local government	Condition of approval for any local government granted solar facility site license	In Virginia, the state legislature mandates that local governments with solar facility siting ordinances include decommissioning requirements within their regulations. Local governments must require owners of solar energy equipment, facilities, or devices owners to submit decommissioning plans and proof of financial assurance to the local entity with jurisdiction (Va. Code Ann. §15.2-2241.2; Va. Admin. Code § 67-103)	Yes	Yes	Yes

Jurisdiction	Policy Type	Oversight Authority	Relationship to Programs, Certificates, Permits, or Other Approvals	Summary of Requirements	Decommissioning Plan Required by Regulations	Financial Assurance Required by Regulations	Cost Estimate Required by Regulations
Washington	State-level/optional	State of Washington Energy Facility Site Evaluation Council	Condition of approval for a certificate from the Energy Facility Site Evaluation Council in lieu of any other state permitting requirements/approvals	In Washington, as a condition of approval for an optional certification program, an energy facility owner must submit a site restoration plan and financial assurance to the energy facility site evaluation council prior to construction.	Yes	Yes	No
Wyoming	State/local hybrid	County Board of Commissioners	Condition of approval for permit application for a solar energy facility larger than 500 kW	In Wyoming, as a condition of approval for an operating permit, the owner of a solar energy facility with a capacity of greater than 500 kW must submit a decommissioning plan to the county board of commissioners that has jurisdiction prior to construction of the facility (Wyo. Stat. Ann. §§ 18-5-501, 18-5-503).	Yes	No	No

A.2 Solar Projects with a BLM Right-of-Way

Table A-2. Solar projects with a BLM Right-of-Way

State	County	Project Name (Company)	Potential Capacity (MW)	BLM Acreage	Technology	Date of Right-of-Way Issuance	Designated Leasing Area (Y/N)	Operating Status
CA	San Bernardino	IVANPAH I (SOLAR PARTNERS II, LLC)	100	914	CSP-tower	2010-Oct	No	Operating
CA	San Bernardino	IVANPAH II (SOLAR PARTNERS I, LLC)	125	1,077	CSP-tower	2010-Oct	No	Operating
CA	San Bernardino	IVANPAH III (SOLAR PARTNERS VIII, LLC)	125	1,235	CSP-tower	2010-Oct	No	Operating
NV	Clark	SILVER STATE NORTH (SILVER STATE SOLAR PWR NORTH, LLC)	50	619	PV	2010-Oct	No	Operating
CA	Riverside	GENESIS SOLAR (GENESIS SOLAR, LLC)	250	1,950	CSP-tower	2010-Nov	Yes	Operating
CA	Riverside	BLYTHE (NEXTERA, LLC)	235	4,518	PV	2010-Nov	Yes	Operating
NV	Nye	CRESCENT DUNES (TONOPAH SOLAR ENERGY, LLC) (PPA was cancelled)	0	2,094	CSP-tower	2010-Dec	No	No longer operating
CA	Riverside	DESERT SUNLIGHT (DESERT SUNLIGHT HOLDINGS)	0	298	Maintenance facility	2011-Aug	No	Operating
CA	Riverside	DESERT SUNLIGHT (DESERT SUNLIGHT 300, LLC)	300	2,050	PV	2011-Sep	No	Operating
CA	Riverside	DESERT SUNLIGHT (DESERT SUNLIGHT 250, LLC)	250	1,659	PV	2011-Sep	No	Operating
AZ	La Paz	QUARTZSITE SCHOOL (AZ PUBLIC SERVICE)	0.05	0.13	PV	2012-Jan	No	No longer operating
CA	San Bernardino	IVANPAH ADMIN (SOLAR PARTNERS II, INC)	0	291	Maintenance facility	2012-Mar	No	Operating
AZ	Maricopa	SONORAN SOLAR ENERGY SOLAR PROJECT (BOULEVARD ASSOC, LLC)	300.00	2,335.60	CSP-trough	2012-Oct	No	Pending Construction
AZ	La Paz	PWR FOR LAPAZCO PUBLIC WORKS (DG SOLAR LESSEE, LLC)	0.11	0.52	PV	2013-Apr	No	Operating
AZ	La Paz	PWR AT GOLF COURSE (DG SOLAR LESSEE, LLC)	0.13	1	PV	2013-Apr	No	Operating
CA	Riverside	DESERT HARVEST (EDF RENEWABLE ENERGY)	150	1,412	PV	2013-Sep	Yes	Pending Construction
CA	Riverside	MCCOY SOLAR UNIT 1 (NEXTERA, LLC)	250	2,103	PV	2013-Dec	Yes	Operating
NM	Santa Fe	BS2A SOLAR SITE (BUCKMAN DIRECT DIVERSION BOARD)	1.50	4.75	PV	2014-Jan	No	Operating

State	County	Project Name (Company)	Potential Capacity (MW)	BLM Acreage	Technology	Date of Right-of-Way Issuance	Designated Leasing Area (Y/N)	Operating Status
CA	San Bernardino	STATELINE (DESERT STATELINE, LLC)	300	1,685	PV	2014-Mar	No	Operating
NV	Clark	SILVER STATE SOUTH (SILVER STATE SOLAR PWR SOUTH)	250	2,862	PV	2014-Jul	No	Operating
CA	Riverside	MCCOY SOLAR UNIT 2(NEXTERA, LLC) (ARLINGTON)	500	2,180	PV	2014-Aug	No	Pending Construction
NV	Mineral	LUNING SOLAR (LUNING ENERGY, LLC)	50	584	PV	2015-Jul	No	Operating
NV	Clark	PLAYA SOLAR (PLAYA SOLAR II, LLC)	79	1,062	PV	2015-Aug	Yes	Operating
NV	Clark	MOAPA SOLAR ENERGY CENTER (MSEC-BIA) (EDF RENEWABLE ENERGY DEVELOPMENT, INC.	200	119	PV - Gen-Tie	2015-Aug	Yes	Pending Construction
NV	Clark	PLAYA SOLAR (PLAYA SOLAR I, LLC)	100	735	PV	2016-Aug	Yes	Operating
NV	Clark	HARRY ALLEN (HENRY ALLEN SOLAR, LLC)	130	640	PV	2018-Apr	Yes	Pending Construction
WY	Sweetwater	SWEETWATER SOLAR (SWEETWATER SOLAR, LLC)	80	584	PV	2018-Jul	No	Operating
AZ	Yuma	PARKING FACILITY (SAN LUIS SPEAR POINT SOLAR I, LLC)	0.37	0.83	PV	2018-Nov	No	Operating
CA	Riverside	PALEN (PALEN SOLAR, LLC)	500	3,140	PV	2019-Mar	No	Pending Construction
NV	Clark	HARRY ALLEN SOLAR ENERGY CENTER (INVENERGY)	11	85	PV	2019-Nov	Yes	LNTP Request
NV	Washoe	DODGE FLAT (NEXTERA)	200	3,500	PV	2019-Nov		Pending Construction
NV	Clark	DRY LAKE SOLAR ENERGY CENTER (NV ENERGY)	130	660	PV	2019-Dec	Yes	Pending Construction
NV	Clark	EAGLE SHADOW MOUNTAIN (BIA) (325MK 8ME, LLC)	420	144	PV	2020-Apr		Pending Construction
CA	Riverside	DESERT QUARTZITE, LLC	600	2,673	PV	2020-Jul	Yes	Operating
NV	Clark	GEMINI (ARIVA)	690	7,063	PV	2020-Dec		Limited NTP
NV	Clark	YELLOW PINE (NEXTERA)	500	2,987	PV	2021-Jan		Pending Construction
CA	Riverside	CRIMSON SOLAR	350	2,489	PV + Storage	2021-May	Yes	Pending Construction