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Establishing Utility-Scale Solar Projects: Federal Involvement

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1. Introduction

Decarbonizing the electric utility sector will require a substantial investment in renewable energy projects.¹ This case study examines the federal permitting process for utility-scale solar projects sited on federal, state, tribal, and private lands to identify the possible barriers associated with achieving federal and state renewable energy goals. Section 2 provides an overview of utility-scale solar projects covered by the study. Section 3 details the permitting processes governing federal funding, siting, and permitting processes for utility-scale solar projects covered by this case study, with a focus on the time required to obtain a permit. Section 4 summarizes our findings and concludes the paper.

1 States have assumed a key role to date in promoting the development of renewable energy facilities to replace fossil fuels in the electricity sector. Individual states have established Renewable Portfolio Standards (RPSs) requiring that a certain percentage of electricity sold to customers within that state must be produced by renewable sources. Thirty-one states, Washington, DC, and three territories have adopted RPSs, while seven states and one territory have set renewable energy goals (Shields 2021).

2. Overview of Case Study

The case study identified 45 utility-scale solar projects in 21 states seeking approval to begin construction over the period from 2008 to 2019 (see Attachments A and B). The solar farms range in capacity from 1 to 594 MW. Thirty-eight of the projects generate electricity using photovoltaic (PV) technology; four projects currently use concentrated solar power (CSP) technologies.² Most of the sites are located on private, state, or tribal lands; only 10 of the projects sought approval for locations on federal lands. Twenty-seven of these 45 projects required federal review during siting, funding, and permitting activities.³

Federal agencies must issue permits or use authorizations prior to construction for projects on federal land. If the project is on private, tribal, or state land, the federal government role focuses on the federal permits required to protect water resources, federally listed plant and animal species, and cultural resources.⁴ If federal permitting and funding decisions constitute a major federal action, they are subject to review under the National Environmental Policy Act (NEPA) prior to construction (discussed in Section 3.1).⁵ The key federal permitting requirements include the following:

- Endangered Species Act (ESA): The US Fish and Wildlife Service (FWS) has the responsibility to protect endangered and extinction resulting from economic growth development.
- Clean Water Act (CWA): The US Environmental Protection Agency (EPA) has the responsibility to limit (and eliminate) pollution discharges to the nation's waterways. Section 402 establishes the CWA National Pollutant Discharge Elimination System (NPDES) permitting program to regulate discharges and stormwater runoff from construction activities and facility operations.
- Clean Water Act/Section 404: EPA and the US Army Corps of Engineers (USACE) share the responsibility for establishing the federal program for permitting and regulating discharges of "fill" material into the waters of the United States. A major focus of the program is the protection of wetlands.

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- 2 Developers abandoned two CSP solar projects before starting construction, one CSP project experienced operational problems and is no longer operating, and one PV project failed to obtain local approval.
 - 3 These utility-scale solar projects were also subject to concurrent state approval processes.
 - 4 State and local governments have jurisdiction if there is no federal nexus. Local governments generally administer siting through zoning ordinances, land management, and city planning.
 - 5 Any issuance of federal funding or financial support, such as a loan guarantee, generally qualifies as a major federal action. However, tax credits or other assistance through the tax code or funding assistance solely in the form of general revenue sharing funds, where there is no federal control over the use of the funds, is not considered a major action subject to NEPA. 40 CFR § 1508.18, <https://www.law.cornell.edu/cfr/text/40/1508.18>.

Table 1. Federal Review Requirements

A. National Environmental Policy Act (NEPA)	
B. Additional Federal Considerations	
B1. Federal Siting, Funding and Interconnection	B2. Federal Permits (if applicable)
US Forest Service • Special use permit (required if on U.S.F.S. land)	Department of the Interior, US Fish and Wildlife Service • Special use permit (Endangered Species Act)
Bureau of Land Management • Right-of-way authorization (required if B.L.M. land)	US Fish and Wildlife Service • Eagle incidental take permit (Bald and Golden Eagle Protection Act)
Department of Energy • Loan guarantee (optional D.O.E. debt assistance)	US Fish and Wildlife Service Migratory bird permits (Migratory Bird Treaty Act)
	US Environmental Protection Agency, US Army Corps of Engineers • Section 401 permit • Section 404 permit • NPDES permit (Clean Water Act)
Federal Energy Regulatory Commission • Interconnection approval (required for a qualifying facility or if it transmits energy interstate)	Federal Aviation Administration • Notice of Proposed Construction or Alteration
	Advisory Council on Historic Preservation • Historical, archaeological, and tribal consults (National Historic Preservation Act)

Table 1 outlines federal jurisdiction by agency, action (e.g., grant or permit), and statutory authority.

2.1. Solar Power

Utility-scale solar production uses either concentrated thermal solar power (CSP) or photovoltaic (PV) technology to generate electricity. CSP converts solar energy by concentrating solar rays through an arrangement of mirrors to produce steam or another high-temperature working fluid to generate electricity with turbines. PV technology uses semiconducting materials that convert light directly into electricity. The PV cell is mounted into a module, or solar panel. These panels are grouped together to form a solar array. PV is the most common and cheapest form of solar energy generation.

Solar energy projects are located primarily in the Southwest, with California, Arizona, and Nevada among the top five producers in 2017 (see Attachment C). New Jersey and North Carolina—the leading producers on the East Coast—were also among the top five producers overall (EIA 2020b).⁶ Solar possesses two advantages over wind as a renewable energy source with respect to project economics: First, solar electricity production is more predictable than production from wind. Second, solar has a longer expected project life—a 30-year estimated facility life for utility-scale solar farms versus 20 years for wind.⁷

The case study included seven CSP projects: Amargosa Farm Road, Ivanpah, Imperial Valley, Solana, Genesis, Crescent Dunes, and Martin Next Generation solar energy facilities.⁸ As with most of the solar projects in the study, the CSP sites are concentrated in the Southwest. The CSP solar facilities vary significantly in terms of design. For example, Ivanpah uses over 352,000 mirrors to reflect light onto three centralized towers to generate steam. Genesis is powered by parabolic trough solar collectors to concentrate sunlight to heat synthetic oil, which then heats water to create steam. The Crescent Dunes design directs the sun at a 640-foot-tall receiver tower to heat molten salt to 554–1,000+ degrees Fahrenheit, which is then pumped into a hot salt storage tank, where it is used to generate steam to drive turbines. Six of these projects sought Department of Energy (DOE) loan guarantees and were fast-tracked by DOE and the Department of Interior (DOI).

Thirty-nine of the identified projects use PV technology. The Alamosa Solar Project—the only PV project in the sample that uses high-concentration PV (HCPV) technology—is sited on 225 acres of private land in the San Luis Valley in Colorado and

6 Florida is one of only four states with a utility-scale solar project using CSP (EIA 2020a).

7 CSP has an estimated 35-year facility life (Bartlett 2019). Wind facilities require more maintenance throughout their lifespan than do solar facilities. Repairs can be costly and not easily performed, such as repairs to the tower and foundation. When these repairs are required, decommissioning the turbine, and eventually the facility, becomes the only alternative, resulting in a shorter lifespan on average (Kolios and Luengo 2016).

8 Developers announced a change in the projected design of the Amargosa and Imperial Valley solar projects from CSP to PV technology before terminating these two projects. Martin Next Generation was built in Florida as a fuel substitution resource to supplement a natural gas-fired power plant.

has 3,528 solar panels.⁹ Of the remaining 38 PV projects, the number of panels range from 4,568 to 9 million and cover 8.5 to 11,300 acres of land (see Attachment B).¹⁰ As with CSP, the PV projects are located primarily in the southwestern United States in Texas, California, New Mexico, Arizona, and Utah. Four of the PV sites are located on former Superfund sites, including two former US Atomic Energy Commission sites.

A few of these solar projects never reached the construction stage. Local authorities denied the application from Minnesota Solar for a conditional use permit to allow construction and operation.¹¹ After obtaining Bureau of Land Management (BLM) approval to site on federal lands, the developers for Amargosa Farm Road and Imperial Valley Solar terminated the projects before starting construction.¹² In addition, the Crescent Dunes Solar Farm has encountered operational problems with its molten salt technology and is currently shut down (Clark 2020).

9 Alamosa generates 30 MW using only 3,528 HCPV panels, which are about twice as efficient as the traditional PV panels (DOE, n.d.d).

10 Generally, 5,000 solar panels are required to generate 1 MW, which in turn powers approximately 190 homes (SEIA, n.d.).

11 Minnesota Solar was not subject to federal jurisdiction and did not encounter any federal permitting hurdles prior to the permit denial by the county.

12 Developers of both projects initially announced the intention to shift from CSP to PV technology before terminating the projects. The developers of Amargosa Valley terminated the project after failing to negotiate a power purchase agreement. Newsletter reports noted the higher costs of CSP technology and design issues with the project (Basin and Range Watch 2011). After terminating Imperial Valley, the developers announced a decision to revive the project, renaming it the Mount Signal Solar project, and relocate it nearby on private farmland next to the Mexican border (Mount Signal Solar 2021).

3. Federal Jurisdiction

Federal preconstruction review is required any time a project is located on federal lands, when a federal agency directly or indirectly authorizes or funds a project, or when it reviews a project as required by federal environmental laws, such as provisions protecting US waters and endangered and threatened species. The construction of projects that are not on federal lands and do not otherwise involve federal agency review is subject only to state and local government siting requirements.

Tables 2–4 present the federal government environmental and cultural reviews required for the 45 utility-scale solar projects. The tables are divided into the following subgroups: 7 thermal CSP, 34 PV, and 4 Superfund sites.

Table 2. CSP Solar Projects

Thermal CSP Solar Projects [largest to smallest capacity, MW]	Lead Federal Agency	Funding	Siting	Federal Permitting Requirements			
		DOE	BLM	NEPA	ESA	CWA	NHPA
Amargosa Farm Road Solar Energy Project , NV, 464 MW, (parabolic trough)	BLM			EIS	BO	NV CGP NPDES permit; SWPPP; § 404 permit; § 401 state certification	SHPO/tribal consult
Ivanpah Solar Electric Generating System , CA, 392 MW, (solar power tower) <i>fast-tracked by Feds</i>	BLM	\$1.6 billion <i>because fast-tracked</i>		EIS	BO; HCP; ITP	SWPPP; JD (no jurisdictional waters of the US)	SHPO/tribal consult
Solana Solar Power Generating Station , AZ, 280 MW (parabolic trough)	DOE	\$1.45 billion		EA	BA	SWPPP; § 404 permit	SHPO concur.
Genesis Solar Energy Project , CA, 250 MW (parabolic trough) <i>fast-tracked by Feds</i>	BLM	\$852 million <i>because fast-tracked</i>		EIS	BO; HCP; ITP	JD (no jurisdictional waters of the US)	SHPO/tribal consult
Crescent Dunes Solar Farm , NV, 110 MW, (solar power tower)	DOE	\$737 million		EIS	BO	NV CGP NPDES permit; SWPPP; JD (no juris. waters of the US); § 401 state certification	SHPO/tribal concur
Imperial Valley Solar , CA, 709 MW, (Stirling engine solar)	BLM			EIS	BA	CA CGP NPDES permit; SWPPP; § 404 permit	SHPO/tribal consult
Martin Next Generation Solar Energy Center , FL, 75 MW (parabolic trough)	EPA					FL DEQ NPDES permit; § 401 state certification	

Sources: Solar projects with BLM ROW: BLM (2019). Amargosa: BLM (2010d); BLM (2012); EPA (2010a). Ivanpah: DOI (2010); BLM (2010b). Solana: DOE (2010a). Genesis: EPA (2010b); BLM (2010f). Crescent Dunes: DOE (2012); BLM (2010c); 76 Fed. Reg. 60475 (Sept. 29, 2011); Nye County, NV (2011); USACE (2010); 76 Fed. Reg. 60477D (Sept. 29, 2011); Streater (2010a). Imperial Valley: BLM (2010e); Sahagun (2011). Martin Next Generation: Martin Next Generation Solar Energy Center (2021).

Table 3. Superfund PV Solar Projects

Superfund PV Solar Projects [largest to smallest capacity, MW]	Lead Federal Agency	Funding	Siting	Federal Permitting Requirements			
		DOE	BLM	NEPA	ESA	CWA	NHPA
Long Island Solar Farm , Brookhaven Lab, NY, 32 MW	DOE			EA	BA	NY CGP NPDES permit; SWPPP; JD (no juris. waters of the US)	SHPO/tribal consult
Maywood Solar Farm , IN, 10.8 MW	EPA						
Los Alamos National Lab Solar Farm , NM, 10 MW	DOE			EA	BA	EPA CGP NPDES permit; SWPPP; JD (no juris. waters of the US)	SHPO/tribal consult
Elizabeth Mine Solar 1 , VT, 4.9 MW	EPA					§ 404 permit	

Sources: Long Island: DOE (2009a,b). Los Alamos: DOE (2019a,b). Elizabeth Mine: EPA (2019c). Maywood: EPA (2014).

Note: The EPA Superfund Task Force continued monitoring and joint site cleanup throughout project planning, construction, and operation for all four sites.

Table 3a. PV Solar Projects, Part I

Photovoltaic (PV) Solar Projects [largest to smallest capacity, MW] Part I: PV Projects 1-17	Lead Federal Agency	Funding	Siting	Federal Permitting Requirements			
		DOE	BLM	NEPA	ESA	CWA	NHPA
Desert Sunlight , CA, 550 MW	BLM	\$1.5 billion		EIS	BO	JD (no jurisdictional waters of the US)	SHPO/tribal consult
Topaz Solar Farm , CA, 550 MW	DOE			EIS	BO; HCP; ITP	CA CGP NPDES permit; SWPPP; § 404 permit	SHPO/tribal concur
Spotsylvania Solar , VA, 500 MW Online 2021	USACE					NPDES permit; SWPPP; § 404 permit	
Mesquite Solar , AZ, 464 MW	DOE	\$337 million		EA	BA	AZ CGP NPDES permit	SHPO concur
Four Brothers Solar Project , UT, 320 MW							
Stateline Solar , CA, 300 MW	BLM			EIS	BO	CA CGP NPDES permit; SWPPP; JD (no juris. waters of the US)	SHPO/tribal concur
Badger Hollow Solar , WI, 300 MW Online 2021							
Agua Caliente Solar Project , AZ, 290 MW <i>fast-tracked by Feds</i>	DOE	\$967 million		EA	BA	AZ NPDES permit; SWPPP; JD (no jurisdictional waters of the US)	SHPO concur
Tranquillity Solar , CA, 258 MW							
California Valley Solar Ranch , CA, 250 MW	DOE	\$1.2 billion		EA	BA	CA CGP NPDES permit; SWPPP; JD (no jurisdictional waters of the US)	SHPO concur
Moapa Southern Paiute Solar , NV, 250 MW	BIA			2x EIS	BO	EPA CGP NPDES permit; SWPPP; JD (no jurisdictional waters of the US)	SHPO/tribal consult
Midway Solar Farm , CO, 100 MW	DOE			EA	BA	CO CGP NPDES permit; SWPPP; JD (no jurisdictional waters of the US)	SHPO concur
Upton Solar 2 , TX, 212.5 MW							
Roserock Solar , TX, 212 MW							
Buckthorn Solar , TX, 202 MW							
Comanche Solar , CO, 156 MW							
Desert Harvest Solar , CA, 150 MW	BLM			EIS	BO	JD (no jurisdictional waters of the US)	SHPO/tribal concur

Sources: Solar projects with BLM ROW: BLM (2019). Desert Sunlight: DOI and BLM (2011); EPA (2011). Topaz: (DOE 2011a,d); Althouse and Meade (2011); USACE (2011). Spotsylvania: Silvia (2019). Mesquite: DOE (2011f). Four Brothers: Roselund (2016). Stateline: EPA (2013a,b); FWS (2013); Basin and Range Watch (2010–15). Badger Hollow: PSCW (n.d.). Agua Caliente: DOE (2010b). Tranquillity: Recurrent Energy (n.d.a.). California Valley: DOE (2011b). Moapa: BIA (2014); BLM (2018c). Midway: DOE (2016). Upton Solar 2: Wells Solar (2020); Luminant (2018). Roserock: Recurrent Energy (n.d.b.); Wells Solar (2020). Buckthorn: Wells Solar (2020). Comanche: SI Staff (2015). Desert Harvest: BLM (2013a,b); EPA (2012).

Table 3b. PV Solar Projects, Part II

Photovoltaic (PV) Solar Projects [largest to smallest capacity, MW] Part II: PV Projects 18-34	Lead Federal Agency	Funding	Siting	Federal Permitting Requirements			
		DOE	BLM	NEPA	ESA	CWA	NHPA
Hardin Solar , OH, 150 MW	FWS, EPA, USACE				BA (USFWS set construction terms)	\$ 404 permit; OH NPDES permit; \$ 401 state certification	Archaeol. survey
Panoche Valley Solar Farm , CA, 130 MW	USACE			EIS	BO	CA CGP stormwater NPDES permit; SWPPP; \$ 404 permit; \$ 401 state certification	SHPO/tribal consult; SHPO concur
Arlington Valley Solar Energy II , AZ, 125 MW							
Hillcrest Solar I Farm , OH, 125 MW <i>Online December 2020</i>							
Butler Solar , GA, 103 MW							
North Star Solar , MN, 100 MW							
Conetoe Solar Farm , NC, 80 MW							
Macho Springs Solar , NM, 50 MW							
Alamosa Solar Project , CO, 30 MW (CPV)	DOE	\$90.6 million		EA	BA	CO CGP NPDES permit; SWPPP; JD (no juris. waters of the US); \$ 401 state certification	SHPO concur
Alta Luna Solar Farm , NM, 28 MW							
Gold Meadow Solar Farm , RI, 21 MW							
Maryland Solar Farm Project , MD, 20 MW	EPA					MD NPDES permit; \$ 401 state Certification	Cultural resources due diligence investigation
Tinton Falls Solar Farm , NJ, 19.88 MW	EPA					NJ NPDES permit; \$ 401 state certification	
Davidson County Solar Farm , NC, 17.2 MW	FERC						
West Tennessee Solar , TN, 5 MW	DOE			EA	BA	TN NPDES permit; SWPPP; USACE preliminary jurisdiction; \$ 401 state certification	SHPO concur
Minnesota Solar , MN, 4 MW <i>Construction permit denied by local authority</i>							
Prairie Sky Solar , KS, 1 MW							

Sources: Solar projects with BLM ROW: BLM (2019). Hardin: Ohio Power Siting Board (2018); Ohio EPA (2021). Panoche: USACE (2016, n.d.). Arlington Valley: Fluor (n.d.). Hillcrest: Cardno (n.d.). Butler: Community Energy (n.d.a.). North Star: Community Energy (n.d.b.). Conetoe: Duke Energy (2015). Macho Springs: EPE (n.d.). Alamosa: DOE (2011e). Alta Luna: Tri-State G&T (2015). Gold Meadow: CS Energy (n.d.). Maryland: Triad Engineering (n.d.). Tinton Falls: Burton (2012); NJ BPU (2013). Davidson County: Davidson County Solar Farm (2019). West Tennessee: DOE (2011g). Minnesota: Minnesota Solar (2017); US Solar (2019). Prairie Sky: KEC (2017).

In the following sections, we focus on the 20 projects subject to NEPA review (identified in Tables 2–4) and provide a discussion of that process along with the key federal agency permitting and funding decisions that accompany NEPA review.

3.1. The National Environmental Policy Act (NEPA)

The National Environmental Policy Act of 1970 requires federal agency review of major actions, with the ultimate goal of providing public officials with relevant information and ensuring a hard look at the potential environmental consequences of the proposed actions. Under NEPA, federal agencies are required to conduct an environmental review for most of their actions, including siting of renewable energy projects on federal land and issuing permits for projects that could potentially affect federally protected species or water resources. A proposed project must complete NEPA review and obtain all applicable federal permits before beginning construction.¹³

NEPA also established the Council for Environmental Quality (CEQ) within the Executive Office of the President to oversee the NEPA process and its implementation. In 1978, CEQ issued regulations establishing a uniform set of requirements for NEPA implementation to reduce delays and produce better national environmental policy decisions.¹⁴ The CEQ regulations are entitled to substantial deference by the courts and are binding on all federal agencies.¹⁵ CEQ’s NEPA regulations also provide a framework to coordinate compliance and conduct concurrent reviews where more than one federal agency is involved in issuing authorizations, permits, or consultations required by the various environmental laws.¹⁶

13 National Environmental Policy Act, 42 USC § 4332 (C)(i). “The purposes of this chapter are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality” (42 USC § 4321).

14 After the adoption of NEPA, President Nixon issued Executive Order (EO) 11514, directing CEQ to issue guidelines for federal agencies regarding the preparation of EISs. In the absence of implementing regulations, however, agencies arrived at a variety of interpretations that generated substantial litigation. President Carter’s EO 11991 amended EO 11514 to direct the CEQ to issue uniform standards for the entire NEPA process (83 Fed. Reg. 119 (June 20, 2018)). The CEQ regulations apply to all federal agencies; each federal agency must adopt NEPA implementing rules that follow the minimum requirements established by CEQ (40 CFR § 1507.3 (a)), Environmental Quality Improvement Act of 1970 as amended (42 USC 4371 et seq.), Section 309 of the Clean Air Act as amended (42 USC 7609), and Executive Order 11991 (40 CFR § 1500.3).

15 *Robertson v. Methow Valley Citizens Council*, 490 US 332, 374 (1989) (citing *Andrus v. Sierra Club*, 442 US 347, 358 (1979)).

16 Lead agencies *should* “prepare draft EISs concurrently with . . . environmental impact analyses and related surveys and studies required by the Fish and Wildlife Coordination Act (16 USC 661 et seq.), the National Historic Preservation Act of 1966 (16 USC 470 et seq.), and the Endangered Species Act of 1973 (16 USC 1531 et seq.), and other environmental review laws and executive orders” (40 CFR § 1502.25 (a); Luther 2008, 2; 40 CFR § 1506.2).

The heart of the NEPA process is the development of the environmental impact statement (EIS) for major actions. The EIS must consider any adverse environmental effects associated with the action that cannot be avoided, alternatives to the proposed action, and any irreversible and irretrievable commitments of resources that would be involved in the proposed action. No action can be taken that will have an adverse environmental impact or limit the choice of reasonable alternatives until the lead agency issues a record of decision (ROD) based on the EIS.¹⁷

To facilitate agency efforts to comply with NEPA, the CEQ regulations created two additional categories to identify federal actions that do not require an EIS: categorical exclusions (CEs) and environmental assessments (EAs). CEs are categories of actions that federal agencies have determined do not individually or cumulatively have a significant effect on the human environment.¹⁸ For CE actions, federal agencies are normally not required to develop an EA or an EIS. The EA involves a scoping process to determine whether a project may have a significant adverse environmental effect. The EA process is completed when the agency either issues a finding of no significant impact (FONSI) or reaches the conclusion (based on the final EA) that an EIS must be prepared (BLM, n.d.c).

The EIS process consists of a detailed review of a proposed project and available alternatives where a project is likely to have a significant environmental effect. The EIS process is completed when the agency issues a record of decision (ROD), the concluding step in the NEPA review when there is a significant effect. The EA and EIS processes involve a set of specific steps: notice to the public and interested parties (NOI) that the agency is preparing an EA or EIS, preparation of a draft report for public comment, and completion of a final report (BLM, n.d.c).

Out of the 20 identified projects requiring a substantive NEPA review, 11 required an EIS and 9 projects completed EAs with a FONSI determination.¹⁹ For the 11 solar projects completing an EIS, the time required between the initial publication of the NOI and the issue of a ROD typically ranged from 1 to 2 years. The Genesis project took the least amount of time, completing its EIS in 1 year. The Panoche Valley project completed an EIS in 3.9 years.

The remaining 9 projects covered by NEPA processes completed EAs and issued a FONSI in 6 months to a little more than 1 year. The average time required to complete an EA with a FONSI was 9 months. The West Tennessee project completed the EA process in less than 6 months. The Midway PV solar farm took the longest time (1.17 years) to complete the EA process.

17 40 CFR § 1502.25(b).

18 Federal agencies that have established specific CEs for solar and wind projects include the Department of Energy, Rural Development, Federal Aviation Administration, Federal Energy Regulatory Commission, and National Capital Planning Commission (CEQ 2018b; 18 CFR § 380.4–5).

19 In addition, the Badger Hollow project prepared a state EA to comply with the Wisconsin Environmental Policy Act (Rahn 2018).

These review times are substantially shorter than the average NEPA review times to complete an EIS and issue a ROD. In its 2018 report, the CEQ found that the average time required to complete an EIS, from the initial filing of an NOI to drafting an EIS to issuing a ROD across all federal agencies was 4.5 years, and the median was 3.6 years (CEQ 2018a). (See Appendix B.)

For these projects, the NEPA review process provided a framework—although not perfect—for the completion of the environmental permitting processes required for utility-scale solar projects. In most cases, the lead agency completed the Section 7 ESA formal consultation process with FWS prior to completing the NEPA process.²⁰ In addition, lead agencies also completed the NHPA consultation process with the state historical preservation officer and affected tribes before issuing a FONSI or ROD. However, in several cases, key CWA decisions were not completed within the timeframe of the NEPA review.²¹ In particular, several USACE decisions were completed after the final EIS was issued. In its comment on these final EISs, EPA specifically raised concerns that the lead agency was treating the USACE Section 404 decision as separate from the NEPA process and strongly encouraged “the integration of NEPA with the Clean Water Act (CWA) Section 404 process” (EPA 2010b).

Tables 5 and 6 summarize key agency actions for each of the projects subject to NEPA review, along with the time required to complete the NEPA review, the date of completion of the review, and the completion dates for other federal agency permitting, siting, and funding actions.

3.2. Permitting

The construction of utility-scale solar facilities can jeopardize endangered or threatened species directly or indirectly due to the loss of habitat caused by construction. Once constructed, these facilities may have adverse effects, such as continuing to displace wildlife from habitat and creating a mortality risk for birds. In addition, they may have areas of wetlands or waterways within the facility boundaries, and stormwater runoff may cause erosion and sedimentation in off-site streams. Operational facilities may also require water for cooling and cleaning panels—water that must be diverted from the generally arid surrounding environment (FWS 2018b). This section details the federal permitting processes that may be required for siting and construction of a proposed solar project. The key federal agencies with permitting responsibility for environmental resources are the FWS, EPA, and USACE.

3.2.1. US Fish and Wildlife Service (FWS)

The FWS holds an important set of terrestrial resources in trust for the public, including federally listed threatened or endangered species, migratory birds,

20 There was one exception: the Imperial Valley solar farm project completed ESA review after completion of the NEPA process and publication of the ROD.

21 For example, the Mesquite I solar project received a construction general permit several months after completion of the NEPA environmental assessment (DOE 2011c). The Amargosa Farm Road solar farm received its Section 404 permit after its ROD was issued (EPA 2010a).

interjurisdictional fishes, and units of the National Wildlife Refuge System.²² Under several environmental protection laws—NEPA, the Endangered Species Act (ESA), Bald and Golden Eagle Protection Act (BGEPA), and Migratory Bird Treaty Act (MBTA)—the FWS has responsibilities that may apply to solar energy projects. Since solar farms cover an extensive area at each site and require clearing and grading for construction, environmental reviews must consider the adverse effect on threatened and endangered species and the potential loss of wildlife habitat.

3.2.1.1. Endangered Species Act (ESA)

The Endangered Species Act was adopted to protect endangered and threatened species from extinction resulting from economic growth and development.²³ The ESA applies to any action that is funded, authorized, or carried out by a federal agency and has the potential to jeopardize the continued existence of a federally designated species or may result in the destruction or adverse modification of critical habitat. Section 7 of the ESA governs the review process for federal agencies by requiring the agencies to consult with the FWS.²⁴ This generally begins with an informal consultation between the action agency and the FWS. This stage of the process concludes with the preparation of a biological assessment (BA) by the action agency. If the action agency concludes through the BA process that its action is likely to affect a listed species adversely, then the agency initiates a formal consultation with the FWS. The formal consultation should be completed concurrently with the NEPA review to the extent possible, and the ROD should discuss the results of the Section 7 consultation (Luther 2008, 2).²⁵ The formal consultation concludes when the FWS issues a biological opinion (BO).²⁶

For projects that are not likely to jeopardize the continued existence of a federally protected species but could result in unintentional “take,” the action agency must obtain an incidental take permit (ITP) before proceeding.²⁷ When this happens, the

22 The National Marine Fisheries Service has responsibility for protecting listed species in the marine environment. None of the solar projects in this case study have such effects.

23 16 USC § 1531 et seq.

24 Section 7 requires federal agencies to ensure that any action they *authorize, fund, or carry out* does not jeopardize the continued existence of an endangered or threatened species or designated or proposed critical habitat (collectively referred to as protected resources) (South Environmental 2021).

25 40 CFR § 1502.25; 40 CFR § 1506.2.

26 The FWS advises that the time required to conduct a formal consultation could be longer than that required to complete NEPA compliance documents, so it encourages action agencies to initiate informal consultation prior to the NEPA public scoping period (FWS and NMFS 1991, 4–11). Taylor et al. (2016) report that most of the solar project formal consultations carried out during their study period (2009–14) were not completed within the 135-day time limit in the ESA.

27 The term “take” under the ESA is defined as to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 USC § 1532(19)). For federal agencies, the FWS will issue the ITP with the BO as an integral part of the Section 7 formal consultation process (FWS 2019). A nonfederal entity may obtain an ITP under Section 10 where it believes its lawful activity may take an endangered or threatened species. Processing time for nonfederal entity incidental take permits reportedly takes six months to one year (FWS 2020a).

Table 5. Solar Projects from Case Study Requiring Environmental Impact Statement (EIS)

Solar Projects Requiring EIS and ROD	Application Date	NEPA		ESA	CWA		NHPA	BLM		DOE	
		ROD Date	NOI -> ROD (months)	BO Date	NPDES Permit	404 Permit		ROW Issue Date	Additional Months After ROD	Issue Date	Additional Months After Rod ¹
Amargosa	BLM: 12/2007 NOI: 12/2009	11/15/2010	11	11/2010	NV CGP SWPPP	Continuing discussion at Final EIS	Tribe/SHPO consult ²	11/2010	0	NA	NA
Crescent Dunes	BLM: 12/2008 NOI: 11/2009	12/2010	13	12/27/2010	NV CGP SWPPP 6/2011	USACE: not juris. 7/2010	Tribe/SHPO concur ³	12/2010	0	9/2011	9
Genesis	BLM: 1/2007 NOI: 11/2009	11/2010	12	11/2010	Final EIS defers erosion, etc. plans to later	USACE: not juris. 10/2010	Tribe/SHPO consult ¹	11/2010	0.5	8/2011	9
Ivanpah (BLM)	BLM: 11/2006 NOI: 11/2008	10/2010	23	10/2010	Final EIS commits construct./oper. SWPPP	USACE: not juris. 5/2009	Tribe/SHPO consult ¹	10/2010	0	4/2011	7
Desert Harvest	NOI: 9/2011	3/2013	18	1/2013	EPA: include SW reqmts. in ROD (final EIS comment)	USACE: not juris. 5/2012	Tribe/SHPO concur 2/2013	9/2013	0	NA	NA
Desert Sunlight	BLM: 11/2006 NOI: 1/2012	8/2011	19	7/2011	CA CGP SWPPP	USACE: not juris. 12/2010	Tribe/SHPO consult ¹	9/2011	0	9/2011	1
Imperial Valley	BLM: 1/2006 NOI: 10/2008	10/2010	24	4/2011 (BA, FWS concur)	CA CGP SWPPP	Continuing discussion at Final EIS	Tribe/SHPO consult ¹	10/2010	0	NA	NA
Moapa	NOI: 8/2012	5/2014	20	1/2014	EPA CGP SWPPP	USACE: not juris. 2/2011	On Tribal Lands Tribe/SHPO consult	NA	NA	NA	NA
Panoche	BLM: 1/2006 NOI: 10/2008	3/2016	43	10/2015 3/2016 (revised)	CA CGP SWPPP 10/2015	404 permit with ROD 3/2016	Tribe/SHPO consult SHPO concur 10/2015	NA	NA	NA	NA
Stateline	BLM: 2/2006 NOI: 8/2011	2/2014	30	9/2013	CA CGP SWPPP	USACE: not juris. 12/2012	Tribe/SHPO concur 11/2012	3/2014	1	NA	NA
Topaz	DOE: 3/2010 NOI: 10/2010	9/2011	22	7/2011	CA CGP SWPPP	404 permit 11/2011	Tribe/SHPO concur ² 6/2011	NA	NA	NA	NA

Sources: Amargosa: BLM (2010d); BLM (2012); EPA (2010a). Crescent Dunes: DOE (2012); BLM (2010c); 76 Fed. Reg. 60475 (Sept. 29, 2011); Nye County, NV (2011); USACE (2010); 76 Fed. Reg. 60477D (Sept. 29, 2011); Streater (2010a). Desert Harvest: BLM (2013a,b); EPA (2012). Desert Sunlight: DOI and BLM (2011); EPA (2011). Genesis: EPA (2010b); BLM (2010f). Imperial Valley: BLM (2010e); Sahagun (2011). Ivanpah: DOI (2010); BLM (2010b). Panoche: USACE (2016, n.d.). Moapa: BIA (2014); BLM (2018c); BIA, BLM, EPA, and NPS (2014). Stateline: EPA (2013a,b); FWS (2013); Basin and Range Watch (2010–15). Topaz: (DOE 2011a,d); Althouse and Meade (2011); USACE (2011).

¹ Additional months after completion of NEPA review to issue of DOE loan guarantee.

² MOA signed prior to or as part of ROD.

³ Complete with final EIS.

Table 6. Solar Projects from Case Study Requiring Environmental Assessments (EA)

Solar Projects Requiring EA and FONSI	Application Date	NEPA		ESA	CWA	404 Permit	NHPA	DOE	
		FONSI Date	Proposal -> FONSI (months)	BA Date	NPDES Permit			Issue Date	Additional Months After FONSI ¹
Solana (DOE)	NOA: 7/2009	5/2010	9.6	USFWS: concurrence 4/2010	SWPPP	NWCGP #12	SHPO concur 4/2010 Tribes: no issue	12/2010	7
Agua Caliente	NOA: 6/2010	11/2010	5.5	DOE: no effect 6/2010 ²	AZ NPDES SWPPP 6/2010	USACE: not juris.	SHPO concur 9/2010 Tribes: no issue	8/2011	9
Alamosa	NOA: 10/2010	4/2011	7	USFWS: concurrence 7/2010	CO CGP SWPPP	USACE: not juris. 7/2010	SHPO concur 12/2010 Tribes: no issue	9/2011	5
California Valley	CA App: 1/2009 NOA: 10/2010	8/2011	10.5	BA: 11/2010 USFWS: concurrence 6/2011	CA CGP SWPPP	USACE: not juris.	SHPO concur 6/2011 Tribes: issues addressed through SHPO conditions	9/2011	1
Mesquite	DOE request for info: 3/2009 NOA: 6/2010	2/2011	8	DOE: no effect ¹ 8/2010	AZ CGP 6/2011	NR ³	SHPO concur 9/2010 Tribes: no issue	9/2011	7
Midway	Independent request: 5/2014 NOA: 7/2016 draft EA	9/2016	14	DOE: unlikely ¹ 7/2016	CO CGP SWPPP	USACE: not juris. 3/8/2017	SHPO concur 12/2015 Tribes: no issue	NA	NA
West Tennessee	NOA: 9/2010	2/2011	5.5	USFWS: concurrence 12/2009 10/2010	TN NPDES SWPPP	USACE: prelim. juris. (NR of final action)	SHPO concur 9/2010 Tribes: no issue	NA	NA
Long Island	LIPA RFP: 4/2008 LIPA/BP: 2/2009	12/2009	<12	DOE: minor effect ¹	NY CGP SWPPP	EA: not juris. ⁴	NR ² SHPO/tribal consult [completed earlier survey of grounds under NHPA before project]	NA	NA
Los Alamos	NOA: 6/2018	6/2019	12	DOE: no effect ¹ 4/2019	EPA CGP SWPPP ⁵ 11/2019	EA: not juris. ³	NR ² SHPO/tribal consult [completed earlier survey of grounds under NHPA before project]	NA	NA

Sources: Solana: DOE (2010a). Agua Caliente: (DOE 2010b). Alamosa: DOE (2011e). California Valley: DOE (2011b). Mesquite: DOE (2011f). Midway: DOE (2016). West Tennessee: DOE (2011g). Long Island: DOE (2009a,b). Los Alamos: DOE (2019a,b).

¹ Additional months after completion of NEPA review to issue of DOE loan guarantee.

² No record of FWS action; no FWS comment on draft EA.

³ No record.

⁴ EA concluded that site does not include jurisdictional waters; no record (NR) of USACE response.

⁵ NM 401 certification.

FWS provides the federal agency with an incidental take statement (ITS) with the biological opinion. In applying for an ITP, the action agency must identify the potential effects associated with the project's incidental take and describe the steps to be taken to mitigate those effects (South Environmental 2021).

Of the 20 utility-scale solar farms requiring a substantive review under NEPA in this study, 10 required a formal Section 7 consultation under the ESA, and FWS issued a BO prior to completion of the project's final ROD or FONSI under NEPA. For the remaining solar projects, the action agency determined that a formal consultation was not required and issued BAs.

On the basis of the information available, most of these projects obtained a BO in 3 to 6 months after the action agency requested a formal consultation. However, FWS required 20 months to issue the Panoche Valley BO after USACE completed its BA and requested a formal consultation. In addition, 2 of the 10 projects, Ivanpah and Panoche Valley, required a second revised BO after construction began.

3.2.1.2. Migratory Bird Treaty Act (MBTA)

The Migratory Bird Treaty Act, enacted in 1918, implements the US commitments under avian protection treaties with Great Britain (for Canada), Mexico, Japan, and Russia. The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except as authorized under a valid permit.²⁸ While the MBTA makes it unlawful to take protected migratory birds, it does not define "take." The absence of a definition has created a circuit split over statutory interpretation with respect to incidental take. Federal agencies have developed two alternative approaches to address the ambiguity with incidental take in the MBTA.²⁹

First, federal agencies making decisions that may adversely affect migratory bird populations have entered into a memorandum of understanding (MOU) with the FWS to promote the conservation of migratory bird species.³⁰ The MOUs require these agencies to develop conservation measures and ensure monitoring of the effectiveness of such measures to minimize, reduce, or avoid unintentional take and habitat loss (DOE and FWS 2013). Second, the project can be held strictly liable if it does not have a permit and a migratory bird is killed by the construction or operation of the project

28 Migratory Bird Treaty Act, 16 USC § 703.

29 The Fifth, Eighth, and Ninth Circuits' definition of "take" does not extend to unintentional acts. *US v. CITGO Petroleum Corp.*, 801 F.3d 477, 488–89 (5th Cir. 2015). The Second Circuit adopted a broader interpretation, extending "take" to both intentional and unintentional acts. On December 22, 2017, the US Department of Interior sided with the Fifth, Eighth, and Ninth Circuits by releasing a memo stating that the MBTA does not prohibit incidental take. (DOI 2017; *US v. FMC Corp.*, 572 F.2d 902, 908 (2d Cir. 1978)). However, this circuit court split can be resolved only by the US Supreme Court or congressional action, neither of which has occurred (Ryley Carlock & Applewhite 2018).

30 EO 13186 required agencies to develop these MOUs with FWS (66 Fed. Reg. 11, 3853 (Jan. 10, 2001)).

(including associated transmission lines)³¹. The regulations governing MBTA permits are found in 50 CFR Parts 13 and 21 (FWS 2018c; 2020b).

With respect to utility-scale solar electric projects, studies over the last decade suggest that solar projects can contribute to avian mortality resulting from collisions with solar panels, exposure to amplified levels of solar flux, and the continuing displacement of birds from their habitat (FWS 2018c; Upton 2014).³² Since avian mortality can be reduced by strategic design (FWS 2014), the FWS highly recommends that every solar project prepare an Avian and Bat Protection Plan (ABPP).³³

An ABPP is a project-specific document outlining measures designed to reduce the operational risks that result from bird and bat interaction with a specific facility. It is an optional tool to ensure project compliance with the MBTA, BGEPA, or ESA and identifies best management practices to avoid and minimize impacts. Depending on the circumstances of each facility, an ABPP may specify required training, construction design standards, and quality control methods.³⁴ The ABPP represents an agreement with FWS on a good faith effort to conserve birds and bats while allowing development of renewable energy projects.³⁵ Since the ABPP is voluntary, FWS approval is not subject to NEPA review.

The ABPP is not a substitute for complying with the ESA, however. If the project is expected to take any listed species, developers must obtain an ITP in addition to the optional preparation of an ABPP. In addition, if the proposed project may potentially have an impact on bald or golden eagles or their habitat, BLM requires an FWS-approved ABPP as a condition for any right-of-way grant (BLM 2010a).

31 16 USC § 707 (a). The federal list of protected migratory birds is found in 50 CFR § 10.13. Note that the Trump administration adopted a regulatory change to exclude liability associated with incidental take (86 Fed. Reg. 1134 (Feb. 8, 2021)).

32 Solar flux is a measure of the energy radiated to a given area; CSP projects using mirrors to concentrate solar energy create a high-temperature solar flux.

33 The voluntary Avian Protection Plan (APP) guidelines were developed in 2005 by the FWS and the Avian Power Line Interaction Committee to help electric facilities mitigate the impact of the projects on the avian population (JBR Environmental Consultants 2011).

34 An ABPP is a document that is evaluated and modified over time to help improve on its effectiveness (FWS and APLIC 2005, 1).

35 Solar projects with ABPP include Crescent Dunes, Desert Sunlight, Genesis, Ivanpah, Stateline, and Topaz.

3.2.1.3. Bald and Golden Eagle Protection Act (BGEPA)

The Bald and Golden Eagle Protection Act—the primary law protecting eagles—makes it illegal to take, possess, or transport bald or golden eagles.³⁶ Under the BGEPA, a take includes the disturbance of eagles that interferes with breeding, feeding, or sheltering behavior and injury stemming from construction and operational activities.³⁷

The BGEPA authorizes the FWS to issue eagle incidental take permits.³⁸ If the construction or operation of a facility or its transmission lines may result in the incidental take of a bald or golden eagle, an application must be filed for an eagle ITP.³⁹

In practice, implementation of the BGEPA appears to be subordinate to MBTA processes and requirements. Three solar projects developed ABPPs to protect golden eagles and other avian species.⁴⁰ In each case, the FWS agreed that eagle mortality was unlikely with the ABPP in place and that these projects achieved compliance with the BGEPA and MBTA without requiring additional measures (e.g., developing an eagle conservation plan to support an incidental take permit).

3.2.2. US Environmental Protection Agency (EPA) and US Army Corps of Engineers (USACE)

Under the Clean Water Act (CWA), EPA has the responsibility to limit (and eliminate) pollution discharges to the nation's waterways. Section 402 establishes the CWA National Pollutant Discharge Elimination System (NPDES) permitting program to regulate

36 Bald and Golden Eagle Protection Act, 16 USC § 668 (a). This includes not only living or dead eagles but also their feathers, nests, eggs, or body parts (50 CFR § 22.1). Applicants used to be able to choose to include bald eagles with an ITP and HCP under the ESA (FWS and NMFS 2020, 7–8). However, the FWS delisted the bald eagle under the Endangered Species List effective August 2007 because their populations had sufficiently recovered (FWS 2011). All projects in this case study have planning and construction activities ranging from 2009 to 2018, after the bald eagle was delisted. The golden eagle has never been listed as an endangered or threatened species (50 CFR § 17.11). Bald and golden eagles are also protected under the MBTA. If any solar project illegally takes an eagle, the developer can be prosecuted under either the BGEPA or MBTA. Bald eagles are also protected by the Lacey Act, which makes it a federal offense to take, possess, transport, sell, import, or export bald eagle nests, eggs, and parts that are taken in violation of any state, tribal, or US law (16 USC §§ 3371–3378).

37 The act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb” (FWS 2018a).

38 The act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb” (FWS 2018a).

39 Renewable energy projects generally apply Eagle ITPs specifically drafted for potentially recurrent take, called a programmatic eagle ITP (FWS and NMFS 2013, 9). The Eagle Conservation Plan Guidance (ECPG) is directed at wind energy, but the concepts and approaches presented in the ECPG can be applied to solar and electric power lines (FWS and NMFS 2013, 5).

40 The three projects are Crescent Dunes (JBR Environmental Consultants 2011), Ivanpah (CEC 2020), and Stateline Solar (BLM 2014).

discharges and stormwater runoff from construction and operational activities. Most of the solar facilities covered in this study required state- or federal-issued NPDES discharge permits to address stormwater runoff.⁴¹ In addition, EPA and USACE share responsibility for regulating activities that affect “wetlands” under Section 404.⁴² EPA coordinates with USACE to ensure compliance with Section 404 of the CWA. USACE is responsible for ensuring that the Section 404 permit process complies with NEPA.⁴³

3.2.2.1. Clean Water Act (CWA)

In our review, all 20 projects required permits under the CWA: 6 received Section 401 state certifications, 20 received NPDES permits (most were general permits issued by states), and 6 received Section 404 permits. USACE also made determinations that no US jurisdictional waters were present for 11 projects.

3.2.2.1.1. NPDES Permit Program

Section 301 of the CWA prohibits the discharge of pollutants from point sources to waters of the United States, unless authorized by an NPDES permit.⁴⁴ Solar projects do not typically release water during operation, so an NPDES permit is generally required only to address stormwater and construction activities.

There are two types of NPDES permits: individual and general. An individual NPDES permit is unique to each facility and targets facilities with environmentally significant discharges. Projects requiring an individual NPDES permit will likely require six months or more to obtain a permit. General permits apply to multiple discharges

41 The solar sites subject to NEPA review in this case study are largely located in arid areas of the US Southwest and are not direct discharges to waters of the United States. As a result, EPA did not serve as the primary agency for NEPA review for any of the projects covered by this study. Note that EPA must comply with NEPA in issuing NPDES permits for the construction and operation of new sources (like solar projects). While Section 511 of the CWA exempts most EPA actions from NEPA review, this exemption does not extend to actions related to new sources (EPA, n.d.).

42 The Clean Water Act (CWA) seeks to restore and maintain the chemical and biological integrity of the nation’s waters by regulating the discharge of all water pollutants (33 USC § 1251). Pollutant is defined as “dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological material, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged” into waters of the United States (33 USC § 1362(6)).

43 In addition, as a part of NEPA review conducted by other federal agencies, USACE or EPA can evaluate the project alternatives identified in an EIS (or EA) and submit comments recommending the adoption of an alternative that minimizes or avoids adverse effects to jurisdictional waters of the United States.

44 40 C.F.R § 122.1 (b)(1). The NPDES program (authorized under Section 402) may be administered by states or tribes with EPA approval. If the state declines to administer its own program, projects within the state must be approved by the EPA regional office (40 CFR Part 123; EPA 2020c; 40 CFR § 122.28 (a); 40 CFR § 122.28 (b)(3)).

with similar operations and discharges (with a minimal effect on the environment). Regulated entities may apply for a general permit by affirming that they will comply with its provisions. Projects can generally expect a short waiting period to obtain approval of an application for an NPDES general permit. Since the regulatory process associated with the development of a general permit includes a NEPA review, individual applications using the general permit process do not require a separate NEPA review. Construction general permits (CGPs) constitute the majority of NPDES permits issued for solar projects covered by this case study. CGPs require applicants to prepare and implement a Stormwater Pollution Prevention Plan. Where EPA is the NPDES permitting authority, applicants may obtain a CGP to cover stormwater issues associated with both construction and operation (EPA 2020a,b). Applicants must apply for CGPs at least 90 days before starting construction. EPA has fully delegated the NPDES permit program in 36 states and partially delegated the program in 11 states (EPA 2020c). These states have CGP programs similar to the EPA program.

3.2.2.1.2. State Water Quality Certifications

Section 401 of the CWA requires project applicants to obtain state water quality certifications verifying compliance of the project with water quality standards for NPDES and Section 404 permits issued for any discharge into the waters of the United States located within the state.⁴⁵ While state participation under Section 401 is optional, and a state can waive its authority, Section 401 gives states “the power indirectly to deny federal permits or licenses by withholding certification and the power to impose conditions upon federal permits by placing limitations on certification.”⁴⁶ However, the CWA limits state review for certification to a “reasonable” period of time, not to exceed one year after receiving a request.⁴⁷

3.2.2.1.3. Section 404 Permit

Section 404 of the CWA establishes the primary federal program for permitting and regulating discharges of fill material into the waters of the United States, including wetlands.⁴⁸ No discharge of dredged or fill material may be permitted if a practicable alternative exists that is less damaging to the aquatic environment or the waters of the

45 33 USC § 1341 (a)(1).

46 Section 401(a)(1) specifies that “any applicant for a Federal license or permit to conduct any activity, including but not limited to the construction or operation of facilities that may result in any discharge into navigable waters, shall provide the federal licensing or permitting agency a certification from the State in which the discharge originates or will originate” (33 USC § 1341 (a)(1)).

47 33 USC § 1341 (a)(1). In California, the Regional Board has between 60 days and 1 year to make a decision (CA Water Boards 2018). For the state of Washington, the process can take no longer than 1 year (ORIA 2020).

48 “Examples of such fill material include, but are not limited to: rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from mining or other excavation activities, and materials used to create any structure or infrastructure in the waters of the U.S.” (33 CFR § 323.2(e)(2)).

United States, or if the nation's waters would be significantly degraded. EPA develops and interprets the policy, guidance, and environmental criteria to be used when evaluating the permits; USACE reviews and issues the permits for projects within the regulatory framework established jointly with EPA. EPA also reviews and comments on individual permit applications and retains the authority to deny or restrict the proposed project.⁴⁹

When applying for Section 404 permits, applicants must show that they have taken steps to avoid wetland impacts, minimized potential impacts on wetlands, and provided compensation for any remaining unavoidable impacts. Applicants also generally provide a preliminary jurisdictional delineation—subject to USACE verification—to identify waters of the United States (e.g., wetlands, headwaters, and riparian areas) at the proposed project site. If such waters are not present, only NPDES permits are required to address direct discharges and stormwater issues associated with construction and operation (EPA 2019b).

Individual permits, issued by USACE, are required for projects with possible significant impacts. The normal processing time for an individual Section 404 permit by USACE is three to four months. However, the USACE permitting process is subject to NEPA review. As a result, obtaining an individual 404 permit can take much longer for a large, complex project. For example, the 247 MW Panoche Valley Solar Project in San Benito County, California, initially filed an application for a general permit in April 2010. USACE determined, however, that the Panoche project required an individual permit, and in July 2012, it issued a notice of intent to prepare an EIS. USACE completed the EIS in September 2015, and the NEPA ROD was completed in March 2016 (USACE and FWS 2015, 1–13).

If a solar project has only minimal effects, it can obtain a nationwide general permit.⁵⁰ General permits are issued for particular categories of activities with minimal effects on wetlands, eliminating individual review and allowing these projects to proceed with little or no delay.⁵¹ Projects using nationwide or regional general permits can proceed with construction 45 days after providing USACE with a complete preconstruction notification.⁵²

49 33 USC § 1344 (b), (c). The states can assume the Section 404 permit program for navigable waters within their jurisdiction, with approval from EPA and DOI (acting through the FWS), as long as the state program is at least as stringent as the federal regulations. However, only two states (Michigan and New Jersey) have assumed responsibility for the 404 program (33 USC § 1344 (h); EPA 2019a).

50 USACE issued Nationwide Permit (NWP) 51 for renewable energy projects in 2012. It is restricted to projects that affect less than half an acre of nontidal wetlands, or no more than 300 linear feet of streambed (USACE 2017). Projects may also use NWP 23 for projects determined to be eligible as categorical exclusions (USACE 2012).

51 USACE Section 404 permits usually qualify as a CE to be performed concurrently with the application review and as a result are not normally subject to NEPA review.

52 However, if the applicant notifies USACE that the activity may affect a listed species, critical habitat, or historic properties, the project cannot begin until it receives written approval (USACE 2017).

3.2.2.2. National Historic Preservation Act (NHPA)

Under the National Historic Preservation Act, the federal agency funding or permitting a project is responsible for coordinating with state, local, and tribal governments, along with private organizations and individuals, to preserve, restore, and maintain the historic and cultural environment of the nation.⁵³ The NHPA Section 106 Consultation Process is required for projects that affect sites listed on, or eligible for listing on, the National Register of Historic Places. The consultation process allows the Advisory Council on Historic Preservation, as well as interested parties such as tribal groups, to comment on the potential effect projects may have on significant archaeological or historic sites in order to minimize potential harm and damage to historic properties (NPS 2020). If the consultation process determines a project will have negative effects on historic properties, then the agency must explore alternatives to avoid adverse effects.⁵⁴ At the end of the process, a memorandum of agreement (MOA) between the lead federal agency and the tribal or historical preservation officer is jointly developed, outlining all objections and agreements made during the Section 106 consultation (ACHP 2018). The consultation process must be concluded before the federal agency decides to issue a permit or provide financial support that may adversely affect a historic property (ACHP 2016).

NHPA consultation is often referred to as part of the general environmental review process and performed concurrently with NEPA, although the consultation process itself is not subject to NEPA. When coordinating Section 106 and NEPA, federal agencies are encouraged to begin consultation early in the NEPA process, “when the purpose of and the need for the proposed action, as well as the widest possible range of alternatives, are under consideration.”⁵⁵

At least 18 of these solar projects required a survey, Section 106 consultation, and tribal consultation under NHPA.⁵⁶ Projects requiring NEPA review completed their NHPA review prior to completion of the FONSI or ROD.

3.2.2.3. Federal Aviation Administration (FAA)

If there is an airport near the project, a Notice of Proposed Construction or Alteration must be filed for any construction or alterations that may affect navigable airspace.

53 National Preservation Act of 1966, 16 USC § 470.

54 An adverse effect diminishes characteristics qualifying a property for inclusion in the National Register (36 USC § 800.5 (a)(1)).

55 Federal agencies should also coordinate their NHPA consultation process with other federal permitting and review processes (36 CFR § 800.3; 36 CFR § 800.8(a)(1)).

56 For example, California Valley initiated a tribal consultation on 11/30/2010, its Section 106 consultation on April 14, 2011, and received approval on June 23, 2011, after a determination that the project would not adversely affect cultural resources or historic properties (DOE 2011b).

Specifically at solar farms, glare or glints from the panels or towers could impair the vision of pilots (Ohio Power Siting Board 2018). The Federal Aviation Administration (FAA) requests that the applicant file notice at least 90–120 days before planned construction to resolve any identified adverse effects. Two of the solar projects covered by NEPA review—Alamosa Solar and Los Alamos—also submitted notices to the FAA.

3.3. Funding: Department of Energy (DOE) Loans and Loan Guarantee Program

Finding and securing funding or financing is an important step when establishing a utility-scale renewable energy project. The federal government offers loans and loan guarantee programs to support national renewable energy goals by providing developers with additional sources for financing beyond funding available from the private sector (DOE, n.d.b).⁵⁷ DOE has issued loan guarantees for nine projects covered by this study: four CSP projects with loan guarantees ranging from \$737 million to \$1.6 billion and five PV projects with guarantees ranging from \$90.6 million to \$1.5 billion (see Tables 7 and 8).

In terms of NEPA review, four required an EIS and five required an EA.⁵⁸ The NEPA process—with BLM or DOE as primary agency—considered the variety of potential impacts of construction and operation on the environment. In mid-2009, DOI and DOE announced fast-track processes for priority processing to complete environmental reviews for 14 projects selected as candidates for federal loan guarantees under the American Recovery and Reinvestment Act (ARRA) (BLM 2009b). These projects faced a deadline of September 30, 2011, for issuing the ARRA-authorized loan guarantees (Streater 2010b; LaMonica 2011). DOE typically issued the loan guarantees seven to nine months after the completion of NEPA review. Desert Sunlight and California Valley received loan guarantees one month after completion of the NEPA review, as DOE rushed to meet the ARRA eligibility deadline for issuing loan guarantees.

Examples of fast-tracked projects include the following: Ivanpah’s developer, BrightSource, completed a formal application for a loan guarantee in November 2008 and received clearance for the loan guarantee in April 2011 after a 28-month review (Desmond 2012). Desert Sunlight submitted a complete application for a \$1.24 billion loan guarantee in January 2010 and received approval 22 months later, in September 2011. The Genesis project took the least amount of time, completing its EIS in one year, and received its loan guarantee 9 months later, in August 2011.⁵⁹

57 Energy Policy Act of 2005, 42 USC Sec. § 16511, et. seq.

58 Applications for the issuance of DOE federal loan guarantees qualify as major federal actions.

59 76 Fed. Reg. 54454 (Sept. 1, 2011).

3.4. Siting

Federal authorization is required for projects located on or over public land, including projects sited directly on federal land, such as BLM or Forest Service (USFS) land, or require authorization for transmission lines that cross over federal land. Only 8 projects in our sample of 45 utility-scale solar farms were sited on BLM land; several additional projects required approval for transmission infrastructure on BLM lands. None of the projects were sited on USFS land.

3.4.1. Bureau of Land Management (BLM)

Under the Federal Land Policy and Management Act (FLPMA), BLM is authorized to grant right-of-way (ROW) authorizations for the generation, transmission, and distribution of electric energy.⁶⁰ BLM ROW authorizations take the form of grants or leases and cover the siting of solar collectors, towers, generators, and thermal storage, as well as for ancillary facilities such as transmission lines, connection facilities, and access roads (BLM 2018b).

FLPMA requires a two-step process in issuing ROW authorizations. First, BLM must develop regional resource management plans to consider a broad range of potential resource scenarios and management approaches, referred to as alternatives, under the principles of multiple use and sustained yield.⁶¹ These plans are generally major federal actions subject to NEPA review. Second, BLM must also conduct a NEPA review in issuing ROW authorizations for individual projects sited within the regions covered by the resource management plans. Box 1 describes a major BLM initiative to streamline this two-step process.

60 43 USC § 1761. A ROW is an easement, lease, permit or license to occupy, use or traverse public lands (43 USC § 1702(f)).

61 Other provisions of law may set forth other specific management requirements, which need to be addressed within the resource management plans (43 USC § 1712). For example, resource management plans need to assure compliance with the Wild and Free-Roaming Horse and Burros Act (16 USC § 1331 (1971)).

Box 1. Western Solar Plan

As a major initiative to promote the siting of solar projects on BLM lands, BLM adopted the Western Solar Plan in 2012 to expedite the leasing of public lands (BLM 2018a). BLM's 2012 Programmatic EIS (PEIS) supporting this plan identified 19 solar energy zones (SEZs) covering nearly 300,000 acres in six southwestern states.⁶² These are areas well suited to solar energy development, with limited environmental and cultural impacts and with access to transmission corridors. BLM believes these areas will support solar projects with a capacity of as much as 27,000 MW (BLM 2019).

As a part of this Solar PEIS, BLM identified an additional much larger area as “variance” lands covering 19.3 million acres. These variance lands comprise BLM-administered lands that are outside of SEZs and not otherwise excluded. BLM will consider right-of-way (ROW) applications for utility-scale solar energy development in variance areas on a case-by-case basis. This will include carrying out the required environmental and cultural review (including NEPA review); consultation with interested federal, state, and tribal authorities; and the associated public comment processes. Finally, the Solar PEIS also excluded utility-scale solar energy projects from 79 million acres of BLM-administered lands (BLM, n.d.b).

In addition to the completed PEIS for the Western Solar Plan, BLM must Plan.⁶³ However, because the 2012 Western Solar Plan included a NEPA review, BLM anticipates that solar projects locating in the SEZs will tier to the Solar PEIS and can expect shorter NEPA reviews for the required site-specific leasing decisions (BLM 2018a).

BLM's project-specific authorization—including NEPA review—typically required 1–2 years. For example, the 464 MW CSP Amargosa Farm Road Solar Energy Project in Nevada took 1.3 years to approve the ROW with NEPA review. The 150 MW Desert Harvest Solar Project in Riverside County, California, took 1.5 years with NEPA review.

Federal agencies have sought to fast-track the reviews required for some of these projects. As discussed in Section 3.3, fast-tracking of projects seeking DOE loan guarantees received priority because of the importance of meeting milestones

62 BLM subsequently identified the SEZs as “designated leasing areas (DLAs)” in its December 2016 “right-of-way” rule (43 Fed. Reg. 2800 (Oct. 1, 1998)). In its September 2016 Desert Renewable Energy Conservation Plan (DRECP), BLM worked with FWS and California to identify desert areas in Southern California that are most suitable for renewable energy development (BLM, n.d.a). The decisions set out in the ROD for the DRECP EIS apply to the three SEZs located in California.

63 Two of the nine projects in this case study are located in SEZs, also called designated leasing areas (BLM 2009a).

Box 2. BLM Fast-Track Review

The Ivanpah solar farm in San Bernardino, California, provides an example where fast-tracking the NEPA review—completed in 1.9 years—may have contributed to subsequent delays in construction. The project received a BO and ITP from the FWS for the desert tortoise in October 2010. But the project quickly passed its allotted take limit of tortoises early in construction. In April 2010, in response to the breach of ITP terms, BLM issued a temporary halt on construction of two-thirds of the project. As lead agency, BLM reinitiated a formal Section 7 consultation with the FWS so a revised BO and ITP could be undertaken for the entire project.¹ In June 2011, FWS issued a new BO with updated terms and ultimately determined that desert tortoise populations would not be jeopardized by the completion of construction. The developer received BLM's approval to resume construction and interconnection activities.² If more time had been allotted for research and planning, the project may have experienced fewer, if any, delays, and it is less likely that protected species would have been adversely affected (DiDonato 2012, 8; O'Reiley 2011).

BLM also used the fast-track process for the Genesis Solar Energy Project in Riverside County, California, completing NEPA review in only one year. However, after over 3,000 Native American artifacts were found at an ancient cremation site during construction, work was halted on 400 acres (one-fifth of the project site), as required under the NHPA, so that BLM could evaluate the discovery. This delay undercut the effectiveness of fast-tracking the Genesis project to reach operational status quickly to meet project goals.

Topaz Solar Farm in San Luis Obispo County, California, a DOE fast-tracked solar project, chose to settle a case brought against it by conservation groups (Defenders of Wildlife, Sierra Club, and Center for Biological Diversity) outside of court before completion of a final EIS. The developer agreed to implement additional conservation protections and acquire another 5,373 acres of land for conservation and mitigation (DOE 2011d).

- 1 In January 2011, several groups, including the Defenders of Wildlife, Western Watersheds Project, and Center for Biological Diversity, intervened with petitions in federal court in an unsuccessful attempt to halt project construction because of concerns about the disruption of the ancient desert lands and endangered desert tortoise habitat. The petition alleged violations of the NEPA, FLPMA, and ESA stemming from the failure of BLM to adequately consider the impacts of the Ivanpah solar plant on the threatened desert tortoise and its critical habitat. The court found that BLM was not required to issue a supplemental EIS; the District Court denial of the motion was later affirmed by the Ninth Circuit (*W. Watersheds Project v. Salazar*, C.D. Cal. No. CV 11-00492 DMG (Ex), 2011 US Dist. LEXIS 151556 (Aug. 10, 2011)). The La Cuna de Aztlan Sacred Sites Protection Circle Advisory Committee also filed a lawsuit in federal district court alleging that with fast-tracking, BLM and applicants failed to adequately perform a tribal consultation under the NHPA (16 USC § 470). The court ruled in favor of BLM and the developers (Soto 2010).
- 2 The endangered San Joaquin kit fox was also adversely affected during construction. The California Energy Commission, with jurisdiction over the project, allowed the developers to destroy dens vacant for only 24 hours. As a result, seven foxes died from stress-related illnesses (Sahagun 2012).

Table 7. CSP Solar Projects That Received DOE Loan Guarantees

4 CSP Solar Projects	DOE Loan Guarantee Amount	NEPA ROD/ FONSI Date	Issue Date	Commerical Operation Start Date
Ivanpah (392 MW) <i>Feds fast-tracked</i>	\$1.6 billion (total of 3 loan guarantees; \$2.2 billion project)	10/7/2010 (EIS-ROD)	4/2011 (took DOE an additional 7 months to review application before issuing)	1/2014
Solana (250 MW)	\$1.45 billion	5/6/2010 (EA-FONSI)	12/2010 (took DOE an additional 7 months to review application before issuing)	10/2013
Genesis (250 MW) <i>Feds fast-tracked</i>	\$852 million (partial loan guarantee; through FIPP) ^a	11/12/2010 (EIS-ROD)	8/2011 (took DOE an additional 9 months to review application before issuing)	4/2014
Crescent Dunes (110 MW)	\$737 million	12/27/2010 (EIS-ROD)	9/2011 (took DOE an additional 9 months to review application before issuing)	9/2015

Sources: Ivanpah: DOE (n.d.i). Solana: DOE (n.d.k). Genesis: DOE (n.d.h). Crescent Dunes: DOE (n.d.f).
^a Financial Institution Partnership Program.

associated with project financing agreements. Examples of solar projects fast-tracked by BLM include the Ivanpah, Genesis, Crescent Dunes, and Amargosa projects (Streater 2009; Austin 2016; Basin and Range Watch 2009a). However, in a couple of cases, additional issues cropped up after completion of the fast-tracked BLM review that delayed the construction of these projects (Sahagun 2012).

3.4.2. US Forest Service (USFS)

If the proposed project is to be located on USFS land, the project will require a special use permit.⁶⁴ The Federal Land and Policy Act of 1976 authorizes the USFS to issue and renew special use permits on USFS lands for the generation and distribution of electric energy.⁶⁵ The proposed project must be consistent with the standards and guidelines in the applicable Land and Resource Management Plan. In addition, NEPA review is required for the special use authorization.

64 36 CFR §§ 251.54, 251.51.

65 36 CFR § 251.53 (I). The maximum term on the permit for a renewable energy project's required transmission lines is 30 years, with the possibility for renewal with revision of terms to reflect changing times and conditions (USFS 2016, 40).

Table 8. PV Solar Projects That Received DOE Loan Guarantees

5 PV Solar Projects	DOE Loan Guarantee Amount	NEPA ROD/ FONSI Date	DOI Issue Date	Commercial Operation Start Date
Desert Sunlight (550 MW)	\$1.5 billion (total of 2 partial loan guarantees; obtained through FIPP) ^a	8/10/2011 (EIS-ROD)	9/2011 (took DOE an additional 1 month to review application before issuing)	1/2015
Agua Caliente (290 MW)	\$967 million	11/24/2010 (EA-FONSI)	8/2011 (took DOE an additional 9 months to review application before issuing)	4/2014
California Valley Solar Ranch (250 MW)	\$1.2 billion	8/30/2011 (EA-FONSI)	9/2011 (took DOE an additional 1 month to review application before issuing)	10/2013
Mesquite I (170 MW)	\$337 million (for first phase of project, initial 170 MW project)	2/17/2011 (EA-FONSI)	9/2011 (took DOE an additional 7 months to review application before issuing)	6/2013
Alamosa (30 MW, HCPV)	\$90.6 million	4/28/2011 (EA-FONSI)	9/2011 (took DOE an additional 5 months to review application before issuing)	4/2012

Sources: Desert Sunlight: DOE (n.d.g). Agua Caliente: DOE (n.d.c). California Valley Solar Ranch: DOE (n.d.e). Mesquite I: DOE (n.d.j). Alamosa: DOE (n.d.d).

^a Financial Institution Partnership Program.

However, the USFS does not usually issue permits to proposed commercial-size solar projects, unless non-USFS lands are unavailable and any adverse impacts can be minimized (USFS 2016, 40).⁶⁶ None of the solar projects in the case study were sited on USFS land.⁶⁷

66 Note that projects cannot obtain a permit in a congressionally designated wilderness area (16 USC § 1131 (c)).

67 However, commercial wind farms have successfully sought and gained authorization from the USFS.

3.4.3. Superfund Sites

A Superfund site is any land in the United States that has been contaminated by hazardous waste and identified by EPA as a candidate for cleanup because it poses a risk to human health or the environment.⁶⁸ Using Superfund and brownfield sites for renewable energy development allows the land to be reused and returned to productive use. As further incentive, EPA issued guidance in 2012 that limits the liability of developers who plan to use contaminated sites for renewable energy development. The sites are attractive candidates for development because the land has already been disturbed, so there will be fewer issues with vegetation removal and minimal, if any, negative consequences to protected species. Often these sites are located in former industrial areas, so the project can use existing infrastructure and transmission lines. However, federal agencies and developers must consult with EPA and its Superfund Task Force, as well as any relevant state agencies, to minimize disturbance to the impaired soil and ensure continued rehabilitation efforts throughout the construction and operation of the project.

Four of the 45 utility-scale solar farms in this case study are located on federal Superfund sites. Two of the four Superfund solar projects prepared EAs for NEPA compliance: the 32 MW Long Island Solar Farm, at the Brookhaven National Laboratory in New York, and the proposed 10 MW solar project at the Los Alamos National Laboratory. The final EA and FONSI were completed for the Los Alamos project after a 12-month review in June 2019. While we do not have full information on the EA for the Long Island Solar Farm, available information on the timeline for the project suggests a review period of not more than one year (Anders 2013).

The remaining two Superfund solar projects did not require a substantive NEPA review, but both required ongoing consultation and EPA approval to avoid triggering Superfund liability (EPA 2014). The 10.8 MW Maywood Solar Farm project took about two years from the time the developer made initial contact with EPA to its start of operation in 2014. Planning for the Elizabeth Mine Solar Farm—once a contaminated, abandoned copper mine—took nearly seven years, from early 2010, when development began, to the start of construction in May 2017.⁶⁹

68 Similar to a Superfund site, a brownfield is any land in the United States that is abandoned, idled, or underused because redevelopment or expansion is complicated by environmental contamination that is either real or perceived. Brownfields differ from Superfund sites in the degree of contamination; they do not pose serious health or environmental threats, but they do prevent development and curb local economic growth.

69 Given the historic nature of the site, the project was subject to an extensive NHPA Section 106 consultation process. The developers also worked with EPA and the state to repurpose the site to be compatible with solar development.

3.5. Interconnection to the Grid

Finally, interconnection of the project to the power grid, the final step in bringing a solar project online, may require approval by the Federal Energy Regulatory Commission (FERC).⁷⁰ FERC is an independent federal agency that regulates the transmission and wholesale sales of electricity in interstate commerce.⁷¹ FERC has exclusive jurisdiction over projects that sell power to the wholesale electricity market, sell electricity across state lines, or for qualifying facilities, sell any of their output to a third party. In all other cases, the state retains authority for overseeing interconnection with the electric grid.

Most of the projects subject to NEPA review in this case study included a review of the transmission infrastructure required by the project.⁷² In those cases where transmission access was not part of the project NEPA review, the lead agency (e.g., DOE or BLM) conducted a separate NEPA review for the transmission facilities. For example, DOE conducted concurrent—but separate—NEPA reviews for the Midway solar farm project site and the off-site transmission facilities (WAPA 2016). The off-site reviews for transmission facilities were generally less controversial because project locations were sited close to existing transmission infrastructure, and acreage required for transmission constituted a relatively small fraction of the total project footprint.

70 Interconnection refers to “two or more electric systems having a common transmission line that permits a flow of energy between them. The physical connection of the electric power transmission facilities allows for the sale or exchange of energy” (EIA, Glossary, s.v. “Interconnection,” <https://www.eia.gov/tools/glossary/index.php?id=I>).

71 Wholesale is defined as a “sale of electric energy to any person for resale” (16 USC § 824(b)).

72 These NEPA reviews were restricted to the effects associated with the transmission corridor—and excluded consideration of the effects of the solar project.

4. Conclusions

We have examined the federal permitting process for utility-scale solar projects to identify potential barriers to achieving renewable energy goals. Eleven solar projects required one to two years to complete a formal environmental review, prepare an EIS, and issue a ROD, and nine projects completed EAs and issued a FONSI in 6 to 12 months. We found that the FWS processes were generally well aligned with the NEPA process—the FWS biological opinions were completed before the action agency issued the ROD for an EIS (or a FONSI to complete an EA).

For most of these projects, FWS review and completion of the BO represented a critical part in the completion of NEPA review. The lead agencies in most cases also completed the Section 106 consultation with the state historical preservation officer and with tribes as required by the NHPA. In several cases, however, the CWA processes—especially for the earlier fast-tracked projects—were completed only after the NEPA process was concluded with the issue of the ROD.

Once the NEPA review was completed, federal agencies finished funding and siting decisions. BLM issued leases for siting on public lands simultaneously with the ROD in a number of cases and in all cases within a month of completion of the ROD. DOE issued loan guarantees for most of the projects within 7 to 9 months after the ROD was issued, although two projects—facing the ARRA September 30, 2011, deadline—obtained loan guarantees within a month of completion of the NEPA review.⁷³

The environmental and cultural resource review processes associated with federal permitting for utility-scale solar projects generally required one to two years—a substantially shorter review period than for other environmental reviews. However, in some cases, the planning processes involved in establishing the utility-scale solar projects also encountered permitting delays similar to those faced by other infrastructure projects. Moreover, the development time for these solar projects, from the announcement of the project to the completion of NEPA review, was often substantially longer.

To facilitate review of solar energy projects, we suggest that BLM identify additional SEZs within its Western Solar Plan—especially in new areas not in the vicinity of the existing SEZs—to augment the public lands where projects would be eligible for expedited review.⁷⁴ To assist in speeding up review, other federal agencies could also identify areas where utility-scale solar energy plants would have minimal impacts.

73 In mid-2009, DOI announced fast-track procedures to receive priority processing to complete environmental reviews in order to receive federal loan guarantees under ARRA. These projects faced a deadline of September 30, 2011, for issuance of the loan guarantee (BLM 2009b; DOI 2009).

74 For example, BLM completed the review for the first three solar projects under the Western Solar Plan process in less than 10 months—less than half the time required under the project-by-project review process (DOI 2015).

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Appendices

Appendix A. 45 Sample Solar Project Sites

Name	Solar Power Type	MW	# of Panels	State	Land Type	Acerage (for panels only)
Prairie Sky	PV	1	4560	KS	Private	8.5
MN Solar	Denied Permit	4		MN	Private	35
Elizabeth Mine	PV	4.9	20000	VT	Private	28
West Tennessee	PV	5	21000	TN	State	25
Maywood	PV	10.8	36000	IN	Private	45
Davidson	PV	17.2	63000	NC	Private	200
Tinton Falls	PV	19.88	85000	NJ	Private	100
Maryland Solar Project	PV	20	300000	MD	State	160
Hope	PV	21	50,000	RI	Private	108
Alta Luna	PV	28	108000	NM	Private	220
Alamosa	CPV, online 2021	30	3528	CO	Private	225
Lond Island	PV	32	164312	NY	Federal	200
Macho Springs	PV	50	704160	NM	State	600
Martin Next	CSP	75	parabolic trough	FL	Private	11300
Conetoe	PV	80	375000	NC	Private	800
North Star	PV	100	440000	MN	Private	1000
Butler	PV	103	1000000	GA	Private	1070
Crescent Dunes	CSP	110	10347 mirrors	CA	Public	298
Arlington Valley	PV	125	700000	AZ	Private	1160
Panoche Valley	PV	130		CA	private	4717
Desert Harvest	PV, online 2020	150		CA	Public	1200
Comanche	PV	156	450000	CO	Private	900
Buckhorn	PV	202	1700000	TX	Private	1250
Roserock	PV	212	700000	TX	Private	1300
Upton	PV	212.5	718000	TX	Private	1900
Midway	PV	236	680000	TX	Private	1500
Moapa Southern Paiute	PV	250	3200000	CA	Tribal	2000
California Valley	PV	250	750000	CA	Private	1966
Genesis	CSP	250	parabolic	CA	Public	1950
Tranquility	PV	258	800000	CA	Private	1900
Solana	CSP	280	parabolic	AZ	Private	1920
Agua Caliente	PV	290	5200000	AZ	Private	2400
Badger Hollow	PV	300	1200000	WI	Private	2500
Stateline	PV	300	3200000	CA	Public	1685
Four Brothers	PV	320	1300000	UT	Private, State	2600
Ivanpah	CSP	392	352,000 mirrors	CA	Public	3,600
Mesquite	PV	400	2100000	AZ	Private	2,300
Amargosa Farm Road	CSP	464	parabolic	NV	Public	4,350
Spotsylvania	PV, Online 2021	500	1800000	VA	Private	3500
Topaz	PV	550	9,000,000	CA	Private	3500
Desert Sunlight	PV	550	8,800,000	CA	Public	3900
Imperial Valley	PV	594	5800000	CA	Private	3940

Appendix B. NEPA Timelines in General

For perspective, the time required to complete NEPA review presented in Table 5 can be compared with each federal agency's average time to complete EISs, across all project types, between 2010 and 2017. Table B.1 provides this information for the federal agencies that played either a lead or joint role in preparing the 11 EISs required in this case study.

Table B.1. Federal Agency Average Number of and Time to Complete EISs, 2010–17

Agency	Number of EISs Completed	Average Years, NOI to Draft EIS	Average Years, Draft to Final EIS	Average Years, Final EIS to ROD	Average Total Years, NOI to ROD
USFS	276	1.8	1.28	0.27	3.35
USACE	89	4.24	1.21	0.68	6.13
DOE, WAPA	10	1.90	0.99	0.3	3.19
BIA	15	1.95	2.16	1.26	5.36
BLM	128	2.45	1.4	0.52	4.41
FWS	40	3.05	1.26	0.33	4.64
FERC	34	1.45	0.68	0.54	2.67

Source: CEQ (2018a).

Appendix C. Case Study Solar Projects: ESA and CWA Review

Table C.1. Three CSP Solar Projects Obtaining BO or ITP under ESA

CSP Solar Projects	Agency BA Issued to FWS for Approval	Section 7 Consult (Formal) Initiated	FWS Draft Biological Opinion Issued	FWS Final BO with ITS Issued	NEPA ROD/FONSI Date
Amargosa	BLM, 11/1/2010 (informal consult discussions initiated 8/2009)	2010 (FWS review lasted 165 days)	Not found	Not found	10/15/2010 (EIS-ROD)
Ivanpah	BLM, 12/2009	12/7/2009	4/26/2010	10/1/2010 ^a	10/7/2010 (EIS-ROD)
Genesis	BLM	July 2010	Not found	11/2/2010	11/12/2010 (EIS-ROD)

Source: Amargosa: Taylor et al. (2016). Ivanpah: Maloy (2012). Genesis: Taylor et al. (2016).

^a The first BO was issued by the FWS on 10/1/2010, but after the ITP for desert tortoises was breached with the discovery of a greater number of desert tortoises than anticipated, the FWS undertook a second BO which was issued on 6/10/2011 before BLM approved construction recommencing. The first FWS review lasted 299 days, and the second FWS review lasted 103 days (Taylor et al. 2016).

Table C.2. Seven PV Projects Requiring BO or ITP under ESA

PV Solar Projects	Agency BA Issued to FWS for Approval	Section 7 Consult (Formal) Initiated	FWS Draft Biological Opinion Issued	FWS Final BO with ITS Issued	NEPA ROD/FONSI Date
Imperial Valley	12/15/2010a	Not found	Not found	4/1/2011	7/2011 (EIS-ROD)
Stateline	3/12/2013c	1/2/2013	9/11/2013	9/30/2013	2/14/2014 (EIS-ROD)
Moapa	BIA, 2/2014	Not found	Not found	Not found	5/6/2014 (EIS-ROD)
Desert Sunlight	BLM, 2010 (informal consult 2007-2010)	4/2010	6/17/2011	7/6/2011	8/10/2011 (EIS-ROD)
Desert Harvest	BLM, 5/8/2012	6/13/2012	Not found	1/15/2013	3/13/2013 (EIS-ROD)
Topaz	2/2011c		2/17/2011	7/22/2011	9/2011 (EIS-ROD)
California Valley	DOE, 11/2010d	11/2010	12/2010	6/24/2011	8/30/2011 (EIS-ROD)
Panoche	USACE, 4/2014	Not found		2016 ^e	3/9/2016 (EIS-ROD)

Source: Imperial Valley: BLM (2011). Stateline: FWS (2013). Moapa: BIA (2014); BLM (2018c); BIA, BLM, EPA, and NPS (2014). Desert Sunlight: DOI and BLM (2011). Desert Harvest: BLM (2013a,b); EPA (2012). Topaz: Althouse and Meade (2011). California Valley: DOE (2011b). Panoche: USACE (2016, n.d.).

^a Amendment to the BA issued to the FWS on February 15, 2011.

^b This is the date that the FWS agreed to combine the BO process for both Stateline and Silver State solar projects due to proximity.

^c Topaz's BA was subsequently amended and reissued in July 2011 to accompany the FWS BO.

^d Informal consultation with the FWS for the preparation of the California Valley Solar Ranch's BA began on January 27, 2010.

^e Similarly to Ivanpah, the FWS issued its first BO for Panoche Valley in early 2016 but subsequently undertook a second BO, which was issued on April 26, 2017.

Note: Seven PV projects from the sample had to obtain a BO from the FWS as an essential component of their NEPA review.

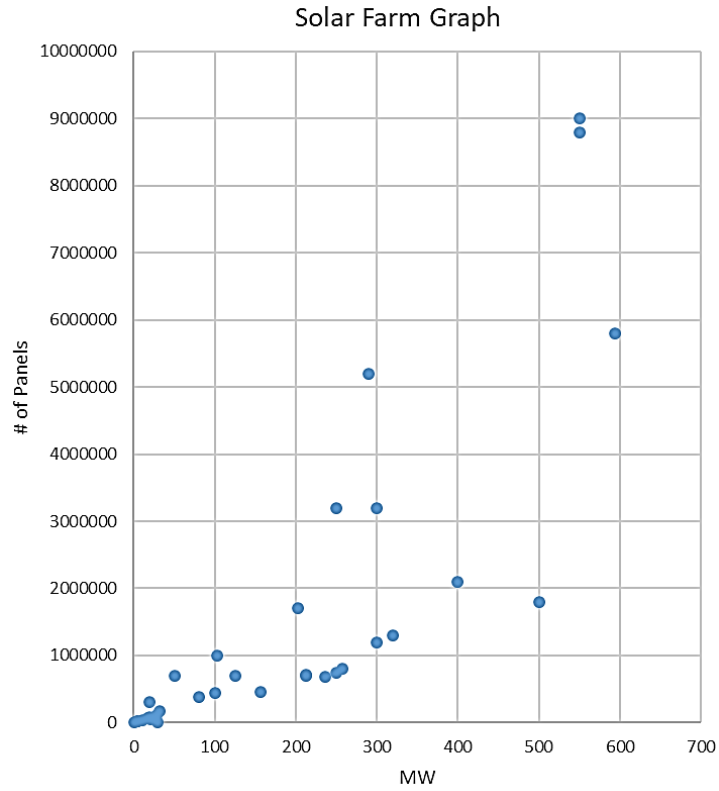
Research Methods

For all projects requiring NEPA review, our team was able to locate draft and final compliance documents, as well as EPA and interested party comment letters that had been produced as a part of the act's public review process. Projects' RODs and FONSI provided the most reliable data, because they were the end result after months to years of project planning and amending. It proved more difficult to locate data for projects that were exclusively under state control during planning.

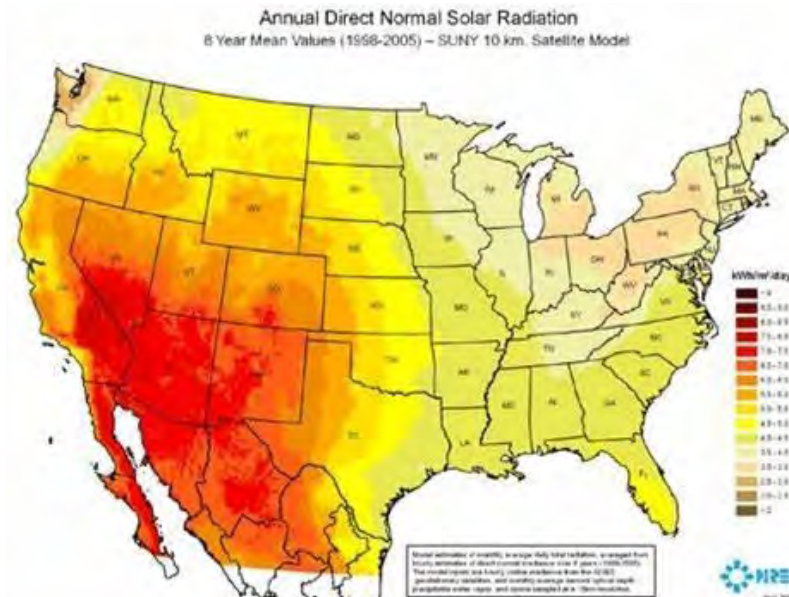
We discovered only 18 additional utility-scale solar farms that required federal review but are not included in this case study. Our sample of 45 solar farms represents the majority of utility-scale solar projects that fell under federal control for planning activities from 2009 to 2019. Accordingly, we believe that this case study provides an illuminating basis from which to make inferences about the federal review processes and involvement required to establish the population of all utility-scale solar farms in the United States.

Attachments

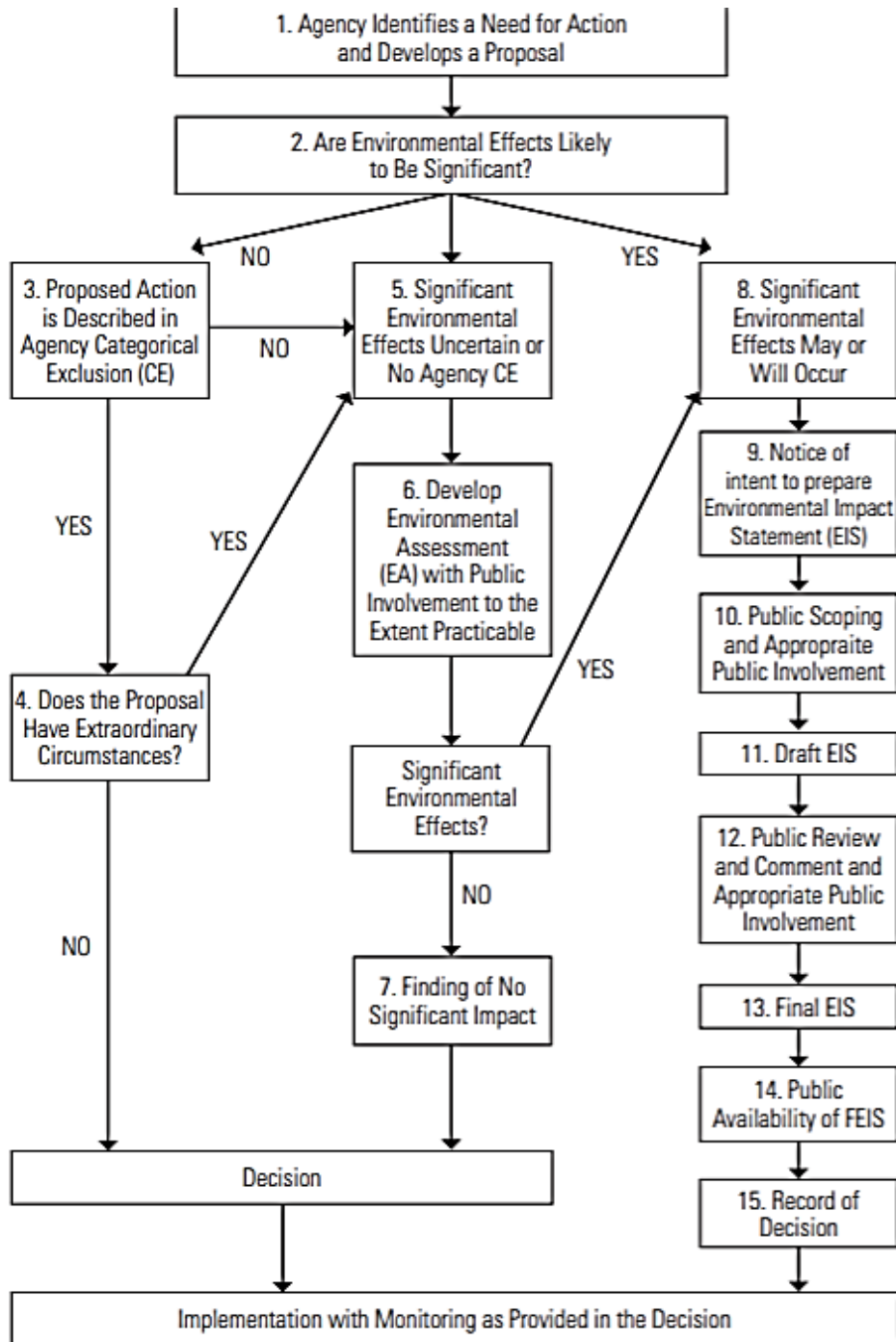
Attachment A. Distribution of PV Solar Projects' Capacity, MW by Panels



Attachment B. US Solar Radiation Map



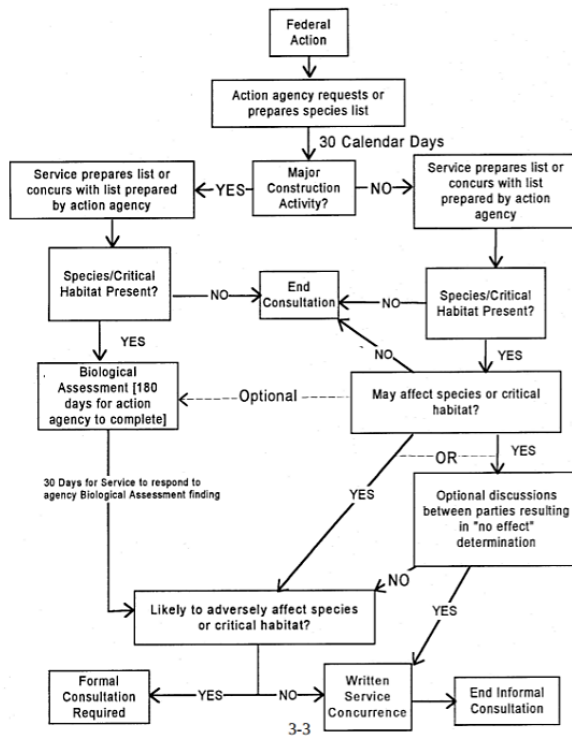
Attachment C. NEPA Process Flowchart



**Significant new circumstances or information relevant to environmental concerns or substantial changes in the proposed action that are relevant to environmental concerns may necessitate preparation of a supplemental EIS following either the draft or final EIS or the Record of Decision (CEQ NEPA Regulations, 40 C.F.R. § 1502.9(c)).*

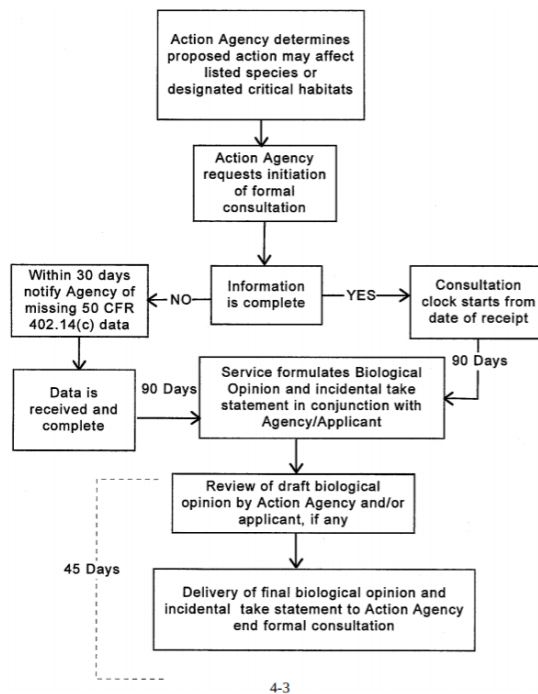
Attachment D. ESA Informal and Formal Consult Flowcharts

Informal Consultation Process



Source: FWS and NMFS (1998, 3-3).

Formal Consultation Process



Source: FWS and NMFS (1998, 4-3).

Further Resources

As we conducted this research project, several high-caliber resources stood out. If you have additional questions about the federal processes detailed in this paper, we highly recommend consulting these federal documents and websites. The agencies tasked with carrying out conservation measures under federal acts designed to promote environmental review generally had created high-quality citizens' guides to encourage participation; these guides are particularly illuminating about the federal processes and requirements imposed on different types of projects.

NEPA

The CEQ developed A Citizen's Guide to the NEPA: Having Your Voice Heard (CEQ 2007).

Funding

DOE Loan Guarantees

Visit the Loans Programs Office official website to find out more about eligibility for federal debt assistance and to view DOE's entire renewable energy portfolio (DOE, n.d.a).

Permitting

ESA

FWS and the National Marine Fisheries Service created the Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act (FWS and NMFS 1998).

CWA

EPA developed A Citizen's Guide to Clean Water (Izaak Walton League of America 1973).

NHPA

The Advisory Council on Historic Preservation created Protecting Historic Properties: A Citizen's Guide to Section 106 Review (ACHP 2016).

