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US Law

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Both federal law and state law play a significant role in governing environmental matters in the United States. Some of these laws, such as the National Environmental Policy Act (NEPA), are generally applicable laws that could be implicated by any geoengineering technique. This chapter first considers these generally applicable laws. Other laws are likely to be relevant only to a limited subset of geoengineering techniques. This latter group of laws includes laws specific to an environmental medium, such as the Clean Air Act, as well as laws governing specific technologies, such as state and local ordinances governing the cultivation of genetically modified organisms.

4.1. GENERALLY APPLICABLE LAWS

Laws that could be triggered by almost any type of geoengineering project include statutes that impose procedural duties and those having substantive effects. Procedural statutes may create obligations to provide notice to the government or public of planned activities, analyze the environmental effects of such activities, allow public comment, and monitor and report on the activities when they are carried out. Substantive statutes include wildlife protection laws and laws providing for extraordinary government powers in emergency situations.

4.1.1. *Procedural Statutes*

NEPA, which was the first law to require environmental impact assessment, is a federal procedural statute that would apply to many geoengineering activities. Some states have adopted laws patterned after NEPA that would apply to geoengineering activities having state involvement or requiring state

or local approval. In addition, federal and state weather modification statutes also impose procedural obligations that geoengineering projects could trigger.

4.1.1.1. National Environmental Policy Act

4.1.1.1.1. NEPA BASICS The federal government, the leading sponsor of basic research in the United States, is likely to be involved significantly in any major geoengineering research.[1] Furthermore, deployment of large-scale geoengineering in United States territory would likely involve the federal government as well because of the potential implications for international relations and global climate policy. Federal research, funding, or approval of geoengineering would implicate NEPA. Although NEPA's requirements may be time-consuming, expensive, and subject to litigation, they are ultimately procedural in nature. Provided that the necessary procedures are followed, the statutory requirements themselves are unlikely to serve as an insuperable barrier to geoengineering experimentation or deployment. Nonetheless, the NEPA process often generates public scrutiny and creates opportunities for those opposed to a planned project to seek to halt it, either politically or in court.

NEPA applies to "major federal actions significantly affecting the quality of the human environment."[2] Major federal actions include activities directly undertaken by the federal government as well as activities that "are potentially subject to federal control and responsibility."[3] Accordingly, NEPA applies not only to federal programs and projects, but also to "actions approved by [federal] permit or other regulatory decision" and actions partially financed or assisted by the federal government.[4] In a project not directly undertaken by the federal government, the critical factor determining the applicability of NEPA is the presence of federal decision-making power, such as the need for a federal permit.[5]

NEPA requires federal agencies to prepare an environmental impact statement (EIS) for "major federal actions significantly affecting the quality of the human environment."[6] The EIS must describe the environmental impacts of the proposed action, alternatives to the proposed action, and irreversible and irretrievable commitments of resources that the proposed action would involve.[7] NEPA's implementing regulations, promulgated by the Council on Environmental Quality (CEQ), specify the steps an agency must follow in preparing an EIS. These steps include scoping the issues, circulating a draft EIS to appropriate agencies and the public, responding to any comments received on the draft, and issuing a final EIS.[8]

The CEQ regulations also detail how an agency should proceed if it is not apparent at the outset that a federal action will have a significant environmental impact. The agency may proceed under a categorical exclusion if the contemplated action falls within categories of actions that the agency previously determined as not having significant impacts.[9] When a contemplated action falls under a categorical exclusion, the agency simply invokes the exclusion and proceeds without further analysis. Otherwise, the agency must prepare an environmental assessment (EA).[10] An EA briefly discusses the need for the proposal, alternatives to the proposed action, environmental impacts, and agencies and persons consulted.[11] Based on its analysis in the EA, the agency must either issue a finding of no significant impact (FONSI) or prepare a full-blown EIS.[12] An agency may prepare an EA even when a categorical exclusion might apply, such as where the agency wishes to document the absence of environmental impacts. Conversely, an agency may not rely on a categorical exclusion when an action corresponds to an existing category but may have a significant environmental effect in that instance.[13]

NEPA contains no citizen suit provisions. However, members of the public who would be affected by an action may sue federal agencies for NEPA violations under the Administrative Procedure Act's judicial review provisions.[14] Upon finding a NEPA violation, courts may order the agency to rectify any procedural shortcomings. Courts also may enjoin an agency from proceeding with its proposed action until it has corrected those shortcomings. In deciding whether to issue an injunction, courts must balance the equities and consider the public interest.[15]

Notwithstanding the general applicability of NEPA to federal agency actions, a statute may exempt an action from NEPA analysis. Statutory exemptions include: an exemption for actions taken by the Environmental Protection Agency (EPA) under the Clean Air Act (CAA), such as issuance of a permit;[16] an exemption for certain specified actions under the Clean Water Act;[17] and an exemption for federal emergency assistance provided under the Stafford Act.[18] Some geoengineering projects could trigger CAA permitting requirements, as this chapter later explains, and thus could be exempt from NEPA once a CAA permit is obtained.

In addition to these statutory exemptions, the CEQ regulations allow for special accommodations in emergencies. Specifically, "when emergency circumstances require taking actions with significant environmental impacts and there is not sufficient time to follow the regular [EIS] process," an agency may consult with the CEQ regarding "alternative arrangements."[19] Emergency circumstances generally involve a sudden, unanticipated event or unforeseeable conditions demanding unusual or immediate action.[20]

Alternative arrangements are intended to serve as a substitute means of NEPA compliance rather than as a complete exemption.[21] Such arrangements "are limited to actions necessary to control the immediate impacts of the emergency."[22] Whether climate change-related conditions would qualify as emergency circumstances is an open question that this chapter will consider in conjunction with government authority to act in emergencies.[23] For the moment, it is worth noting that some climate impacts will be foreseeable and gradual, where others will be more sudden and unexpected.

4.1.1.1.2. NEPA APPLIED TO GEOENGINEERING Geoengineering projects subject to federal control or having significant federal involvement would require NEPA analysis. Full-scale geoengineering deployment by the federal government would surely require preparation of an EIS. Even federally sponsored field research may require NEPA analysis.[24] Private interest in conducting geoengineering research could give rise to research projects lacking NEPA analysis if such projects are privately funded and involve no federal permitting or control. Some researchers, however, have expressed reluctance to proceed with field experiments without federal involvement or sanction.[25] NEPA analysis of geoengineering projects, public or private, would provide some assurance to the public and to environmental regulators that environmental concerns were analyzed and considered. The NEPA process also could offer a means of inviting and incorporating public input.

If the federal government were to embark on a geoengineering research program, that would raise the issue of whether the government would have to prepare a programmatic EIS in addition to the environmental analysis required for individual research projects.[26] A programmatic EIS could address general environmental issues relating to the establishment of a geoengineering research program. It could also help to frame subsequent project-specific federal actions.[27] However, unless federal geoengineering research activities constitute a single proposal or are systematically connected, no programmatic EIS would be required.[28]

The specific NEPA obligations triggered by a geoengineering project would depend in part on the federal agencies involved. In addition to complying with the CEQ NEPA regulations, each federal agency must follow its own regulations governing NEPA compliance. The Department of Energy (DOE) and the National Science Foundation (NSF) are active sponsors of climate change-related research, and their NEPA regulations may be especially relevant to geoengineering research activities. As it turns out, these regulations contain categorical exclusions that may apply to some field experiments, particularly those occurring on a smaller scale.

The DOE conducts and sponsors research on energy technologies and other matters relevant to climate change, and its technical expertise could be applied to geoengineering research.[29] The DOE's NEPA-implementing procedures include a categorical exclusion for "[s]iting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations … and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions."[30] However, this categorical exclusion does not extend to "demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment."[31] Other DOE categorical exclusions potentially applicable to geoengineering research projects include an exclusion for "[o]utdoor terrestrial ecological and environmental research in a small area (generally less than 5 acres)," and an exclusion for "[s]mall-scale, temporary surveying, site characterization, and research activities in aquatic environments."[32]

The NSF's NEPA regulations also could be relevant to geoengineering field experiments in light of that agency's significant sponsorship of federal research. Reasoning that the environmental effects of research are largely long term, "basically speculative[,] and unknowable in advance," the NSF regulations categorically exclude from NEPA analysis most research projects.[33] Geoengineering research projects may not qualify for this categorical exclusion, however. If a research project itself has potential environmental effects, the NSF regulations require preparation of at least an EA.[34] Indeed, the regulations explicitly require at least an EA for projects involving "weather modification, or other techniques that may alter a local environment," as well as "[c]ases where field work affecting the natural environment will be conducted."[35]

4.1.1.2. State Counterparts to NEPA

Fifteen states, the District of Columbia, and Puerto Rico have enacted analogs to NEPA.[36] Like NEPA, these state environmental policy acts (SEPAs) generally require government agencies to analyze the environmental impacts of specified actions.[37] The precise details of SEPAs vary from state to state. Some SEPAs apply only to state agencies, while others apply to local governments as well.[38] Where the scope of SEPAs extends to local government actions, a wide range of private activities, such as development projects necessitating local government permits, may be subject to SEPA requirements.[39] Courts generally may review whether a state or local agency has complied with a SEPA.[40] And

in contrast to NEPA, some SEPAs, such as the California Environmental Quality Act (CEQA), have substantive requirements that may limit or prohibit projects whose environmental impacts exceed a certain threshold.[41]

CEQA is a fairly detailed statute that provides a useful comparison with NEPA.[42] CEQA requires preparation of an environmental impact report (EIR) for "any project which [state and local agencies] propose to carry out or approve that may have a significant effect on the environment."[43] Because the statute applies to zoning decisions and the granting of permits, licenses, leases, and other entitlements,[44] a wide range of otherwise private activities may come under its scope. The EIR mandated by CEQA must describe significant effects, including any growth-inducing effects, proposed measures to mitigate or minimize significant effects, and alternatives to the proposed project.[45] The threshold for preparing an EIR under CEQA is arguably lower than the threshold for preparing an EIS under NEPA; CEQA requires an EIR if an action "may have a significant effect on the environment," whereas NEPA requires an EIS for "actions significantly affecting the quality of the human environment."[46] If it is unclear whether an EIR is necessary, CEQA directs an agency to prepare an initial study to determine if the project may have a significant effect on the environment.[47]

In addition to its procedural requirements, CEQA also imposes a substantive obligation on an agency to mitigate or avoid significant environmental effects "whenever it is feasible to do so."[48] Mitigation measures are to be "fully enforceable through permit conditions, agreements, or other measures."[49] Nonetheless "[i]f economic, social, or other conditions make it infeasible to mitigate one or more significant effects," an agency has the discretion to carry out or approve a project.[50] In such circumstances, the agency must make a finding that "specific overriding economic, legal, social, technological, or other benefits of the project outweigh the significant effects on the environment."[51]

Geoengineering activities could implicate SEPAs to the extent that activities require state or local government approval. For example, projects involving new land uses, construction of new buildings, or the release of pollutants may require state or local permits and thus also may trigger SEPA obligations. Field research activities per se typically do not require state or local approval. Accordingly, so long as geoengineering research does not otherwise involve land use changes or other activities requiring state or local approval, it may not necessarily trigger SEPA review. However, as discussed below, some states do require a permit prior to conducting weather modification operations. Geoengineering activities that require a state weather modification permit would likely be subject to SEPA obligations as well.

permitting requirements for specified research activities, full-scale deployment would not. Techniques most likely to be implicated include marine cloud brightening, cirrus cloud modification, and other efforts to manipulate clouds or change precipitation patterns. Even stratospheric aerosol release efforts would likely fall within the definition of weather modification in many jurisdictions. Furthermore, because geoengineering activities could modify the weather in more than one jurisdiction, multiple licenses and permits may be required.[71] Many states' definitions of weather modification generally refer to weather modification activities and their effects but contain no explicit geographic restrictions.[72] Thus, it is unclear whether geoengineering activities occurring outside a state's boundaries but having effects within that state would require a license or permit. Notably, some states prohibit the carrying out of weather modification operations within that state "for the purpose of affecting weather in any other state which prohibits such operations."[73]

4.1.1.5. Proposed State and Local Initiatives

Thus far, no government in the United States, whether at the federal, state, or local level, has enacted legislation explicitly addressing geoengineering. Such legislation may be forthcoming, however. In 2015, for example, a bill was introduced in the Rhode Island legislature to regulate geoengineering. The bill defined geoengineering broadly as activities "designed to effect a change in the area climate," including "attempts to remove carbon dioxide from the atmosphere" and "solar radiation management or cloud whitening, or similar process[es]."[74] The bill would have required any proposed geoengineering activity within the state to obtain a permit and be subject to at least two public hearings.[75] Re-drafted versions of the bill, modified to focus on SRM and oversight of potential research, were introduced in 2016 and 2017.[76]

4.1.2. *Wildlife Laws*

Geoengineering activities could affect wildlife and thereby trigger various federal and state laws that protect wildlife. This section focuses on the most prominent of these laws: the federal Endangered Species Act, state endangered species acts, the Migratory Bird Treaty Act, and the Marine Mammal Protection Act.

4.1.2.1. The Endangered Species Act and State Analogs

4.1.2.1.1. ENDANGERED SPECIES ACT The federal Endangered Species Act (ESA) provides for the protection of federally designated threatened and

endangered species. Section 4 of the ESA authorizes the federal government to list protected species and to designate critical habitat for such species.[77] Two key provisions of the ESA protect listed species: Section 7, which applies only to federal agencies; and Section 9, which applies to all persons.

If an action is authorized, funded, or carried out by a federal agency, Section 7 requires the agency to engage in a consultation process with the US Fish and Wildlife Service or, in the case of marine and anadromous species, NOAA Fisheries (collectively referred to as the "wildlife agencies"). The purpose of consultation is to "insure" that the proposed agency action "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of critical habitat.[78] The action agency initiates consultation by asking the wildlife agencies if any listed species may be present in the project area.[79] If listed species may be present and the action agency determines the project is likely to affect any such species, the agency must engage in formal consultation with the wildlife agency. Formal consultation generates a determination regarding whether the action is likely to jeopardize a protected species or adversely modify its critical habitat.[80] A jeopardy determination is made if an action "reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."[81] Upon a finding of no jeopardy and no adverse modification, the action agency may proceed. However, if there is a finding of jeopardy or adverse modification, the wildlife agency issues a biological opinion proposing reasonable and prudent action alternatives that are not expected to result in jeopardy or adverse modification.[82] The action agency may then proceed under one of the reasonable and prudent action alternatives.

Section 9 of the ESA makes it unlawful for any person to take any endangered species within the United States, the territorial sea of the United States, or the high seas.[83] This prohibition applies to all actions, federal and nonfederal, and by regulation protects threatened species in addition to endangered species.[84] The term "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."[85] It includes not only acts that directly harm protected species, but also "significant habitat modification that actually kills or injures wildlife."[86] The government may bring enforcement actions seeking injunctive relief, civil penalties, and even criminal sanctions for violations of the ESA or its regulations.[87] The ESA also authorizes citizen suits against any private or public "person" to enforce the statute.[88]

Two important exceptions soften the seemingly absolute take prohibition of Section 9. First, a federal agency that undergoes the Section 7 consultation

process may obtain authorization for an "incidental take," meaning that the harm to the animals is a side effect of the action and not its purpose, provided that the take will not lead to jeopardy or adverse modification and that the agency adopts reasonable and prudent measures to minimize the impact of its action.[89] Second, a nonfederal actor may obtain an incidental take permit under Section 10 of the ESA if it prepares a habitat conservation plan that specifies the impacts likely to result from the taking, the steps the applicant will take to minimize and mitigate impacts on protected species, the funding to implement such steps, alternative actions the applicant considered and reasons why they were not taken, and other necessary measures.[90] A Section 10 incidental take permit shall issue if, inter alia, the taking will be incidental and "will not appreciably reduce the likelihood of the survival and recovery of the species in the wild."[91]

Any geoengineering project that threatens to harm individual members of a protected species or significantly modify the habitat of a protected species could trigger Section 9's take prohibition. In addition, federal involvement in a geoengineering project could trigger Section 7's consultation requirements as well as its prohibition on jeopardy and adverse modification. In ESA litigation over a geoengineering project, at least two issues would likely be disputed: (1) whether a project caused or would cause harm to a species or its habitat, and (2) whether any of a project's effects rise to the level of a take (under Section 9) or jeopardy (under Section 7). If a project directly harms a protected species, causation and take elements under Section 9 would likely be satisfied, and perhaps the jeopardy element of Section 7 would be satisfied as well. Each of these issues may be subject to dispute, however, if plaintiffs allege that future harm would be caused indirectly by changed habitat or climatic conditions following a geoengineering project. Courts largely interpret Section 9 to prohibit only habitat modification that foreseeably causes actual death or injury to identifiable animals.[92] Some effects of geoengineering projects on protected species may not be foreseeable, at least initially, given the unprecedented nature and scale of such projects. Even for foreseeable effects, plaintiffs may still face a difficult task of linking geoengineering activity specifically to observed detrimental effects on a species.

However, the fact that geoengineering has the avowed purpose of causing detectable changes in climate would strengthen the case for causation. Furthermore, as harmful effects on protected species become more obvious, continuation of an ongoing geoengineering project could be subject to the prohibitions of Section 7 and/or Section 9. Under such circumstances, courts may order a halt to geoengineering activity until the necessary procedures are followed and any required incidental take authorizations or permits are issued.

4.1.2.1.2. STATE ENDANGERED SPECIES ACTS States have traditionally been responsible for managing wildlife within their borders, and most states have laws providing some degree of protection to endangered species.[93] Generally, state endangered species acts authorize the listing of endangered species within the state, and state lists may include species that are not federally endangered.[94] State endangered species acts nonetheless vary widely: Some laws only prohibit trafficking or intentionally harming protected species, whereas others establish more comprehensive schemes patterned on the federal ESA.[95] Several states, for instance, have enacted provisions comparable to ESA Section 7, requiring agencies to consult with wildlife agencies on proposed state projects to ensure that those projects do not jeopardize a protected species.[96]

Exemplifying the more comprehensive approach, the California Endangered Species Act (CESA) provides for the listing of protected species, prohibits the take of such species, and establishes a process for issuing incidental take permits.[97] The protections of CESA are somewhat broader than those of the federal ESA in that they extend to candidate species – species proposed for listing – as well as threatened and endangered species.[98] However, CESA defines take more narrowly than the federal ESA to mean "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."[99] Courts have ruled that the statute prohibits the killing of protected species in the course of lawful activity,[100] but that it does not prohibit the adverse modification of habitat in and of itself.[101] The precise scope of the term "take" nonetheless remains somewhat uncertain as to whether it requires mortality.[102]

If an action will result in take that is incidental to otherwise lawful activity, a person may apply for a state incidental take permit similar to that available under the federal ESA. The California Department of Fish and Game may issue a permit for incidental take if impacts will be minimized and fully mitigated, the applicant ensures adequate funding to implement mitigation measures, and if the take would not jeopardize the continued existence of the species.[103] In addition, a person who has obtained a federal incidental take permit (under ESA § 10) or incidental take authorization (under ESA § 7) may seek a consistency determination from the state in lieu of obtaining a state incidental take permit.[104]

4.1.2.2. Other Wildlife Statutes

Geoengineering projects that harm wildlife may implicate other statutes in addition to ESA. Statutes such as the Migratory Bird Treaty Act (MBTA) and the Marine Mammal Protection Act (MMPA) protect specific types of wildlife.[105]

4.1.2.2.1. MIGRATORY BIRD TREATY ACT MBTA imposes strict liability for taking a migratory bird.[106] While the statute clearly forbids the intentional killing of a migratory bird, case law is divided on whether the term "take" extends to the inadvertent killing of a migratory bird.[107] In contrast to the ESA, whose definition of "take" includes "harm," neither MBTA nor its regulations define take to include harm. The text of MBTA contains no definition of take, and MBTA regulations' definition of take is limited to "pursue, hunt, shoot, wound, kill, trap, capture or collect," or to attempt to undertake these actions.[108] Accordingly, some courts require that a defendant "take an affirmative action to cause migratory bird deaths" before imposing liability.[109] Also in contrast to the ESA, MBTA's implementing regulations do not presently authorize the issuance of permits for incidental takes or deaths of migratory birds.[110] The absence of a permitting system further suggests that the statute may not govern actions that incidentally harm migratory birds.

MBTA is a criminal statute.[111] Although the statute does not authorize citizen suits,[112] private parties sometimes sue federal agencies for MBTA violations under the Administrative Procedure Act's judicial review provisions. Courts are divided on whether MBTA's take prohibition applies to the federal government and whether that prohibition may be enforced through an action for injunctive relief.[113]

Assuming that an MBTA cause of action is available, any challenge to a geoengineering project under MBTA likely would encounter issues of causation and harm similar to those encountered under the ESA. MBTA's narrow definition of take could also present problems for plaintiffs. In many instances, harms to migratory birds caused by geoengineering projects may be inadvertent and thus potentially outside the scope of MBTA and its regulations.[114] Although MBTA is a strict liability statute,[115] courts may be reluctant to construe its take prohibition broadly because it is a criminal statute.[116] At a minimum, courts would likely require that any harm to migratory birds be foreseeable before imposing liability.[117]

4.1.2.2.2. MARINE MAMMAL PROTECTION ACT MMPA generally prohibits the take of marine mammals (such as whales, dolphins, and seals) in US waters or lands, as well as the take of marine mammals on the high seas by any person or vessel subject to the jurisdiction of the United States.[118] The statute defines take as "to harass, hunt, capture, or kill," or to attempt to do so. Although MMPA's definition of take may initially appear similar to the take definition found in MBTA, MMPA's inclusion of harassment suggests a wider scope. MMPA defines harassment as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal … or has

the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns."[119] Pertinent regulations further specify that take includes "the doing of any negligent or intentional act which results in disturbing or molesting a marine mammal."[120] Also in contrast to MBTA, MMPA establishes a permitting process for unintentional take. NOAA Fisheries may issue an incidental take authorization if the take would involve a small number of individuals, have no more than a negligible impact on the species at issue, and have no more than an unmitigable adverse impact on the availability of species for subsistence uses.[121]

Civil or criminal penalties may be imposed for violations of MMPA.[122] Although the statute does not explicitly authorize citizen suits, a party with conservationist, economic, or other interests in marine mammal protection may bring suit to challenge the issuance of a permit or the failure to apply for a required permit.[123]

Operational activities that incidentally harm marine mammals, such as Navy sonar operations, fall within the scope of MMPA.[124] At first glance, it may seem unlikely that marine geoengineering activities would affect marine mammals as directly or severely as Navy sonar operations. Nonetheless, efforts to brighten marine clouds, enhance ocean upwelling or downwelling, or fertilize the oceans all could affect marine mammals. Because MMPA's protections extend to individual mammals and prohibit the disruption of their behavioral patterns, some of these geoengineering projects could require an MMPA incidental take authorization.

4.1.3. *Emergency Authorities*

Various authorities grant federal, state, and local governments extraordinary powers to act in emergency situations generally or in emergencies involving environmental hazards. Such powers could enable government actors to regulate or halt geoengineering projects that give rise to emergency circumstances. Conversely, such powers also could be invoked by governments to initiate some types of geoengineering in response to a climate-related emergency.

4.1.3.1. Federal

Federal emergency authority may be based on statutory grants of specified authorities or on the US Constitution. Some statutory grants are restricted, authorizing fairly limited responses in narrow factual circumstances. Other sources of emergency powers are far broader. This section canvasses the sources of federal emergency authority potentially most relevant to geoengineering and considers how they might apply to geoengineering activities.