ENERGY DEVELOPMENT & LAND USE:

FISH & WILDLIFE PLATFORM

As our nation moves toward a diverse energy portfolio of power generation that reduces carbon emissions, hunters, anglers, wildlife professionals and land trusts recommend an approach that minimizes impacts to land and water and prioritizes conservation of the nation's fish and wildlife resources.

Purpose

This statement is intended to highlight the physical land requirements of different types of electric power generation, and to offer the perspective of the undersigned hunting and angling organizations as Congress, the Executive Branch, states, and other decision makers consider how to meet 21st Century electric generation and transmission needs in the United States. We recognize that other important competing considerations exist for each type of electric power generation. This statement compares the land requirements of each type of generation because it often translates directly into loss of fish and wildlife habitat that may lead to population declines, reduced hunting and angling opportunity, and impacts to local communities. We encourage decision makers to consider the cost to competing uses of both public and private lands as they develop policies affecting onshore domestic electric power generation and transmission to meet current and future demands and carbon reduction goals. Doing so will help minimize impacts to the natural habitats, agricultural lands, and robust fish and wildlife populations that support healthy communities and our outdoor traditions.

Background and Need

The conservation community has been at the forefront of efforts to promote innovative and responsible approaches to energy development for decades.[i] As the nation rushes to advance policies designed to reduce greenhouse gas emissions by promoting the deployment of low carbon sources of energy, it is essential that we minimize the cost to our nation's fish and wildlife resources from the different methods of electric power generation and transmission. The reduction of greenhouse gas emissions must be accomplished in a manner that is complimentary to decades of efforts to conserve our natural resources and sporting heritage.

America's 148 million hunters, anglers, and wildlife watchers are being impacted by more frequent and extreme weather events, catastrophic fires, invasive species, prolonged drought, disease proliferation, and expanding algal blooms and aquatic dead zones. These changes additionally affect the annual $200 billion hunting and fishing economy and the $862 billion outdoor recreation economy.[ii] We recognize the need to address these challenges, and we support policies promoting a diverse mix of energy sources that result in thriving communities and equitably meet our nation's greenhouse gas emissions reduction goals, while also minimizing the impacts to fish and wildlife habitats. The conservation community also supports land and water-based solutions to reduce greenhouse gas emissions that harness the power of our natural systems to sequester carbon while building climate resiliency and enhancing fish and wildlife habitat.[iii] As we work to tackle greenhouse gas emissions reductions and build toward a more resilient future, we cannot afford to compound the impacts of more variable and extreme weather on our fish and wildlife resources by fragmenting and developing habitats essential for their persistence and abundance.

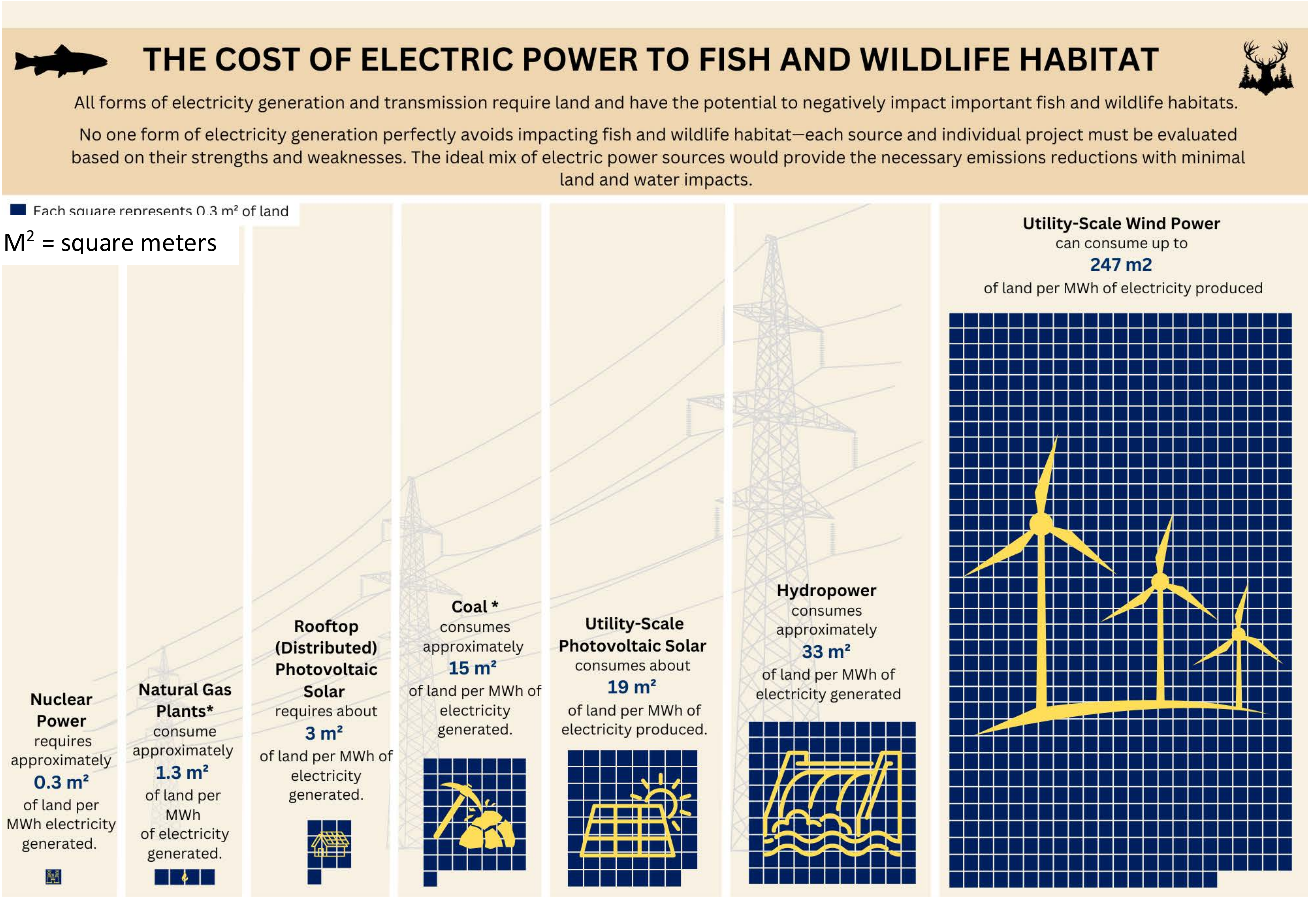
Our nation has the opportunity to accelerate development of low carbon sources of energy in ways that minimize impacts to vital natural habitats, ecoystems, and important agricultural lands. Reduced impacts to fish and wildlife habitat requires thoughtful planning that incorporates smart siting principles like the guidelines and best management practices recommended by the United States Fish & Wildlife Service[iv] and individual state and Tribal fish and wildlife agencies.[v]

The Cost of Electric Power to Fish and Wildlife Habitat

All forms of electricity generation and transmission require land and thus have the potential to negatively impact critically important fish and wildlife habitats. Researchers at Princeton University recently estimated that the current footprint of all types of energy production in the U.S. is approximately 81 million acres.[vi] To achieve net zero greenhouse gas emissions using primarily wind and solar, the footprint of energy production **quadruples to around 360 million acres**. Importantly, this estimated disturbance footprint does not include possible indirect impacts (i.e., suitable habitat near energy facilities rendered unsuitable due to avoidance and without habituation over time) for some species. It is possible to achieve net zero with a much smaller land use impact (around 160 million acres) and to greatly reduce corresponding impacts to fish and wildlife habitats, but that requires expansion of a diverse electric power portfolio. No one form of electricity generation perfectly avoids impacting fish and wildlife habitat—each source and individual project must be evaluated based on their strengths and weaknesses. The ideal mix of electric power sources would provide the necessary emissions reductions with minimal land and water impacts to fish and wildlife habitat.

The following acreage estimates depict the land occupancy requirements associated with different types of electric power generation - not including possible indirect impacts to fish and wildlife, including high human traffic in and around some of this energy infrastructure. These estimates are based on several sources that reviewed and compiled the land surface occupation required for generating facilities combined with the land surface occupation needed for extracting the necessary raw materials (through mining) to generate electricity.[vii] The report is organized by the type of power generation that consumes the least amount of land to the type that consumes the most – regardless of competing concerns like emissions of greenhouse gases or other types of pollutants, and risks posed by related impacts from accidental spills, etc.

This is not to minimize these additional impacts and concerns, which also must be fully considered. Rather, the report is intended to address one key factor – land occupancy – and highlight that there are dramatically different consequences for fish and wildlife habitats depending on 1) the types of energy generation we choose to meet our emissions goals, and 2) where those generating facilities are sited on the landscape. The following symbols are used in this report to compare the land requirements for different types of electric power:



*Investment in and utilization of Carbon Capture, Utilization, and Storage (CCUS) technologies will be necessary to make this a low-carbon form of power generation.

Nuclear Power requires approximately 0.3 square meters of land per megawatt-hour of electricity generated. This is by far the smallest land requirement per megawatt-hour of electricity when compared to other types of electric power generation although additional indirect impacts associated with nuclear power facilities should be anticipated for some terrestrial and aquatic species.[viii] Like wind, solar, and geothermal, electricity generated from nuclear power produces no greenhouse gases. While the contaminant risks associated with nuclear waste are well documented, recent advances in nuclear power plant designs have resulted in next-generation nuclear plants that promise both increased safety and energy storage capacity.[ix] Further, nuclear electricity generation is centralized, and can take advantage of existing transmission infrastructure if planned properly as fossil-fuel power plants are retired. For these reasons, many of our organizations support commonsense permitting reform for nuclear power generating facilities and expanded nuclear power generating capacity to meet current and future domestic energy demand. Many of our organizations also support policies that require thoughtful sourcing of the necessary raw materials needed for nuclear power generation and responsible disposal of waste materials that avoids impacts to communities, water resources, sensitive fish and wildlife habitats, and important cultural resources.

Natural Gas consumes approximately 1.3 square meters of land per megawatt-hour of electricity generated. By comparison, natural gas development requires over 3 times more land per megawatt-hour of electricity than nuclear power.[x,xi] In addition, this direct land impact estimate for natural gas development is likely a gross underestimate of the actual functional habitat loss to fish and wildlife because indirect impacts inthe form of behavioral avoidance of natural gas production facilities is well documented for many wildlife species—including migratory ungulates. This is well known to extend far beyond the direct footprint of development.[xii] Fracking for natural gas production also consumes vast quantities of fresh water and may further strain surface water supplies needed to support aquatic species in arid regions already severely impacted by drought.[xiii] Nevertheless, carbon capture, utilization, and sequestration or storage (CCUS) technologies show promise for reducing carbon emissions associated with the burning of fossil fuels may allow natural gas to continue to contribute to the nation's power portfolio with reduced greenhouse gas emissions.
[xiv,xv]

Geothermal Power land requirements are highly variable—dependent upon whether geothermal heat pumps are distributed at the source of energy consumption, or whether centralized utility-scale geothermal plants are developed to generate electricity to be distributed via transmission lines. Centralized geothermal power plants have a relatively small footprint compared to other types of electric power generation and require no offsite mining of raw materials to generate power. Due to the variable development models associated with each type of geothermal technology, estimating the land (and water) requirements for geothermal energy production is also variable. In some cases, utility-scale geothermal development has similar land occupancy requirements to tightly spaced natural gas development due to a similar development model relying on underground wells and gathering lines. Similar to natural gas, research has shown that this type of utility-scale development model for geothermal power may have adverse indirect impacts for some species—including greater sage-grouse.[xvi] Research has also shown that when groundwater is used for plant operations, geothermal plants can lower the surrounding water table over time.[xvii]

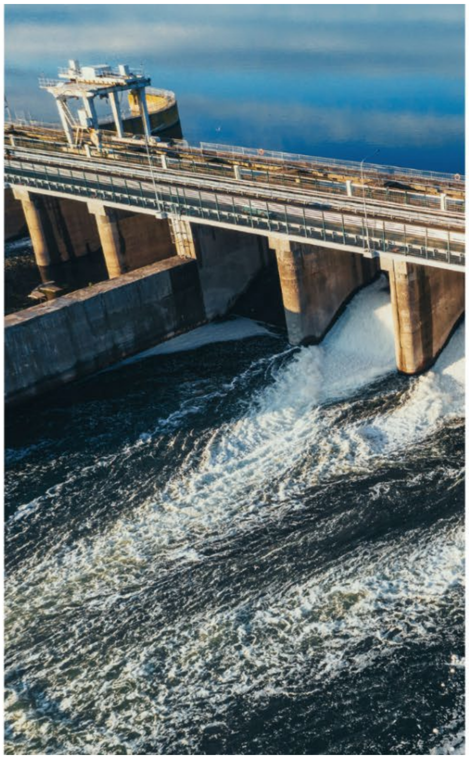
Our organizations support geothermal energy production via accelerated installation of heat pumps and localized direct use systems utilizing non-freshwater resources for plant operations where impacts to freshwater and aquatic habitats are insignificant. We also support utility-scale geothermal development where it follows smart siting principles to avoid impacts to the most sensitive fish and wildlife habitats and important cultural resources, incorporates the mitigation hierarchy to avoid, minimize, and mitigate adverse impacts to natural habitats and working lands and waters, and is embraced by the local community.

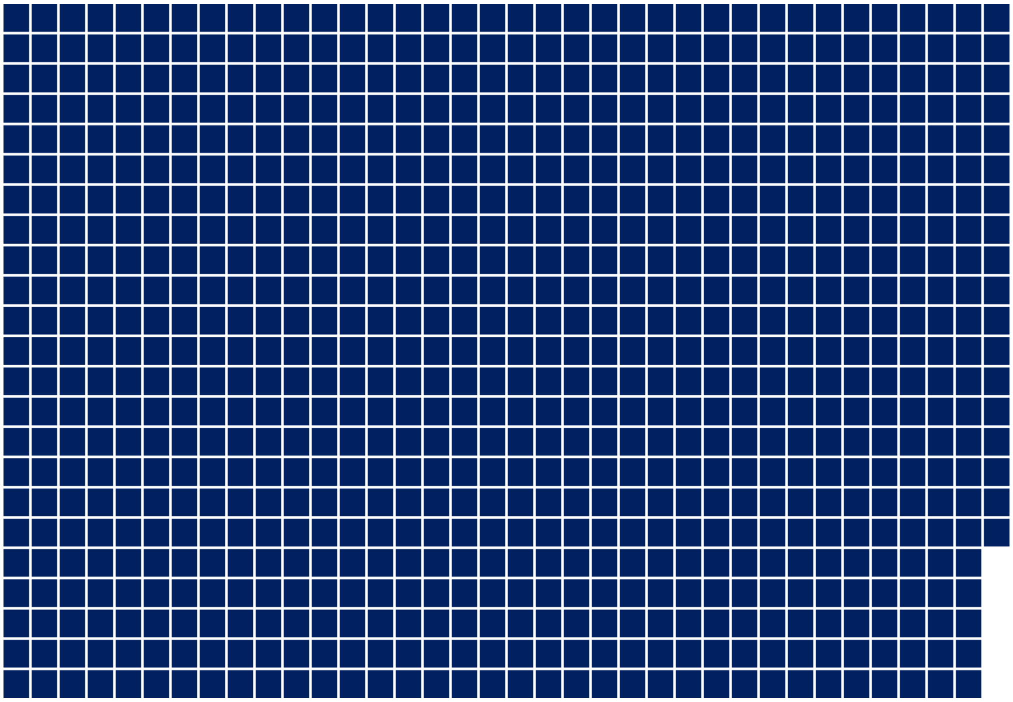
Rooftop (Distributed) Photovoltaic Solar requires about 3 square meters of land per megawatt-hour of electricity generated.[xviii] This number is not zero even though the panels would be mounted on existing buildings or other infrastructure because additional land is still required for the mining of raw materials to build the solar panels. Our organizations support policies that facilitate greatly expanded deployment of distributed rooftop solar to help meet current and future domestic electricity needs due to its limited impact on fish and wildlife habitats when compared to other types of electric power generation. We also support updated mining laws and policies that require smart siting of new mines for the necessary raw materials to build solar panels that employs the mitigation hierarchy to avoid, minimize, and mitigate adverse impacts to cultural resources and fish and wildlife habitats from expanded mining activities.

Coal consumes approximately 15 square meters of land per megawatt- hour of electricity generated.[xix] Most land consumed by coal development is from the mining and excavation of coal deposits. Coal mines and power plants are known to heavily impact lakes, rivers, streams, and water supplies.[xx] Nevertheless, like natural gas, carbon capture, utilization, and sequestration or storage (CCUS) technologies for coal power plants show promise and may allow coal power generation to continue to contribute to the nation's power portfolio with reduced greenhouse gas emissions.[xxi,xxii]

Utility-Scale Photovoltaic Solar consumes about 19m^2 of land per megawatt-hour of electricity produced.[xxiii] Utility-scale photovoltaic solar generating facilities often exceed several thousand acres in size and are particularly problematic barriers for wildlife movements and public access because they are required to be fenced. Indirect impacts and reduced habitat use adjacent to utility-scale solar facilities have also been documented for some species.[xxiv] If current development trends continue, expanded utility-scale solar development will also disproportionately impact rural communities and agricultural lands important for wildlife—like those enrolled in the Conservation Reserve Program (CRP).[xxv,xxvi] This is particularly concerning, as the total number of acres enrolled into the CRP program has been declining and these lands offer both wildlife habitat and recreational opportunities. The Nature Conservancy has developed a web-based mapping tool for smart siting of generating facilities to avoid the most sensitive habitats,[xxvii] and recently released their Power of Place report outlining innovative ways to reduce renewable energy development impacts on natural habitats, communities, and working lands and waters.[xxviii] Many state fish and wildlife agencies, and some other conservation groups, have produced guidelines and best management practices for smart siting of utility-scale solar development to reduce impacts to fish and wildlife.[xxix] Our organizations support utility-scale photovoltaic solar development that incorporates impact minimization and mitigation practices and follows smart siting principles to avoid impacts to the most sensitive fish and wildlife habitats, cultural resources, and public access. It is important to keep in mind that by dramatically increasing distributed solar on rooftops and previously disturbed lands, utility-scale solar development on undisturbed fish and wildlife habitats may be significantly reduced or completely unnecessary to meet our current and future net zero energy needs.[xxx]

Hydropower consumes approximately 33m^2 of land per megawatt-hour of electricity generated (but this can vary greatly depending on the size of the hydropower plant and reservoir).[xxxi] While hydropower is considered a low carbon source of electricity, it is not emission free.[xxxii,xxxiii] Additionally, hydropower development has historically disproportionately negatively impacted indigenous peoples and severed aquatic habitat connectivity necessary for salmonids and other culturally and economically important aquatic species to thrive.[xxxiv] Dam demolitions are on the rise—both for safety reasons and to restore habitat connectivity essential for aquatic species.[xxxv] Still, of the 90,000+ dams in the U.S., only around 2,500 produce power. Retrofitting existing non-power dams could produce up to 12 gigawatts of additional electricity—enough power for up to 12 million homes.[xxxvi] With careful evaluation to avoid cultural and aquatic impacts, hydropower has an ongoing role to play in meeting our nation's energy demands. Our organizations support actions to restore environmental and recreational values at hydropower projects presently being relicensed across the country, and to reform hydropower policy to guarantee needed environmental protection measures in hydropower regulations.





Utility-Scale Wind Power requires a minimal amount of land when solely considering the direct surface footprint— 0.4m^2 per megawatt-hour of electricity (only slightly more than nuclear power). However, if the land between each wind turbine is taken into account, wind power can consume up to 247 m^2 of land per megawatt-hour of electricity produced (823 times more land than nuclear power).[xxxvii] While wind power does allow for other productive land uses between the turbines (e.g. farming, hunting, etc.), direct mortality to birds and bats is well documented.[xxxviii] Direct mortality of bird and bat species should be addressed through operational and other mitigation approaches at these facilities through coordination with the United States Fish & Wildlife Service and individual state and Tribal fish and wildlife agencies. Additionally, similar to natural gas development, there is increasing evidence that indirect impacts in the form of behavioral avoidance of wind turbines by some species—including prairie grouse and popular game species like pronghorn—may result in functional habitat loss that extends well beyond the direct footprint of wind facilities.[xxxixxlxli] With this in mind, proper siting of new wind facilities is critical and the engagement of the conservation community as early as possible in the siting and scoping process is important. Our organizations support utility- scale wind power development in places where it follows smart siting principles articulated by federal, state and Tribal fish and wildlife agencies to avoid impacts to the most sensitive fish and wildlife habitats, incorporates impact minimization and mitigation practices, and is embraced by the local community.

Transmission of electricity from where it is generated to where it is consumed also has a significant impact to fish and wildlife. Transmission lines have been shown to cause direct wildlife mortality, fragment habitats, and be barriers to wildlife movement.[xlii,xliii,xliv] Indirect impacts are also possible for some fish and wildlife species. In order to increase deployment of utility-scale wind and solar generating facilities sufficient to achieve net zero greenhouse gas emissions, existing transmission line capacity in the U.S.—and its corresponding impacts to fish and wildlife—would need to triple.[xlv] For this reason, our organizations support siting of utility-scale generating facilities that can take advantage of existing transmission infrastructure to the maximum extent possible—such as nuclear or solar re-development at the locations of existing fossil-fuel generating stations scheduled to be retired. Similarly, we support policies that advance the development of generating facilities that require minimal new transmission capacity by locating them near where the electricity is going to be consumed (e.g. rooftop solar and distributed or direct use geothermal). We recognize that significant additional transmission capacity and upgrades to the grid are required to meet our greenhouse gas reduction goals. We support common sense permitting reform that strategically targets necessary new transmission capacity and grid upgrades, ensures compliance with existing environmental laws, recognizes the needs of local communities and Tribes, and follows the mitigation hierarchy to avoid, minimize, and mitigate adverse impacts to the most sensitive natural habitats and working lands and waters.[xlvi]

Conclusion

In the U.S., we have incredible fish and wildlife resources and public access opportunities for hunting, angling, wildlife viewing, and other forms of wildlife-oriented recreation on both public and private lands. Public lands and working lands that currently provide the most important connected habitats for fish and wildlife also hold some of the greatest potential for clean energy development. [xlvii] Achieving net zero greenhouse gas emissions in the U.S. by relying on primarily wind and solar will require an estimated 250 million acres of new onshore wind farms and 17 million acres of new solar farms. Much of this development is predicted to occur on private lands in the Midwest, but significant development is already occurring in the East and across the West and is predicted to increase dramatically in these regions.[xlviii] The Department of the Interior (DOI) indicates there are over 20 million acres of public lands potentially suitable for wind energy development. [xlix]Additionally, the DOI is currently in the process of expanding its Western Solar Plan to guide increased solar development on public lands.[l] In addition, almost two-thirds of geothermal resources lie on federally managed public lands.[li] Deliberate steps must be taken to maintain fish and wildlife populations, while supporting the transition to clean energy. First, transparency about the negative impacts to land and water associated with different types of clean energy is needed and intentional investments should be made in a diverse mix of clean energy sources that minimize impacts on undeveloped public lands and working lands. Second, permitting agencies must adopt smart siting policies for clean energy that include financial incentivizes to utilize previously disturbed lands and areas that minimize impacts to natural habitats and the working lands and waters that are critical for sustaining robust fish and wildlife populations. These policies should require avoidance of the most sensitive natural habitats, important agricultural lands, and culturally important areas. They should also require mitigation of unavoidable direct and indirect adverse impacts. This can be done by adopting existing guidelines and best management practices, [liii] by developing new guidelines that minimize harm to important agricultural lands, and by prioritizing engagement with Tribes and local communities to seek out and respect cultural knowledge and local priorities.

Finally, in addition to land use requirements, analysis of impacts from energy development to fish and wildlife resources should include the indirect impacts of increased noise levels, additional feature related traffic, transmission lines, pipelines, ground water resources, and the cumulative impacts through time as facilities expand and ancillary feature additions occur. Embracing this thoughtful approach is the only way to meet our climate goals while not compounding the already accelerated loss of working lands and wildlands, natural habitats, and fish and wildlife populations.



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[v] See the Association of Fish & Wildlife Agencies Energy & Wildlife Policy Committee's web page for links to individual state wildlife agency development guidelines and best management practices for different types of energy development. https://www.fishwildlife.org/afwa-acts/afwa-commitees/energy-and-wildlife-policy-commitee

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[vii] Ritchie, Hannah. 2022. How does the land use of different electricity sources compare? Our World in Data. https://ourworldindata.org/land-use-per-energy-source, and the underlying UNECE report on the lifecycle footprints of different electricity sources. https://unece.org/sites/default/files/2021-10/LCA-2.pdf. Note that the land requirements for additional electric transmission capacity needed to accommodate each individual type of electrical generation are discussed separately in this report.

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[xv] https://www.scientificamerican.com/article/why-the-epa-might-make-new-gas-plants-catch-carbon/

[xvi] https://www.usgs.gov/news/featured-story/building-maps-help-geothermal-energy-and-greater-sage-grouse-coexist-nevadas

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[xx] https://www.ucsusa.org/resources/coal-and-water-pollution

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