COMMON GROUNDS FOR A CLEAN ENERGY FUTURE

A Case for Co-Locating Wind and Solar Power on Federal Oil and Gas Land

Planet Reimagined

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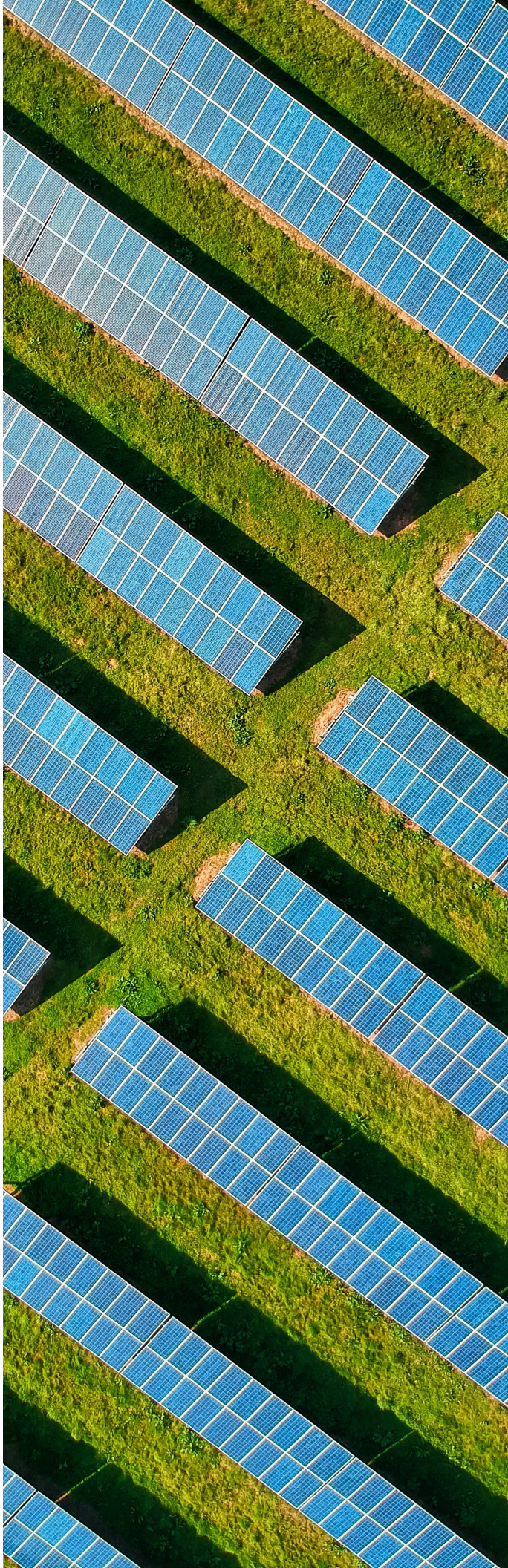

EXECUTIVE SUMMARY

The United States is committed to achieving carbon neutrality by 2050—a goal that will require both an urgent shift away from fossil fuels and the rapid expansion of renewable energy generating capacity. This transition from oil and gas wells and coal mines to wind farms and solar panel arrays poses significant challenges: to the federal government that needs to ensure the nation's energy security; to fossil fuel companies that need to remake themselves as renewable energy suppliers; and to the communities and families whose livelihood currently depend on oil, gas, and coal production.

This historic shift will also involve new demands on land, and in particular on the 245 million acres of public land administered by the Bureau of Land Management that make up 10% of the United States' land area.

Congress has already instructed the Department of Interior to deploy 25 gigawatts of power generation capacity on government-owned land by 2025, enough to power almost 5 million homes. The Biden Administration is set to surpass that goal and is asking Congress to set more ambitious targets.

This report argues that the United States is currently overlooking one important and as yet unused resource in this shift to renewables—the nearly 23 million acres (as of FY2022) of federal land that are currently leased for oil and gas production and exploration.

It proposes policy steps to incentivize energy land-sharing—the co-location of renewable energy facilities on land already leased for oil and gas production and exploration.

This approach would result in a range of benefits to existing lease holders, many of whom are small "mom-and-pop" operators, as well as to surrounding communities, while accelerating America's broader transition to a clean energy future.

RECOMMENDATIONS

Encourage energy land-sharing on public lands:

- Proactively plan for renewable energy priority zones by identifying low-impact, high-potential sites.
- Ease permitting through a simplified environmental review process and make pre-screened sites easily accessible through an online dashboard.
- Align financial incentives for co-locating clean energy development with broader environmental and equity goals.

Revitalize energy communities through reinvestment:

- Create an Office of Just Energy Transition Technical Assistance and a "Transition in Place" Fund using federal revenues from oil and gas activities.
- Share revenue from wind and solar projects on public lands with local communities.
- Open the door to plugging and reclaiming wells to replace them with renewables.

Reduce energy-related emissions:

- Mandate emission cutting measures including on-site renewables deployment for operational use.
- Expand categorical exclusion to include small-scale, on-site renewable projects.
- Subsidize clean energy integration for "mom-and-pop" operators.

INTRODUCTION

Roughly a quarter of all crude oil and more than a tenth of all natural gas produced in the United States in 2021 came from lands and waters leased to oil and gas companies by the federal government. These territories have accounted for a quarter of the United States' Green House Gases (GHG) emissions since 2005.[1] If these federal lands and waters were a country, they would be the fifth largest GHG emitter in the world.[2]

The most recent report of the UN Intergovernmental Panel on Climate Change made one thing abundantly clear: that urgent reductions in the production and consumption of these fossil fuels is essential if the world is to have any hope of holding global warming to the target of no more than 1.5 degrees Celsius above pre-industrial levels.[3]

But at the same time, there is an immediate opportunity to advance America's progress towards its goal of being carbon neutral by 2050: by using the nearly 23 million acres of federal lands now leased to oil and gas companies[4] to co-locate wind and solar power generation.

Congress has recognized the important role that federal lands can play in the development of new clean energy generation. It has already instructed the Department of Interior to deploy 25 gigawatts of power generation capacity on government-owned land by 2025, enough to power nearly 5 million homes.[5] The Biden Administration is set to surpass that goal—and, on the heels of the Inflation Reduction Act and recent reforms to the permitting process, is asking Congress to set more ambitious targets.[6]

On first glance, there is apparently a large amount of public land available for renewable power generation: altogether, the Bureau of Land Management (BLM) administers a total of around 245 million surface acres, or 10% of the country's land area, largely in Western states. But this vast area currently holds just 6% of national installed solar capacity and 1% of wind.[7]

This is partly due to administrative bottlenecks, some of which were remedied by permitting reform in the June spending bill and the IRA last year. But it also reflects public opposition to building wind and solar farms arising from concern over potential impact, including on natural habitats, recreation areas, and farming or other interests.[8]

Researchers at Princeton University expect that by 2050 wind and solar farms could cover an area anywhere between 61 million to 272 million acres.[9] At the upper limit, that's nearly the size of Texas and California combined. If done right, the lands held in our public trust can absorb some of this demand, while continuing to promote conservation.

Here, the almost 23 million acres of oil and gas lease lands can pave the way to their eventual and expedited retirement. As much as 78% of surveyed oil and gas fields on federal lands are suitable for siting renewable energy projects.

What Do We Mean By Co-Location?

In principle, the concept of co-locating or land-sharing is not new. From farms dotted with wind turbines to homeowners installing solar arrays on their rooftops, renewable energy generation is especially well-suited to mixed-use siting strategies.

Co-location is the mixed use of one unit of land for multiple productive purposes. Cross-sectoral energy land-sharing is the idea that utility-scale wind and solar projects can be sited on land also used for oil and gas production. It is a strategy that benefits both renewable energy developers and the oil and gas industry, while promoting net zero GHG goals, minimizing impact on working lands, and delivering sustainable power to electricity consumers.

In This Report

This report outlines several steps that federal decision makers in Congress and the Department of Interior should take in order to pave the way for the private sector to take advantage of this opportunity. This study has resulted from a year-long process of consultation both with stakeholders across the energy sector and with environmental groups, starting from the premise that the energy transition requires not only technological innovation, but also federal assistance in overcoming non-technical barriers.

BACKGROUND

Faced with limited space and a narrow decarbonization window, siting clean energy on federally-managed lands is the best opportunity to facilitate an expeditious and just energy transition. The Department of Interior's Bureau of Land Management (BLM) and Department of Agriculture's Forest Service (USFS) together administer 437.3 million acres of land,[10] with the 23,396 acres of solar, wind and geothermal projects to date.[11] The Administration's commitment to reach net zero emissions by 2050 will require the siting of renewable energy projects on up to 272 million of the 2.27 billion acres of land in the United States.[12] Meanwhile, the President's goal to conserve 30 percent of lands and waters by 2030, established by Executive Order 14008 and the America the Beautiful Initiative, is estimated to need an additional 440 million acres, further constraining the land available for energy development.[13]

Clean energy projects will almost inevitably encroach on other land uses. An important example is agriculture, which accounts for about 43% of the surface area of the lower 48 states.[14] The American Farmland Trust expects over 80% of new solar installations to be placed on farmlands, and more than half on prime productive lands.[15] In New York state, one study found that farmland made up 84% of the land suited to utility-scale solar.[16] Another analysis suggests that up to half of the new wind and solar needed for California to meet its decarbonization goal will need to be sited on existing agricultural croplands and rangelands.[17]

In parallel to this land squeeze, a transition away from fossil fuel presents the prospect of severe economic disruption for communities and families depending on work in the oil and gas fields across the United States. Already, technological change and shifting markets have reduced employment in the industry to nearly half of its peak less than a decade ago.[18] In Texas, for example, there was a 30% drop in extraction jobs between 2014 to 2018 despite a 60% increase in production.[19] [20] In contrast, clean energy jobs tripled in that same period.[21] Oil and gas workers have reported less job security, more turnover, worse wages, and are ready to migrate to other fields within the energy sector, under the right conditions.[22] Hundreds of communities depend on the revenue coming from the extraction of coal, oil and natural gas, including for essential services like schools and hospitals.[23]

Co-locating green power generating capacity on lands already being used for oil and gas production presents a way of both addressing the "land squeeze", and reducing the economic impact of the energy transition on oil and gas communities—turning them into the energy communities of the future.

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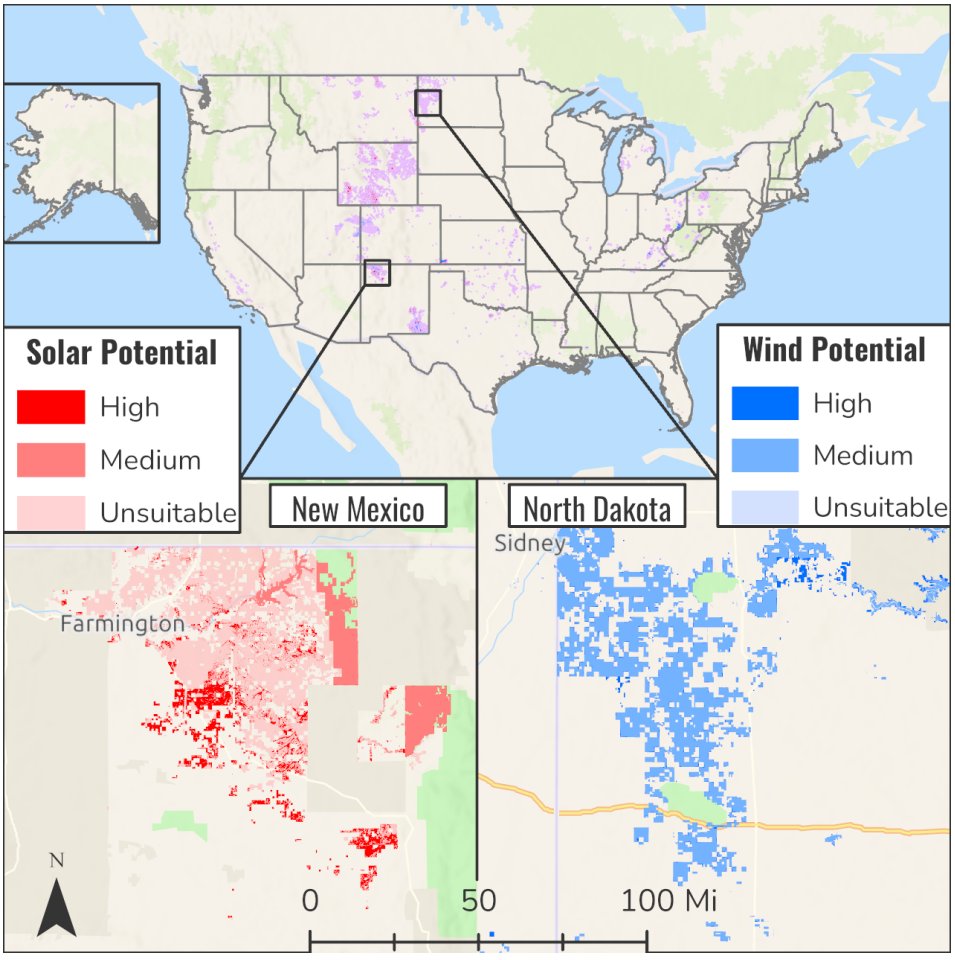
At the same time, efforts to promote co-location must take account of the structure of the onshore oil and gas sector: nine out of every 10 wells in the US, accounting for 83% and 90% of oil and natural gas production, respectively, are operated by independent producers with an average staff of 12 employees.[24] Due to their nature, these small operators will need support, both technical and financial, to take advantage of the opportunities of co-location, which offers them in the short term additional income, and in the longer term, a stake in the developing green energy sector.

Enabling co-location also presents a challenge to existing permitting procedures on public lands. For instance, a renewable energy project may currently be required to undergo an environmental impact review, even when being located on a site of an oil and gas project that has itself already gone through the same process (*see pg. 15 in Appendix for more information*).

Optimal Siting for Wind and Solar Projects on Federal Oil and Gas Land



An analysis of solar photovoltaic potential (red) and wind resource potential (blue) on current oil and gas federal leases to determine the efficacy of land sharing on each parcel. By way of example, North Dakota shows high potential for new wind projects and New Mexico shows high potential for new solar projects, but land-sharing shows promise across the United States and in particular in the Rocky Mountain region.

THE CASE FOR LAND-SHARING

A New Lease on Life for Energy Communities

- **Ensuring a Place for All in a Just Transition**. Co-location creates localized employment opportunities in clean energy, while offering a lifeline to small-scale operators who are commercially threatened by the energy transition, and compensating communities heavily dependent on oil and gas royalties.
- **Energy Communities Are Cost Effective**. In addition to qualifying for IRA energy community tax credits, developers can save money by tapping into fossil fuel era infrastructure, from access roads to transmission lines.
- **A Renewable Powered Phase-Out**. Deploying both small-scale and utility-scale solar installations adjacent to oil and gas operations reduces the ultimate carbon footprint of production, while laying the groundwork for a future without these polluting sources.

Responsible, Expedited Permitting on Disturbed Lands

- **Building on Past Environmental Review**. Recent changes to the National Environmental Policy Act (NEPA) reaffirm that new scientific or technical information doesn't need to be collected for each environmental review. Having gone through the process once already, oil and gas lands have site-specific data that can be utilized for wind and solar projects, expediting the permit process and reducing project timelines.
- **Planning and Permitting Proactively**. By assessing and identifying sites and their potential environmental impacts ahead of time and on a national scale, local land managers can cut down on the time it takes to evaluate each individual project.
- **Making the Most of Disturbed Lands**. Developing on oil and gas lands that have not yet undergone reclamation is similar to building on "brownfields," or contaminated former industrial lands. Disturbed lands are ideal sites because they hold reduced value as wild or working lands without significant restoration.

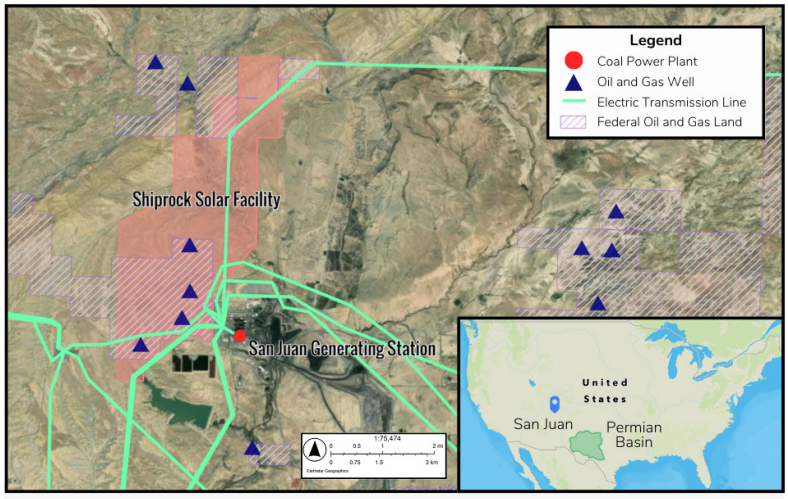
Minimizing Conflict, Maximizing Value

- **Keeping More Wilderness and Working Lands Intact and Untouched**. By siting new solar and wind projects as much as possible on land already disturbed and designated for energy development, more public lands can be left alone.
- **Preventing False Choices**. Certain public lands have been prioritized for fossil energy development, even in instances where renewable resources on the same land are more suitable and profitable. By opening a pathway to land-sharing, a forced decision between energy types becomes irrelevant.
- **Maintaining Bedrock Environmental Protections**. Though co-location can benefit from standardized environmental review processes, it does not necessitate any changes to NEPA.

CASE STUDY: From a "Permian Paradox" to a Green Machine

The Texan Permian Basin, a boon of the booming fossil fuel industry and the second biggest shale play in the country, is also a thriving hub for renewables. The Basin accounts for 40% of American oil and 15% of gas production, but also holds nearly 12,000 MW of generating capacity.[25] [26] There is more wind capacity in Texan Permian counties than in the CAISO grid servicing most of California.[27] Seeing this, many fossil companies have seized on the opportunity to cut both their energy costs and the carbon footprint of their carbonaceous product – in what one reporter termed the "Permian Paradox." With a power draw that triples every three years, these energy intensive processes are the tip of the spear of the industry's net zero targets.[28] These emission savings, if achieved, are not negligible. The industry consumes 1 barrel of oil for every 10 that it brings to market, and the carbon intensity of its product is trending upwards as fossil resources become harder to pull out of the ground.[29]

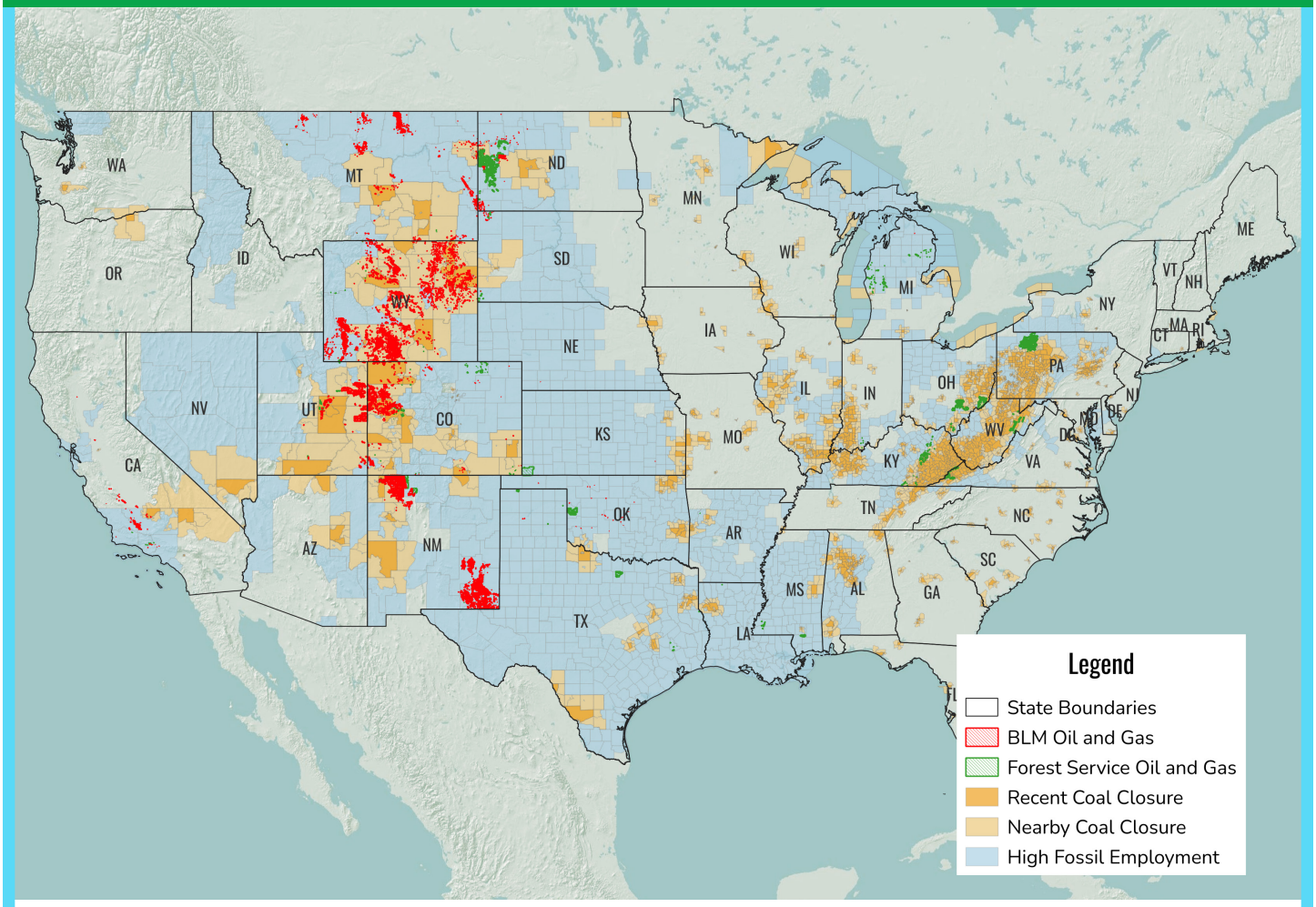
Meanwhile, in times of surplus, the clean energy makes it onto the grid. Occidental, Exxon and Chevron signed deals with renewable developers to build and operate plants that can power their oil and gas fields. Chevron, for example, partnered with renewable developer Algonquin to co-develop 500MW of renewable projects to power its operations in the Permian.[30] In a case study of a ConocoPhillips field, a research team at the National Renewable Energy Laboratory found that clean energy integration into operations could reduce up to 50 tons of CO2 equivalent annually at a cost of $32.11 – or $6.82, when selling back to the grid.[31] That compares to the prevailing federal social cost of carbon – the damage done by each additional ton of carbon emissions – of $51, though that number may quadruple.[32]



The San Juan Generating Station in northwest New Mexico, after a half-century of burning coal, was shut-down in 2022. The Shiprock Solar Facility (pictured above), sitting on 2,000 acres of BLM-administered public land and 555 acres of private land, is one of the clean energy projects slated to power nearby communities in its stead.

For many wind and solar projects, locating themselves in what was fossil fuel country can be desirable, irrespective of having conveniently energy-sucking neighbors. For example, some projects such as Shiprock Solar (pictured above right), in northwest New Mexico, have set themselves up to replace retiring power plants.[33] To match the state's decarbonization goals, the Utility Public Service Company of New Mexico (PNM) is working to replace the generating capacity of the 800 MW San Juan Coal Plant with several solar projects, including Shiprock.[34] Developers have taken this as an opportunity to tap into the extensive transmission system that once brought coal power to the grid. In an example of what land-sharing could look like, the proposed solar project is located on a mix of private and public lands, including land used for traditional energy production.

Energy Communities: Ripe for a Local Transition



Unsurprisingly, federal oil and gas lands form the backbone of America's traditional energy geography. By siting projects in these so-called "energy communities," renewable developers can benefit from a slew of tax breaks and incentives. These communities are defined as districts that either have retired a coal power plant in the past decade (yellow), or have a large share of employment in fossil energy (blue) and who have a lower-than-average unemployment rate.

Efforts to promote co-location must take account of the structure of the onshore oil and gas sector: nine out of every 10 wells in the US, accounting for 83% and 90% of oil and natural gas production, respectively, are operated by independent producers with an average staff of 12 employees. By their nature, these small operators will need support, both technical and financial, to take advantage of the opportunities of co-location, which offers them in the short term additional income, and in the longer term, a stake in the developing green energy sector.

Our goal is to develop solutions that **rapidly accelerate the clean energy transition**. This approach engages with both sides of the aisle, environmental organizations, a range of energy companies, and communities. It will foster the expansion of wind and solar energy without any additional oil or gas leases, and **preserve huge swathes of untouched land**. Producing renewable energy on federal oil and gas land is the kind of sensible solution that can thrive regardless of politics.

Adam Met

Executive Director of Planet Reimagined

RECOMMENDATIONS FOR POLICYMAKERS

Encouraging the co-location of renewable energy assets on oil and gas lease lands can unlock an opportunity with immediate impact.

Policymakers should undertake three courses of action.

- **Lay out a clear legal framework for land-sharing and subleasing, making it clear that such partnerships are encouraged by the Department of Interior.**
- **Pave the way for collaboration by eliminating administrative barriers and aligning incentives to match the social and environmental value of land-sharing.**
- **Provide funding for capacity building and technical assistance programs for the small "mom-and-pop" energy companies to navigate the energy transition, including through land-sharing.**

These can be undertaken using the following levers across the public lands leasing process.

America's Environmental Review Process

Under the National Environmental Policy Act (NEPA), there are three ways of evaluating the environmental impacts of a proposed action, such as permitting a wind or solar project:

- A detailed Environmental Impact Statement (EIS), when a significant effect on the environment is expected.
- A shorter Environmental Assessment (EA), typically supporting a Finding of No Significant Impact (FONSI), for less significant, or mitigatable, effects.
- A brief environmental analysis to confirm a project fits within an existing category of action excluded from detailed review.[35]

ENCOURAGE ENERGY LAND-SHARING ON PUBLIC LANDS

Proactively plan for renewable energy priority zones by identifying low-impact, high-potential sites.

1. Allocate federal funding for a comprehensive review of fossil fuel and renewable energy siting compatibility (including current or planned transmission). Congress can and should appropriate money to complete this review. However, barring this, there are also several funding opportunities through the Inflation Reduction Act, including: SEC. 50303 of the IRA, which delivers $150 million to the Department of Interior for a number of activities that broadly "facilitate timely and efficient environmental reviews and authorizations" and SEC. 70007, which allocates $350 million to the Federal Permitting Improvement Steering Council's Environmental Review Improvement Fund.[36]

2. Develop reliable, nation-wide data sources that can be incorporated into multiple review processes. Mapping environmental sensitivities and social impacts across the country, such as done by The Nature Conservancy's *Power of Place* report, can be an important "off-the-shelf" resource for completing permitting reviews.[37] This interpretation is aided by recent modifications to NEPA, which state that environmental review can "make use of any reliable data source" and specifying that new scientific and technical research may not be necessary.[38]

3. Based on the geographies identified, establish new Solar Energy Zones (SEZ) and Designated Leasing Areas (DLA), which greatly incentivize the development of renewable energy. An Instruction Memorandum (IM) can also be issued to Bureau of Land Management field offices to clarify initial screening measures and standardized prioritization methodologies for co-located solar and wind right-of-way (ROW) grant and lease nominations.

Ease permitting through a simplified and accelerated environmental impact review process and make project areas easy to find through an online dashboard.

4. Issue a tiered Programmatic Environmental Impact Statement (PEIS), as set out in NEPA, for siting renewable projects on fossil fuel leases. Wind, solar, and fossil fuels each have distinctive land-use footprints. Co-location, which requires intimate collaboration on configuration, will need bespoke assessments. However, a PEIS can set a framework for responsibly conjoining energy development projects. The Bureau of Land Management is currently expanding its west-wide Solar PEIS.[39] The Council on Environmental Quality (CEQ) Final Guidance on PEIS states that programmatic reviews may be helpful when projects have similar impacts, methods of implementation, and subject matter.[40] For example, the Bureau of Ocean Energy Management recently began developing a programmatic review for the deployment of offshore wind energy capacity off the coasts of New York and New Jersey.[41] This action will ease partnership for fossil fuel operators, who are often not renewable energy experts, and encourage renewable energy development on public land already designated for energy development.

5. Highlight potential sites in an easily accessible online dashboard. This can be incorporated into an existing resource, the Environmental Protection Agency's *RE-Powering America's Land*, which maps contaminated land, land-fills, mines and other low-impact sites suitable for renewable energy development.[42] A public land-specific dashboard can also be created by the Department of Interior.

Align financial incentives for co-locating clean energy development to their value to broader environmental and equity goals.

6. Include fossil fuel co-location as a factor for variable offsets, which can reduce the financial costs of a renewable lease to 20% of the bonus bid, the amount paid above the minimum bid. Among the eligible criteria for being granted an offset by the Bureau of Land Management is "holding a solar or wind energy grant or lease on adjacent or mixed land ownership" (43 CFR § 2809.16).[43] A 2016 rule gives the Bureau of Land Management the flexibility to vary the factors that could enable a bidder to obtain a variable offset from one competitive offer to another.

7. Explore a competitive split-payment scheme. Oil and gas leaseholders and solar and wind project developers both pay the Department of Interior a per acre fee for use of the land. As the same acreage would have both projects, and therefore both payments, Interior should explore how it can adjust fee collection to make these partnerships more attractive. For example, Interior can pass savings on to the renewable energy developers.

REVITALIZE ENERGY COMMUNITIES THROUGH REINVESTMENT

Use federal oil and gas revenues to create an Office of Just Energy Transition Technical Assistance and a "Transition in Place" Fund.

8. Establish and fund an Office of Just Energy Transition Technical Assistance that makes the resolutions in this proposal, and others that encourage participation in the energy transition, accessible to all. Most "mom-and-pop" smaller producers do not have the resources to navigate the changing energy economy, diversify their operation towards renewables or benefit from new revenue streams, or to navigate the shifting regulatory and financial environment.

9. Establish a "Transition in Place" Fund based on royalties from fossil fuel production which can be disbursed to accelerate the local energy transition through skills-retraining, incentives for hiring from the traditional energy workforce, and the deployment of renewable energy generating capacity in energy communities and on fossil fuel lease lands. The IRA recently increased the minimum royalty rate from 12.5 to 16.67 percent, while the Biden Administration has adopted an even higher rate for new leases – presumably unlocking new revenue in the near future.[44]

Share revenue from clean energy projects on public lands with communities.

10. Split renewable energy revenues between the federal government, states and counties. Revenues from federal oil and gas leases are shared with the states they are located in, while renewable energy projects go to the federal government. States, in turn, have built their school, public health, and infrastructure systems around these revenues. A sudden halt to drilling would devastate communities across the West. Finding a similar revenue sharing scheme, while not immediately filling the gap, can ease these local transitions while building local buy-in. Given a 50/50 split, the same for drilling for all states except Alaska, would have accounted for over $300 million invested in communities as of 2019.[45] The Public Lands Renewable Energy Development Act, for example, proposes transferring 25% of revenues to counties, 25% to states, 25% to build federal permitting capacity, and 25% to create a conservation fund to restore impacted lands.[46]

Open the door to plugging and reclaiming wells to replace them with renewables.

11. Explore a new mechanism to transition the energy workforce by turning reclamation into renewables. Of those employed in the energy sector, fossil fuel workers are most well equipped and willing to transition to plugging and remediating the wells they used to drill.[47] There is a need for it: improperly decommissioned or abandoned wells leak methane, pollute the air and contaminate groundwater.[48] The 2021 Bipartisan Infrastructure Law released $4.7 billion to states and federal agencies for plugging "orphan wells," with no owner of record. Of this, $250 million is set to plug the over 10,000 inactive or abandoned wells on public lands.[49] While the issue has been less acute for the Bureau of Land Management, the agency can explore creating a pathway for wells to be plugged and reclaimed, to be turned into solar or wind farms.

REDUCE ENERGY-RELATED EMISSIONS

Mandate emission cutting measures including, where feasible, on-site renewables deployment for operational use.

12. Require emission mitigation measures in all lease contracts and Application to Drill (APD) approvals on production activities. Through the integration of clean energy in operations and electrification of industrial equipment, substantial emissions can be reached at reasonable costs. The Bureau of Land Management has two legal mechanisms to impose net-zero aligned standards on operators: its authority within the lease contract itself; and imposing conditions of approval for an Application for Permitting to Drill (APD).[50] The Bureau of Land Management should require emission mitigation as part of a license to operate, encouraging the deployment of small-scale renewable energy on-site. This is particularly relevant to the 14,167 leases (covering 13.3 million acres) that have been awarded, but not drilled. The right to drill for oil and gas on federal land is predicated on the duty to minimize adverse impacts, even if those impacts are not known at the time of the lease sale.

Expand categorical exclusions to include small-scale, on-site renewable projects.

13. Issue categorical exclusions for small-scale solar and wind projects, as well as micro-grids and battery capacity, in predetermined low-impact areas (*see Recommendations 1-2*) if under a predefined capacity limit and for the explicit purpose to reduce operational emissions. The Departments of Energy and Interior already have categorical exclusions for unobtrusive developments to study the wind potential of a site, while there is also an exclusion for small rural developments.[51]

Subsidize clean energy integration for "mom-and-pop" smaller operators.

14. Provide financial support to small operators to comply with mitigation standards, and to offset administrative costs of energy land-sharing. The fund would support operators who do not on their own have the experience, resources or capacity to venture into land-sharing partnerships.

The Bureau of Land Management has two legal mechanisms to impose net-zero aligned standards on operators: its authority within the lease contract itself; and imposing conditions of approval for an Application for Permitting to Drill (APD). The Bureau of Land Management should require emission mitigation as part of a license to operate, encouraging the deployment of small-scale renewable energy on-site. This is particularly relevant to the 14,167 leases (covering 13.3 million acres) that have been awarded, but not drilled.

Where Does The Money Currently Go?

Revenue from oil and natural gas leases on onshore federal lands totaled $4.2 billion in FY2019, 50% of which is disbursed to the states in which production occurs (except Alaska, which receives 90%). Operators pay a fee for expressions of interest, a nomination fee, APD processing fee, rental fee prior to production, and, most significantly, royalties throughout production.[52] The Inflation Reduction Act increased the minimum royalty rate for the first time since 1920, raising the baseline from 12.5% to 16.67%,[53] meanwhile, the Biden Administration has adopted a rate of 18.75% for new leases, in line with many state and private lessors.[54] In 1920, Congress mandated that 40% of natural resource leasing revenues ($1.54 billion in 2019) go towards the Reclamation Fund, which invests in irrigation and hydropower projects in the American West, that currently sits at $19 billion, with a long-running annual surplus.[55] [56] Other disbursements go to the Permit Processing Fund ($172 million in 2019) and the Treasury General Fund ($444 million in 2019).

APPENDIX

One Goal - Two Frameworks

Overarching Statutory and Regulatory Framework of Public Lands:

Whether public lands are leased to the oil and gas industry, or to wind and solar industry, the end goal is the same: meeting the country's energy needs. But how each industry gets to build on land held in the public trust is radically different under the federal land management framework.

The Federal Land Policy and Management Act (FLPMA) mandates multiple-use, sustained yield, and environmental protection as the guiding principles for public land management. This means striking a balance among often competing land-use values, including recreation, agriculture, grazing, timber, and energy development, with the Bureau of Land Management's recently proposed Public Land Rule clarifying "that conservation is a use on par with other uses of the public lands" within this framework.[57] Many uses are not mutually exclusive. Some that have led to land conflicts in the past can in future be reconciled in the same land with policy innovation and interpretation of this mandate.

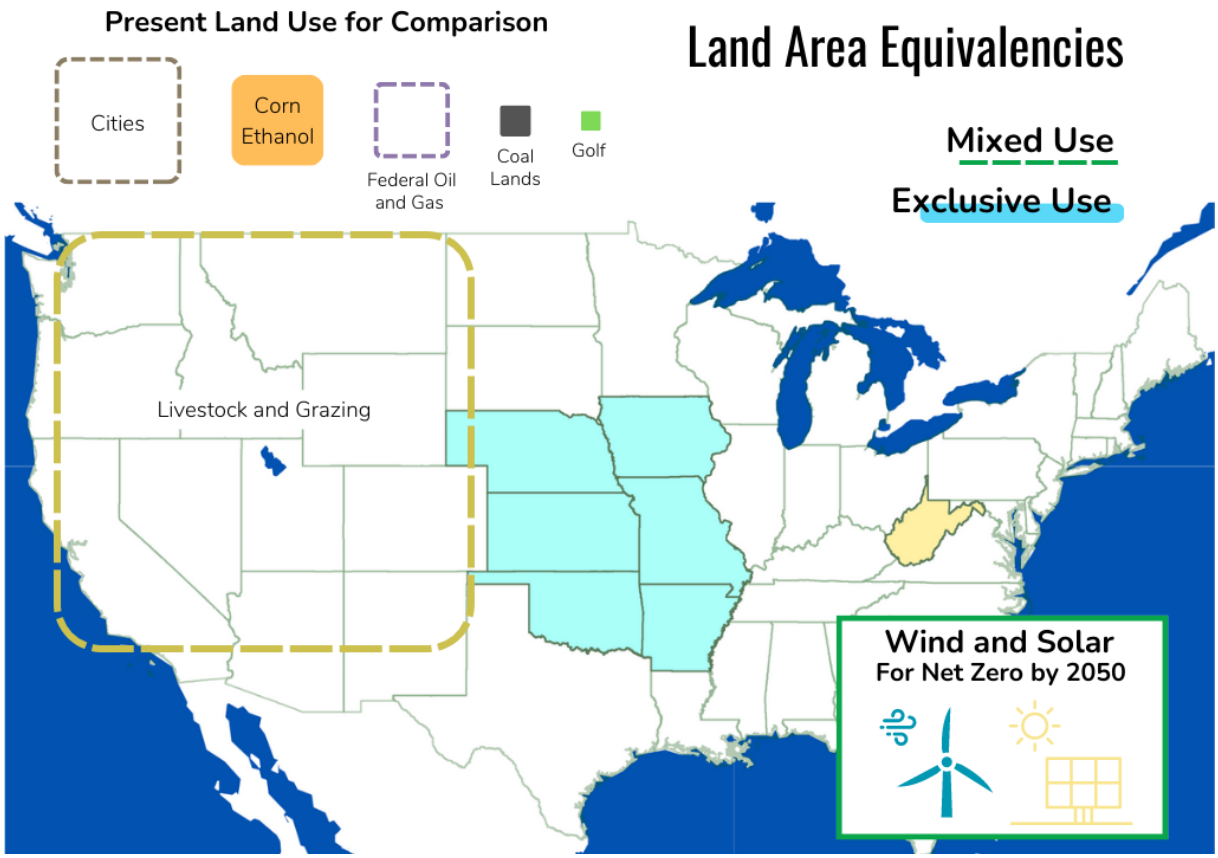
Framework for Fossil Fuel Energy Development on Public Lands:

There are three general stages of a well's life on US public land: 1) the permitting process to drill, 2) active extraction of a fossil fuel resource, and 3) plugging and abandonment of the well. There are three phases to oil and gas development from an agency perspective: 1) the Bureau of Land Management determines which lands are available for oil and gas leasing through landscape-scale Resource Management Plans. 2) Prior to lease sale, BLM analyzes individual leases and decides lease stipulations that will be applied to protect other resources and values. 3) Prior to drilling, the Bureau of Land Management sets "conditions of approval" to further mitigate harm as necessary on permits to drill for additional protection before approving an Application to Drill (APD). Land reclamation commences after initial production. Throughout this process, BLM holds several "retained rights" regarding its leases.

Framework for Renewable Energy Development on Public Lands:

The generation, transmission, and distribution of renewable energy are authorized under Title V of the FLPMA.[58] In 2012, the Bureau of Land Management produced a Programmatic EIS (PEIS) and Record of Decision (ROD), labeled the Western Solar Plan, for six states, and is now expanding it further.[59] In 2005, a PEIS and ROD explored the impact of utility-scale wind generation in Western BLM-managed lands. In 2016, the Bureau of Land Management amended its regulations implementing FLPMA to create a competitive leasing program for solar and wind development. This rule designated three categories: 1) excluded areas, where development is barred; 2) variance areas, where development is permitted; and 3) designated leasing areas (DLAs), where development is incentivized and expedited.[60]

Different Blueprints, Different Footprints



Though a kilowatt is a kilowatt, not every megawatt of energy is created equally. In addition to the crucial difference that fossil fuels emit greenhouse gasses when burned whereas renewable sources of energy do not, they also have differing land footprints.

Fossil-fuel generated electricity has a power density of 200 to 1000 watts per square meter (W/m2), disturbing a parcel of land roughly the size of a bathroom to power an average American household. In comparison, solar and wind energy generation has a density of 10 W/m2, using the equivalent of a house to power a household.[61] [62] Only a small portion of a wind farm area is directly impacted by infrastructure or equipment (about 1% of the facility area), whereas solar generation disturbs the vast majority of the land it uses (91% impact area for solar facilities).[63]

Less than 2% of acres used for oil and gas are estimated to exhibit surface disturbance, including well pads, roads, and pipelines.[64] With directional drilling, it is now common to drill multiple wells on a single well pad, reducing land disturbance by up to 70% in recent years.[65] Current technology allows developers to confidently predict where on a lease to best tap into oil reserves. That means over 20 million acres of federal lands designated for energy development can conceivably be co-located on.

As a result of the stark difference between the power densities, or the land surface area needed to produce a given amount of energy, of renewables in comparison to oil and gas, the energy system of the future will have a much larger land footprint. At 23 million acres, federal oil and gas lease lands are equivalent to the state of Indiana. Whereas wind and solar, with a much higher area of impact, will rival land uses such as livestock and grazing.

Land-Saving Siting Strategies

Siting strategies that promote synergistic co-location between various land uses can pre-empt land conflicts that are otherwise bound to arise from the energy transition. For example, one analysis found that negative environmental impacts can be avoided across 110,000 acres of land – nearly the size of Arizona – at a modest cost by deviating from the "siting as usual" approach.[66] A suite of innovative, mutually benefiting mixed-use schemes have been proposed by a range of stakeholders. In a non-exhaustive list, these include:

- **Brownfields and contaminated lands:** By siting wind and solar projects on brownfields and contaminated lands, the US can reclaim and repurpose these degraded areas for renewable energy generation, minimizing the need for new land development while revitalizing polluted sites.
- **Solar on the built environment:** Utilizing the built environment for solar installations, such as rooftops, allows the US to maximize the use of existing infrastructure while reducing the demand for additional land, enabling the integration of renewable energy into urban areas. Other proposals include placing them along parking lots and highways.
- **Agrivoltaics:** Agrivoltaics involves co-locating solar panels with agricultural activities, allowing for the dual use of land for both renewable energy production and crop cultivation or pollinator habitat. This strategy optimizes land use efficiency and promotes sustainable farming practices.
- **Floatovoltaics:** Floatovoltaics refers to the installation of solar panels on bodies of water, such as lakes, reservoirs, and ponds. By utilizing these water surfaces for solar energy generation, the US can minimize land use requirements, preserve ecosystems, and even reduce water evaporation.
- **Offshore wind turbines and aquaculture:** By strategically siting wind turbines in areas suitable for aquaculture, marine space is efficiently used for both renewable energy production and sustainable seafood cultivation. This approach promotes a synergistic relationship where wind turbines provide clean energy while benefiting aquaculture by creating artificial reefs that enhance habitat for marine life and potentially improving water quality through increased circulation. Offshore wind farms have even been shown to be colonized by wildlife as a refuge.
- **Wind and solar co-location:** Co-locating wind and solar projects involves siting both technologies within the same area, maximizing energy output from a single site and reducing the overall footprint. By combining these renewable sources, the US can optimize land use efficiency and enhance the stability of the renewable energy system.

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