NET ZERO WEDGES TOOLKIT

GETTING TO NET ZERO FOSSIL FUEL GREENHOUSE GAS EMISSIONS FROM FEDERAL LANDS AND WATERS BY 2030

May 6, 2021

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CONTEXT

The Wilderness Society (TWS) assembled this toolkit to better understand an array of action options to help make our federal public lands and waters a leading part of the climate solution. The aim is to achieve net zero greenhouse gas (GHG) emissions from fossil fuel development on federal public lands and offshore waters by 2030 and no fossil fuel development by 2050 at the latest.[1] The toolkit is the first that we know of to combine existing research across public land's roles in energy and natural systems.

We use "wedge" figures to explore combinations of potential actions across energy and natural systems that aim to reduce and offset GHG emissions stemming from fossil fuel development on federal public lands and waters. This toolkit and the wedge figures set the stage to understand: (1) a range of options to consider across energy and natural climate strategies; (2) the scale of gross federal emissions reduction or offsets from potential actions individually, and, to a large degree, in combination with other actions; and (3) the relative amount of baseline emissions remaining to be addressed by additional actions to align with getting to net zero by 2030.

It is important to understand what this toolkit does not do and know that it will continue to evolve. The order of actions in these wedge figures do not indicate prioritization. Nor do the inclusion of actions indicate an endorsement by TWS of any specific actions. This toolkit does not constitute a complete list of potential actions. Reduction estimates in the toolkit come mainly from existing external research on individual policies. These figures do not show estimates from a single integrated model and, thus, do not fully account for interactions. These figures display gross lifecycle emissions stemming from federal lands and waters, which we refer to as "federal emissions." These reductions are important for efforts to tackle climate change, and they are also largely under direct control of the Biden administration. It is important to acknowledge, however, that a reduction in federal fossil fuel production alone would lead to a *partial* shift in production from federal to non-federal lands and waters. We include global *net* emission reductions as available in the methodology section. Actions included in this toolkit will continue to expand as new data becomes available and estimates will continue to be refined to further account for potential interactions between actions. It is our hope that the federal government will conduct comprehensive modeling using the extensive data and integrated modeling capabilities at their disposal and will make this data available for public involvement. The input from integrated models is essential for informing a comprehensive plan to pursue actions to meet critical national and global climate goals.

[1] TWS defines "net zero fossil fuel emissions" from public lands and waters as follows: when the lifecycle GHG emissions stemming from fossil fuel development on U.S. federal public lands and waters (full lifecycle – from production sites to burning by end users) over a specified period are balanced by an equal amount of GHG emissions removed from the atmosphere and a combination of responsible offsets that will be phased out as our public lands become free of fossil fuel development. "No fossil fuel emissions by 2050" is defined as no emissions (both GHG and local air pollution) stemming from fossil fuel development on federal public lands and waters, i.e., no fossil fuel development on federal public lands and waters.

This toolkit includes emissions reduction potentials of specific actions estimated by existing research studies and, unless noted, are not estimates derived from nor explicitly verified by TWS staff at this time. TWS provided financial support for independent modeling of a baseline for federal fossil fuel GHG emissions by Apogee Economics and Policy and independent modeling of oil and gas supply side policies by Resources for the Future.

Federal actions to reduce local air pollution stemming from our federal public lands are extremely important to tackle. This particular toolkit includes only GHG emissions directly in its calculations at this time. Local air pollution largely comes from practices used to burn fossil fuels at power plants to generate heat and electricity, in industrial manufacturing, and in transportation. Reducing fossil fuel production stemming from federal public lands and waters has the co-benefit of reducing local air pollution stemming from federal fossil fuels. More can and should be done to incorporate the impacts of potential actions on local air pollution as well as incorporating those costs and benefits into decision making on federal lands.

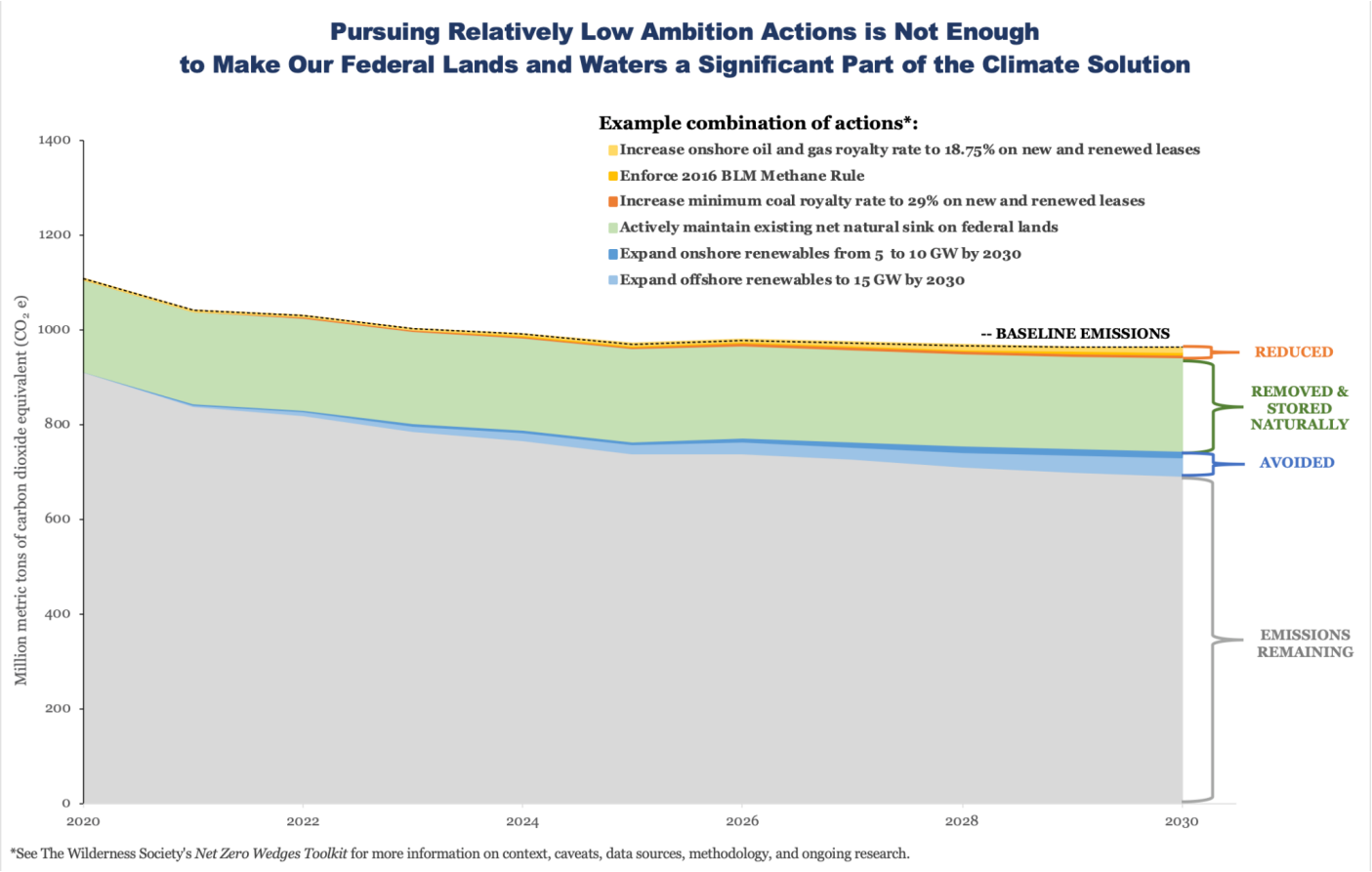
Please see the methodology at the end of this toolkit for more information on data and assumptions. Contact TWS for ongoing research.

EXAMPLE WEDGE FIGURES

Please see p. 2 of toolkit for context and caveats.

A. Relatively low ambition actions on federal lands and waters are not enough

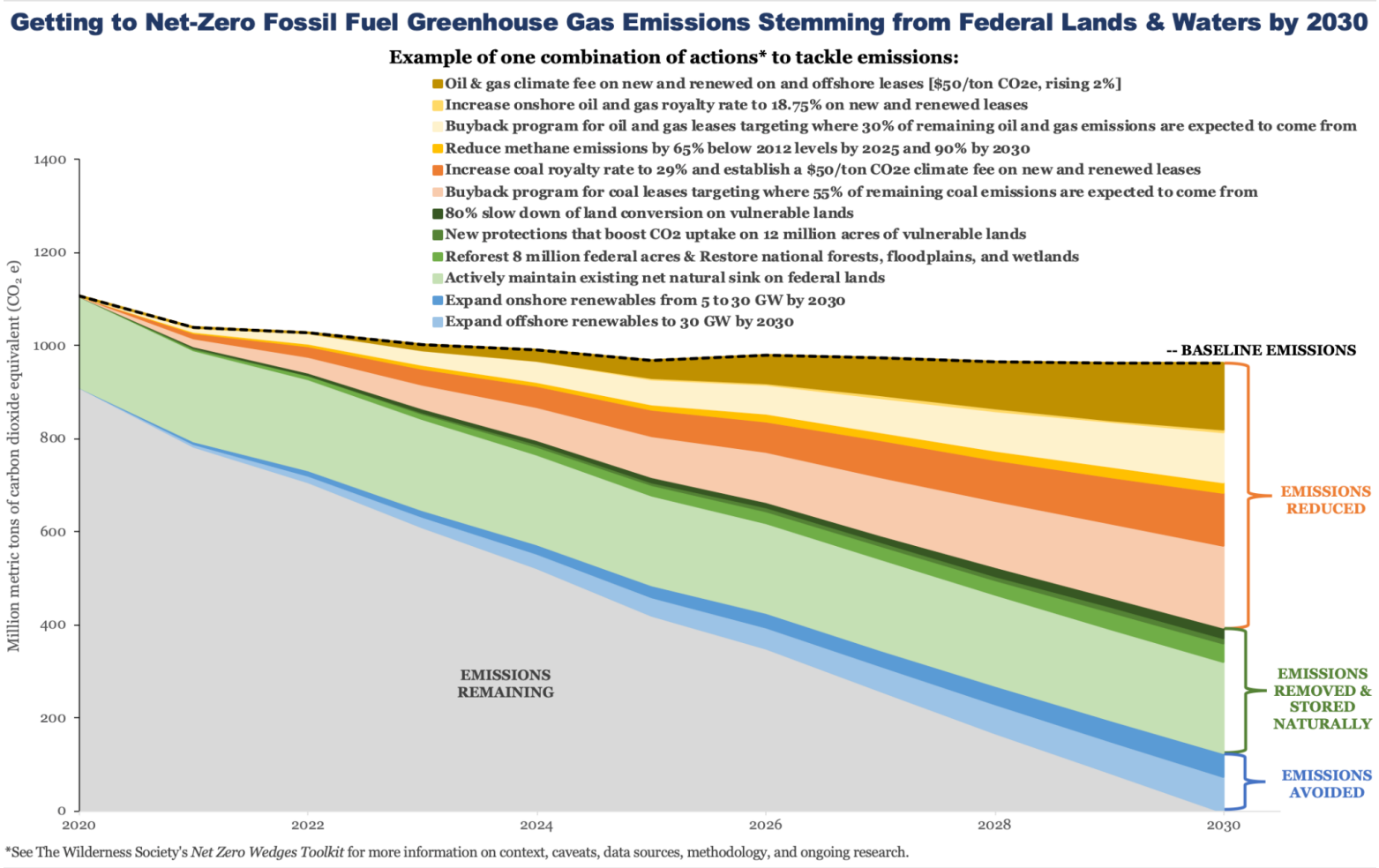
Based on existing data, pursuing only relatively low ambition climate actions that have been considered for years would result in around 690 MMT CO2e remaining in 2030 and would not put our public lands and waters on a path to get to net zero.



It is likely that there will be new policies at the state and national levels that continue to drive down demand for federal fossil fuel production (especially for coal in the near term) from baseline projected levels. But it is important to also look at what could be achieved by policies solely at the federal level, many under the Administration's control.

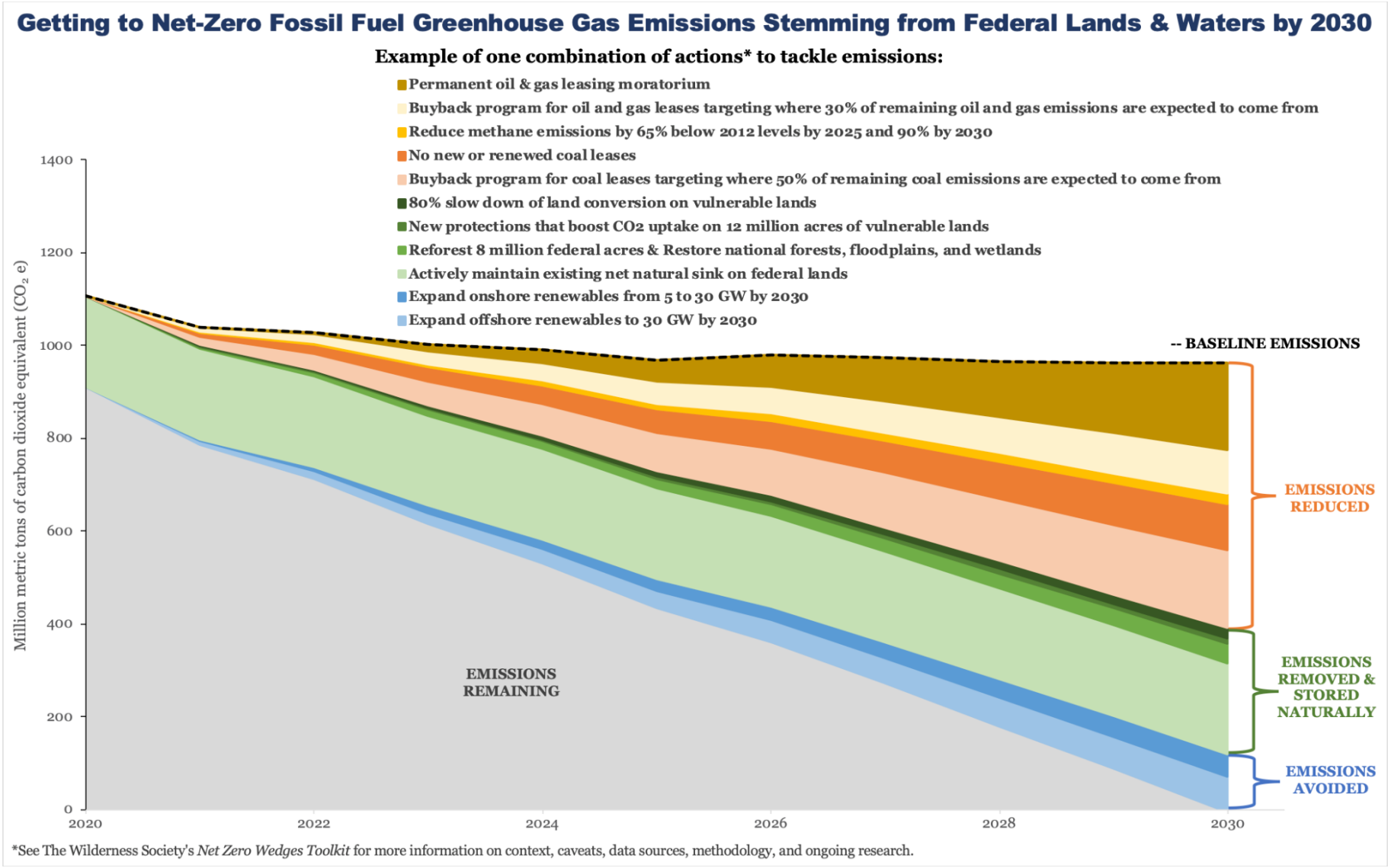
B. A combination of higher ambition actions could get us to net zero federal emissions by 2030 even without additional US-wide actions

One hypothetical combination of policies on federal lands and waters that could result in reaching net zero federal emissions in 2030 includes: instituting climate fees such as $50 per ton of CO2e for oil, gas, and coal, which would also create significant revenue that could be used for climate mitigation; expanding both onshore and offshore renewables to 30GW; and instituting a voluntary federal lease buyback program that scales down production at a level that aligns with a net zero target. Lease buyback programs should prioritize phasing out extraction where fuels are the most emissions-intensive, where community-involved assessments determine that local economies are most resilient, and should prioritize areas to protect indigenous rights, public health, and areas with high cultural and conservation value.[2]



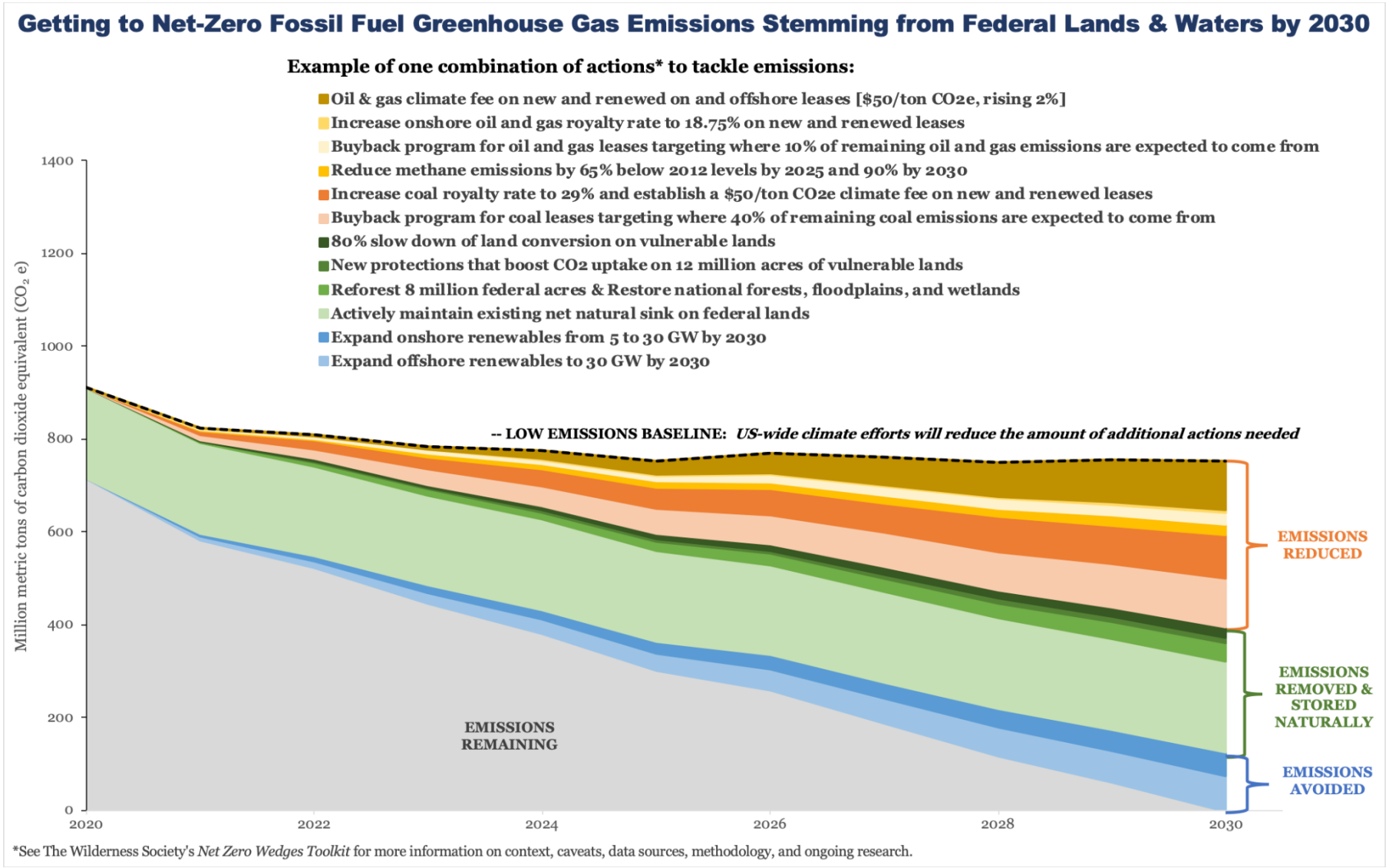
[2] Koski, J., Kartha, S. and Erickson, P. (2019). Principles for aligning U.S. fossil fuel extraction with climate limits. SEI Working Paper. Stockholm Environment Institute, Stockholm. https://www.sei.org/publications/principles-for-aligning-fossil-fuel-extraction-with-climate-limits/

C. Alternative combinations of higher ambition actions could also get us to net zero federal emissions by 2030 even without additional US-wide actions



D. State and US-wide climate efforts would reduce the amount of additional actions needed to get us to net zero federal emissions by 2030

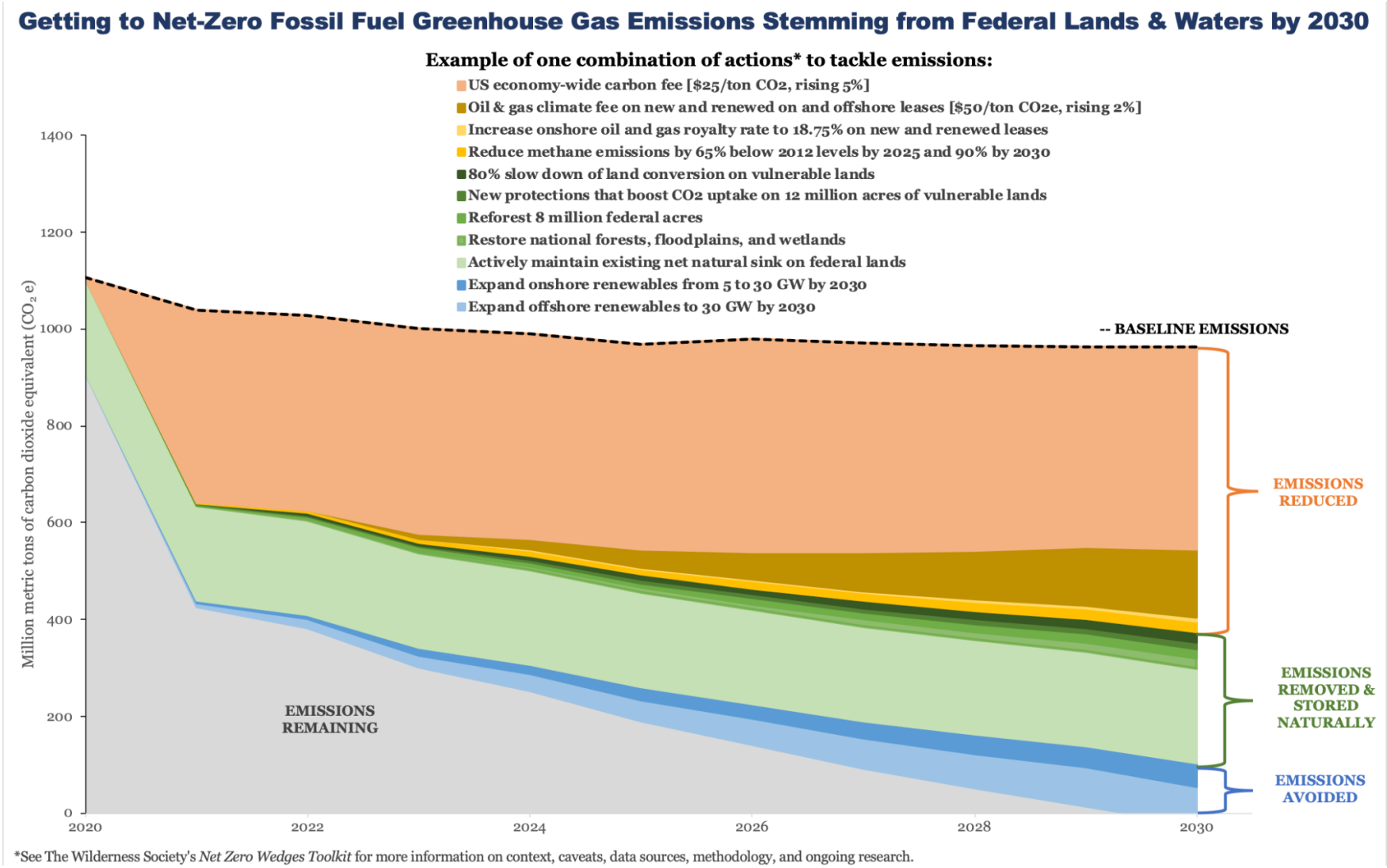
With so much climate action occuring right now at state and national levels, it is likely that these other actions will reduce demand for federal production as well. Given this, below we show the estimated reductions from a similar set of high ambition actions on federal lands and waters as Case B, but under a *Low Emissions Baseline* scenario.



*See The Wilderness Society's *Net Zero Wedges Toolkit* for more information on context, caveats, data sources, methodology, and ongoing research.

E. US-wide climate efforts would reduce the amount of additional actions needed to get us to net zero federal emissions by 2030

To illustrate the impact that prominent nation-wide policy tools would have on reducing the amount and scale of additional actions that would need to occur in order to reach climate goals for federal lands, below we show the projected annual emissions reductions stemming from federal lands and waters that is expected to come from a moderately priced economy-wide carbon fee.



SUMMARY TABLE OF TOOL OPTIONS FOR WEDGE FIGURES

Please see p. 2 of toolkit for context and caveats.

Below is an evolving list of potential actions across energy and natural systems involving our federal public lands and waters. Not all tools listed below are shown in the example wedge figures included in this toolkit. While this is a useful guide, a number of tools are mutually exclusive (e.g., cannot increase base royalty rates for oil and gas leases and also pursue a permanent leasing moratorium). Please contact TWS if interested in seeing a specific combination of policy actions.

The table includes known mechanisms to enact the tool, known legal authority, estimated annual gross federal emissions reductions below baseline in the year 2030, and the research that the emissions reduction estimate is based upon. More information on the data and assumptions used to derive these estimates can be found in the extended methodology section at the end of this toolkit.

Tools to Tackle Emissions from Federal Lands and Waters				
TOOL	MECHANISM	LEGAL AUTHORITY	ESTIMATED FEDERAL REDUCTIONS BELOW BASELINE IN 2030 (MMT CO_2e)	EXISTING RESEARCH ESTIMATE IS BASED ON
REDUCE EMISSIONS: REFORM FEDERAL FOSSIL FUEL PROGRAMS				
Increase on and offshore oil and gas royalty rate to 18.75% or 25%	- Impose increased royalty rate on lease issuance or renewal. - Establish royalty rate policy via Instruction Memorandum and in BLM handbook. - Increase royalty rate through legislation, e.g. Sen. Rosen & Sen Grassley's the Fair Return for Public Lands Act of 2021 (S. 264); Rep.	- Onshore (competitive new leases and renewals): MLA, 30 U.S.C. § 226(b)(1)(A); 43 C.F.R. § 3103.3-1. - Offshore: OCSLA, 43 U.S.C. §§ 1332(3), 1337; 30 C.F.R. § 560.202. - FLPMA, 43 U.S.C. § 1701(a)(9). - 30 U.S.C. § 352 (applying to leases on acquired land).	6-22 Depends if alone or combined with a climate fee: 18.75% alone: 9 25% alone: 22 18.75% with $50 climate fee: ~6 25% with $50 climate fee: ~15	Prest 2020 and Prest 2021 supplemental results Also have estimates if 25% increase to base royalty rate only applied to onshore leases.

	Porter's the Ending Taxpayer Welfare for Oil and Gas Companies Act of 2021 (H.R. 1517), Rep. Levin's Restoring Community Input and Public Protections in Oil and Gas Leasing Act of 2021 (H.R. 1503). - Institute increased royalty rate via rulemaking (but existing regulation is sufficient).			
Charge emissions fee on new and renewed on and offshore oil & gas leases ($50 or $100/ton CO_2e, rising 2% annually)	- Impose fee as compensatory mitigation in lease stipulation. - Incorporate into royalty rates. - Issue Instruction Memorandum requiring imposition of emissions fee on new and renewed leases.	- Onshore royalties(competitive new leases and renewals): MLA, 30 U.S.C. § 226(b)(1)(A); 43 C.F.R. § 3103.3-1 & 3101.1–3. - Offshore royalties: OCSLA, 43 U.S.C. §§ 1332(3), 1337; 30 C.F.R. § 560.202. - FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b), (c) & (h), 1732(a) & (b). - MLA, 30 U.S.C. § 226(b)(1)(A). - *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1200 (9th Cir. 2008) (requiring valuation of carbon emissions). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	131-186 Depends if alone or in combination with increase to minimum royalty rate: $50 alone: 131-142 $100 alone: 186 $50 and 18.75% RR increase combo: 148 $50 and 25% RR increase combo: 145-156	Prest 2020 and Prest 2021 supplemental results Also have estimates if fees only applied to onshore leases.
Compensatory mitigation emissions fee at APD stage for existing leases	- Impose fee as compensatory mitigation as a condition of approval on APDs. - Issue Instruction Memorandum requiring imposition of emissions fee on APDs.	- MLA, 30 U.S.C. § 226(b)(1)(A) & (g). - 43 C.F.R. §§ 3101.1-2 & 3101.1-3. - FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b), (c), & (h), 1732(a) & (b). - *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1200 (9th Cir. 2008) (requiring valuation of carbon emissions). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	~8% higher than reductions from emissions fee applied only on new and renewed leases	Based on Prest 2021 section 2.2.3

Permanent End to New O&G Leases	- Secretarial Order instituting a no leasing policy pursuant to the Secretary's discretion under the MLA. - BLM continually cancels quarterly lease sales in perpetuity because no lands are available for leasing under the MLA. - Rulemaking. - Legislation ending new leasing on federal public lands.	- MLA, 30 U.S.C. § 226(a). - FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b) & (c), 1732(a) & (b). - OCSLA, 43 U.S.C. § 1332(3). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	186	Prest 2021 supplemental results
End to New O&G Drilling Permits	- Secretarial Order instituting a no new drilling policy pursuant to the Secretary's discretion under the MLA. - Rulemaking. - Legislation ending new leasing on federal public lands.	- MLA, 30 U.S.C. § 226(a) & (g). - FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b) & (c), 1732(a) & (b). - OCSLA, 43 U.S.C. § 1332(3). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	No current estimate available	None
Federal oil and gas lease buyback program	- Develop a voluntary program for buying back existing leases with appropriate and effective valuation. - Legislation to support efforts, including authorization and appropriations.	- General modification of contract agreement or as settlement agreement via litigation. - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	Scale lease buyback program based on projected emissions remaining to reach net zero by 2030.	None
Reduce methane emissions	- EPA rulemaking. - BLM rulemaking. - NTL-4A enforcement. - Enhanced guidance via an IM.	- 30 U.S.C. § 225. - 43 U.S.C. §§ 1701(a)(8), 1702(b) & (c), 7411(a)(1). - 42 U.S.C. § 7411(b) and (d). - 43 C.F.R. § 3101.1-2.	4.5-23	BLM Methane Rule 2016 EA for 4.5 MMT Reduce methane emissions below 2012 levels by 90% by 2030: 23 MMT using TWS' FLEAT 2020 model

	- Best practices in RMPs and for new leases. - APD COAs. - Legislation, e.g. H.R. 1492 (Rep. Diana DeGette) Methane Waste Prevention Act			
Increase coal royalty rate to 29% on new and renewed leases	- Impose increased royalty rate on lease issuance or renewal. - Establish royalty rate policy via Instruction Memorandum and in BLM handbook. - Increase royalty rate through legislation.	- FLPMA, 43 U.S.C. § 1701(a)(9). - 30 U.S.C. § 207. - 43 C.F.R. § 3473.3-2.	6-8	Assumes a quarter of CEA 2016 impact in year 10 to adjust for updated lease renewal profile and lower demand for federal coal lease. Range depends on if using a low or central baseline.
Charge climate fee on new and renewed coal leases ($50 per ton CO2e)	- Impose fee as compensatory mitigation in lease stipulation. - Incorporate into royalty rates. - Issue Instruction Memorandum requiring imposition of emissions fee on new and renewed leases.	- FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b), (c) & (h). - MLA, 30 U.S.C. §§ 201, 208, 226(b)(1)(A). - *Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1200 (9th Cir. 2008) (requiring valuation of carbon emissions). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	86-105	Assumes a quarter of Gerarden, Stock, Reeder 2020 impact in year 2030 to adjust for updated lease renewal profile and lower demand for federal coal lease. Range depends on if using a low or central baseline.
End issuing new or renewing existing coal leases	- Secretarial Order instituting a no leasing policy pursuant to the Secretary's discretion under the MLA. - Rulemaking. - Legislation ending new leasing on federal public lands.	- MLA, 30 U.S.C. §§ 181, 182, 201. - Surface Mining Control and Reclamation Act, 30 U.S.C. §§ 1202, 1211(c). - FLPMA, 43 U.S.C. §§ 1701(a)(8) & (9), 1702(b) & (c), 1732(a) & (b). - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	82-100	Assumes a quarter of the derived 2030 impact of *no new leases or renewals tonnage cap* scenario from Gerarden, Stock, Reeder 2020 to adjust for updated lease renewal profile and lower demand for federal coal lease. Range depends on if using a low or central baseline.
Federal coal lease buyback program	- Develop a voluntary program for buying back existing leases with	- General modification of contract agreement or as settlement agreement via litigation. - NEPA, 42 U.S.C. §§ 4331(b), 4332(2)(C), (E) & (F).	Scale lease buyback program based on projected emissions	None

	appropriate and effective valuation. - Legislation to support efforts, including authorization and appropriations.		remaining to reach net zero by 2030.	
REMOVE EMISSIONS: PROTECT AND ENHANCE EXISTING NATURAL SEQUESTRATION AND STORAGE				
80% slowdown of land conversion on vulnerable lands	- Best practices in RMPs and new leases. - Administrative withdrawals under FLPMA. - Monument designations under the Antiquities Act. - Amend Forest Plans. - Issue nationwide policy via Instruction Memorandum. - Compensatory mitigation requirement on new leases or at APD stage.	- FLPMA, 43 U.S.C. §§ 1701(a)(8), 1702(a), (b), (c), (h), 1714. - NEPA, 42 U.S.C. §§ 4321, 4331, 4332. - 54 U.S.C. § 320301. - 76 Fed. Reg. 3843, 3846–47. - 36 C.F.R. Parts 218, 219.	22	CAP 2020 based on CSP 2019, Fargione et al 2018, Nature4Climate; and USGS LandCarbon
New protections that boost CO_2 uptake on 12 million acres of vulnerable lands			12	
Reforest 8 million federal acres	- Best practices in RMPs and new leases. - Administrative withdrawals under FLPMA. - Amend Forest Plans. - Issue nationwide policy via Instruction Memorandum. - Compensatory mitigation requirement on new leases or at APD stage.	- FLPMA, 43 U.S.C. §§ 1701(a)(8), 1702(a), (b), (c), (h), 1714. - NEPA, 42 U.S.C. §§ 4321, 4331, 4332. - 76 Fed. Reg. 3843, 3846–47. - 36 C.F.R. Parts 218, 219.	20	CAP 2020 based on Fargione et al 2018 supplementary data; Nature4Climate

Restore national forests, floodplains, and wetlands	- Best practices in RMPs and new leases. - Administrative withdrawals. - Monument designations under Antiquities Act. - Issue nationwide policy via Instruction Memorandum. - Amend Forest Plans. - Compensatory mitigation requirement on new leases or at APD stage.	- FLPMA, 43 U.S.C. §§ 1701(a)(8), 1702(a), (b), (c), (h), 1714. - NEPA, 42 U.S.C. §§ 4321, 4331, 4332. - 76 Fed. Reg. 3843, 3846–47. - 36 C.F.R. Parts 218, 219.	21	CAP 2020 based on Fargione et al 2018 supplementary data; USFS 2012 for baseline
Actively maintain existing net natural land sink	- Best practices in RMPs and new leases. - Administrative withdrawals. - Monument designations under Antiquities Act. - Issue nationwide policy via Instruction Memorandum. - Amend Forest Plans. - Compensatory mitigation requirement on new leases or at APD stage.	- FLPMA, 43 U.S.C. §§ 1701(a)(8), 1702(a), (b), (c), (h), 1714. - NEPA, 42 U.S.C. §§ 4321, 4331, 4332. - 54 U.S.C. § 320301. - 76 Fed. Reg. 3843, 3846–47. - 36 C.F.R. Parts 218, 219.	195	Merrill et al 2018
Actively maintain and enhance existing net natural sink for public waters	- Best practices in RMPs and new leases. - Administrative withdrawals. - Monument designations under Antiquities Act.	- FLPMA, 43 U.S.C. §§ 1701(a)(8), 1702(a), (b), (c), (h), 1714. - NEPA, 42 U.S.C. §§ 4321,4331, 4332. - 54 U.S.C. § 320301. - 40 C.F.R. § 122.26(a)(9)(i)(C), (D). - 76 Fed. Reg. 3843, 3846–47. - 36 C.F.R. Parts 218, 219.	No current estimate available	Estimates for aquatic sequestration baseline not available

	- Issue nationwide policy via Instruction Memorandum. - Compensatory mitigation requirement on new leases or at APD stage.			
AVOID EMISSIONS: EXPAND RESPONSIBLE RENEWABLE DEVELOPMENT				
Expand onshore renewables from 5 to 30 GW by 2030	- Best practices in RMPs. - Agency permitting prioritization.	- 42 U.S.C. § 13311-13317. - 43 U.S.C. §§ 1702(c), (h). - 43 C.F.R. Parts 2800, 2880	31-51	HR 133 2021 spending bill set a target to permit at least 25GW of new renewables on federal land by 2025; continued progress could reach 30 GW by 2030. Assume historic shares by renewable type stays constant: 52% utility scale solar PV, 22% wind, and 26% geothermal.
Expand offshore renewables to 30 GW by 2030	- Agency permitting prioritization.	- 42 U.S.C. § 13311-13317. - 43 U.S.C. §§ 1337, 1344(a)(1). - 30 C.F.R. §§ 585.100-585.1019	76	30 GW offshore wind deployment by 2030 is current Biden Administration commitment

METHODOLOGY

Baseline Historic and Projected Emissions

Baseline historic (2005-2019) federal fossil fuel emissions: For historic emission calculations we use TWS' Federal Lands Emissions Accountability Tool (FLEAT) results modeled by Apogee EP.[3] FLEAT aggregates historic (2005-2019) production from federal lands and waters collected by the Office of Natural Resource Revenue.[4] The model then creates an emissions profile for each of the five fuel sources [onshore oil, offshore oil, onshore gas, offshore gas, and coal], based on the methodology used in the Environmental Protection Agency's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018, which includes carbon dioxide, methane, and nitrous oxide.[5] To calculate downstream emissions, we multiply production volumes by sector specific energy flows from EIA's Annual Energy Review[6] and apply sector specific emission factors derived by multiplying average annual heat content by fuel type and consuming sector from EIA by EPA's emission factors by gas or carbon content coefficient by fuel type.[7] To calculate upstream and midstream emissions by fuel type, we scale down EPA's national-level, fuel- and segment-specific emissions data using a ratio of federal production to EIA national production.

Baseline projected (2020-2030) federal fossil fuel emissions: For onshore and offshore oil and gas, we use Prest 2021 supplemental results for baseline projections.[8] For coal, we use FLEAT 2020 central federal coal production projection estimates. Apogee EP imputes future federal coal production to 2030 via a regularized synthetic control method[9] using forecasts from the reference case scenario in the EIA's Annual Energy Outlook 2020 as control variables.[10] Same as with historic emissions, we calculate associated lifecycle greenhouse gas emissions based on EPA calculation methods and assumptions employed by the EPA Inventory. We combine FLEAT 2020 predicted coal emissions, with Prest 2021 onshore and offshore oil and gas predicted emission estimates to obtain total projected federal fossil fuel baseline emissions estimates from 2020 to 2030.

Low production alternative baseline: This toolkit focuses on federal actions that are largely under the Administration's control that can reduce emissions, but economy-wide actions such as a clean energy standard for the power sector and higher fuel economy standards have the

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[3] https://www.wilderness.org/articles/article/federal-lands-emissions-accountability-tool
[4] US Office of Natural Resources Revenue (2020) Calendar year production data (2005-2019). US Department of the Interior, ONRR. https://revenuedata.doi.gov/downloads/production/calendar_year_production.xlsx
[5] US Environmental Protection Agency (2020) Inventory of US Greenhouse Gas Emissions and Sinks:1990-2018. US EPA 430-R-20-002. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
[6] US Energy Information Administration (EIA) (2020) Annual Energy Review. https://www.eia.gov/totalenergy/data/annual/
[7] US EPA (2018) EPA emission factors for greenhouse gas inventories. Modified 9 March 2018. https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf
[8] Prest B (2021) Supply-side reforms to oil and gas production on federal lands: Modeling the implications for climate emissions, revenues, and production shifts. Resources for the Future. Working Paper 20-16. Updated March 2021 https://www.rff.org/documents/2872/WP_20-16_Updated.pdf
[9] Doudchenko N, Imbens G (2016) Balancing, Regression, Difference-In-Differences and Synthetic Control Methods: A Synthesis. https://arxiv.org/abs/1610.07748.
[10] US Energy Information Administration (EIA) (2020a) Annual Energy Outlook 2020. https://www.eia.gov/outlooks/aeo/

potential to substantially lower the baseline projected production and thus the baseline emissions.[11] To account for the uncertainty of US-wide climate actions that are currently under debate, in some wedge versions we show the estimated reductions from a set of actions using a *Low Emissions Baseline* scenario. The *Low Emissions Baseline* scenario uses FLEAT 2020 low projection estimates for coal and a 25% reduction from Prest 2021 baseline for oil and gas emissions. In turn, we assume a subsequent 25% reduction from estimated annual impacts of oil and gas supply-side actions that are based on Prest 2021.[12]

Baseline ecosystem carbon emissions: For baseline land use emissions we use 2005-2014 annual average ecosystem carbon emissions fluxes (harvesting, wildfire, and other carbon removals due to land use, land-use change and disturbance such as agricultural production and urbanization losses) from Merrill et al 2018.[13] These emissions are baked into the "maintain existing net natural sink" wedge.

Tools to Reduce Federal Fossil Fuel Emissions

Oil and Gas

Estimates for oil and gas tools are based on Prest 2020 and Prest 2021 supplemental annual results.[14] Increasing royalty rates to 18.75% for new and renewed oil and gas leases would reduce federal emissions by between 16 and 24 MMT of CO2e on average out to 2050 (or between 4 to 7 annual average global emissions reductions) and would raise an additional $1 to $2.1 billion in federal revenues per year compared to business as usual.[15] Increasing royalty rates to 25% for new and renewed onshore and offshore oil and gas leases would reduce federal emissions by between 37 and 57 MMT of CO2e on average out to 2050 (or between 10 and 17 annual average global emissions reductions) and would raise an additional $2.6 to $5.3 billion in federal revenues per year compared to business as usual.[16] Instituting a permanent moratorium on new and renewed onshore and offshore oil and gas leases would reduce federal emissions by between 314 and 460 MMT of CO2e on average out to 2050 (or between 85 and 147 annual average global emissions reductions), but would reduce annual federal revenues by between $5.5 and $11.1 billion per year compared to business as usual.[17]

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[11] For more information on economy-wide standards and methods to achieving Biden's commitment to decarbonize the electricity sector by 2035, *see* Goldman School of Public Policy, *2035: The Report*, University of California Berkeley (June 2020), *available at:* *https://www.2035report.com/* ; *see also* Strokes, L., et al, *A Roadmap to 100% Clean Electricity by 2035,* Evergreen Collaborative (February 2021), *available at:*https://www.filesforprogress.org/memos/evergreen-ces-report.pdf

[12] 25% reduction is in line with the difference between EIA's Annual Energy Outlook 2021 *Reference* case and *Low oil and gas supply* case for year 2030. https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2021%C2%AEion=0-0&cases=ref2021~lowogs~aeo2020ref&start=2019&end=2050&f=A&sourcekey=0

[13] Merrill MD et al (2018) Federal Lands Greenhouse Emissions and Sequestration in the United States — Estimates for 2005–14: US Geological Survey Scientific Investigations Report 2018–5131. https://doi.org/10.3133/sir20185131

[14] Prest B (2020) Supply-side reforms to oil and gas production on federal lands: Modeling the implications for climate emissions, revenues, and production shifts. Resources for the Future. Working Paper 20-16. Original paper release September 2020: https://media.rff.org/documents/RFF_WP_20-16_Prest.pdf?_ga=2.8733237.1240995157.1618309948-1103774153.1607126855 and Prest 2021. RFF WP 20-16 updated on March 15, 2021. https://www.rff.org/documents/2872/WP_20-16_Updated.pdf

[15] Prest 2021. Table 1, p.25 and Table A.9, p.65

[16] Prest 2021. Table 1, p.25 and Table A.9, p.65

[17] Prest 2021. Table 1, p.25 and Table A.9, p.65

Another supply-side policy option is to implement a fee per ton of CO2e that is pegged to production. The amount that a climate fee should be depends on the desired outcomes. A $50/ton CO2e fee applied to new and renewed oil and gas leases would reduce annual federal emissions by between 225 and 292 MMT of CO2e on average out to 2050 (or between 61 to 69 annual average global emissions reductions) and would raise an additional $2.9 to $5.9 billion in federal revenues per year compared to business as usual.[18] A $100/ton CO2e fee represents a fee that is close to or equivalent to the production and emissions impacts that would come from a permanent leasing moratorium. Prest and Stock 2021 also look at the impact of charging distinct oil and gas climate fees.[19] The highest that they modeled, a $90/ton CO2e oil climate fee and a $50/ton CO2e gas climate fee would combined have the same impact on emissions reductions as a permanent leasing moratorium.

If the desired policy outcome is to maximize global emission reductions but to not go below business-as-usual federal revenue from the federal oil and gas programs, then a policymaker would choose a $50 climate fee/ton on gas and a $70 climate fee/ton on oil.[20] This would mean an increase in revenue of about $400 million per year above BAU and result in around 71-123 MMT CO2e in average global emission reductions per year out to 2050 (based on leakage rates that translates to 258 MMT CO2e annual average reduction in gross federal emissions). There are a number of distinct oil and gas carbon fee combinations that would get relatively close to the same amount of global emission reductions without losing money from a BAU scenario, e.g., a fee on gas at about $15 per ton and a fee on oil around $80 per ton would still mean an increase in revenue of about $200 million per year above BAU and result in around 70-123 MMT CO2e in global emission reductions over 30 years.

To estimate impact of applying a climate fee on all new drilling permits for onshore and offshore oil and gas, we apply Prest's finding that being able to apply the policies modeled in his paper to all new wells would result in around an 8% increase in cumulative emissions reductions compared to federal emission reductions that would come from being able to apply an oil and gas climate fee only to new leases.[21]

Methane

We currently include two options to represent a high- and low-end range of federal methane emission reduction potential that could stem from actions impacting lifecycle methane emissions from oil and gas production coming from federal public lands and waters in 2030. For reference, FLEAT estimates baseline federal lifecycle oil and gas methane emissions in 2030 to total more than 27 MMT CO2e (using a global warming potential of 25).[22]

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[18] Prest 2021. Table 1, p.25 and Table A.9, p.65

[19] Prest B. Stock J H. (2021) Climate Royalty Surcharges. NBER Working Paper 28564. Cambridge, MA. http://www.nber.org/papers/w28564

[20] See tables 4 and 5. Prest B. Stock J H. (2021) Climate Royalty Surcharges. NBER Working Paper 28564. Cambridge, MA. http://www.nber.org/papers/w28564

[21] Prest 2021 section 2.2.3

[22] To facilitate comparisons to US-wide emissions, we use the same global warming potentials as the EPA uses for the annual Inventory of US Greenhouse Gas Emissions and Sinks submitted each year to the UNFCCC. For more on why the EPA uses the IPCC AR4 GWP values in the US inventory see: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#Learn%20why

For a high-end estimate we model the methane emissions reductions that would be required to be in line with the goal included in the Methane Waste Prevention Act of 2021 -- reduce lifecycle oil and gas methane emissions in 2025 to levels at least 65% below 2012 levels and in 2030 to levels at least 90% below 2012 levels.[23] We use FLEAT calculations for 2012 lifecycle methane emissions stemming from oil and gas production on public lands and waters (42.8 MMT CO2e in 2012) and reducing 2025 methane emissions (baseline 2025 expected to be 28.1 MMT CO2e in 2025) by 65% below 2012 levels by 2025 (65% below 2012 levels by 2025 [42.8-(42.8*0.65)=15] means reduce expected 2025 levels by 15 MMT. If baseline 2025 methane emissions are 28.1 MMT CO2e, then a 15 MMT reduction would mean reaching 13.1 MMT in 2025 [28.1-15=13.1]. Then, 90% of 2012 levels by 2030 [42.8-(42.8*0.9)=would mean methane emissions would not exceed 4.3 MMT in 2030. (given that baseline projected methane emissions are 27.2 MMT CO2e, then that would mean reducing baseline methane emissions by at least 22.9 MMT CO2e in 2030 [27.2-4.3=22.9].

Emission estimates weigh methane by their 100-year global warming potential.[24] FLEAT assumes methane leakage rates based on EPA official inventory methods; these likely underestimate emissions. EPA revised its methane emissions methodology in 2019 to show a 1.1% leakage rate for the natural gas system, which is below top-down estimates of 2.36%.[25]

The BLM's 2016 Waste Prevention Rule (commonly referred to as the BLM Methane Rule), imposed new regulations on natural gas producers to reduce wasted gas (methane emissions), on federal public lands from venting, flaring, and leaks.[26] Due to a series of administrative and judicial interventions, the rule was never fully implemented and on October 8, 2020 a US District Court vacated the vast majority of the rule — including the parts pertaining to the loss of gas through venting, flaring, and leaks.[27] (The effect of the ruling is that venting, flaring, and avoidably/unavoidably lost determinations are subject to NTL-4A.) The Biden administration has announced a clear intention to pursue actions to reduce methane emissions in the US including from federal public lands and waters.

For a low-end range of methane emission reductions, we currently use a proxy that would only address a portion of reduction potential targeting upstream, onshore federal oil and gas production. The 2016 Waste Prevention Rule EA found that upon full implementation the rule would prevent an estimated 4.5 MMT CO2e of methane emissions per year from oil and gas

[23] Methane Waste Prevention Act of 2021. Introduced in House on 2 March 2021. Sec. 2(a)(1)and (a)(2). https://degette.house.gov/sites/degette.house.gov/files/DeGette%20Methane%20Waste%20Prevention%20Act%20210302.pdf
[24] Intergovernmental Panel on Climate Change (2007) TS.2.5 Net Global Radiative Forcing, Global Warming Potentials and Patterns of Forcing. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html
[25] Alvarez R et al (2018) Assessment of methane emissions from the U.S. oil and gas supply chain. Science. 361, 6398: 186-88. http://doi.org/10.1126/science.aar7204
[26] BLM, Waste Prevention, Production Subject to Royalties, and Resource Conservation, 81 Fed. Reg. 83,008, 83,008 (Nov. 18, 2016).
[27] Parts vacated included including all of 43 C.F.R. subpart 3179 and the waste minimization plan requirement of 43 C.F.R. §3162.3-1(j). This case is on appeal as of April 2021.

production on federal lands.[28] The 2016 EA assumed that the EPA 2016 rule targeting new sources was in place and removed any overlap. As such, a rule that addresses both existing and new sources from oil and gas production on federal public lands (and waters) would reduce more than the 4.5 MMT CO2e estimated in the 2016 EA. More will be done to improve this estimate based on modeling of new proposed actions, current methane emission projections, and the estimated impact of specific proposed actions in as much as it would entail tighter restrictions or cover more sources that enacted state regulations.

Coal

Between 2005 and 2019, 39% of US coal production came from federal lands. The single largest basin for federal coal production is the Powder River Basin (PRB) in Wyoming and Montana. Coal from those two states made up over 89% of federal coal in 2019 and it is almost entirely surface-mined. The DOI has broad statutory discretion in setting royalty rates for new or renewed leases, although they cannot be changed on existing leases.[29] There has been little demonstrated demand for new federal coal leases since 2016 and future demand for new federal coal leases regardless of policy is unclear. Increasing royalty rates or adding a climate fee for federal coal will only be able to reduce emissions if there is demand for new coal leases or still demand for renewed leases. Yet, in 2019, 2020, and 2021 the US Energy Information Administration (EIA) projects that US coal production in the PRB will stabilize unless new regulations are implemented.[30]

Like for oil and gas, for federal coal we include a number of distinct policy options. Gerarden, Stock, Reeder 2020, estimate a 96.7% decline in PRB coal production and a 13% decline in U.S. power sector emissions in 2030 compared to baseline due to a federal coal climate surcharge set at approximately 100% the value of the social cost of carbon.[31] Gerarden et al 2020 assumes that policies start to be implemented in 2016 and although original lease terms are 20 years, the authors use linear approximation modeling to apply a federal lease renewal profile and assume that 100% of leases weighted by tonnage would be covered by these policies as of 2025 (year 10). Similarly CEA 2016 uses a 10 year horizon and estimates that increasing federal coal royalty rates to 29% in 2016 would result in a 7% decrease in federal coal production and an annual decrease in US-wide emissions of 32 million metric tons of CO2 after year 10.[32] To approximate what an updated lease renewal profile means as of 2021, we turn to Figure 2 in

[28] US Department of the Interior, Bureau of Land Management. (10 Nov 2016). Environmental Assessment: Waste Prevention, Production Subject to Royalties, and Resource Conservation DOI-BLM-WO-WO2100-2017-0001-EA. https://downloads.regulations.gov/BLM-2016-0001-9128/content.pdf

[29] Title 30, Section 207(a) of the US Federal Code states conditions on federal leases; also see Krupnick, Alan, Joel Darmstadter, Nathan Richardson, and Katrina McLaughlin. 2015. "Putting a Carbon Charge on Federal Coal: Legal and Economic Issues." Resources for the Future Discussion Paper 15-13.

[30] US Energy Information Administration (EIA). 2019. Annual Energy Outlook 2019: With Projections to 2050. https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf.

[31] Gerarden TD, Reeder WS, Stock JH (2020) Federal Coal Program Reform, the Clean Power Plan, and the Interaction of Upstream and Downstream Climate Policies. American Economic Journal: Economic Policy 12(1): 167–199. https://doi.org/10.1257/pol.20160246

[32] Executive Office of the President of the United States, Council of Economic Advisers (CEA), The Economics of Coal Leasing on Federal Lands: Ensuring a Fair Return to Taxpayers (Washington, D.C.: June 2016). https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160622_cea_coal_leasing.pdf
Although on p.5 these 32 million metric tons in annual emission reductions are described as net decrease in total nationwide emissions, Table 2 on p. 26 refers to 32 MMtCO2/year as the "direct reduction from reduced coal use nationwide." Based on the methodology described in the paper, it appears this accounts both for small shifts to nonfederal coal and overall reductions in US coal consumption and reduced emissions due to shifts to other fuel sources for power generation.

Gerarden et al 2020 that shows the federal coal lease renewal profile as of January 2016 based on BLM data compiled by Headwaters Economics. At year 5 (2021 in Gerarden et al 2020 Figure 2), approximately half of the leases weighted by tonnage would have already been readjusted (typically by renewal) and that leaves about half of the remaining leases weighted by tonnage to come up for renewal in the next 15 years. Based on the data in the figure, approximately 95% of leases weighted by tonnage would come up for readjustment by year 14 (2030) and all would come up for readjustment by year 17 (2033). To adjust for the updated approximated federal coal lease renewal profile, we assume that half of the impact of actions estimated by Gerarden et al 2020 and CEA 2016 could be reached by 2030 if policies begin in 2021 rather than 2016.

To improve these estimates, we need to know the actual demand for coal lease renewals (weighted by tonnage) since January 2016, the amount of tonnage remaining that could be covered by these policies, and updated demand for new and renewed federal coal leases. There is a lot of uncertainty about the impact of policies on new federal coal leases with the last new sales reported by DOI being in 2017 and it is difficult to find public data on annual changes in federal lease renewals. Even though our baseline remains based on AEO projections that show demand for coal in the PRB remaining high absent new policies and the numerous uncertainties that we outline above, for now we remain conservative and assume that there is only half of the historic demand for new and renewed federal coal leases. When combining this assumption to account for decreased demand for new and renewed federal coal leases with the updated coal lease renewal profile weighted by tonnage, we assume that these policies that can only be applied to new and renewed federal coal leases would have 25% of the impact in year 10 as what was estimated by Gerarden et al 2020 and CEA 2016. In other words, we assume a 1.75% reduction in 2030 federal coal production due to increasing base royalty rates to 29% (as opposed to the 7% reduction found by CEA 2016) and we assume a 24.2% reduction in 2030 federal coal production due to a climate fee charging the full social cost of carbon added on to royalty rate fees (as opposed to the 97.6% reduction found by Gerarden et al 2020.

To estimate the impact of a policy in which the federal government issues no new coal leases and stops renewing existing federal coal leases, we use Gerarden et al 2020 quantity limit policy scenario that finds a *no new leases or renewals* scenario would result in a 90.43% reduction in PRB coal in 2040 and 15.2% decline in US-wide power sector emissions from a *business-as-usual no surcharge and no CPP* scenario. To derive what that estimate would have been for the impact by year 2030, we apply the 2030 versus 2040 share of PRB production reduction for the *100% SCC surcharge and no CPP* scenario compared to baseline. We find that a *no new leases or renewals* scenario would result in around a 92% decline in PRB coal production in 2030.[33] Again, same as with the other cases that are based on assumed demand for new and renewed federal coal leases as of 2016, we assume only 25% of Gerarden et al 2020

[33] Gerarden et al 2020. Table 6, p.193 for *no new leases or renewals* scenario and derived 12.34% decline in year 2030 based on impact of *100% SCC surcharge and no CPP* case for 2040 in Table 6 vs for 2030 in Table 4. The IPM results found approximately 0.81 of the impact in 2040 would occur by 2030. As such, approximately 12.3% reduction (0.81*0.152) would be estimated for the emissions reductions achieved by 2030 for a *no new leases or renewals* policy.

impact to adjust for an updated lease renewal profile and a lower demand for coal lease readjustments.

To illustrate the impact that prominent nation-wide policy tools would have on reducing projected annual emissions stemming from federal lands, we include an economy-wide carbon fee policy based on EIA's AEO 2020 *$25 carbon fee* side case.[34] We apply the annual percent change to PRB coal production between AEO 2020 *reference case* and AEO 2020 *$25 carbon fee* side case to the FLEAT 2020 coal baseline. AEO 2020 *$25 carbon fee* side case assumes economy-wide implementation of a $25 per MT of carbon dioxide starting in 2021. The fee increases annually by 5% (in real dollars). AEO 2020 assumes that the revenues are distributed back to consumers via lump-sum payments. Although there will be some change to federal oil and gas production as well in the first decade, the majority of the impact of this economy-wide fee is on coal production. We estimate less than a 1% change to the other federal fuel types out to 2030 due to this policy.

Tools to Protect & Enhance the Existing Natural Carbon Sink on Federal Lands

In November 2018 the USGS published a study estimating the net greenhouse gas emissions of federal lands, including ecosystem carbon emissions and sequestration on those lands.[35] Merrill et al. (2018) estimates terrestrial ecosystems (forests, grasslands, and shrublands) on federal lands sequestered an average of 195 MMT CO2e/year between 2005 and 2014 when accounting for interannual flux. For now, we assume that going forward actions that would maintain this existing annual average net natural carbon sink on US onshore federal lands.

Next we include the estimated impact from existing research on what 5 distinct actions could have to enhance the federal onshore natural carbon sink via new protections, reforestation, and restoration. Both the level of actions and resulting impacts are directly pulled from calculations done by Center for American Progress (CAP) reported in 2020 that are specific to actions entirely focused on federal public lands.[36] Based on existing data and available research CAP estimates that a combination of five additional actions that can enhance the existing natural sink on federal public lands -75 MMT CO2e in 2030. Below is an overview of the data and research used for CAP's calculations of each action.

CAP calculations include two actions that require additional protections including: (1) new protections that force land conversion to slow down by 80% on vulnerable lands to avoid conversion of more than 1.2 million acres of forests and other natural areas that otherwise would have been cleared for human use by 2030 and (2) additional land protections that boosts future sequestration potential of the 12 million acres of vulnerable lands. To estimate the emissions

[34] US Energy Information Administration (EIA) (2020b) Annual Energy Outlook 2020: Alternative Policies. Released 5 March 2020. https://www.eia.gov/outlooks/aeo/section_issue_policies.php
[35] Merrill et al. 2018
[36] Richards R. (2020) The Plan for a 100 Percent Clean Future Must Include Saving Nature. Center for American Progress (CAP). 11 August 2020. https://www.americanprogress.org/issues/green/reports/2020/08/11/489154/plan-100-percent-clean-future-must-include-saving-nature/

reductions impacts of both these actions that involve additional protections, CAP offers the following explanation of its methodology:

> *The climate benefits of new protections for lands were calculated in two parts: the quantity of emissions avoided by protecting lands that would be lost to development between now and 2030 and the amount of greenhouse gases sequestered in 2030 by these same lands. Both components are based on observed trends in natural area loss and generalized per-acre estimates for annual sequestration rates and stored aboveground carbon in the United States.*
>
> *To account for additionality, the only lands considered in calculations were those that can be reasonably expected to be converted for development by 2030, absent new protections. CAP based these calculations on analyses made by Conservation Science Partners[37] of natural area loss from 2001 to 2017 and assume that this trend will continue through 2030. It was assumed that the pursuit of a 30×30 goal would not completely offset development patterns, and therefore estimate that only 80 percent of natural area loss will be avoided through new land protections by 2030. This estimate is much lower than the full extent of new protections needed to achieve a 30 percent goal because not all of the land that would be protected in pursuit of a 30×30 goal would have otherwise been lost to development by 2030.*
>
> *The per-acre estimates of both carbon storage and annual sequestration draw on peer-reviewed research and other publicly available data for ecosystems in the United States.[38] CAP generalized these estimates because the specific locations of avoided natural area losses between now and 2030 are unknown.*

CAP estimates the impact of reforesting 8 million acres on federal lands -- an amount chosen to reflect the land's historical natural state -- by using peer-reviewed spatial analyses to estimate the baseline area on federal lands that were historically forested but currently have no tree cover.[39] The authors base annual sequestration in 2030 on acres that would need to be planted between now and 2030 to reforest 8 million acres, and uses sequestration rates from Fargione et al 2018 supplementary data.

Finally, CAP calculates the net federal emissions reductions of two restoration actions that we include in this toolkit: (1) increasing restoration investments in order to restore at least 6 million

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[37] CAP 2020 Endnote 9: Conservation Science Partners (2019) Methods and approach used to estimate the loss and fragmentation of natural lands in the conterminous U.S. from 2001 to 2017. Technical report. Truckee, CA.
https://www.csp-inc.org/public/CSP_Disappearing_US_Tech_Report_v101719.pdf.

[38] CAP 2020 Endnote 28: Sources include online resources and peer-reviewed literature, including Nature4Climate, "U.S. State Mapper," available at https://nature4climate.org/u-s-carbon-mapper/ (last accessed August 2020); Fargione and others, "Natural climate solutions for the United States" https://advances.sciencemag.org/content/4/11/eaat1869; U.S. Geological Survey, "LandCarbon," available at https://www.usgs.gov/mission-areas/land-resources/science/landcarbon?qt-science_center_objects=0#qt-science_center_objects (last accessed August 2020).

[39] CAP 2020 Endnote 29: Nature4Climate, "U.S. State Mapper," available at https://nature4climate.org/u-s-carbon-mapper/ (last accessed August 2020);
Sample, "Potential for Additional Carbon Sequestration through Regeneration of Nonstocked Forest Land in the United States."

acres of national forests per year, and (2) restoring floodplains and wetlands. CAP bases annual average sequestration estimates for forest and wetland restoration activities from Fargione et al 2018 supplementary data. CAP estimates acreage gained from specific activities based on increases above reported baselines and potential acreage still needing restoration in each of these ecosystems based on reports by the US Forest Service[40] (65-82 million acres of national forest land need restoration and 2-4 million acres of restoration work each year) and from the US Environmental Protection Agency[41] (around half of remaining US wetlands need restoration).

Tools to Ramp up Responsible Renewables and Aid US Transition to Decarbonized Electricity Grid by 2035

A lot of work has to come from supply- and demand-side actions in order to achieve the rapid transition to a low carbon energy system that is needed to bring US emissions in line with what is needed for a chance to avoid a 1.5℃ rise in global temperatures by 2100. Renewable generation projects in the US have to dramatically ramp up in order to meet top climate targets -- to achieve 50-52% below 2005 GHG levels by 2030 (the new US NDC), 100% decarbonization of the US electricity grid by 2035, and net-zero emissions in the US by 2050. According to Princeton's Net-Zero America Project, achieving 100% decarbonization of the US electricity grid by 2035 requires that 60% of the US grid come from wind and solar generation by 2035.[42] For reference, we are currently at about 10% of the US grid being wind and solar. The Zero Carbon Action Plan found that to achieve Biden's goal of net-zero emissions by 2050 the US will need to add renewable generation capacity by an average of 100 gigawatts every year until 2050 to increase from the 2020 level of 284 GW[43] of renewable generation capacity in the US to 3,000 GW by 2050.[44] This new generating capacity will mostly be from wind and solar.

Achieving this level of renewable energy expansion will require massive actions in the next 10 years and US federal public lands and waters have much to contribute. This toolkit includes various ambitions for renewable generating capacity expansions by 2030 for both onshore and offshore, but it does not explicitly delineate the numerous actions needed to invest in incentives and infrastructure necessary to responsibly expand both onshore and offshore federal renewable generating capacity by 2030. Demand side actions to meet these clean energy priorities include: renewable energy subsidies, massive investment in infrastructure expansion for wind and solar transmission, investment in expansion of electric vehicle charging stations, and emission

[40] CAP 2020 Endnote 30: U.S. Forest Service, "From Accelerating Restoration To Creating and Maintaining Resilient Landscapes and Communities Across the Nation: Update on Progress From 2012"; U.S. Forest Service, "Increasing the Pace of Restoration and Job Creation on Our National Forests" (Washington: U.S. Department of Agriculture, 2012), available at https://www.fs.usda.gov/sites/default/files/media/types/publication/field_pdf/increasing-pace-restoration-job-creation-2012.pdf

[41] CAP 2020 Endnote 31: U.S. Environmental Protection Agency, "Wetlands – Status and Trends," available at https://archive.epa.gov/water/archive/web/html/vital_status.html (last accessed August 2020); U.S. Environmental Protection Agency, "EPA Releases Report Showing Nearly Half of Nation's Wetlands in Good Health," Press release, May 11, 2016, available at https://archive.epa.gov/epa/newsreleases/epa-releases-report-showing-nearly-half-nations-wetlands-good-health.html

[42] Princeton University. Net Zero America Project. https://environmenthalfcentury.princeton.edu/

[43] U.S. EIA. Electric Power Monthly, February 2021, preliminary data for 2020. https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php#:~:text=At%20the%20end%20of%202020,solar%20photovoltaic%20electricity%20generating%20capacity.

[44] Sustainable Development Solutions Network (SDSN). 2020. Zero Carbon Action Plan. New York. p.33: https://irp-cdn.multiscreensite.com/6f2c9f57/files/uploaded/zero-carbon-action-plan.pdf

reduction credits or offsets. Supply-side actions, especially for DOI, largely involve increased permitting efficiency and prioritization. A smart from the start approach is crucial to ensuring responsible development on public lands that protects our natural and cultural heritage.[45]

Onshore renewable energy

Less than 5% of the total U.S. solar, wind and geothermal capacity comes from projects on public lands.[46] As of 2019 there were 96 utility-scale renewable energy projects operating on public lands and these projects had a total generating capacity of 5,041 MW. TWS has assessed that expanding onshore federal renewables by 25 GW from the current 5GW to reach 30GW operating by 2030 is a reasonable goal for responsible federal onshore development. This goal is also consistent with the target included in the government spending bill approved by Congress in December 2020: to permit at least 25GW of onshore renewables on federal land by 2025 through management of public lands and administration of federal laws.[47] A far less ambitious goal would be to simply reach the 10GW permitting level that was set in 2005.[48]

In this toolkit we assume the share of additional renewable generating capacity by technology type remains constant as the existing 5 GW as documented in a joint report released by TWS and Yale Center for Business and the Environment in May 2020.[49] The additional 25 GW is assumed to be 52% utility scale solar PV (13 GW), 22% wind (5.5 GW), and 26% geothermal (6.5 GW). We use EPA's AVERT tool to calculate estimated avoided emissions in 2030.[50] The estimate varies based on where the projects are located.

Offshore renewable energy

For offshore, we include emission reduction estimates from a relatively low goal of achieving 15 GW of offshore renewable generating capacity in federal public waters (meaning in the outer continental shelf (OCS)) by 2030 and a moderate goal of achieving 30 GW in federal public waters by 2030. According to BOEM, the OCS blocks leased as of July 2016 had the potential to support 14.6 GW of commercial wind generation if leases were developed as planned.[51] The Biden Administration set a goal of deploying 30 GW of offshore wind by 2030.[52]

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[45] Springer N. Daue A. (2020) Key Economic Benefits of Renewable Energy on Public Lands. Yale Center for Business and the Environment and The Wilderness Society. https://www.wilderness.org/renewableenergyreport
[46] *Id.*
[47] Consolidated Appropriations Act, 2021. Sec. 3104. (b).
https://rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-116HR133SA-RCP-116-68.pdf
[48] The Energy Policy Act of 2005 set a goal for DOI to permit 10 GW of renewables by 2010.
https://www.congress.gov/109/plaws/publ58/PLAW-109publ58.pdf
[49] Springer N. Daue A. (2020) Key Economic Benefits of Renewable Energy on Public Lands. Yale Center for Business and the Environment and The Wilderness Society. https://www.wilderness.org/renewableenergyreport
[50] US EPA. AVoided Emissions and geneRation Tool (AVERT).
https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert#when
[51] Bureau of Ocean Energy Management (BOEM) 5 year leasing program EIS 2017-2022: p. 1-12.
[52] FACT SHEET: Biden Administration Jump Starts Offshore Wind Energy Projects to Create Jobs.
https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

To calculate roughly what these offshore GW targets mean in terms of avoided emissions, we use the same ratio as the BOEM National Offshore Wind Strategy Report, 1 GW = 2.55 million metric tons of CO2e avoided per year.[53]

[53] BOEM (2016) National Offshore Wind Strategy Report. 2016.
https://www.boem.gov/sites/default/files/renewable-energy-program/National-Offshore-Wind-Strategy-report-09082016.pdf