Impact Fees, Bonding Reform, and Oil and Gas Development

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Abstract

Local and state governments use impact fees to pay for the costs of development. Impact fees improve economic efficiency by internalizing external costs such as the loss of open space and the increased truck traffic that compromises local public infrastructure. Colorado recently expanded the use of impact fees to cover the reasonably foreseeable direct and indirect costs of oil and gas development. Impact fees provide revenue to pay for fiscal costs not covered by severance taxes, property taxes, royalty payments, and mill levy revenues. Economists examining net fiscal impacts from oil and gas development have focused on two fiscal costs: increased staff time and road maintenance costs. We investigate two additional fiscal costs: (1) legacy costs from inadequate bonding for abandoned wells; and (2) loss of property tax revenue. We also examine the adequacy of bonding policies to prevent future legacy costs. As more state and local governments examine net fiscal impacts, we recommend: (1) accounting for all fiscal costs when estimating net fiscal impacts; (2) expanding the scope of fiscal costs covered by impact fees; (3) applying per-well impact fees to pay for legacy costs; (4) reforming bonding policies; and (5) keeping the legal concept of the rational nexus test in mind when estimating economically and legally defensible impact fees.

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INTRODUCTION

The U.S. domestic drilling boom that started in 2000 increased the pace and scale of oil and natural gas drilling, production, and distribution, and moved these operations closer to population centers.[1] Eliza Czolowski et al. estimate that 17.6 million Americans live within one mile of at least one active oil or gas well.[2] Lisa M. McKenzie et al. estimate at least 378,000 Coloradans live within one mile of an active oil or gas well.[3] The increase in oil and gas development near communities has led to externalized costs,[4] including complaints about air, water, noise pollution, and associated public health damages.[5] The externalized public health costs associated with air pollution include the increase in health treatment costs, time lost from work, and pain and suffering.[6]

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1 Lisa M. McKenzie et al., *Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources*, 424 SCI. OF THE TOTAL ENV'T 79, 79–87 (2012); Diane A. Garcia-Gonzales et al., *Hazardous Air Pollutants Associated with Upstream Oil and Natural Gas Dev elopment: A Critical Synthesis of Current Peer-Reviewed Literature,* 40 ANN. REV. OF PUB. HEALTH 283, 283–304 (2019).

2 Eliza D. Czolowski et al., *Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review*, 125 ENV'T. HEALTH PERSP. 1, 4 (2017).

3 Lisa M. McKenzie et al., *Population Size, Growth, and Environmental Justice near Oil and Gas Wells in Colorado*, 50 ENV'T. SCI. AND TECH. 11471, 11478 (2016).

4 External and externalized costs, also called negative externalities by economists, refer to the public costs "hidden" from the market price for a good or service. For example, the decline in property values from proximity to oil and gas development. Externalities can also be positive. For example, the positive benefits to home prices from close proximity to parks, trails, and open space.

5 *See, e.g.*, Boulder Cnty., *Boulder County Commissioners Pledge to Continue to Protect Public Health, Safety, and the Environment from Local Oil & Gas Development*, (Apr. 25, 2017), https://www.bouldercounty.org/news/boulder-county-commissioners-pledge-to-continue-to-protect-public-health-safety-and-the-environment-from-local-oil-gas-development/; Tara Opsal & Stephanie Malin, *Don't Frack So Close to Me: Colorado Voters Will Weigh In on Drilling Distances from Homes and Schools*, THE CONVERSATION (Sept. 26, 2018, 6:20 AM), https://theconversation.com/dont-frack-so-close-to-me-colorado-voters-will-weigh-in-on-drilling-distances-from-homes-and-schools-102544; Tresi Houpt, *Guest Opinion: COGCC Should Hold the Oil and Gas Operators Accountable*, POST INDEP. (June 22, 2020), https://www.postindependent.com/news/cogcc-should-hold-the-oil-and-gas-operators-accountable/; COLO. OIL AND GAS CONSERVATION COMM'N (COGCC), 2019 ANNUAL REPORT TO THE WATER QUALITY CONTROL COMMISSION & WATER QUALITY CONTROL DIVISION OF THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT 7 (2019) ("In 2019, COGCC received 483 complaints accounting for a significant staff workload.").

6 *See* Kerry R. Pride et al., *Associations of Short-Term Exposure to Ground-level Ozone and Respiratory Outpatient Clinic Visits in a Rural Location. Sublette County,*

This Article expands the definition of externalized costs to include the fiscal health of local and state governments.[7] While oil and gas development directly and indirectly generates revenue for state and local governments, it also imposes costs. Direct revenue sources are: (1) ad valorem property taxes (based on mill levy rates)[8] on oil and gas property and production; (2) portions of state severance taxes[9] sent to local governments; and (3) lease bonuses and royalties[10] from oil and gas development on public land.[11] Indirect revenue sources are sales and income taxes from population growth and increased economic activity. We focus specifically on the fiscal costs that must be deducted from gross fiscal revenue to estimate net fiscal impacts. How much money does the government spend for the regulatory oversight necessary to safely and responsibly develop oil and gas resources? For Colorado, that would mean taking into account the fiscal year 2016–2017 $15.8 million budget[12] of the Colorado Oil and Gas

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Wyoming, 2008–2011, 137 ENV'T. RES. 1, 1–7 (2014); JOE KERKVLIET & PETE MORTON, CONSERVATION ECON. INST., ASSESSING THE COSTS OF AIR POLLUTION FROM UNCONVENTIONAL OIL AND NATURAL GAS ACTIVITIES 1, 9 (2020).

7 Fiscal costs and revenues refer to taxation, public revenues, or public debt. *Fiscal*, MERRIAM-WEBSTER DICTIONARY, https://www.merriam-webster.com/dictionary/fiscal (last visited Sept. 1, 2021).

8 Local governments assess an ad valorem tax, also referred to as a property tax, on the oil and gas produced within their boundaries. The property tax is based on a mill levy rate assessed on the dollar value of production. Colorado recently increased its mill levy rate from 1.1 to a 1.5 mill levy rate (.15 cents tax per dollar) on the market value of oil and gas produced in the state. *See* Dennis Webb, *Oil, Gas Panel May Hike Levy on Production to Aid Budget*, THE DAILY SENTINEL (July 2, 2020), https://www.gjsentinel.com/news/oil-gas-panel-may-hike-levy-on-production-to-aid-budget/article_8da053f4-bbb9-11ea-a0f9-4b3c7655e4b8.html; *and* Mark Jaffe, *Colorado Increases Tax on Oil and Gas Operators to Fund a $3.4 Million Shortfall in Regulators' Budget*, THE COLO. SUN (Aug. 5, 2020), https://coloradosun.com/2020/08/05/colorado-raises-tax-oil-gas-cogcc/.

9 Severance taxes are charged by states as compensation for the loss or "severance" of non-renewable resources like oil and gas. Colorado's effective severance tax rate ranged from 2.1 percent in 2008 to a low of 0.2 percent in 2015. Effective severance tax rates are lower than statutory rates because they account for the tax incentives and deductions granted to oil and gas producers. *See* LARSON SILBAUGH, LEGIS. COUNCIL STAFF, EFFECTIVE TAX RATES ON OIL AND NATURAL GAS 7 (2020).

10 Lease bonuses are one-time payments to a land or mineral owner when an oil or gas lease is signed. Royalties are money paid to the owners of mineral rights based on a portion of the proceeds from the sale of the oil and gas produced. Companies pay royalties to taxpayers for the right to produce oil and gas on state and federal lands. The federal onshore royalty rate is 12.5 percent of the amount or value of production.

11 *See* DANIEL RAIMI & RICHARD G. NEWELL, DUKE UNIV. ENERGY INITIATIVE, COLORADO'S PICEANCE BASIN: VARIATION IN THE LOCAL PUBLIC FINANCE EFFECTS OF OIL AND GAS DEVELOPMENT (2016).

12 FIN. UNIT, COLO. OIL AND GAS CONSERVATION COMM'N, ANNUAL FUNDING AND BUDGET 2 (2015).

Conservation Commission ("COGCC").[13] Severance taxes accounted for forty-seven percent of COGCC's budget, while fifty-two percent came from the Oil and Gas Conservation and Environmental Response Fund.[14] Figure 1 lists reasonably foreseeable fiscal costs associated with oil and gas development.[15]

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13 The COGCC is the state agency responsible for coordinating oversight of oil and gas development. COGCC employs engineers, scientists, and experienced technicians to implement and enforce the Commission's rules. COLO. OIL AND GAS CONSERVATION COMM'N, MISSION CHANGE WHITEPAPER 1 (2019).

14 Oil and Gas Conservation and Environmental Response Fund funding primarily comes from a 0.0015 mill levy on the value of production (i.e., quantity of production multiplied by price), plus penalties, fines, and bond claims. COLO. OIL AND GAS CONSERVATION COMM'N, *supra* note 12, at 1–2.

15 PETE MORTON & JOE KERKVLIET, CONSERVATION ECON. INST., IMPACT FEES FOR COVERING THE FISCAL COSTS OF OIL AND GAS DEVELOPMENT 13 (2020).

Fiscal Cost	Explanation	Methods to Estimate
Road costs	Increased road maintenance costs from heavy truck traffic.	Survey and interview local officials. Engineering models on road costs.
Staffing costs	Salary costs and increased staff time for permitting, community relations, and inspections.	Survey and interview local officials. Budgets of state regulating agencies.
Police and emergency services costs	Salary costs of increased time for police, fire, and emergency services.	Survey and interview local officials.
Debt financing costs from capital investments	Long-term risk and cost with financing investments in infrastructure.	Survey and interview local officials.
Research and legal costs	Legal costs of hiring lawyers and the cost of research on impact fees.	Survey and interview local officials and experts. Budgets of state regulating agencies.
Data collection, monitoring, and enforcement costs	Cost to collect and monitor baseline data as well as the cost of inspections and enforcing regulations.	Survey and interview local officials and experts. Budgets of state regulating agencies.
Legacy costs[16] from old wells and pipelines	Cost of plugging and restoration costs that exceed bonding amounts.[17]	Regression analysis of plugging and reclamation costs subtracted from bonding amounts per well.
Loss of property tax revenues	Cost of decline in home values and property tax revenue.	Hedonic studies, regression analysis, and benefit transfer.

Figure 1. Reasonably Foreseeable Fiscal Costs Associated with Oil and Gas Development

Traditionally, local governments used impact fees to recover fiscal costs resulting from real estate development. More recently, local and state governments have charged impact fees to cover the costs associated with oil and gas development. Importantly, impact fees are relevant for stakeholders in Colorado because a new state law permits impact fees for

16 Legacy costs represent costs passed on to current and future generations when the per well bonding amounts posted are less than the cost of plugging and reclaiming the roads and the oil and gas wells covered by the bond.

17 Bonding amounts refer to the total cash amount or size of the bond posted by operators and available to pay for the total cost of plugging wells and reclaiming land. Bonding amounts increase as coverage increases from a single well, to blanket bonds covering all the wells in a state or a country.

reasonably foreseeable direct and indirect costs of oil and gas development.[18] Colorado stakeholders generally agree that government revenue from oil and gas is an important benefit of oil and gas development.[19] Colorado is setting a national precedent with what many view as the "strictest [oil and gas] regulations in the country."[20] States and countries interested in updating their oil and gas regulations may benefit from a better understanding of oil and gas development in Colorado.

We specifically examine impact fees for two fiscal costs associated with oil and gas development: (1) the costs associated with inadequate bonding for orphaned and abandoned wells,[21] which we call legacy costs; and (2) the potential decline in property values. Legacy costs represent fiscal costs that cover an extended length of time between when a well is drilled and when state or federal government expenditures arrive to plug the well and restore the site. The loss in property values translates into a fiscal cost in the form of declining property tax revenue. The additional costs included in Figure 1, for example the costs of monitoring and collecting baseline data, so as not to be forgotten, are included in our discussion section. We also investigate the adequacy of oil and gas bonding

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18 Colorado General Assembly, *SB 19-181: Protect Public Welfare Oil And Gas Operations,* https://leg.colorado.gov/bills/sb19-181 (last visited Sept. 4, 2021). Colorado Senate Bill 19-181 significantly changed the regulatory framework for oil and gas development including: (1) more control for local governments; (2) transition to a professional commission representing diverse interests; (3) new rulemaking on Flowlines, Practice and Procedure, Alternative Location Analysis, Cumulative Impacts, and Mission Change; (4) additional air quality rules to minimize emissions from oil and gas activities; and (5) resources to hire additional staff and increase oversight. COLO. OIL AND GAS CONSERVATION COMM'N, *supra* note 5, at 12. *See also* Colo. Oil and Gas Conservation Comm'n, *Senate Bill 19-181*, https://cogcc.state.co.us/sb19181.html#/overview (last visited Sept. 4, 2021).

19 TANYA HEIKKILA & CHRIS WEIBLE, A SUMMARY REPORT OF A 2015 SURVEY OF THE POLITICS OF OIL AND GAS DEVELOPMENT USING HYDRAULIC FRACTURING IN COLORADO 5 (2015). The stakeholders included 453 individuals actively involved or knowledgeable about oil and gas development in Colorado. *Id.* at 3 (the authors identified stakeholders based on evidence in "media reports, online reports, public hearings and testimony, and recommendations from interviews.").

20 Jason Salzman, *Job Killing! Fast Track! Opposition to New Oil and Gas Regulations Looks like 2008 All over Again*, COLO. TIMES RECORDER (Mar. 5, 2019), https://coloradotimesrecorder.com/2019/03/opposition-to-new-oil-and-gas-regs-looks-like-2008-all-over-again/14371/.

21 Orphaned wells have not been plugged and reclaimed and are not connected to a solvent company. Abandoned wells are connected to a solvent company that has suspended or slowed production.

policies[22] to mitigate legacy costs. To what extent do the bonding amounts cover the cost of plugging and reclaiming oil and gas wells?[23]

Our intent is to make the case for expanding the use of impact fees and reforming bonding policies in order to promote more fiscally responsible oil and gas development in Colorado and elsewhere. In Part I we provide a synthesis of impact fee literature. Part II reviews the literature on net fiscal impacts to local governments from oil and gas development. Part III reviews the research on legacy costs and methods for estimating impact fees to cover these costs, while Part IV does the same for lost property tax revenue. Part V discusses the results and makes recommendations, followed by concluding remarks.

I. IMPACT FEES

Impact fees are monetary payments assessed on property developers that cause them to internalize the external costs[24] of residential and commercial development,[25] including wastewater treatment facilities, compromised infrastructure, and degraded environmental quality.[26] Impact fees are designed to shift the burden of paying for development-induced costs from current residents to developers and new residents.[27] Impact fees are widely used by local governments for two purposes: (1) to generate revenue from developers to cover the proportionate costs of needed improvements arising from new development; and (2) to manage the pace of

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22 Bonding policies require oil and gas operators to post bonds before drilling that will pay for the full costs of plugging wells and reclaiming the land.

23 Language in SB 19-181 addresses legacy costs. COGCC will conduct a rulemaking that "must consider: increasing financial assurance for inactive wells and for wells transferred to a new owner; requiring a financial assurance account, which must remain tied to the well in the event of a transfer of ownership, to be fully funded in the initial years of operation for each new well to cover future costs to plug, reclaim, and remediate the well; and creating a pooled fund to address orphaned wells for which no owner, operator, or responsible party is capable of covering the costs of plugging, reclamation, and remediation." COLO. OIL AND GAS CONSERVATION COMM'N, *supra* note 13, at 18.

24 Internalize refers to including or fully accounting for external costs and revenues when making land use planning decisions, completing an economic analysis of a policy, or establishing market prices. Charging an impact fee or pollution tax at the wellhead, for example, will help internalize the externalized health costs of air pollution into market prices for oil and gas.

25 Gregory S. Burge & Keith R. Ihlanfeldt, *Promoting Sustainable Land Development Patterns Through Impact Fee Programs*, 15 CITYSCAPE: J. POL'Y DEV. & RES. 83, 84–85 (2013).

26 LAWRENCE W. LIBBY & CARMEN CARRION, DEVELOPMENT IMPACT FEES (2004).

27 *Id.*; *see generally* Burge & Ihlanfeldt, *supra* note 25.

growth and the scale of development.[28] Impact fee revenue primarily funds new infrastructure, including transportation, fire, water, sewers, parks, law enforcement, public buildings, emergency services, affordable housing, and open space.[29]

Calculations of impact fee rates are commonly based on either standards or plans. [30] Plan-based fees require a master plan that compares projected growth with the expected costs of facilities and services necessitated by the growth. The two basic approaches for estimating expected costs are the average-cost pricing method, which sets a flat connection fee, and the marginal-cost pricing system.[31] Standards-based fees involve sustaining a desired level of service, such as acres of open space per household. Most of the existing impact fees in Colorado are standards-based.[32]

Texas adopted the first general impact fee enabling act in 1987, and twenty-nine states have subsequently adopted similar legislation.[33] Facilities eligible for impact fees in Colorado include roads, water, sewer, stormwater infrastructure, parks, fire, police, library, and solid waste.[34] In Colorado, Rio Blanco County, Boulder County, and the Town of Greeley have all enacted oil and gas impact fees to help cover road costs.[35]

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28 Local governments have evolved the concept of impact fees to include "linkage fees" to fund " 'soft,' 'social,' or 'green' " infrastructure projects, such as affordable housing, public art, and open space. While different in name, the courts have generally determined there is no fundamental difference between impact fees and linkage fees. James C. Nicholas & Julian Conrad Juergensmeyer, *Market Based Approaches to Environmental Preservation: To Environmental Mitigation Fees and Beyond*, 43 NAT. RES. J. 837, 839 (2003); *see* ARTHUR C. NELSON, JAMES C. NICHOLAS & JULIAN C. JUERGENSMEYER, IMPACT FEES: PRINCIPLES AND PRACTICE OF PROPORTIONATE-SHARE DEVELOPMENT FEES.

29 CHRISTOPHER COUTTS ET AL., DEVELOPMENT IMPACT FEES: A VEHICLE OR RESTRAINT FOR LAND DEVELOPMENT? 4 (2015); Nicholas & Juergensmeyer, *supra* note 28; NELSEN, NICHOLAS & JUERGENSMEYER, *supra* note 28.

30 DUNCAN ASSOCS., IMPACT FEE STUDY PREPARED FOR THE CITY OF GREELEY, COLORADO 9 (2014).

31 LIBBY & CARRION, *supra* note 26.

32 DUNCAN ASSOCS., *supra* note 30, at 13.

33 CLANCY MULLEN & DUNCAN ASSOCS., STATE IMPACT FEE ENABLING ACTS 1 (2015).

34 COLO. REV. STAT. § 29-20-104.5 (2016) ("Pursuant to the authority granted in section 29-20-104(1)(g) and as a condition of issuance of a development permit, a local government may impose an impact fee or other similar development charge to fund expenditures by such local government on capital facilities needed to serve new development.") *See* MULLEN & DUNCAN ASSOCS., *supra* note 33.

35 *See* MORTON & KERKVLIET, *supra* note 15. Often the roads most negatively impacted by heavy truck traffic are local and county roads, constructed and maintained with locally sourced funds. These roads are typically built to handle smaller volumes of traffic. In contrast, state and federally funded roads are constructed to withstand heavy truck

Importantly, a recently enacted Colorado law now gives local governments additional authority "to regulate the siting of oil and gas locations to minimize adverse impacts to public safety, health, welfare, and the environment," using regulations, fees, and fines to cover reasonably foreseeable direct and indirect costs from oil and gas development.[36] This law provides municipalities with more local control over oil and gas development by expanding the use of impact fees beyond what was previously allowed. Impact fees can now be used, for example, to pay for local monitoring and inspection of oil and gas wells.

Although impact fees have primarily been used by local governments, state governments can also employ them. In 2012, Pennsylvania enacted legislation charging an impact fee on each unconventional gas well.[37] Unconventional natural gas includes shale gas and tight sands gas, which are extracted using hydraulic fracturing technology. While impact fees have traditionally covered the marginal costs of new development, Pennsylvania's law also charges impact fees on existing oil and gas wells.[38]

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traffic. *See* Leah A. Dundon, Managing Hydraulic Fracturing: Approaches to Assessing and Addressing Transportation Impacts (Dec. 16, 2017) (Ph.D. dissertation, Vanderbilt University) (ProQuest).

36 Colorado General Assembly, *SB 19-181: Protect Public Welfare Oil And Gas Operations,* https://leg.colorado.gov/bills/sb19-181 (last visited Sept. 4, 2021) ("Section 4 [of S.B. 19-181] clarifies that local governments have land-use authority to regulate the siting of oil and gas locations to minimize adverse impacts to public safety, health, welfare, and the environment and to regulate land use and surface impacts, including the ability to inspect oil and gas facilities; impose fines for leaks, spills, and emissions; and impose fees on operators or owners to cover the reasonably foreseeable direct and indirect costs of permitting and regulation and the costs of any monitoring and inspection program necessary to address the impacts of development and enforce local governmental requirements."); Matt Bloom, *Curious Colorado: What Senate Bill 181 Does – And Doesn't Do*, KUNC (Mar. 29, 2019), https://www.kunc.org/oil-and-gas/2019-03-29/curious-colorado-what-senate-bill-181-does-and-doesnt-do.

37 Katie Jo Black et al., *When Externalities Are Taxed: The Effects and Incidence of Pennsylvania's Impact Fee on Shale Gas Wells*, 5 J. ASS'N ENV'T & RES. ECONOMISTS 107, 113 (2018).

38 Unlike Colorado, Pennsylvania does not collect severance taxes. The Pennsylvania Independent Fiscal Office translated the impact fee into an annual average effective tax rate in order to quantify the implicit tax burden imposed by the impact fee in a given year. Between 2014 and 2018, the annual effective tax rate in Pennsylvania fluctuated between 2.2 percent and 6.3 percent, which is higher than the effective severance rate in Colorado. One of the reasons Colorado's effective tax rate is so low is that the Oil and Gas Severance Tax Ad Valorem Credit [Section 39-29-105(2)(b), C.R.S.] allows companies to claim a credit of 87.5 percent of the property taxes assessed or paid to a local government on oil and gas produced to offset their state severance tax liability. INDEP. FISCAL OFFICE, 2018 IMPACT FEE ESTIMATE 1, http://www.ifo.state.pa.us/download.cfm?file=Resources/Documents/RB-2019-01.pdf. *See also* SILBAUGH, *supra* note 9.

A. Impact Fees and Economic Efficiency

Paying for infrastructure with impact fees improves economic efficiency[39] and ensures the benefits flow to those who pay them.[40] George Burge and Keith Ihlanfeldt conclude, "impact fees enable local governments to correct for development-driven externalities[41] while retaining the power of the market pricing mechanism."[42] Impact fees improve economic efficiency by internalizing the fiscal costs not covered by severance taxes, property taxes, mill levy revenue, and royalty payments from oil and gas development. Impact fees are justified when net fiscal impacts are negative.

Jeremy Weber and Max Harleman documented the value of Pennsylvania's per-well impact fee as a revenue-sharing policy that helped local residents pay for the external costs from shale development.[43] The authors did not estimate whether the revenues to municipalities actually covered the fiscal costs from oil and gas development, but they found that without the revenue from the per-well impact fee, municipalities in high drilling areas would have exhausted their pre-drilling fund balances in less than three years.

B. Impact Fees and Legal Issues

A local or state government's ability to charge impact fees originates from the state's police power to regulate development for the public's health, safety, or general welfare under the Tenth Amendment of the U.S.

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39 A policy is conducted at an economically efficient level when its incremental benefits equal its incremental costs. Economically efficient bonding levels equal the full costs of plugging wells, restoring well pads, and repairing other damages attributable to oil and gas development. These costs may vary with the characteristics of the well and the environment in which it is located.

40 Arthur Nelson & Mitch Moody, *Paying for Prosperity: Impact Fees and Job Growth*, BROOKINGS (June 1, 2003), https://www.brookings.edu/research/paying-for-prosperity-impact-fees-and-job-growth/.

41 In general, externalities refer to the "hidden" costs or revenues that are not considered (not internalized) in decision-making, the analysis of benefits and costs of a policy, or the market prices of a good or service. For example, the negative externalities associated with oil and gas development include air pollution, water pollution, and the loss of wildlife habitat, which are not reflected (internalized) in the market prices for oil and gas.

42 *See* Burge & Ihlanfeldt, *supra* note 25, at 84.

43 JEREMY WEBER & MAX HARLEMAN, CTR. FOR METRO. STUDIES, SHALE DEVELOPMENT, IMPACT FEES, AND MUNICIPAL FINANCES IN PENNSYLVANIA 1–2 (Winter 2015/16), https://gspia.pitt.edu/sites/default/files/2019-09/ShalePolicyBrief.pdf.

Constitution.[44] Impact fees raise several constitutional issues, including equal protection, due process, and the taking of private property without just compensation.[45] In general, impact fees may be permissible if they do not violate the "unconstitutional conditions" doctrine; that is, government should not use its regulatory powers to coerce individuals or companies into giving up constitutional protections.[46]

Impact fees have a history rife with lawsuits from which an extensive body of case law has developed.[47] The primary legal challenges to impact fee programs have centered on the rational nexus test. Under the rational nexus test, an impact fee program must: (1) establish a clear nexus between new growth and the need for new expenditures and ensure that fees are roughly proportional to the new expenditures; and (2) derive some benefit from the impact fee expenditures to the payer of the impact fee.[48] The most successful impact fees—fees that are upheld in legal challenges—fairly and accurately reflect the proportional share of the costs of maintaining a desired level of service identified as a goal in a comprehensive plan.[49]

Road impact fees have been met with legal challenges from the oil and gas industry. Applying the rational nexus test, a reviewing court may ask whether the impact fee is proportional to the marginal increase in the costs associated with heavy truck traffic that occurs as part of oil and gas development, or whether the impact fee revenue will benefit the company by repairing the roads in question.[50] Dundon documents the efforts of the city of Arlington, Texas, to impose a road damage fee based on the costs of road repairs due to oil and gas truck traffic.[51] Industry challenged

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44 Gus Bauman & William H. Ethier, *Development Exactions and Impact Fees: A Survey of American Practices*, L. & CONTEMP. PROBS. 50, 51–68 (1987); Nicholas & Juergensmeyer, *supra* note 28.

45 *See* LIBBY & CARRION, *supra* note 26, at 6–7.

46 *See* Dundon, *supra* note 35, at 83.

47 Bryan A. Mantz & Henry L. Thomas, *Utility Impact Fees: Practices and Challenges*, 104 J. AM. WATER WORKS ASS'N E218, E218 (2012). Impactfees.com, *Case Law*, http://www.impactfees.com/resources/case-law/ (last visited Jan. 12, 2022) (providing case law information).

48 *See* Burge & Ihlanfeldt, *supra* note 25, at 97; Nicholas & Juergensmeyer, *supra* note 28, at 843.

49 While striving to pass both requirements is the goal, if an impact fee can pass the nexus and proportionality requirement, it will generally withstand legal challenges. Nicholas & Juergensmeyer, *supra* note 28, at 843.

50 *See* Dundon, *supra* note 35, at 84.

51 *Id.* at 78–79.

Arlington's ordinance, but the road damage fee and permitting requirements remain.[52]

II. NET FISCAL IMPACTS FROM OIL AND GAS DEVELOPMENT

Local and state governments are on the front line of managing fiscal costs accompanying oil and gas development. The industry's historical social license to operate is based in part on its economic contribution to local and state economies. Although oil and gas drilling creates jobs and revenue,[53] it poses challenges for local governments that bear substantial responsibility for public infrastructure, human services, and public health and safety.[54] Many communities are simply unprepared to handle the fast pace and large scale of the oil and gas industry.[55]

In response to the increase in oil and gas drilling, local governments have increased spending.[56] Does the additional revenue from oil and gas development cover the increased spending? That is, are the net fiscal impacts for state and local governments positive? If not, how much additional revenue is needed to cover the fiscal costs to local governments of implementing responsible oil and gas development?

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52 In *City of Arlington v. Texas Oil and Gas Association*, the primary challenge by industry was to a fee being charged for training and equipping city firemen on how to fight gas well fires. Industry argued that similar fees were never imposed on other industries and, in their view, amounted to an unlawful occupation tax under Texas Law. The city ultimately amended the ordinance and withdrew that fee, and the case settled. City of Arlington v. Texas Oil & Gas Ass'n, No. 02-13-00138-CV, 2014 WL 4639912, at 1 (Tex. App. Sept. 18, 2014). *See* Dundon, *supra* note 35, at 79 (noting that the road use permitting fees are still in force).

53 LISA MCDONALD ET AL., COLO. ENERGY RES. INST., OIL AND GAS ECONOMIC IMPACT ANALYSIS ix (2007); Colo. Fiscal Inst., *A Delicate Balance: Oil and Gas in Colorado's Economy*, (2007), https://www.coloradofiscal.org/delicate-balance-oil-gas-colorado-economy/issues/.

54 Susan Christopherson & Ned Rightor, *How Shale Gas Extraction Affects Drilling Localities: Lessons For Regional and City Policy Makers*, 2 J. TOWN & CITY MGMT. 350, 361 (2012); Timothy W. Kelsey, *Unconventional Oil and Gas Development: Challenges and Opportunities for Local Governments*, 29 CHOICES 1, 1 (2014); Austin Zwick, *Public Finance Challenges of Fracking for Local Government*, 38 PAPERS ON MUN. FIN. & GOVERNANCE 1, 2–3 (2018).

55 Michelle Haefele & Pete Morton, *The Influence of the Pace and Scale of Energy Development on Communities: Lessons from the Natural Gas Drilling Boom in the Rocky Mountains*, 8 W. ECON. F. 1, 2–3 (2009); ALAN J. KRUPNICK ET AL., RES. FOR THE FUTURE, LOCAL GOVERNMENT IMPACTS OF UNCONVENTIONAL OIL AND GAS DEVELOPMENT 4 (2017).

56 *See* WEBER & HARLEMAN, *supra* note 43, at 1.

Recent research on net fiscal impacts has primarily focused on two costs directly related to oil and gas development: increased staff time and increased costs for road repairs due to heavy truck traffic.[57] The costs associated with the increase in heavy truck traffic—road damage, traffic accidents, congestion, air pollution, and safety concerns—are well documented.[58]

Richard G. Newell and Daniel Raimi interviewed local government officials and 74 percent of the officials thought net fiscal impacts had been positive, fourteen percent reported neutral impacts, and twelve percent reported negative fiscal impacts.[59] Results varied widely based on scale of activity, population density, and tax policy. But there are additional fiscal costs, such as declines in property tax revenue and legacy costs from abandoned wells, which Newell and Raimi did not consider. When these additional costs are counted, the percentage of local governments with positive net fiscal impacts may be lower. To improve future fiscal outcomes, the authors recommend that local officials plan for impacts, state policymakers reexamine revenue policies, and operators pursue collaborative agreements with both local and state governments.

In general, municipalities and counties can meet the increased demand and costs for services related to shale development, but that rapid development can cause problems.[60] A rapid pace of development can easily overwhelm the infrastructure and budgets of municipalities and counties. For example, boomtowns in the Rockies experienced an influx of nonlocal workers, a rise in crime and emergency service calls, increased demand for public services, more wear and tear on local infrastructure, and upward pressure on local wages and housing costs.[61]

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57 *See* KRUPNICK ET AL., *supra* note 55, at 6.

58 FELSBURG, HOLT & ULLEVIG, DOUGLAS CNTY. OIL & GAS PROD. TRANSP. IMPACT STUDY ES–5 (2012); FELSBURG, HOLT & ULLEVIG, BOULDER CNTY. OIL AND GAS IMPACT STUDY 1 (2013); Kevin R. Gilmore, Rebekah L. Hupp & Janine Glathar, *Transport of Hydraulic Fracturing Water and Wastes in the Susquehanna River Basin, Pennsylvania*, J. ENV'T ENG. 140(5), 1–10 (2013); Shmuel Abramzon et al., *Estimating the Consumptive Use Costs of Shale Natural Gas Extraction on Pennsylvania Roadways*, 20 J. OF INFRASTRUCTURE SYS., Feb. 18, 2014, at 1, 6; Jove Graham et al., *Increased Traffic Accident Rates Associated with Shale Gas Drilling in Pennsylvania*, 74 ACCIDENT ANALYSIS & PREVENTION 203, 205 (2015); Lauren A. Patterson & Kelly O. Maloney, *Transport of Hydraulic Fracturing Waste form Pennsylvania Wells: A County-level Analysis of Road Use and Associated Road Repair Costs*, 181 J. ENV'T MGMT. 353, 357–58 (2016); LUCIJA MUEHLENBACHS ET AL., THE ACCIDENT EXTERNALITY FROM TRUCKING: EVIDENCE FROM SHALE GAS DEVELOPMENT 18–20 (2021).

59 Richard G. Newell & Daniel Raimi, *The Fiscal Impacts of Increased U.S. Oil and Gas Development on Local Governments*, 117 ENERGY POL'Y 14, 21 (2018).

60 KRUPNICK ET AL., *supra* note 55, at 1, 6, 15.

61 Haefele and Morton, *supra* note 55, at 1.

Raimi and Newell examined the effects of lower oil prices and lower rates of oil and gas development on the fiscal conditions of local governments in five key regions: Bakken, Denver-Julesburg, Eagle Ford, Marcellus, and the Permian basins.[62] The authors found that fiscal conditions generally improved, but that revenue volatility presents a major challenge, as does economic diversification for rural communities dependent on the oil and gas development.[63]

A. Western Slope of Colorado

In Colorado, Raimi and Newell examined the net fiscal impacts from oil and gas development for two Western Slope[64] rural counties (Garfield and Rio Blanco) and two rural municipalities (Grand Junction and Rifle).[65] Garfield and Rio Blanco rely heavily on oil and gas property taxes, which include surface equipment and the oil and gas produced.[66] In these counties, oil and gas account for more than half of county property tax revenues.

Garfield County has experienced a rapid increase in property tax revenue from oil and gas development, creating large fiscal benefits. In contrast, the revenues in Rio Blanco County, including the revenue from the county's per-well impact fee, did not keep pace with the increases in the fiscal cost of new service demands. Rio Blanco County officials estimate that necessary road repairs would cost over $100 million—more than twice Rio Blanco County's annual revenues.[67]

The Western Slope municipalities of Rifle and Grand Junction also had contrasting fiscal experiences. Rifle's limited infrastructure, coupled with a rapidly growing population, created fiscal challenges. As a drilling bust set in, many of the fiscal challenges subsided, but the rosy economic impact projections (i.e., jobs and revenue) made during the drilling boom proved too optimistic. As a result, Rifle overbuilt its water and wastewater systems, saddling residents with large new capital costs.[68] In contrast, Grand Junction has a more diverse economy and the new demands for service and new revenues associated with the oil and gas industry were

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62 DANIEL RAIMI & RICHARD G. NEWELL, LOCAL FISCAL EFFECTS OF A DRILLING DOWNTURN: LOCAL GOVERNMENT IMPACTS OF DECREASED OIL AND GAS ACTIVITY IN FIVE U.S. SHALE REGIONS 7 (2017).

63 *Id.* at 5-32.

64 The Western Slope of Colorado refers to the mostly rural counties west of the Continental Divide.

65 RAIMI & NEWELL, *supra* note 11, at 1.

66 *Id.* at 10; RAIMI & NEWELL, *supra* note 62, at 6.

67 RAIMI & NEWELL, *supra* note 11, at 2.

68 *Id.* at 2–3.

smaller relative to Rifle. The oil and gas industry appears to have helped Grand Junction rebound from the recession of 2008–2009.[69]

B. Front Range of Colorado

On the Front Range of Colorado,[70] Weld County and the city of Greeley have done quite well fiscally. Property taxes are the leading revenue source for Weld County, making up roughly half of annual revenues, with oil and gas constituting roughly two-thirds of countywide assessed value. Oil and gas development continues to have a positive net fiscal impact for Greeley.[71] In other Colorado Front Range counties and municipalities, oil and gas development has limited fiscal impacts because local governments along the Front Range do not rely heavily on oil and gas revenues, and those revenues represent only a small part of budgets. While finding limited fiscal impacts, Raimi and Newell[72] did report local problems with workforce retention from wage inflation, while at the same time facing an increase in the demand for law enforcement.

As discussed, Newell and Raimi did not consider two important fiscal costs: legacy costs from abandoned wells and potential decreases in property tax revenue. We examine legacy costs and lost property tax revenue in the following sections.

III. LEGACY COSTS FROM ABANDONED WELLS

Legacy costs are created when bonding amounts paid by oil and gas developers fail to cover the costs of plugging abandoned wells and of environmental remediation and reclamation of well pads. Without sufficient bonding, legacy costs fall disproportionately on state and federal taxpayers. For example, in 2017, two companies abandoned more than fifty wells in La Plata County, Colorado—leaving only $60,000 in bonds that covered only a fraction of the plugging and cleanup costs for state taxpayers.[73]

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69 *Id.* at 25.

70 The Front Range of Colorado refers to rural and urban counties east of the Continental Divide including the Fort Collins, Greeley, Boulder, Denver, Colorado Springs, Pueblo metropolitan corridor.

71 RAIMI & NEWELL, *supra* note 62, at 28.

72 *Id.* at 22–30.

73 Jonathan Romeo, *State on the Hook to Clean Up Orphan Oil and Gas Wells in La Plata County*, DURANGO HERALD (Oct. 21, 2017, 10:42 AM), https://durangoherald.com/articles/190438-state-on-the-hook-to-clean-up-orphan-oil-and-gas-wells-in-la-plata-county.

Nationally, approximately 3 million oil and gas wells are abandoned across the United States that, if unplugged or improperly plugged, sealed, and reclaimed, create environmental liabilities.[74] According to The National Petroleum Council:

> In areas where shale-gas reservoirs are being newly developed, plugging of older wells has become an issue due to the potential for stray gas to migrate from the shale formation to other formations that are open to the old wells in the area. The old wells can transmit gas from the formation to the fresh water or even the surface, thereby posing an environmental risk to the local area. Older wells are a risk if they are poorly plugged or not plugged across the shale production zone. Even if the older well has casing, the casing might not be adequately cemented across the shale production zones.[75]

Abandoned wells can contaminate underground drinking water by acting as a conduit for drilling fluids or contaminated surface water.[76] In addition to surface water pollution, gas leaks along the cement casing cause methane pollution years after production has stopped and the well has been plugged and abandoned.[77]

Upwardly migrating gas, which is mostly methane, is a local issue as it represents an explosive hazard if not properly vented away from buildings, homes, and drinking water wells.[78] Methane is also a global issue because it is a potent greenhouse gas. In recent years, a flurry of studies found compelling evidence of methane pollution emitted by abandoned wells and well pads.[79]

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74 Adam Brandt et al., *Energy and Environment. Methane leaks from North American Natural Gas Systems*, 343 SCI., 733, 733–35 (2014).

75 J. DANIEL ARTHUR ET AL., PLUGGING AND ABANDONMENT OF OIL AND GAS WELLS 16 (Nat'l Petroleum Council, Working Paper No. 2-25, 2011).

76 AM. PETROLEUM INST., ONSHORE OIL AND GAS PRODUCTION PRACTICES FOR PROTECTION OF THE ENVIRONMENT 7 (2001).

77 MAURICE B. DUSSEAULT ET AL., WHY OIL WELLS LEAK: CEMENT BEHAVIOR AND LONG-TERM CONSEQUENCES 1 (2000); Ali Nowamooz et al., *Numerical Investigation of Methane and Formation Fluid Leakage along the Casing of a Decommissioned Shale Gas Well* 51 WATER RES. RSCH. 4592, 4592 (2015); *See* MORTON & KERKVLIET, *supra* note 15, at 35.

78 Austin L. Mitchell & Elizabeth A. Casman, *Economic Incentives and Regulatory Framework for Shale Gas Well Site Reclamation in Pennsylvania*, 45 ENV'T SCI. TECH. 9506, 9507 (2011).

79 Mary Kang et al*., Direct Measurements of Methane Emissions from Abandoned Oil and Gas Wells in Pennsylvania*, 111 PROCEEDINGS NAT'L ACAD. SCIS. 18173, 18176 (2014); Amy Townsend-Small et al., *Emissions of Coalbed and Natural Gas Methane from Abandoned Oil and Gas Wells in the United States*, 43 GEOPHYSICAL RSCH. LETTERS 2283,

A. Background on Bonding

When companies drill oil or gas wells, they are required to post a bond to cover the costs of plugging, abandoning, and reclaiming well pads and infrastructure.[80] For federal public land, the Bureau of Land Management ("BLM") has authority to require a bond ranging from $10,000 for a single well to $25,000 for a statewide bond or $150,000 for a nationwide bond—no matter how many oil and gas wells a company has permitted and drilled. Federal bonding amounts have not been updated since the 1950s and 1960s. The U.S. Government Accountability Office ("GAO") has repeatedly raised concerns about the current bonding system being inadequate for reclamation needs.[81] Similar bonding problems have been found for private and state land.[82] Without sufficient bonding, companies in financial stress may have more to gain by abandoning a well than by reclaiming it.[83]

Colorado Rule 706, bonding requirements for plugging and reclamation, consists of a $60,000 statewide bond for up to ninety-nine wells, and a $100,000 statewide bond when a company has more than 100 wells. Under such a policy, a company with ninety-nine wells has a bonding amount equal to $606 per well. A company with 100 or 200 wells has bonding amounts equal to $1000 or $500 per well, respectively. On a per-well

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2286 (2016); *See* Natalie J. Pekney et al., *Measurement of Methane Emissions from Abandoned Oil and Gas Wells in Hillman State Park, Pennsylvania*, 9 CARBON MGMT. 165, 165-75 (2018); *and* Stuart N. Riddick et al., *Measuring Methane Emissions from Abandoned and Active Oil and Gas Wells in West Virginia,* 651 SCI. TOTAL ENV'T 1849, 1853 (2019).

80 U.S. GOV'T ACCOUNTABILITY OFF., GAO-11-292, OIL AND GAS: BUREAU OF LAND MANAGEMENT SHOULD ADDRESS RISKS FROM INSUFFICIENT BONDS TO RECLAIM WELLS 9 (2019).

81 U.S. GOV'T ACCOUNTABILITY OFF., GAO-10-245, OIL AND GAS BONDS: BONDING REQUIREMENTS AND BLM EXPENDITURES TO RECLAIM ORPHANED WELLS (2010); U.S. GOV'T ACCOUNTABILITY OFF., GAO-18-245, OIL AND GAS WELLS: BUREAU OF LAND MANAGEMENT NEEDS TO IMPROVE ITS DATA AND OVERSIGHT OF ITS POTENTIAL LIABILITIES 5 (2018); U.S. GOV'T ACCOUNTABILITY OFF., GAO-19-615, OIL AND GAS: BUREAU OF LAND MANAGEMENT SHOULD ADDRESS RISKS FROM INSUFFICIENT BONDS TO RECLAIM WELLS 24 (2018).

82 JUDSON BOOMHOWER ET AL., ORPHAN WELLS IN CALIFORNIA: AN INITIAL ASSESSMENT OF THE STATE'S POTENTIAL LIABILITIES TO PLUG AND DECOMMISSION ORPHAN OIL AND GAS WELLS 39 (2018).

83 Jeremy Weber et al., *The Boom, the Bust, and the Cost of the Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*, U.S. Assoc. for Energy Econ., Working Paper No. 18-358, at 8 (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3245620.

basis, these bonding amounts are clearly less than COGCC's estimated average costs of $82,500 for plugging, reclaiming, and restoring wells.[84]

In addition to bonds for plugging and reclaiming wells, Colorado requires a variety of bonds for other components of oil and gas development. Figure 2 outlines the different types of bonds within the COGCC's jurisdiction.[85] In recent years, COGCC has relied heavily on Rule 707, inactive well bonds, to supplement the low bonding requirements under Rule 706 plugging bonds.[86] As a result of reviewing bonding amounts on inactive wells, COGCC has secured more than $90 million in additional bonding.[87]

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84 COLO. OIL & GAS CONSERVATION COMM'N, DEP'T OF NAT. RES., EXECUTIVE ORDER D 2018-12 FINANCIAL ASSURANCE TECHNICAL WORKING GROUP FINAL REPORT 7 (2018).

85 *Id.* at 6.

86 An inactive well is defined as "any shut-in well from which: no production has been sold for a period of twelve (12) consecutive months; any well which has been temporarily abandoned for a period of six (6) consecutive months; or, any injection well which has not been utilized for a period of twelve (12) consecutive months." *Id.* at 11.

87 COLO. OIL & GAS CONSERVATION COMM'N, READINESS WHITEPAPER 8 (2020).

Bond Type	Bonding Amounts
Rule 703: Surface Bond	A $2,000 (non-irrigated) or $5,000 (irrigated) individual bond by well or a $25,000 statewide blanket bond for surface owners to cover unreasonable crop loss or land damage that cannot be remediated.
Rule 704: E&P Waste Management Facilities Bond	Bonding equals the total estimated cost to properly reclaim, close, and abandon a facility, including those on federal land.
Rule 705: Seismic Operations Bond	A $25,000 statewide blanket bond for plugging of shot holes and surface reclamation.
Rule 706: Plugging Bond	A $10,000 individual bond for a well less than 3,000 feet in total measured depth or $20,000 if equal to or more than 3,000 feet in total measured depth, or a $60,000 statewide blanket bond for less than 100 wells or $100,000 for 100 wells or more.
Rule 707: Inactive Wells Bond	A $10,000 bond for each "excess" inactive well less than 3,000 feet in depth or $20,000 if more than 3,000 feet in depth.
Rule 711: Natural Gas Gathering, Processing, or Underground Storage Facilities Bond	A $50,000 statewide blanket bond or $5,000 individual bond for small gas gathering systems or processing less than 5 MMSCFD or 700 barrels of water per day. This was revised in 2018 to include produced water transfer systems.

Figure 2. Colorado Oil and Gas Conservation Commission Financial Assurance Rules[88]

To be consistent with economic theory and the Polluter Pays Principle,[89] bonding amounts must cover the costs of plugging and reclaiming well pads.[90] From an efficiency perspective, adequate bonding encourages firms to consider reclamation costs prior to drilling wells, especially when drilling speculative and marginal wells. From an equity perspective, bonds provide funds for reclamation, reducing the cost outlays for the state or

88 Not listed is Rule 708, which requires general liability insurance of $1,000,000 per occurrence to cover property damage and bodily injury to third parties. COLO. OIL & GAS CONSERVATION COMM'N., *supra* note 84, at 6.

89 The Polluter Pays Principle ("PPP") simply says that oil and gas companies will pay all the direct market and indirect nonmarket costs, including environmental damages, that occur as part of their business operations. Internalizing environmental externalities is the main objective of PPP. Economists argue that only when external costs have been fully considered will firms act to prevent market failures and move to a socially optimal level of output. Payments are made in many forms, including royalties, severance taxes, compliance costs, pollution taxes, impact fees, assurances bonds, and direct in-kind services.

90 Weber et al., *supra* note 83, at 16–17.

affected landowners. As Jeremy Weber et al. note, "[w]ithout bonds, greater costs would be shifted to parties that did not benefit economically from the well."[91]

There is a consensus among economists that bonding requirements should reflect the actual cost of plugging and well reclamation. In the last decade, researchers have examined the adequacy of bonding in covering costs and the resultant legacy costs from abandoned wells when bonding amounts are too low.

B. Research on Legacy Costs

University of Wyoming economists Matt Andersen and Roger Coupal completed one of the first studies to estimate legacy costs since the recent drilling boom began.[92] They established that a statistically significant relationship exists between reclamation costs and drilling depth. Their analysis used Wyoming Oil and Gas Conservation Commission data over a ten-year period (1997–2007) on well depth and the actual cost of reclaiming 255 abandoned oil and gas wells in forty-eight locations. The authors estimated mean average reclamations costs of $27,555 per well.

In follow-up research, Anderson and colleagues performed a statistical analysis of the cost of reclaiming 280 orphaned wells at sixty-seven locations in Wyoming.[93] The total cost of reclamation was dependent on three independent variables: (1) the number of wells per location; (2) the total drilling depth per location; and (3) the thirty-year average of annual precipitation. Precipitation was chosen as an environmental variable influencing the costs of reclamation. In general, locations with higher average precipitation are likely to experience relatively more natural revegetation. An increase in natural vegetation can decrease the costs of re-establishing grazing conditions, for example, that existed prior to drilling.

The results showed strong correlation with the three independent variables, explaining ninety-five percent of variation in total reclamation costs.[94] On a per-well basis, the regression predicts a fixed cost of $15,144—mostly road reclamation costs that are not influenced by well depth. Well pad reclamation costs increase by $4.80 for each additional foot drilled, and they decrease by $5,277 for locations with higher precipitation.

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91 Weber et al., *supra* note 83, at 7.

92 *See* Matt Andersen & Roger Coupal, *Economic Issues and Policies Affecting Reclamation in Wyoming's Oil and Gas Industry*, 26 NAT'L MEETING OF AM. SOC'Y OF MINING AND RECLAMATION 1 (2009).

93 Matt Andersen et al., *Reclamation Costs and Regulation of Oil and Gas Development with Application to Wyoming*, 8 W. ECON. FORUM 40, 45 (2009).

94 Andersen et al., *supra* note 93, at 46.

The authors predicted an average reclamation cost per well of $23,662.[95] The per-well reclamation cost was compared with the per-well bonding amount of $10,180, estimated with state data from 220 wells in twenty-five locations. Subtracting the average bond from the cost per well gave an estimated shortfall of $13,482 per well, which was multiplied by the 60,403 active wells to estimate a legacy cost of $814 million for the state of Wyoming.[96]

Stephanie Joyce and Jordan Wirfs-Brock[97] used similar methods to those of Anderson et al.[98] with updated data from Wyoming to estimate average reclamation costs of more than $100,000 per well—which is higher than Anderson's estimates due to wells being drilled deeper than in the past. Joyce and Wirfs-Brock conclude that it will be difficult for Wyoming taxpayers to cover the reclamation costs under the state's new bonding rules.

Kristin Lee[99] used updated data and regression methods from Anderson et al.[100] and Joyce and Wirfs-Brock[101] to estimate $6.1 billion in reclamation costs for the 94,096 producing oil and gas wells on federal public land. When compared to an estimated $162 million in bonds available, Lee concluded that federal taxpayers face legacy costs that exceed the value of the bonds by a considerable amount.[102]

Jacqueline S. Ho et al. developed a statistical analysis using data on plugging and reclamation costs, well depth, and bonding collected from thirteen state agencies.[103] The authors conclude that current state bonding requirements are insufficient to cover the average reclamation costs of orphaned wells in eleven of the thirteen states, including Colorado. Figures 3 and 4 summarize the results from these studies with estimates of the per-well legacy cost for various states.

Research has consistently shown that reclamation costs are positively correlated with well depth. In general, deeper wells are not only more

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95 *Id.* at 47.

96 *Id.*

97 Stephanie Joyce & Jordan Wirfs-Brock, *The Rising Cost of Cleaning Up After Oil and Gas*, INSIDE ENERGY (Oct. 1, 2015), http://insideenergy.org/2015/10/01/the-rising-cost-of-cleaning-up-after-oil-and-gas/.

98 Andersen et al., *supra* note 93, at 47.

99 KRISTIN LEE, ECONORTHWEST, RECLAIMING OIL AND GAS WELLS ON FEDERAL LANDS: ESTIMATE OF COSTS 10–11 (2018).

100 Andersen et al., *supra* note 93, at 47.

101 Joyce & Wirfs-Brock, *supra* note 97.

102 LEE, *supra* note 99, at 13.

103 Jacqueline S. Ho et al., *Managing Environmental Liability: An Evaluation of Bonding Requirements for Oil and Gas Wells in the United States*, 52 ENV'T SCI. & TECH. 3908, 3909 (2018).

expensive to drill, but they are more expensive to reclaim than shallow wells. Ho et al. divided plugging and reclamation costs by the following categories: (1) equipment costs such as the drilling rig, pulling unit, backhoe, and vacuum truck; (2) material costs for plugs such as cement or cast-iron bridge plugs; (3) special services such as perforation or casing cuts; (4) fees for waste disposal; and (5) labor or supervision costs.[104]

Reference	State	Plugging and Reclamation Costs Per Well	Bonding Amounts Per Well	Estimated Legacy Costs Per Well
Anderson et al., (2008)[105]	Wyoming	$23,662	$10,180	$13,482
Ho et al., (2018)[106]	Indiana	$7,107	$2,500	$4,607
Ho et al., (2018)	New York	$6,021	$5,000	$1,021
Ho et al., (2018)	Arizona	$10,663	$3,000	$7,663
Ho et al., (2018)	Pennsylvania	$9,820	$2,500	$7,320
Ho et al., (2018)	Ohio	$11,029	$5,000	$6,029
Ho et al., (2018)	Montana	$14,073	$5,000	$9,073
Ho et al., (2018)	Colorado	$31,094	$20,000	$11,094
Ho et al., (2018)	Michigan	$51,069	$25,000	$26,069

Figure 3. Legacy Costs – Plugging and Reclamation - Per Oil and Gas Well for Various States.

104 *Id.* at 3910.

105 Andersen et al., *supra* note 93, at 47.

106 Jacqueline S. Ho et al., *supra* note 103, at 3913.

Reference	State	Plugging Cost Only Per Well	Bonding Amounts Per Well	Estimated Legacy Costs Per Well
Ho et al., (2018)[107]	Kansas	$3,288	$2,795	$493
Ho et al., (2018)	Illinois	$4,378	$1,500	$2,878
Ho et al., (2018)	Texas	$9,756	$13,046	$0
Ho et al., (2018)	Oklahoma	$15,239	$25,000	$0
Ho et al., (2018)	California	$26,678	$25,000	$1,678

Figure 4. Legacy Costs – Plugging Only – Per Oil and Gas Wells for Various States.

Using those five cost categories, we offer the following explanations for why plugging and reclamation costs are greater for deeper wells. We suspect that equipment rental costs will be higher for deeper wells because the time necessary to flush and plug the well will be longer than for shallow wells. We expect that material costs will be greater for deeper wells as more cement will be needed to plug the well. Flushing and cleaning deeper wells before they are plugged produces more waste, which in turn could increase waste disposal fees. Deeper wells that take longer to plug will require more hours of labor and supervision.

The GAO[108] recently examined data from the BLM to estimate and compare per-well reclamation costs with per-well bonding amounts for wells on federal public land. Based on their review, the GAO determined that the BLM held bonds worth an average of $2,122 per well. Based on a clustering of BLM data, the GAO identified two reclamation cost scenarios—a low-cost scenario of around $20,000 per well and a high-cost scenario of about $145,000 per well. We combined the GAO[109] cost estimates with BLM[110] data on the number of wells to estimate a range of legacy costs for public land. Figure 5 shows our estimates of $1.7–$13.7 billion in legacy costs for oil and gas wells on federal public land. Our results are

107 *Id.*

108 U.S. GOV'T ACCOUNTABILITY OFF., GAO-11-292, OIL AND GAS: BUREAU OF LAND MANAGEMENT SHOULD ADDRESS RISKS FROM INSUFFICIENT BONDS TO RECLAIM WELLS 3 (2019).

109 *Id.* at 6.

110 U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT PUBLIC LAND STATISTICS 2018, at 112–13 (2019).

consistent with past research, and Lee's $6 billion estimate provides a mid-point to our estimated range.[111]

State	Num. of Wells	Avg. Bond Per Well	Reclamation Cost Per Well Low Est.	Reclamation Cost Per Well High Est.	Total Legacy Costs Low Est.	Total Legacy Costs High Est.
CA	7,938	$2,122	$20,000	$145,000	$142m	$1.1b
CO	7,272	$2,122	$20,000	$145,000	$130m	$1b
MT	3,000	$2,122	$20,000	$145,000	$53.6m	$429m
NM	31,214	$2,122	$20,000	$145,000	$558m	$4.4b
ND	2,701	$2,122	$20,000	$145,000	$48.3m	$386m
UT	9,285	$2,122	$20,000	$145,000	$166m	$1.3b
WY	30,730	$2,122	$20,000	$145,000	$549m	$4.3b
Other	4,059	$2,122	$20,000	$145,000	$72.5m	$580m
Total	96,199	$2,122	$20,000	$145,000	$1.7b	$13.7b

Figure 5. Estimated Legacy Costs for Oil and Gas Wells for Onshore Federal Public Land

C. Estimating Legacy Costs in Colorado

Legacy costs for state and private land must be addressed at the state level since the state of Colorado has the authority to set bonding amounts. Colorado's inventory of 53,045 oil and gas wells includes 38,352 producing wells, 10,263 shut-in wells, and 1,527 wells temporarily abandoned.[112] The COGCC maintains an online mapping tool that includes location and other spatial data for oil and gas wells in Colorado.[113]

Ho et al. collected Colorado-specific data for the years 2006–2015 and found that the costs of plugging and reclaiming an orphan well ranged

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111 LEE, *supra* note 99, at 11.

112 COLO. OIL & GAS CONSERVATION COMM'N, DEP'T OF NAT. RES., STAFF REPORT FOR MAY 21, 2019, at 23 (2019). Abandoned wells are connected to a solvent company that has suspended or slowed production. COGCC oversight requires operators of temporarily abandoned wells to disconnect and remove production equipment, and/or plug the well. Wells are often considered "shut in" due to repair or low market prices. The shut-in process is not subject to COGCC oversight, but COGCC rules that wells are shut in when valves stop the flow of oil or gas. *See* COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 87, at 4–5.

113 COGCC's GIS mapping tool has over 170 spatial datasets, combined with aerial photos, topographic quads, and geologic maps. Colo. Oil & Gas Conservation Comm'n, Dep't of Nat. Res., *Oil and Gas Wells in Colorado*, in *COGCC GIS Online*, https://cogccmap.state.co.us/cogcc_gis_online/ (last visited Sept. 7, 2021).

widely from $1,360 to $195,991, with an average cost of $31,000.[114] Multiplying average reclamation costs of $31,000 per well from Ho et al.[115] by the total number of oil and gas wells (50,380) in Colorado yields a total reclamation cost of $1.56 billion—some of which will be paid by industry. Unfortunately, the number of oil and gas operators declaring bankruptcy continues to increase.[116] Bankrupt operators are less likely to have funds available to pay reclamation costs.

While the average reclamation cost was $31,094, the average bonding amount was only $20,000.[117] The difference of $11,094 is an estimate of the legacy cost per well in Colorado. Multiplying the $11,094 legacy cost by the total number of oil and gas wells provides an estimate of the scale of legacy costs from inadequate bonding policies. With this method, we estimate the total legacy costs from Colorado's current inventory of 50,380 oil and gas wells to be $559 million.[118]

A second method for estimating legacy costs in Colorado is to use the three to four percent orphan well rate found in Wyoming by Joyce and Wirfs-Brock,[119] apply that rate to the 50,380 oil and gas wells currently in Colorado, and multiply the estimated number of orphaned wells by the $31,000 per-well reclamation costs estimated by Ho et al.[120] Based on this method, we estimate future legacy costs of $47 million to $62 million for orphaned wells in Colorado.

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114 Ho et al., *supra* note 103, at 3910.

115 *Id.*

116 Judith Kohler, *Will the extraction industry's economic turmoil blight Colorado?*, HIGH COUNTRY NEWS (Oct. 22, 2022), https://www.hcn.org/articles/energy-and-industry-will-the-extraction-industry-economic-turmoil-blight-colorado; Robert Rapier, *Oil Bankruptcies are Piling Up*, FORBES (Jan. 27, 2020), https://www.forbes.com/sites/rrapier/2020/01/27/oil-bankruptcies-are-piling-up/?sh=72b1577e7b1f; Judith Kohler, *Denver-based Extraction Oil and Gas latest producer to file for bankruptcy, pays millions to executives*, DENVER POST (June 15, 2020), https://www.denverpost.com/2020/06/15/extraction-oil-gas-bankruptcy-colorado/; Dennis Webb, *Gas company is in bankruptcy for second time*, THE DAILY SENTINEL (Apr. 8, 2019), https://www.gjsentinel.com/news/western_colorado/gas-company-is-in-bankruptcy-for-second-time/article_8d0fc946-59c3-11e9-a15d-20677ce06c14.html; Chase Woodruff, *More abandoned oil and gas wells likely in Colorado – but how many?*, COLO. NEWSLINE (July 9, 2020), https://coloradonewsline.com/2020/07/09/orphaned-oil-and-gas-wells-rising-colorado-covid-19/.

117 Jacqueline S. Ho et al., *supra* note 103, at 3910.

118 Data from the Energy Information Administration on drilling depths in the United States indicate a trend toward the drilling of deeper wells suggesting that reclamation costs will increase in the future. If bonding requirements or technology don't adjust to account for future increases in reclamation costs, the legacy costs could be greater than estimated here using reclamation costs from shallower wells.

119 Joyce & Wirfs-Brock, *supra* note 97, at 3.

120 Jacqueline S. Ho et al., *supra* note 103, at 3913.

A third method for estimating legacy costs in Colorado relies on bonding and cost data from COGCC.[121] In 2018, COGCC reported holding $131.8 million in total bonds/financial assurance for 43,474 wells, which equates to an average bonding amount per well of $3,031. COGCC estimates the average plugging and reclamation cost for a well pad with one well equals $82,500.[122] Based on COGCC data, Colorado has a legacy cost of $79,469 per well. Total legacy costs for Colorado taxpayers can be estimated by multiplying $79,469 by the current inventory of 50,380 wells which equals $4.0 billion, the largest of the three estimates.

The three estimates above suggest significant legacy costs for the state of Colorado. With the new impact fee authority granted by Senate Bill 19-181, the state should begin charging a per-well impact fee for all new and existing wells in order to generate dedicated funding for addressing legacy costs.

IV. LOSS OF PROPERTY TAX REVENUE

The potential long-term loss of property tax revenue represents a fiscal cost for local governments that needs to be accounted for when estimating total fiscal costs of oil and gas development. In Colorado, local officials interviewed by Raimi and Newell[123] voiced concerns that the growing network of oil and gas pipelines could restrict future growth of residential and commercial property in the coming decades, leading to foregone property and income tax revenue from future development. Recent research supports concerns that fiscal impacts to local governments extend far beyond well pads to include pipelines. Robert A. Simons et al.,[124] in a case study examining the fiscal impacts of a proposed pipeline route, conclude that the city of Green, Ohio, would disproportionately bear the burden of anticipated economic losses and reduction in tax revenue associated with the pipeline. The authors project that, over a fifty-year period, the pipeline will cause fiscal losses of over $52 million, primarily from foregone property and income taxes.[125]

In addition to foregone tax revenue from future development, the potential decline in property tax revenue from lower property values for homes near oil and gas development represents a fiscal cost. The total

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121 COLO. OIL & GAS CONSERVATION COMM'N, supra note 84, at 9.

122 *Id.*

123 RAIMI & NEWELL, *supra* note 62, at 24.

124 Robert A. Simons et al., *Fiscal and Economic Impact Analysis of Proposed Nexus Natural Gas Pipeline on the City of Green, Ohio: A Case Study,* 9 J. OF SUSTAINABLE REAL ESTATE 86, 106 (2017).

125 *Id.*

fiscal costs must be compared to the total revenues to determine net fiscal impacts and whether an impact fee is needed. In the next section we examine methods for estimating this cost.

A. Colorado Hedonic Studies

To estimate the change in property values from oil and gas development, economists often use the hedonic method, which statistically analyzes variations in actual sales prices of properties in order to isolate the effects of proximity to oil and gas wells. Properly conducted hedonic studies must control for the relevant attributes of the properties (e.g., acreage, number of rooms, date of construction, square footage) and its surroundings (e.g., schools, stores, parks, and fire protection). By controlling for property attributes and surroundings, economists isolate the potential disamenities of proximate oil and gas production (e.g., truck traffic, air pollution, noise pollution, groundwater pollution).

Kerkvliet and Morton reviewed four hedonic studies of Colorado property sales prices.[126] The results are summarized in Figure 6.[127] Three of these studies found zero to very small, but negative, effects of oil and gas development on property prices. All three studies acknowledge their potential weaknesses stemming from two deficiencies: lack of control for the mineral rights ownership and lack of control for the source of domestic water.

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126 KERKVLIET & MORTON, *supra* note 6, at 24.

127 *See* BBC RESEARCH & CONSULTING, GARFIELD COUNTRY LAND VALUES AND SOLUTIONS STUDY IV-1 to IV-10 (2006). *See also* Ashley Bennett & John Loomis, A*re Housing Prices Pulled Down or Pushed Up by Fracking Oil and Gas Wells? A Hedonic Price Analysis of Housing Values in Weld County, Colorado*, 28 SOC'Y & NAT. RES. 1168, 1178–1181 (2015); Xuanhao He et al., *The Case of the Missing Negative Externality? Housing Market Effects of Fracking in the Niobrara Shale Play, Colorado*, 7 J. OF ENV'T ECON. AND POL'Y 223, 234–238 (2017); Andrew Boslett et al., *Valuation of the External Costs of Unconventional Oil and Gas Development: The Critical Importance of Mineral Rights Ownership*, 6 J. OF THE ASS'N OF ENV'T AND RES. ECONOMISTS 531, 548–52 (2019).

	BBC Consulting 2006	Bennett and Loomis 2015	He et al. 2018	Boslett et al. 2019
Location	Garfield County	Weld County	Weld County	Garfield, Mesa and Rio Blanco Counties
Dates	1980–2005	2009–2012	2014–2017	2000–2014
Metric	Well drilled on rural property within 90 days, or 2 years, or more than 2 years prior to sale	Distance to nearest well being drilled	Location of drilling permits	One mile from producing well
Results	Price decreases of 15, 10 percent, and 7 percent for properties with drilled wells within 90 days, two years, or more than 2 years prior to the sale, respectively	Price decrease of 5–6 percent for rural properties 1000 meters from a well being drilled. Conflicting results for urban properties	No change	Price decrease of 35 percent for properties within 1 mile of producing well
Statistically significant	No	Yes	Yes	Yes
Control for Water Source	No	No	No	No
Control for mineral rights	No	No	No	Yes

Figure 6. Colorado Hedonic Studies on Property Values and Oil and Gas Development

The first potential deficiency of all four Colorado hedonic studies, lack of control for domestic water source, applies to all of the studies listed in Figure 6. The cause of this deficiency is a dearth of information in Colorado on whether a property has a piped source of treated domestic water or relies on a groundwater well. Yet there is evidence that groundwater quality may be compromised by nearby oil and gas development. Although water source data are not available in Colorado, they are available in Pennsylvania. The Pennsylvania-based hedonic study by Lucija

Muehlenbachs et al. shows that the size and even the sign (negative or positive) of the estimated impacts of oil and gas development depends on water source.[128]

The second deficiency, lack of control for mineral rights ownership, has potentially large effects on property prices because the potential or actual royalty payments from oil and gas production will be capitalized in the property's sale price. But often, the owner of a property's surface rights is not the same as the owner of a property's mineral rights. This is called "split estate." Sales prices (of surface rights) will potentially be lower as a result of split estate. The size of this split estate effect is suggested by Claudia Hitaj et al.'s finding that mineral rights payments to farmland owners in oil-rich U.S. counties totaled over $7 billion in 2014, approximately twenty-six percent of the total value of oil and gas produced on farmland in these counties.[129] The failure of the three studies to control for mineral rights ownership was not due to authors' oversight. Although Hitaj et al. (2018) estimated that eighty-one percent of U.S. farmland properties are split estate, these data are simply not publicly available at the parcel level in Colorado or nearly any other state.

Boslett et al. cleverly controlled for mineral rights ownership and provide evidence on the importance of including these data in hedonic studies.[130] The authors' strategy to know whether the sales price of a property did or did not include the capitalized value of mineral rights was to distinguish between properties conveyed to private land owners by the U.S. government under the 1916 Stock-Raising Homestead Act, where the government retained mineral rights, versus properties conveyed by the 1862 Homestead Act, where the government did not. These authors examined real estate sales prices in three counties on Colorado's western slope: Garfield, Mesa, and Rio Blanco. They estimated that properties with severed mineral rights located within one mile of a producing well sell for $63,788 (34.8 percent) less than similar properties without a producing well within one mile. Location near an oil and gas well had no effect on sales price for properties with ownership of mineral rights. This result suggests that hedonic studies failing to account for mineral rights may seriously underestimate the negative effects of oil and gas development on real estate prices. The finding also suggests the importance of collecting data on mineral

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128 Lucija Muehlenbachs et al., *The Housing Market Impacts of Shale Gas Development*, 105 AM. ECON. REV. 3633, 3649–55 (2015); KERKVLIET & MORTON, *supra* note 6 at 28.

129 CLAUDIA HITAJ ET AL., OWNERSHIP OF OIL AND GAS RIGHTS AND FARM SECTOR INCOME AND WEALTH 8 (2018).

130 Boslett et al., *supra* note 127, at 533.

rights ownership in order to better understand the economic impacts of oil and gas development.[131]

B. Estimating Loss of Property Tax Revenue

While future hedonic studies tease out the influence of mineral rights and water sources, what can local governments do in the meantime? How can impact fees be estimated to mitigate tax revenue losses from a decline in property values? The effect of oil and gas development on property values can be approximated using benefit transfer methods based on the results from published hedonic studies.[132] Benefit transfer "is the use of preexisting empirical estimates from primary studies at one or more sites or contexts where research has been conducted to predict … [monetary damage] estimates at unstudied sites or contexts."[133] An example of benefit transfer methods for Colorado would be to apply the estimated property value reduction from Bennet and Loomis combined with those from Boslett et al.[134] Such an approach may be necessary and reasonable for capturing the fiscal costs from lower property tax revenues when property values decline.[135]

One reasonable method is to calculate the total value of homes within one to five miles from oil and gas wells and use benefit transfer methods from hedonic studies to estimate the change in property values. For example, if home prices drop twenty percent within one mile of a well, a county could estimate the total loss of property value for all homes within one mile and hence the loss of property tax revenue as a result of the well. For homes within a five-mile radius, counties could apply a fifty percent decay rate per mile. In this case, the twenty percent drop in value could be lowered to ten percent for homes within one to two miles, five percent for homes within two to three miles, 2.5 percent for homes within three to four miles, and a 1.25 percent decline in value for homes within four to five miles of a well. The loss of property tax revenues would be equal to the cumulative loss of property tax revenue over a fixed distance from a well up to the five-mile radius.

The cumulative loss of property tax revenue should be included as one of the fiscal costs that are deducted from revenue when estimating net fiscal impacts from oil and gas development. If the net fiscal impacts are

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131 KERKVLIET & MORTON, *supra* note 6, at 24.

132 The economic criteria for accurate and defensible BT studies are similar to the legal rational nexus test for accurate and defensible impact fees.

133 Robert Johnston et al., *Benefit Transfer of Environmental and Resource Values: Progress, Prospects, and Challenges*, 12 INT'L REV. ENV'T RES. ECON. 177, 254 (2018).

134 Boslett et al., *supra* note 127.

135 KERKVLIET & MORTON, *supra* note 6, at 27.

negative, an impact fee for loss of property tax revenue is justified. To better withstand a court challenge, local and state governments should have a plan and budget in place for how the impact fee revenue will be spent in lieu of the lost property tax revenue.

V. DISCUSSION AND RECOMMENDATIONS

Impact fees have become a source of revenue for local governments to compensate for the long-term decline in federal and state funding.[136] Impact fees can be used to pay for the fiscal costs of oil and gas operations not covered by severance taxes, property taxes, mill levy revenue, and royalty payments from oil and gas development. Impact fees are especially defensible when the net fiscal impacts are negative.

As more states and local governments examine fiscal impacts and the use of impact fees, we recommend: (1) a full accounting of fiscal costs by state and federal agencies; (2) expanding the scope of fiscal costs covered by impact fees; and (3) full, transparent reporting of net fiscal impacts by state and federal agencies. Internalizing these costs and reporting net fiscal impacts is essential for promoting fiscally responsible oil and gas development.

As economists continue to research net fiscal impacts, we will gain a better understanding of the extent to which local and state governments experience positive, neutral, or negative net fiscal impacts. To what extent can impact fees be used to improve the fiscal outcomes for local and state governments? Can impact fee revenue reduce the fiscal risks to municipalities from long-term debt to pay for infrastructure projects? Can the net positive fiscal impacts be increased to cover the long-term risks associated with the resource extraction?[137]

We focused here on oil and gas development because the industry is a prime candidate for impact fees due to the heavy truck traffic, air pollution, and boom and bust cycles that can be fiscally devastating for municipalities. While our focus is on impact fees and net fiscal impacts from the oil and gas industry, all types of development can be subject to impact fees. How do the net fiscal impacts from oil and gas compare to the net fiscal impacts from other industries?

For example, what are the net fiscal impacts to municipalities from pursuing cleaner and renewable sources of energy? Does renewable energy have similar or different effects on property values compared to oil and gas development? What are the legacy costs associated with other

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136 Bauman & Ethier, *supra* note 44, at 51.

137 JOE KERKVLIET & PETE MORTON, USE PRECAUTION: THE FRACKING BOOM COMES WITH RISK OF THE RESOURCE CURSE, CONSERVATION ECON. INST. 4 (2017).

industries (e.g., abandoned mine tailings, wind turbines, and solar panels)? Additional research on the net fiscal impact from other industries is needed for comparison purposes and may turn up some surprising results.

Natural amenity, tourism, and recreation communities may want to examine the fiscal costs from visitors, such as increases in traffic, pollution, crowd management, and emergency services. Similar to oil and gas development, local governments may not know which industries have fiscal impacts that are net positive or net negative. For some industries, communities may be moving from the days of offering tax breaks for relocated companies to charging them greater impact fees.

A. Data Collection, Research, and Monitoring

One of the lessons learned from Raimi and Newell's body of research is that the net fiscal impacts from oil and gas development are not uniform across counties or across municipalities in the state of Colorado. The variation in fiscal risk is especially relevant for small and geographically isolated communities with limited infrastructure that experience rapid population growth. Collecting baseline data on pre-development fiscal conditions is important for understanding how local government finances might be impacted by development and whether the net fiscal impacts are positive or negative.

We believe it is reasonable to use impact fees to pay for data collection and research necessary for setting legally defensible impact fees. Allowing local governments to charge impact fees to pay for collecting baseline data is consistent with recommendations included in the Minority Report of the 2015 Governor's Task Force.[138]

Proper due diligence by local and state governments requires collecting and monitoring baseline data and completing credible research in order to successfully defend against legal challenges to impact fees. While we focus on fiscal costs, additional focus on data collection, research, and monitoring is needed to quantify environmental costs.[139]

Industry can also benefit from data collection efforts by establishing pre-existing baseline conditions so as to not be responsible for past problems. If, for example, spills of wastewater or fracking fluid result in

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138 THE KEYSTONE CENTER, COLORADO OIL AND GAS TASK FORCE FINAL REPORT 25 (2015).

139 Data collection, research, and monitoring of environmental impacts, while traditionally funded at the federal level, represent an increasing role for local and state governments that require an increased long-term budget commitment. This new role for local and state governments is a result of federal budget cuts that have hampered federal agencies from serving their traditional "science role" in terms of data collection, research, and monitoring.

pollutants being discharged into local streams, having baseline information on stream water quality prior to the spills will help verify and quantify the marginal damages from groundwater contamination and accurately link them to individual operators.[140]

COGCC Rule 609 requires operators of oil and gas wells to collect baseline water samples prior to drilling activity and after drilling.[141] Compared to other states, COGCC data on water quality and spills at drilling sites in Colorado are more detailed,[142] more transparent, and are publicly available on COGCC's website.[143] Boulder County's proposed update to its Land Use Regulations requires companies to provide baseline data on soil conditions and water quality from a qualified, independent consultant. Once submitted, the baseline data will be reviewed by county staff and made available to the public.[144] In contrast, Pennsylvania state agencies do not collect pre-drilling baseline water quality data, and the public does not have access to the baseline water quality data collected by industry.[145]

Court challenges to impact fees emphasize the importance of ensuring the data collected are up-to-date and applicable. The following example vividly illustrates this: Colorado air quality officials had long assumed that oil and gas development in general, and condensate storage tanks specifically, were an insignificant emission source of VOC emissions and did not regulate them. In fact, condensate storage tanks were exempt from reporting and permitting requirements, despite the fact that officials had

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140 Elaine Hill & Lala Ma, *The Fracking Concern with Water Quality*, 373 SCIENCE 853, 853 (2021) (providing recent research on water pollution from oil and gas development); Pietro Bonetti et al., *Large-Sample Evidence on the Impact of Unconventional Oil and Gas Development on Surface Waters,* 373 SCI. 896, 901 (2021).

141 COLO. OIL & GAS CONS. CONSERVATION COMM'N, DEP'T OF NAT. RES., COLORADO OIL AND GAS CONSERVATION COMMISSION RULES § 609 (2013).

142 COGCC in partnership with the Groundwater Protection Council developed a publicly available, searchable database of groundwater, surface water, and soil samples. The database contains 52,510 samples from over 18,280 sample locations. COLO. OIL AND GAS CONSERVATION COMM'N, *supra* note 5.

143 Sherilyn A. Gross et al., *Analysis of BTEX Groundwater Concentrations from Surface Spills Associated with Hydraulic Fracturing Operations*, 63 J. OF THE AIR & WASTE MGMT. ASS'N 424 (2013); Shanti Gamper-Rabindran, *Information Collection, Access, and Dissemination to Support Evidence-Based Shale Gas Policies*, 2 ENERGY TECH. 977, 982 (2014). As evidence of increased public transparency by COGCC, spill data, inspection reports, and GIS shapefiles can be downloaded here http://cogcc.state.co.us/data2.html#/downloads.

144 BOULDER COUNTY COMMISSIONERS, BOULDER COUNTY LAND USE CODE FOR OIL AND GAS OPERATIONS art. 12 (2020).

145 Gamper-Rabindran, *supra* note 143, at 981.

minimal understanding of the potential for VOC leakage and venting from the storage tanks.[146]

That changed in 2000 when scientists discovered that, as a result of "flash emissions," storage tanks were responsible for the majority of VOCs emitted in Colorado.[147] In other words, while the state was collecting and monitoring air quality data, the data were not applicable for a community concerned about VOC pollution from nearby storage tanks. In 2014, Colorado passed new rules requiring methane and VOC leak detection from tanks and pipelines using infrared cameras.[148]

Communities concerned about air pollution should seek information on the number and proximity of the air monitoring stations, as well as the frequency at which air quality monitoring occurs. Is the monitoring station located nearby and does the monitoring occur continuously twenty-four hours per day? Research from the Four Corners region shows variability between day and nighttime baseline air pollution levels. Petron et al. found that the increased methane levels occur "at night and early morning when limited air circulation leads to the pooling of emissions near sources, especially in low elevation portions of the basin."[149] To account for day to night variability in air pollution levels, we recommend 24-hour monitoring.

Concern over the applicability of air quality data collected by the state of Colorado resulted in Boulder County applying for and receiving a $500,000 grant from the Environmental Protection Agency to install monitors in five locations across the county to better understand the flow of air pollution into the county from oil and gas wells in nearby Weld County.[150] At the state level, the Colorado Department of Public Health and Environment has deployed a trailer with various instruments and sampling frequencies to measure air pollution near oil and gas operations and residences or schools.[151]

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146 GARRY KAUFMAN, REGULATING OIL AND GAS EMISSIONS IN THE DENVER JULESBURG BASIN (June 6, 2014).

147 *Id.*

148 *Id.*

149 Gabrielle Pétron et al., *Investigating large methane enhancements in the U.S. San Juan Basin*, 8 ELEMENTA SCIENCE OF THE ANTHROPOCENE (2020).

150 DETLEV HELMIG, BOULDER ATMOSPHERE INNOVATION RESEARCH, AIR QUALITY MONITORING AT THE BOULDER RESERVOIR 9 (2020), https://assets.bouldercounty.org/wp-content/uploads/2020/10/Boulder-Reservoir-Air-Monitoring-Findings-October_8_2020.pdf.

151 The Colorado Department of Public Health and Environment trailer is called CAMML and can be used for community investigations of air pollution levels. Colo. Dep't of Pub. Health & Env't, *Meet the Camml*, https://drive.google.com/file/d/1_ZUa1_BK5q0MchJ5UaKxTzVdkB5bgISY/view;

For Boulder County, investing in data collection, research, and monitoring empowered county residents with applicable information on local air quality. These expenditures could be viewed as precautionary (i.e., do no harm) costs for a concerned community that in return may have high legal value in court. In order for a community (or industry) to know if harm occurs, baseline levels of harm must be established.

The economic value of investing in baseline information and research will vary from county to county and state to state. Whether the precautionary cost of obtaining information is worth it—whether a local or state government believes the benefits of investing in baseline data, research, and monitoring is worth the cost—will vary across the rural-urban political landscape. What a community is willing to pay for information is in part based on its ability to pay.

In wealthy natural amenity counties like Boulder County—which embraced the precautionary principle to guide its policies—both the willingness and ability to invest in data collection, research, and monitoring is quite high. On the other hand, poorer counties with fewer resources, although willing, may have less ability to pay for the precautionary information. The inability to pay can be addressed by charging impact fees to provide poorer counties with a source of revenue to invest in precautionary information.

B. Legacy Costs from Abandoned Wells

A straightforward method for estimating legacy costs starts with the statistical relationship between well depth, plugging, and reclamation costs. Estimated reclamation costs can then be compared to the available bonding amounts to derive outstanding legacy costs. Economic research indicates that legacy costs created by inadequate bonding are a multi-billion-dollar problem in the U.S. The legacy costs need to be accounted for when estimating net fiscal impacts from oil and gas development.

Economists and policy analysts have quantified the billions in "front-end subsidies" granted to the oil and gas industry over the last sixty years.[152] The legacy costs from outdated and insufficient bonding policies represent "back-end subsidies" as these costs are directly and indirectly

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https://cdphe.colorado.gov/oil-and-gas-and-your-health/oil-and-gas-community-investigations (last visited Jan. 9, 2022).

152 The Windfall Profit Tax of 1980, Section 29 of the Internal Revenue Code, established tax credits for unconventional oil and natural gas, including oil produced from shale and tar sands, and natural gas from shale and tight gas formations. Between 1950 to 2010 the oil and natural gas industry received $490 billion in federal energy subsidies and incentives. *See* MGMT. INFO. SERV., NUCLEAR ENERGY INST., 60 YEARS OF ENERGY INCENTIVES 9 (2011).

subsidized by taxpayers. Net fiscal impact analysis by state and federal agencies should account for legacy costs. Legacy costs can also be internalized with impact fees when states and the federal government update their oil and gas leasing and bonding policies.

Inadequate bonding for plugging and reclamation is not a new problem in Colorado. In 1990, the Colorado state legislature first authorized the Plugging and Reclaiming Orphan Wells ("PROW") appropriation line item in the budget to plug and reclaim orphaned wells. For fiscal year 2019, the Colorado legislature dramatically increased the PROW appropriation from $445,000 in fiscal year 2018–2019 to $5,011,000.[153] While there are substantial public benefits from increasing PROW appropriations for reclaiming orphaned wells, ideally the former owners of the wells would be paying the full bill.

PROW funding relies primarily on revenue from a mill levy on the value of production, combined with fines and penalties from spills and explosions.[154] Using mill levy revenue to pay for legacy costs represents foregone revenue to the state's general fund. In other words, for nearly thirty years, Colorado taxpayers have foregone mill levy tax revenue on oil and gas production (a non-renewable resource) to help pay the legacy costs to reclaim oil and gas wells that were abandoned by the oil and gas industry.

1. Impact Fees

To provide a pool of consistent and dedicated funding to address legacy costs on state and private land, we recommend states begin charging per-well impact fees on the current inventory of oil and gas wells. The federal government should also charge per-well impact fees to address legacy costs on federal public land. In 2008, the GAO made a similar recommendation for user fees as a way to reduce the costs to taxpayers of reclaiming old wells.[155]

Per-well impact fees provide a predictable, stable, and dedicated source of funding for addressing legacy costs. In contrast, PROW funding provides an inconsistent source of revenue due to swings in market prices and production levels. For example, annual levy revenue in Colorado declined from $9.2 million in fiscal year 2013–2014 to $5.7 million in fiscal

153 COLO. OIL & GAS CONSERVATION COMM'N, DEP. OF NAT'L RES., FISCAL YEAR 2018 ANNUAL REPORT ORPHANED WELL PROGRAM 1 (2018).

154 COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 12, at 1.

155 U.S. GOV'T ACCOUNTABILITY OFF., GAO-08-386, FEDERAL USE FEES: A DESIGN GUIDE 1 (2001).

year 2015–2016.[156] Over the last decade, annual penalty revenue has ranged from around $370,000 to just over $1.5 million.

Charging per-well impact fees on existing wells would provide stable and dedicated funding to address legacy costs while also freeing up mill levy revenue to maintain and increase COGCC oversight of oil and gas development in Colorado. Additional mill levy revenue could, for example, be used to hire more inspectors to bring Colorado up to the inspection level in peer states. Each inspector at COGCC is responsible on average for inspecting 1,900 wells. In contrast, other states average 1,621 wells per inspector.[157] Hiring more inspectors with mill levy revenue will reduce the workload per inspector and provide better oversight. Currently, COGCC inspects wells on average every 1.8 years.[158] Additional mill levy revenue will enable COGCC to increase the frequency of inspection and decrease the time between inspections. Gross et al. found that over a one-year period, fourteen of the sixty-two spill reports of groundwater contamination with BTEX[159] at drilling sites in Weld County were discovered during inspection, highlighting the importance of inspections for discovering spills and mitigating damages.[160]

When prices and production are down there is much less revenue to support COGCC's operating budget, let alone to address legacy costs.[161] A recent increase in the mill levy to $.0015[162] is expected to cover an anticipated COGCC budget shortfall of nearly $4 million.[163] During a bust period with low revenue from the mill levy, legacy wells are more likely to be ignored and forgotten as in the past. A per-well impact fee directly addresses this shortcoming by providing a stable source of funding for addressing legacy costs when markets are down.

Since reclamation costs vary with the depth of a well, it's reasonable to base the per-well impact fee on the depth of each well. A portion of the

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156 COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 12, at 1.

157 THE KEYSTONE CENTER, *supra* note 138, at 25.

158 COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 87, at 107.

159 Benzene, toluene, ethylbenzene, and xylene ("BTEX") water pollution comes from surface spills and leaks of the flowback or produced water that comes to the surface as a result of hydraulic fracturing.

160 Gross et al., *supra* note 143, at 427.

161 Andrew Baker, *Colorado Oil, Natural Gas Regulator Raises Mill Levy to Balance Budget Amid Pandemic*, NATURAL GAS INTELLIGENCE (Aug. 4, 2021), https://www.naturalgasintel.com/colorado-oil-natural-gas-regulator-raises-mill-levy-to-balance-budget-amid-pandemic/.

162 The mill levy rate cannot be increased above $.0017 without changing Colorado's Oil and Gas Act.

163 Judith Kohler, *Colorado Oil, Gas Commission Proposes Fee Hike to Cover Shortfall Due to Falling Energy Production*, DENVER POST (July 1, 2020), at 15A.

impact fee can be retained to ensure site-specific funding to plug and reclaim the site, with the balance of money allocated to a statewide pool for addressing legacy costs. Pooling impact fees for addressing legacy costs is similar in concept to the pooled bonding approach recommended by COGCC's Financial Assurance Technical Working Group in 2018.[164] The difference is that we propose charging impact fees based on the depth of existing and new wells to fund the pool, while the Working Group recommended charging a set fee on permits for new wells.

Orphaned and improperly plugged abandoned wells are an industry-wide problem, and a proportional industry-wide per-well impact fee solution is reasonable and necessary. Abandoned wells are directly connected to past and current oil and gas development. Using impact fees to specifically plug and reclaim orphaned and abandoned wells will satisfy the requirements of the rational nexus test. A clear nexus is established as the impact fee is proportional to the costs of plugging wells and reclaiming the land. And industry will derive benefits from plugging wells and reclaiming the land by reducing costs, maintaining its social license to operate, and improving employee relations.

Part of the legacy problem is lack of a long-term vision and an understanding of the benefits to industry from properly plugging and reclaiming abandoned and orphaned wells. The cost-savings benefits include: (1) reduced operational costs and/or increased production, especially in redeveloped, older fields; and (2) avoiding future environmental costs (including litigation costs) associated with fluid or gas leakage.[165] Additional industry benefits include improved community relations by being a good neighbor and generating goodwill with stakeholders. Goodwill enhances industry's reputation of being responsible operators, which can reduce costs and help industry retain its social license to continue operating. From an employment perspective, plugging and reclaiming old legacy wells provides jobs for oil and gas workers, which will improve employee relations. This is especially true when workers are laid off following a bust. In this sense, jobs created by plugging and reclaiming legacy wells can help "flatten" the boom-and-bust curve.

2. Environmental Mitigation Fees

A variant to impact fees for addressing legacy costs is an environmental mitigation fee, which combines the principles of impact fees with mitigation banking.[166] Nicholas and Juergensmeyer recommend environmental mitigation fees for maintaining a desired level of environmental

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164 COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 84, at 12.

165 ARTHUR ET AL., *supra* note 75, at 5.

166 Nicholas & Juergensmeyer, *supra* note 28, at 847.

service that is linked to a plan with these key components: (1) a desired level of environmental services; (2) a guide for assessing the impacts of development on environmental services; and (3) environmental mitigation fees to maintain the desired level of environmental service.[167]

Environmental mitigation fees could be based on achieving the desired level or rate of plugging and restoration of legacy wells identified in a strategic plan for spending impact fee revenue once collected. For example, a prioritization plan to reclaim old wells could start with legacy wells that are high emitters of methane pollution, along with wells that have low reclamation costs and high ecosystem service values. Using such a decision-making framework would efficiently begin addressing legacy costs.

Where economically and geologically feasible, it is worth considering the benefits of repurposing abandoned oil and gas fields and associated pipelines to CO_2 transport and long-term storage sites. Past research suggests that abandoned oil and gas fields in the United States have an estimated CO_2 storage capacity of one gigaton (one billion metric tons), with a potential storage capacity of approximately twenty-five to thirty gigatons.[168] Although the oil and gas industry has decades of experience using CO_2 for enhanced oil recovery, long term storage of CO_2 involves different goals. With enhanced oil production, industry's goal is to maximize production using as little CO_2 as possible. Whereas with carbon storage, the goal is to maximize CO_2 injection—subject to environmental and geologic risks assessments—and to store the carbon for thousands of years (U.S. Department of Energy 2002).[169]

Long-term monitoring for CO_2 leakage will be necessary to maintain the desired level of CO_2 stored in the wells and to address public concerns and valid objections to the approach. We recommend a phased approach. Start slow and adjust pace and scale based on monitoring results. What percent of total CO_2 stored remains stored in the wells after twenty, fifty, or 100 years? What is the annual leakage rate over that time period?

In general, large stationary sources of CO_2 like electric power plants, oil refineries, and cement plants in close proximity to legacy wells will

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167 *Id.* at 862–63.

168 EDWARD M. WINTER & PERRY D. BREGMAN, DISPOSAL OF CARBON DIOXIDE IN AQUIFERS IN THE U.S. 192 (1995), https://www.osti.gov/servlets/purl/121401; SCOTT H. STEVENS ET AL., SEQUESTRATION OF CO_2 IN DEPLETED OIL FIELDS AND GAS FIELDS: GLOBAL CAPACITY, COSTS, AND BARRIERS 278–83 (2001), https://www.osti.gov/etdeweb/biblio/20195787; Soren Anderson & Richard Newell, *Prospects for Carbon Capture and Storage Technologies* 25 (Res. for the Future, Discussion Paper, RFF DP 02-68) https://media.rff.org/documents/RFF-DP-02-68.pdf.

169 U.S. DEP'T. OF ENERGY, CO2 CAPTURE AND STORAGE IN GEOLOGIC FORMATIONS (2002).

have a comparative advantage for carbon storage.[170] Technology is available for separating CO_2 from power plant flue emissions, but the process uses energy which reduces the energy produced by the plant. Pilot studies suggest the "energy penalty" can be lowered to twenty percent for conventional coal and ten percent for natural gas power plants.[171]

In Colorado, there are over 20,000 oil and gas wells and five power plants located in Weld County. Moffat County in northwest Colorado has similar repurposing opportunities. Bundling legacy costs with environmental mitigation fees for oil and gas development can allow local and state governments the opportunity to turn environmental liabilities, such as abandoned wells, into environmental assets as underground CO_2 storage sites.[172] Repurposing abandoned wells to CO_2 storage sites can be part of an economic transition strategy for communities interested in phasing down their dependency on oil and gas production.

3. Hold Past Operators Jointly Responsible for Legacy Costs

Retroactive "claw back" policies that hold past operators jointly responsible for legacy costs represent an alternative to impact fees. Policies that incorporate "joint liabilities" make past owners liable for their portion of legacy costs.[173] The concept of joint liabilities essentially means that if you were involved in operating a well, past or present, you are liable for reclamation costs and damages.

The 1980 Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), also known as Superfund, imposes joint liability on parties responsible for, in whole or in part, the presence of hazardous substances at an orphaned site.[174] CERCLA's "Superfund" joint liability is retroactive and strict[175] and could be utilized to address legacy costs from orphaned oil and gas wells.

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170 DAG NUMMEDAL ET AL., ENHANCED OIL RECOVERY IN WYOMING. PROSPECTS AND CHALLENGES 13 (2003).

171 Anderson & Newell., *supra* note 168, at 13.

172 NUMMEDAL ET AL., *supra* note 170, at 9–11.

173 CORNELL LAW SCHOOL, *Joint and Several Liability*, LEGAL INFO. INST., https://www.law.cornell.edu/wex/joint_and_several_liability (last visited Aug. 31, 2021).

174 Environmental Protection Agency, *Summary of the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)*, LAWS & REGULATIONS, https://www.epa.gov/laws-regulations/summary-comprehensive-environmental-response-compensation-and-liability-act (last visited Aug. 31, 2021).

175 CORNELL LAW SCHOOL, *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)*, LEGAL INFO. INST., https://www.law.cornell.edu/wex/comprehensive_environmental_response_compensation_and_liability_act_%28cercla%29 (last visited Aug. 31, 2021).

Legislating joint liabilities for oil and gas wells may help relieve the financial burden on small operators from legacy costs. As often happens, large, highly capitalized oil and gas operators, after extracting the majority of oil and gas production, sell the low-producing wells to smaller operators with lower overhead. These smaller operators often lack the financial resources to close a well when the time has come, leading to legacy costs for taxpayers.

A reasonable approach to estimate an operator's joint liability for well closure costs could be based on the percent of total production that occurred during the length of time they were responsible for operating the well. This approach would be similar to a variant of joint liability called *market share liability*.[176]

In Colorado, holding past operators liable for legacy costs on state and private land through a "quasi CERCLA program" would require a statutory change.[177] With respect to federal land, the BLM, as the lessor of oil and gas leases to operators, successfully held a past operator jointly liable for plugging, reclamation, and remediation of orphaned wells.[178] In *Monahan v. U.S. Department of Interior*, the court, based on language included in the Mineral Leasing Act of 1920, found the lease holder liable even though they had transferred operating rights to another company (that eventually went bankrupt).[179]

Impact fees may be easier and less expensive to implement than taking past operators to court. However, for impact fees to work efficiently, there must be enough active wells still operating to generate sufficient money to address legacy costs. In the case of a mature field with high legacy costs but with only a small number of active wells, holding past operators liable for legacy costs may be the better option to pursue.

C. Reform Bonding Policies

While per-well impact fees can address legacy costs, bonding policies need to be reformed to mitigate future legacy costs for taxpayers. Bonding policies can be reformed in concert with per-well impact fees to pay for past legacy costs. Boulder County is updating its bonding policy to embrace the new authority given to local governments by Senate Bill 19-181. The County will now "require financial assurances (such as bonds and letters of credit) from operators to guarantee compliance with all permits,

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176 Cornell Law School, *supra* note 173.

177 *See* COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 84, at 14.

178 Monahan v. U.S. Dep't of Interior, No. 05-8068, 2007 WL 2993577, at *1, *4 (10th Cir. Oct. 15, 2007).

179 *Id.*

clean-up of any pollution and complete reclamation. In addition, operators' financial fitness will be considered during staffs and the Board's analyses."[180]

The state of Colorado is also updating bonding policies for state and private land. The COGCC recently estimated that on a per-well basis, the average cost to plug orphaned wells is six times greater than the bonding amount held by the state. When the cost of environmental remediation and site reclamation are included, the total costs are fourteen times greater than the bonding amounts.[181]

1. Increase Bonding Amounts to Fully Cover Costs

The bonding amounts must be increased to fully cover plugging and reclamation costs. COGCC's Financial Assurance Technical Working Group[182] made similar recommendations for updating bonding policies. To estimate reclamation costs for setting bonding amounts, we recommend the following variables in addition to well depth: soil type, slope, miles of road and pipelines, annual precipitation, distance to groundwater, distance to water wells, bird and wildlife habitat, and proximity to homes, schools, open space, and natural areas. Another factor that may influence reclamation costs is the number of spills, because more spills will increase cleanup and remediation costs.[183]

Questions remain surrounding the unknown costs of plugging and reclaiming the newer, larger well pads associated with horizontal drilling. Horizontal drilling in Colorado did not take off until 2009,[184] and none of the horizontally drilled wells (some are up to three miles) have been plugged and reclaimed. Horizontal drilling concentrates surface impacts to larger multi-well pads, but the wells are deeper. In contrast, vertically drilled wells are not as deep and the well pads are smaller, but they are connected by a network of roads, which are expensive to reclaim. Collecting data on the reclamation costs of larger multi-well pads as they close will provide valuable information for estimating future bonding amounts.

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180 *See* BOULDER COUNTY COMMISSIONERS, *supra* note 144.

181 Colo. Exec. Order D 2018-12 (July 18, 2018).

182 COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 84, at 3.

183 COGCC's task force attributed high cost orphaned well projects to: "age of the wells and equipment, challenging pits, steep slopes, long access roads, water issues, extensive tank batteries or flowlines, and a history of spills" COLO. OIL & GAS CONSERVATION COMM'N, *supra* note 84.

184 In 2009, 31 horizontal wells were drilled in Colorado. By 2019, the number of horizontally drilled wells had increased to 1094—approximately 69% of the total well starts for the state. Opsal & Malin, *supra* note 5, at 3.

We recommend requiring a cash bond that is invested in an interest-bearing reclamation account (e.g., low-risk government securities).[185] For instance, if a state were to collect $10,000 at the time the well is drilled and earns four percent on that cash bond, by the twentieth year it would have $21,911. The accumulated interest will increase the amount of money available over time to pay for plugging and reclamation.

2. Research Long Term Trends in Site Recovery

When estimating reclamation costs, it is important to consider whether the reclamation treatment successfully restored a site. Whereas reclamation occurs over a couple of years, fully restoring a site to its original condition can take decades. Minnick and Alward found that well pads in sagebrush shrublands had not fully restored vegetation and soil conditions forty-seven years after well closure.[186] Nauman et al. developed a remote sensing tool for assessing site recovery from oil and gas development on the Colorado Plateau.[187] Their "disturbance automated reference toolset" uses a vegetation index to compare well pad recovery to reference areas with similar soils, topography, and geology.[188] Their results indicate that the ecological recovery of more than half of the oil and gas wells examined were below the twenty-fifth percentile of reference areas. In other words, despite past reclamation efforts, half of the oil and gas well pads had only twenty-five percent of the vegetation when compared to undrilled habitat of similar attributes. Given these significant results, legacy costs include not just inadequate bonding amounts, but also the discounted stream of the lost ecosystem services. [189]

Given that past reclamation efforts may not result in timely or successful restoration of many sites, bonding amounts that are based on past reclamation costs will likely underestimate the bonding amounts necessary for successful site restoration. The above research points to the need for long-term funding to monitor the success of reclamation. In other words, regulating agencies cannot just walk away after a well is plugged and

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185 Andersen & Coupal, *supra* note 92, at 15.

186 Tamera J. Minnick & Richard Alward, *Plant-Soil Feedbacks and the Partial Recovery of Soil Spatial Patterns on Abandoned Well Pads in a Sagebrush Shrubland*, 25 ECOLOGICAL APPLICATIONS 3, 8 (2015).

187 Travis W. Nauman et al., *Disturbance Automated Reference Toolset (DART): Assessing Patterns in Ecological Recovery from Energy Development on the Colorado Plateau*, 2017 SCI. OF THE TOTAL ENV'T 476, 484 (2017).

188 *Id.* at 477.

189 Current bonding policies do not internalize the external costs (negative externalities) from the loss of ecosystem services associated with building roads and drilling wells. If bonding amounts included the lost ecosystem services from unsuccessful restoration and poor recovery rates of well pads, bonding amounts would be considerably higher.

assume all is well. Future research on reclamation costs should be expanded to take into consideration the relationship between reclamation cost, reclamation treatment, and successful site restoration.

D. Loss of Property Tax Revenue

The loss of property tax revenue is a potential fiscal cost for local governments. Hedonic studies have been widely used to estimate the potential effects of oil and gas development on real estate prices and hence on property tax revenue. The Colorado hedonic property value studies reviewed are far from conclusive, but in general, they show the potential for oil and gas development to indirectly reduce the value of homes in close proximity to wells.

A determination of whether an impact fee is reasonable is in part based on the accuracy of the analysis used to estimate the impact fee.[190] Most of the Colorado hedonic studies reviewed were published in peer-reviewed journals that place great attention on the statistical reliability of estimates.[191] In contrast, legal defense of a proposed impact fee may give less weight to statistical reliability[192] and, instead, rely on other standards, such as reasonableness.[193]

We propose a method for proportionately estimating the loss of property tax revenue using the results from hedonic studies and benefit transfer methods. Future research on the decay function—how home prices change with increasing distance from wells—will help refine methods for estimating lost property tax revenue. Additionally, local governments will need methods for determining whether the lost property tax revenues result in negative net fiscal impacts.

With impact fee proportionality in place, can impact fees for lost property tax revenue provide benefits to the oil and gas industry? Compensating local governments by paying an impact fee for the loss of property tax revenues would provide community relations benefits to industry.

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190 Nicholas & Juergensmeyer, *supra* note 28, at 844.

191 Statistical reliability refers to the overall consistency of a measure—that is, the ability to reproduce the results again and again. A measure is said to have high reliability if it produces similar results under consistent conditions: Statistical reliability is needed in order to ensure the validity and precision of the analysis and results. *Reliability (statistics)*, WIKIPEDIA, https://en.wikipedia.org/wiki/Reliability_%28statistics%29 (last visited Sept. 6, 2021).

192 The relative importance of statistical reliability in presenting evidence in legal proceedings raises some interesting questions beyond the scope of this paper. Does the court put greater weight on evidence if the evidence is based on statistically reliable results? Is statistical reliability relevant in case law? Or is expert opinion and reasonableness more prevalent?

193 KERKVLIET & MORTON, *supra* note 6, at 35.

Better relationships with stakeholders will improve community goodwill[194] and help industry retain its social license to operate.

1. Collect Data on Mineral Rights Ownership and Water Source

The fact that the hedonic studies reviewed did not have data or knowledge on whether or not a particular property had piped water or well water makes it difficult to track possible water contamination problems. To improve the accuracy of future hedonic studies for estimating changes in property values and setting impact fees, we recommend that Colorado authorities collect and make publicly available data on water sources and ownership of mineral rights.

Hitaj et al. examined ownership of mineral rights for oil and gas for U.S. farmland. Based on their survey results, only ten percent of farm operators and thirteen percent of nonoperator landlords in oil and gas counties received oil and gas royalty payments from energy companies.[195] Their research suggests that a majority of the mineral rights owners are not local residents. Mineral rights and royalties operate in a global market. Investors from all over the world can buy shares of royalty trusts, which own rights to oil and gas royalties.[196] The global market for royalty ownership helps explain the low percentage of royalty owners who are local or state residents. Collecting data on the percent of mineral rights and royalty owners that reside in each county, the state of Colorado, or the country, will provide pertinent information for improving hedonic studies on property values.

2. Improve Economic Impact Analysis

Collecting mineral rights ownership and water source data can serve two purposes in addition to facilitating reliable hedonic property value studies. First, knowing which properties depend on groundwater for domestic water will improve planning for piped water expansions when oil and gas development expands to new areas. Second, economic impact analyses can be made more accurate and informative. Political allies of the

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194 Goodwill is an intangible asset on a company's books that includes proprietary or intellectual property and brand recognition, which are not easily quantifiable. *Goodwill*, INVESTOPEDIA, https://www.investopedia.com/terms/g/goodwill.asp (last visited Sept. 8, 2021).

195 CLAUDIA HITAJ, JEREMY WEBER, & KEN ERICKSON, U.S. DEP'T OF AGRIC., OWNERSHIP OF OIL AND GAS RIGHTS: IMPLICATIONS FOR U.S. FARM INCOME AND WEALTH 1, 13 (2018).

196 *See* Laurentian Rsch., *The Oil Royalty Companies: Get An Exposure To Rising Oil Price At Half Of The Risk*, SEEKING ALPHA, https://seekingalpha.com/article/4207167-oil-royalty-companies-get-exposure-to-rising-oil-price-half-of-risk (last visited Sept. 8, 2021).

oil and gas industry regularly use economic impact analyses as their prime argument for the putative economic benefits of oil and gas development.[197] However, without knowing who owns the mineral rights and where they live and spend their money, economic impact analyses of oil and gas development is seriously handicapped.

Economic impact analyses model the direct and indirect impacts of new economic activity on the hundreds of economic sectors in a modern economy. For example, new revenue from increased oil and gas production cycles through the economy and directly produces new revenue and employment in the oil and gas industry. The new revenue also indirectly impacts economically linked sectors, such as transportation, retail stores, and housing construction to provide homes for in-migrating oil and gas workers.

A critical component of economic impact analysis is how quickly new revenue leaks out of the economy. For example, new oil and gas production may require purchasing machinery produced in China. If so, the leakage of money spent on the Chinese machines is almost immediate and the effect on the local (Colorado) economy of purchasing the machinery is very small. McDonald et al. estimated that seventy-three percent of the economic activity in Colorado's Piceance Basin leaked out of the basin, and for the State of Colorado, fifty-seven percent of oil and gas extraction revenue left the state.[198]

Since mineral rights ownership is largely unknown in Colorado, economic impact analyses must make assumptions about who gets bonus bids and royalty payments and where this revenue is spent. Studies that assume one hundred percent local mineral rights ownership will estimate higher economic impacts than studies that assume thirty percent local ownership of mineral rights. In extant economic impact analyses, payments to mineral rights owners are typically assumed to be made to local owners. If, however, owners of mineral rights are located outside the local economy, economic impacts may be substantially exaggerated.

There is a considerable amount of money involved, so accurate economic impact analysis cannot be achieved without knowing who mineral rights owners are and where they live and spend their money. For

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197 The Boulder Weekly completed a detailed investigation of models used to estimate the economic impacts from oil and gas development in Colorado. *See* Joel Dyer, Opinion, *Transparency Lacking in Leeds School's REMI Report on 2,500-foot Setback Initiative*, BOULDER WEEKLY (July 28, 2016), https://www.boulderweekly.com/opinion/transparency-lacking-in-leeds-schools-remi-report-on-2500-foot-setback-initiative/; Joel Dyer, *Behind the Curtain: An Inside Look at the Oil & Gas Industry/Republican 'REDPRINT' for Turning Colorado from Blue to Red*, BOULDER WEEKLY (Sept. 28, 2015), https://www.boulderweekly.com/news/behind-the-curtain/.

198 LISA MCDONALD ET AL., *supra* note 53, at 31.

Colorado, Lewandowski and Wobbekind estimated private land mineral rights owners received $827 million in oil and gas payments in 2012.[199]

Collecting baseline data on ownership of mineral rights will improve the accuracy of economic impact studies. Colorado currently does not have a searchable public database of who owns mineral and royalty rights. We recommend developing one. Having a searchable database on mineral rights ownership will also improve the information available and the transparency for market transactions between real estate buyers and sellers in Colorado.

CONCLUSION

As part of his climate policy, President Biden has issued a moratorium on new oil and gas leasing on federal public land to allow time for a comprehensive review of leasing and permitting policies.[200] The leasing moratorium allows time for data to be collected, studies to be completed, and decision documents to be updated in order to make more informed policy decisions. While production continues on existing wells, the BLM has time to identify fiscal inefficiencies in the current oil and gas leasing program and make changes to establish a more fiscally responsible approach to oil and gas development on federal lands.[201]

The moratorium provides the BLM with a perfect opportunity to reform federal bonding policy, estimate legacy costs, review long-term reclamation success of previously reclaimed lands, and implement per-well impact fees. Implementing per-well impact fees for current and new oil and gas wells on federal land will provide a stable source of funding to plug wells leaking methane, reclaim well pads, and fully restore lands damaged by oil and gas development. A targeted focus on plugging orphaned and abandoned wells on federal land will also create tens of

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199 BRIAN LEWANDOWSKI & RICHARD WOBBEKIND, UNIV. OF COLO. LEEDS SCH. OF BUS., ASSESSMENT OF OIL AND GAS INDUSTRY: 2012 INDUSTRY ECONOMIC AND FISCAL CONTRIBUTIONS IN COLORADO 8 (2013). Lewandowski and Wobbekind did not explicitly state their assumption of the percent of local mineral rights owners. *Id.* Based on a review of their results, it appears they assumed 100% of mineral rights owners live locally in Colorado.

200 Exec. Order. No. 14,008, 86 Fed. Reg. 7619 (Jan. 27, 2021). Moratorium does not include Tribal lands.

201 EVAN HJERPE ET AL., CONSERVATION ECON. INST. ECONOMIC EFFECTS OF PAUSING OIL AND GAS LEASING ON FEDERAL LANDS (2021).

thousands of jobs in communities transitioning away from dependence on oil and gas development.[202]

Bonding reform and impact fees at the state and local level also have a critical role in making oil and gas development more efficient and fiscally responsible. Colorado is updating its bonding policies, and state law SB 19-181 expands the scope of impact fees to cover the reasonably foreseeable direct and indirect costs of oil and gas development.[203]

This Article has presented methods for estimating impact fees to cover legacy costs and lost property tax revenue and estimating bonding amounts to mitigate legacy costs in the future. Some of the pertinent challenges in developing comprehensive impact fees for oil and gas development include: (1) overlapping jurisdictions between cities, counties, states, and the federal government, which should be responsible for making sure taxpayers are not on the hook for the fiscal costs; and (2) translating temporal issues of legacy costs, since those costs do not manifest for many years, as opposed to fiscal costs such as roads and infrastructure that are incurred as soon as development begins.

Local governments would do well to keep the rational nexus test in mind when researching impact fees to cover the fiscal costs from oil and gas development. Well-crafted impact fees reasonably connected and proportional to the costs identified that provide some benefit to operators are more likely to win in court if challenged. This is true whether estimating impact fees for road costs, data collection and monitoring, loss of property tax revenue, legacy costs, or public health costs from air pollution.

A full accounting of these costs is needed to determine the net fiscal impacts to communities and states from oil and gas development. State and federal agencies should begin transparent accounting and reporting of net fiscal impacts. If the costs from oil and gas development exceed the revenues, impact fees can make up the difference. If bonding amounts are too low, per-well impact fees generate revenue to pay legacy costs. Updating bonding policies improves economic efficiency by reducing the legacy costs passed onto future generations. Colorado's new law expanding the use of impact fees to internalize the reasonably foreseeable direct and indirect costs of oil and gas development is a good model for other states and countries to follow and adopt.

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202 Pollin et al. estimate plugging and reclaiming 2.6 million abandoned oil and gas wells in the U.S. could produce as many as 941,378 direct jobs. ROBERT POLLIN ET AL., EMPLOYMENT IMPACTS OF PROPOSED U.S. ECONOMIC STIMULUS PROGRAMS: JOB CREATION, JOB QUALITY, AND DEMOGRAPHIC DISTRIBUTION MEASURES 20 (2021).

203 Colo. Gen. Assembly, *Protect Public Welfare Oil and Gas Operations*, https://leg.colorado.gov/bills/sb19-181 (last visited Sept. 4, 2021).