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Natural Gas Flaring in Texas: A Regulatory Capture Study

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Abstract:

Flaring, the practice of oil and gas equipment deliberately burning natural gas without using it, is a controversial practice. While some flaring is mechanically necessary, many stakeholders fear that the practice is too frequent in Texas. Using publicly available permit data, I analyze the flaring permit application process to evaluate the variables that drive permit outcomes. I find that Texas regulators have rejected less than 1% of permits, frequently granting permits for applications that are incomplete, incoherent or directly contravene stated policy. I also find that every permit rejected was rejected after the flaring had already occurred, so no permit rejections have actually curtailed flaring. The findings also indicate that regulators are subsidizing otherwise uneconomical new wells by exempting them from flaring regulations. Finally, I argue that these findings indicate strong regulatory capture and that reforms to curtail agency discretion are necessary to improve flaring regulation.

Introduction:

The Permian Basin in West Texas is one of the highest producing oil fields in the world (Rapier 2019). The once pristine landscape is now peppered with drilling infrastructure. One of the most striking features of that landscape is the open flames roaring out of massive vertical pipes at almost every site. The practice of burning natural gas and releasing the products into the atmosphere during fossil fuel production, referred to as flaring, has become a locus for environmental activism. Flares are loud, bright, frequently odorous, and are allowed to run in the middle of the night, which can make them a particular nuisance for those living near oil and gas development (Cushing et al. 2020). These nuisance conditions coupled with the hydrocarbon compounds that are released during the flaring process have been found to have significant health effects (Chen et al. 2022). Further, flares release CO_2 into the atmosphere, exacerbating climate change ("Gas Flaring - Energy System," n.d.). Conservationists have also taken issue with flaring's "waste" of gas by burning it without harnessing it for any productive use (Tollefson 2016). Despite these headwinds, flaring has persisted because companies have successfully argued that flaring is a necessary practice to alleviate occasional high pressure at wells, which risks both damage to equipment and (in extreme circumstances) explosions ("What Is Gas Flaring?," n.d.).

Though concerns about flaring have increased, leading to heightened pressure to ban the practice outright (Deville 2022), no state in the U.S. nor country internationally has fully banned flaring. Operators have successfully resisted these efforts by arguing that some flaring is unavoidable ("EPA Enforcement Targets Flaring Efficiency Violations," 2012). This issue has been particularly contentious in Texas (Pskowski 2023), which produces 42% of U.S. oil, more than the next four highest-producing states combined ("Where Our Oil Comes From" 2023).

Texas also flares more gas than any other state. Texas's flaring regulations are outlined in Texas Statewide Rule 32, which is implemented by the Texas Railroad Commission (RRC) (*Gas Well Gas and Casinghead Gas Shall Be Utilized for Legal Purposes* 2009). Rule 32 bans flaring across the state except under tightly constrained circumstances, but the RRC is empowered to grant exceptions to the ban (these exceptions are generally referred to as permits by both regulators and operators). All three sitting RRC Commissioners have publicly stated that they wish to reduce flaring and have noted that flaring is one of the highest profile oil and gas issues in Texas which they have aimed to address through rigorous enforcement of Rule 32 (Dubee 2020b; Spiess 2021).

Central to the permitting process, operators must submit a narrative explanation for the flaring they are conducting. These explanations are intended to give the RRC additional insight into broad flaring trends while also allowing the RRC to determine whether the necessity of the flaring actually merits a permit.

This paper evaluates the RRC's implementation of the flaring controls set forth by Statewide Rule 32. Given the RRC's interest in reducing flaring, particularly routine flaring, this paper focuses on the explanations given by operators for their flaring under the Rule 32 system. This paper will evaluate the extent to which the explanations provided by operators impact permit outcomes. Though the explanations provided by operators are the primary research interest of this paper, I also explore other potential factors that may determine permit outcomes, including permit length, hydrogen sulfide concentration, and proximity to residences. I draw on publicly available permitting data provided by the RRC to examine these various factors that could impact permit outcomes.

Analyzing the implementation of Rule 32 has several potential policy implications. Flaring has a variety of harms to both local residences and the climate, so understanding and improving the efficacy of existing flaring regulations could materially improve environmental conditions. Additionally, the RRC's flaring regulatory regime is a complex environment that can serve as a rich ground for applying and modifying regulatory capture theory. Regulatory capture theory attempts to describe the observed phenomenon where some regulators seem to spur outcomes that are neither market efficient nor consistent with an exogenous public interest. While conceptually simple, identifying a captured agency is difficult, and many theorists have accused empirical analyses of being too haphazard in designating agencies as captured. Thus, this paper will draw from a schema generated by Harvard researchers, Daniel Carpenter and David Moss, to identify capture (2013). This schema will be enhanced with an agential analysis of the RRC to determine how the election of Railroad Commissioners potentially subverts capture expectations.

Flaring in Texas is a particularly fraught topic to address with regulatory capture theory because Texas's public sentiments appear to strongly favor limited regulation of oil and gas (Baumann 2023). However, flaring as a specific policy area within oil and gas regulation has drawn ire both locally and internationally, and is publicly acknowledged as a problem by the RRC (Spiess 2021). This tension between a general mandate for low regulation of the oil and gas industry and a more specific mandate for limited flaring creates a situation that is somewhat unique within the environmental regulatory capture literature.

This paper will begin with a comprehensive background on flaring practice, starting with a technical explanation and a summary of the potential harms from the practice to human health and the environment then moving into a history of its regulation in Texas. This paper will then situate itself in the existing regulatory capture literature with a particular emphasis on the existing works focused on the regulation of fossil fuel extraction (Fitzgerald 2024). Next, I will present the findings of this research.

Those findings indicate that the RRC universally uses the discretion afforded to it by Rule 32 to approve permits. Since May 2021, the RRC has rejected less than .05% (53) of permit applications. Every rejection was either for missing the filing deadline or failing to request a hearing with the Commissioners where statutorily required. These solely clerical criteria appear to be the only way permits are rejected, but neither criteria is used consistently to reject permits. Only 14% of approved permits were submitted before the publicly advertised filing deadline. Dozens of permits were approved without a Commissioner hearing even when one should have been required. Operators are required to explain the necessity for their flaring, and many operators received permits even if they left the explanation portion of the form blank. Permits were even approved for explanations that fell on the RRC's list of unacceptable explanations. Further, extensions to permits were approved even in circumstances where the operator had demonstrably exacerbated their flaring problem by drilling new wells at the permitted site. Hundreds of permits have been approved despite leaving the name or location of the facility being permitted blank. Even flares producing significant concentrations of deadly oil field pollutants like hydrogen sulfide are approved without regard for the location of nearby communities. Further, despite public condemnation of routine flaring from the RRC, permits of large volumes for months or years are frequently approved even when the operator makes clear that the permit is not for any specific reason and is being used to shift the determination of necessary flaring from the RRC to the operator. This analysis also indicates that flaring across different oilfields in the state varies widely, indicating that high flaring basins could curtail their flaring with infrastructure investment.

Finally, I will contextualize these findings both in terms of their environmental impacts and their significance as applications of regulatory capture theory. I will propose modifications to the Rule 32 system to both increase clarity in system mechanics and discourage reckless flaring practices. Given the clear evidence of regulatory capture present in this analysis, recommendations aim to decrease opportunities for RRC discretion in the regulatory process.

Background:

Flaring:

Natural gas, methane, is a potent greenhouse gas. Over 100 years, a molecule of methane will trap about 28 times more heat than a molecule of CO_2 ("Importance of Methane" 2016). However, with a lifespan of just 12 years, methane breaks down much more quickly in the atmosphere than CO_2. This means that over a shorter reference frame, methane's warming effect relative to CO_2 increases. Over 20 years, methane is 86 times more potent as a greenhouse gas than CO_2 ("Methane," n.d.). This extreme heat trapping behavior over a short period of time means that reductions in methane have a much larger impact on short term climate change than CO_2, which has made methane a particular focus of environmental advocacy (Wood 2023).

While natural gas is a commodity that is bought and sold globally, not all natural gas makes it to market; some is instead released at various points in the supply chain. These releases are usually either through flaring or venting. When gas is flared, the natural gas is burned as it is released. When gas is vented, the natural gas is released into the atmosphere uncombusted. Venting is usually reserved for circumstances in which flaring is mechanically impossible. In most contexts, flaring is the preferred disposal method for releasing natural gas because combusted methane breaks down into CO_2, so flared gas has significantly lower warming potential than gas that is released through other mechanisms. Globally, estimates indicate that enough gas is flared each year to support all of sub-saharan Africa's gas consumption (Tran et al. 2024). Research has also indicated that as much as 3.5% of global gas production is flared annually (Tollefson 2016).

The reasons for why flaring and venting occur vary. Geologic factors lead to many wells producing a combination of both oil and natural gas. Gas produced from a well that primarily produces oil is referred to as casinghead gas ("Natural Gas: Table Definitions, Sources, and Explanatory Notes," n.d.). Generally, oil is a more profitable commodity, so these wells focus on oil production — but must still determine a use for their casinghead gas (Robinson 2024). Unlike oil, which can be easily stored in onsite storage tanks, natural gas typically cannot be stored at a wellsite. To sell the gas, most facilities have a pipeline that transfers gas as it is produced to a refining facility which then pipes the gas to a point of sale. In general, flaring and venting are conducted to relieve the pressure of natural gas on production equipment in circumstances when sale through a pipeline is not possible ("Gas Flaring - Energy System," n.d.). As a gas, an overabundance of methane must be disposed of somehow, either by flaring, venting, or transportation off-site via pipeline; otherwise, facilities risk overpressurizing and exploding ("What Is Gas Flaring?," n.d.).

Operators can overproduce methane in a variety of ways.[1] In some cases, a well can lose access to the pipeline it needs to sell gas, and is then forced to dispose of the gas onsite. Wells can lose access to pipelines if their gas is too high in certain corrosives (particularly hydrogen sulfide), if the pipeline is shut down for maintenance, or if the pipeline is overpressurized. Without access to a pipeline, or with curtailed pipeline capacity, even standard gas production

[1] These are poorly elaborated on in the literature, but are apparent in the data included in this project.

will lead to flaring to avoid overpressurizing equipment on-site. Flaring also occurs at wells that have never had access to a gas pipeline and must dispose of all gas onsite. While some of these facilities try to avoid flaring by using the gas in onsite generators to provide electrical power to the facility, any gas that cannot be used for generation must be flared. The economics of pipeline infrastructure are complex, but generally facilities without access to pipelines produce comparatively small quantities of gas which is not valuable enough to offset the installation cost of connecting to a gatherer's pipeline. However, operators continue to drill these wells because when operating costs are kept low by not paying for a pipeline connection, the wells can be profitable by selling produced oil and flaring gas. In an area where the cost to bring gas to market is greater than the value of the gas (which generally occurs in areas with limited pipeline capacity), operators may also have a financial *incentive* to flare gas but no technical necessity (Robinson 2024).

Economic motivation for flaring is complicated by the price volatility of the gas market. Gas prices in production fields are set both by what consumers are willing to pay for gas and how readily gas can be brought to market. Operators enter into contracts with gathering companies that own the pipelines connecting wells to gas plants. At the plants, the gas is processed and then put into a much larger pipeline where it is then sent to market. In places where gathering capacity is limited, the cost to bid into contract with a gatherer can exceed the value of the gas (Iraola and Peterson 2024). This is an especially common problem in the Permian Basin in Texas, which is the only U.S. oilfield to have experienced negative gas prices during 2024 (Iraola and Peterson 2024). Despite being one of the largest producing oil fields in the world, the gathering capacity for gas in the Permian is limited. When broader gas prices drop or when a major gathering line undergoes maintenance, the Permian is particularly likely to have prices become negative, which can last for weeks (Robinson 2024). When gas prices are negative, operators may flare to avoid having to lose money bringing their gas to market. This incentive can be even stronger for operators who are leasing the mineral rights for their production from a mineral owner, because a mineral owner's royalty can make the loss from bringing gas to market even larger, and most mineral lease agreements do not require that the mineral owner receive a royalty for flared gas (McFarland 2017).

Flaring does still occur at facilities that have pipeline connections and profitable gas markets. Typically in those circumstances, operators flare to clear gas from their equipment for onsite maintenance or repairs.

While flaring is, in some cases, necessary for the continued operation of oil and gas equipment it poses a variety of potential health risks for those living nearby. An early cohort study in Eastern Texas conducted by Lara Cushing and a team of researchers from University of California, Los Angeles found that flaring near homes leads to an elevated risk of preterm births for some mothers (Cushing et al. 2020). While the exact mechanism of the health effect is unknown, the authors note that previous studies have associated preterm births with combustion compounds that are known to be present in flare releases. They note that flaring often takes place at night and is loud, bright, and frequently odorous, which may lead to high stress levels — which are also associated with preterm births.

Flaring's health impacts are also an environmental justice problem. Studies conducted by Cushing beyond Eastern Texas have found that flaring disproportionately affects minority groups. In a study published in 2021, Cushing and a new team of researchers analyzed flaring across the United States as observed by satellite data and cross referenced those flaring incidences with census blocks (Cushing et al. 2021). Most flaring happens in rural areas where census blocks can be hundreds of square miles wide, so they further refined their analyses using satellite imaging of buildings to identify the locations of homes within census tracts. They determined that more than 535,000 U.S. citizens live within five kilometers of a flare and more than 210,000 live within five kilometers of more than 100 flares. They found that flaring in some basins disproportionately affects Native Americans and that the majority of people exposed to flaring in the major Texas basins are people of color.

Existing research has repeatedly concluded that the siting of oil and gas development has led to air and water pollution that disproportionately harms people of color, so it is possible that these observed flaring patterns are covariant with general oil and gas production rather than a tendency of equipment near minority residences to flare more (Donaghy et al. 2023). Regardless of the mechanism, it is clear that flaring is a source of environmental injustice.

Other researchers have further explored the exact mechanisms by which flaring can impact human health. While pure natural gas burned at perfect efficiency releases only CO_2, impurities in gas streams and efficiency limitations for flares lead to the production of other air pollutants. Researchers have identified particulate matter under 2.5 micrometers in diameter (PM2.5) and black carbon as major drivers of flaring-related adverse health outcomes (Chen et al. 2022). Depending on modeling mechanisms, researchers have concluded that as many as 360 people in the U.S. die each year from exposure from flaring-related black carbon (Chen et al. 2022). Unfortunately, the huge variety of potentially toxic compounds released from flares including black carbon, "dioxins, benzene, toluene, nitrogen, and sulfur dioxide" can potentially cause health impacts that are the result of cumulative effects (Nwosisi et al. 2021). To attempt to quantify those impacts, some researchers have begun disseminating medical surveys to gauge health impacts for those most impacted by flaring. In one survey conducted in the Niger delta, researchers found increased incidents of doctors visits for both respiratory and dermal issues in areas with flaring (Nwosisi et al. 2021).

In a study published in 2024, a team of researchers led by Huy Tran from University of North Carolina Chapel Hill attempted to aggregate the various pollutants and mechanisms for adverse health outcomes from flaring into a comprehensive study of its impact on United States life expectancy (Tran et al. 2024). Using a combination of satellite data and state level emissions inventory data, they created estimates for the volume of several major air pollutants emitted by flares. They then used that data to evaluate the National Emissions Inventory collected by the EPA. They found that "These refined estimates are higher than those reported in the National Emission Inventory: by up to 15 times for fine particulate matter (PM2.5), two times for sulfur dioxides, and 22% higher for nitrogen oxides (NOx)" (Tran et al. 2024). Using those new refined estimates they estimated that flaring "cause(s) over $7.4 billion in health damages, 710 premature deaths, and 73,000 asthma exacerbations among children annually" (Tran et al. 2024).

The combination of flaring and venting upstream also complicates estimating the broader climate impact of natural gas. Historically, estimates for the climate footprint of natural gas have focused on the point of consumption. Since natural gas burns down into CO_2 more efficiently than both oil and coal, natural gas has been termed a bridge fuel between more polluting coal and oil and cleaner renewable energy. For many years, this language was even used by major environmental advocates such as the Sierra Club (Walsh 2012).

However, in the wake of the fracking boom, researchers began to look at these calculations with more scrutiny. Bob Howarth at Cornell in 2011 published a paper examining gas production in unconventional shale plays (gas produced via fracking) and found that the upstream methane release rate for these shale plays was 7.9% (Howarth, Santoro, and Ingraffea

2011). Since methane is more warming than CO_2, Howarth's team determined that natural gas actually caused as much as 20% more warming than coal. Subsequent research has refined these estimates (Howarth 2022), and while there is still disagreement in the literature about the exact upstream release rate (Sherwin et al. 2024; Storrow 2020), many estimates conclude that the upstream release rates are sufficiently high to make natural gas equivalent to or worse than coal for the climate (Gordon et al. 2023; Howarth 2022).

Texas Oil and Gas Regulatory Apparatus:

Like some other states, Texas divides responsibility for regulating the oil and gas industry across multiple state agencies. The two most important agencies are the Texas Commission on Environmental Quality (TCEQ) and the Texas Railroad Commission (RRC).

The TCEQ was formed in 1993 as the Texas Natural Resource Conservation Commission as part of an effort to consolidate various environmental regulators into one unified agency ("History of TCEQ and Its Predecessor Agencies" 2024). It is charged by the Texas legislature with "protect(ing) our state's public health and natural resources consistent with sustainable economic development", with the goal of "clean air, clean water, and the safe management of waste" ("Mission Statement and Agency Philosophy" 2025).

The Texas Railroad Commission was formed in 1881 to regulate railway monopolies and mediate rail commerce. In 1919, the Texas governor appointed the RRC with "the inspection of refined oils which are the product of petroleum and which may be used for illuminating purposes within this State, and to regulate the sale and use thereof; and to provide penalties for the violation of the same" (Willyard 2019). Though the RRC previously had no experience with oil and gas regulation, they were viewed as the logical enforcer of these regulations because oil transportation at the time occurred almost exclusively over rail. Over the next 80 years, the

RRC's railway related responsibilities were slowly subsumed by federal regulators (Willyard 2019). Eventually, in 2005, the RRC's remaining railway regulation responsibilities were moved to the Texas Department of Transportation, leaving the RRC as solely an oil and gas regulator ("About the Railroad Commission of Texas," n.d.). The RRC's current mission is to "to serve Texas by our stewardship of natural resources and the environment, our concern for personal and community safety, and our support of enhanced development and economic vitality for the benefit of Texans" ("About the Railroad Commission of Texas," n.d.).

Both agencies are structurally similar, with three Commissioners overseeing a large bureaucratic team across several regional offices ("TCEQ Organization Information" 2025; "RRC Commissioners," n.d.). Those Commissioners meet monthly to evaluate financial penalties for violations, permitting disputes, and potential new rulemakings. However, the two commissions are selected differently. While the TCEQ's Commissioners are appointed by the governor and can be removed at any time, the RRC's Commissioners are elected in a statewide election and serve for six year terms ("TCEQ Organization Information" 2025; "RRC Commissioners," n.d.). After each election, the three Commissioners select a chairperson to lead the Commissioner meetings ("RRC Commissioners," n.d.). By convention, the Commissioners select the Commissioner with an upcoming election to serve as chairmen so that the incumbent up for election is always the sitting chair.

Both the RRC and the TCEQ fall within the Natural Resources portion of the Texas state budget, which in total was allocated $8.7 billion for the 2024 fiscal year, about 2.7% of the total state budget (Texas 2036 2024). The current bill funding the RRC allocates $481 million for the next two fiscal years. In addition to that funding, the RRC has requested an additional $100 million to fund a cleanup program to repair leaking wells for which a responsible owner cannot be found (McEwen 2024). The TCEQ's budget for 2024 is $558 million dollars ("Biennial Report to the 89th Legislature," n.d.), which puts its funding at about double that of the RRC. Despite the relatively meager budget of these two agencies, they garner substantial public interest. In the 2024 Railroad Commissioner Election, incumbent Cristi Craddick raised $9.2 million (Kolenda 2024), more than the total fundraising of the most expensive state congressional race in Texas history (Thomas, Madden, and Chandler 2024) and nearly double the fundraising of attorney general Ken Paxton during his hotly contested 2022 reelection bid ("Ken Paxton Jr Money Profile," n.d.).

Notably, the mission statements of the two agencies have significant jurisdictional overlap; however, the agencies often implement their regulatory mandates slightly differently. For example, as part of their regulatory mandates to control hydrogen sulfide, both agencies have defined sour gas (natural gas rich in hydrogen sulfide). At the RRC, gas is sour if its hydrogen sulfide concentration is above 100 ppm ("Sour Gas Handling Compliance" 2025). At the TCEQ, gas is considered sour if its hydrogen sulfide concentration is above 24 ppm, less than a quarter of the concentration at the RRC ("Sour Gas Handling Compliance" 2025). The TCEQ's primary interactions with the oil and gas industry are driven by its role as the state delegate of EPA enforcement power for both the Clean Air Act and Clean Water Act, as well as its role as the enforcer of the Texas equivalents of both of those laws. In its capacity enforcing both the federal and state Clean Air Acts, the TCEQ is responsible for granting air quality permits for the emission of a variety of compounds associated with oil and gas extraction, including benzene, toluene, carbon monoxide and ethylbenzene ("Air Permitting" 2025). These air quality permits set expectations for equipment quality to be deployed at extraction sites as well as setting limits on the amount of certain pollutants that these sites are permitted to release annually.

While the RRC is also tasked with protecting the environment, its primary focus is on the safe and sustainable use of Texas' natural resources. The RRC's responsibilities include most oil and gas regulations that are not directly related to environmental protection. This includes areas like regulating setbacks (the distance wells must be from residences), signage regulations ensuring wells are identifiable, and issuing permits for drilling new wells. There are some areas of RRC regulation that have environmental implications (and would therefore seem more aptly regulated by the TCEQ), but those usually arise from regulatory areas that have a primary non-environmental impact driving the regulation; in these cases, environmental conservation appears to be a secondary concern (Craddick, Christian, and Wright 2024).

While both agencies have garnered interest from public advocates, and Texas oil and gas development has had a consistent media presence – especially since the fracking boom in the late aughts – academic analysis of these agencies has been infrequent[2]. This dearth of analysis is particularly unfortunate given that nonacademic, particularly advocate, discourse is quick to accuse these agencies of regulatory capture (McDonald and Wilson 2021; Cunningham 2021). This paper aims to conduct that academic analysis of potential regulatory capture at the RRC in the context of flaring and venting.

Regulation of Flaring and Venting in Texas:

Flaring and venting sit at the intersection of the RRC and TCEQ's jurisdictions. Flaring and venting raise ambient air levels of a variety of pollutants, which is an environmental concern (Tran et al. 2024). Flaring and venting also release significant amounts of greenhouse gasses into the atmosphere, exacerbating climate change (Tran et al. 2024). However, the deliberate release

[2] For exceptions see: "State Energy Cartels" Coleman 2021, "An historical political economy analysis and review of Texas oil and gas well flaring laws and policy" Willyard 2019, and "Particulate Emissions Measured during the TCEQ Comprehensive Flare Emission Study" Fortner et al 2012,

of a valuable Texan natural resource without either profiting or finding some use for it is a natural resource conservation issue that would normally be regulated by the RRC.

Section 382.05102 of the Texas Clean Air Act forbids the TCEQ from regulating any greenhouse gasses (including methane) except where required by federal law. Since flaring and venting primarily release methane and CO_2, and federal methane standards only apply to much larger facilities, the TCEQ's authority is significantly limited. The TCEQ does still regulate some other compounds that may be emitted by flares, but these are regulated through site air permits in which those emissions count towards the total permitted emission for each year rather than controlling flares directly. The TCEQ also regulates how much smoke that flares may release under federal standard 40 CFR 60.18, but this regulation does not affect the frequency or duration of flaring.

Instead, the primary regulator of flaring and venting in Texas is the RRC. Flaring and venting are regulated through Texas Administrative Statewide Rule 32, the political history of which will be addressed in the literature review. This rule bans flaring in Texas except under a narrow set of circumstances, such as during the first 10 days of a well's production when a well's output is being measured. If operators wish to flare outside of those circumstances, they are required to apply for a Rule 32 exception (flaring permit) with the RRC. Notably, despite frequently being framed as permits for flaring by various actors including the Department of Energy ("Texas Natural Gas Flaring and Venting Regulations" 2019), the structure of Rule 32 formally deems these "permits" to be exceptions to a statewide flaring ban rather than an analog to a drilling permit or other oil and gas permits[3]. These permits allow operators to flare for a specified amount of time at a limited volume. Both the time and volume are stated in the

[3] In keeping with the language used in most documentation, this paper will refer to these exceptions as permits though they are more accurately described as exceptions.

application for the permit. The RRC is empowered to reject, accept, or request amendments on these permits.

Rule 32 also outlines some of the processes the RRC must take on when evaluating these permits. Permits may be granted administratively for up to 90 days, with an opportunity for an administrative renewal of up to 180 days (Figure A). Permits that are longer than 180 days and produce more than 50,000 cubic feet of gas per day may not be approved administratively and instead must be approved by the three Railroad Commissioners during a monthly public Commissioner's meeting. Since May 2021 (when the current RRC database was brought online), there have been 13,031 applications to flare. Only 53 (<1%) were rejected. Notably, an RRC flaring permit does not exempt an operator from reporting their flares emissions to the TCEQ and permitted flaring and venting is bound by the Texas Clean Air Act. Operators who receive flaring permits are also expected to report their annual flaring totals to the RRC.

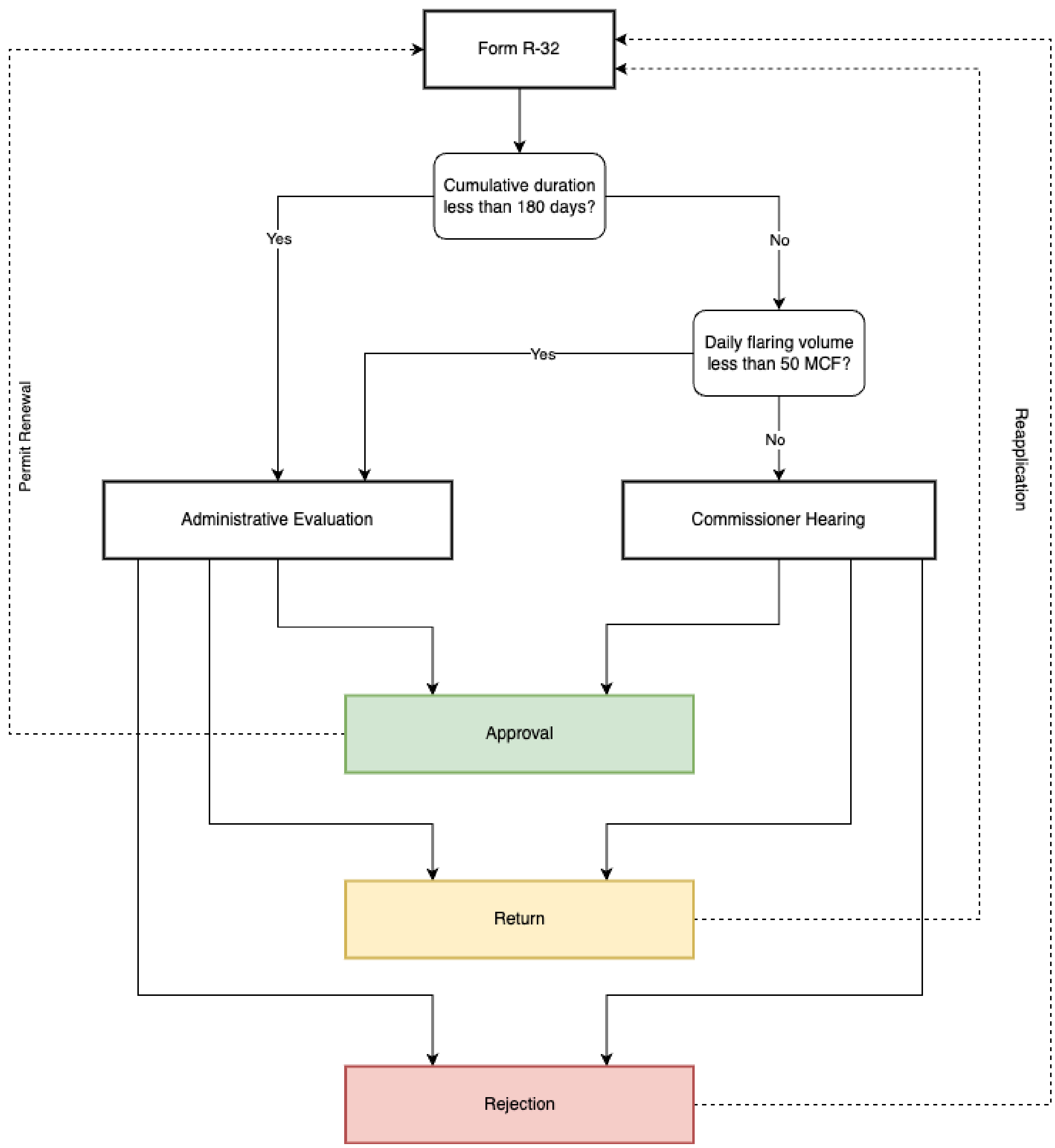

Figure A: This process diagram shows the regulatory structure by which Rule 32 exceptions/permits are evaluated.

In May 2021, the RRC unveiled a new Rule 32 application system. Previously, permit applications entailed mailing or emailing a form letter to the RRC with the required information and waiting for a response; the new system allows operators to apply for Rule 32 exceptions directly through an online portal. Accompanying this software update were some modifications to the Rule 32 exception form (Form R-32) which were intended to “help collect more accurate data as we (RRC) assess the role of flaring and look for ways to reduce it going forward”, per one of the Commissioners (Dubee 2020b). Another Commissioner stated: “This form change is a big and important step towards minimizing routine flaring in Texas, allowing our agency to collect the information it needs to better determine who is following the rules when it comes to flaring and who is not” (Dubee 2020b). The RRC overhaul was accompanied by seminars to introduce operators to the new system and the modifications to the paperwork (Nattin 2021). Those presentations served both to clarify changes to the forms as well as to emphasize existing policies. They informed operators that the RRC would also no longer be backdating permits, so if an operator wanted a permit for flaring that had already occurred unpermitted they would need to apply for the permit no more than 24 hours after the start of the flaring incident. They also clarified that all gas releases greater than 24 hours should be flared rather than vented unless the gas cannot be burned safely. Finally, and most relevant to this research project, they gave operators guidance on what information was necessary for an exception and what would constitute an “insufficient explanation” (Nattin 2021, 26) (Figure B).

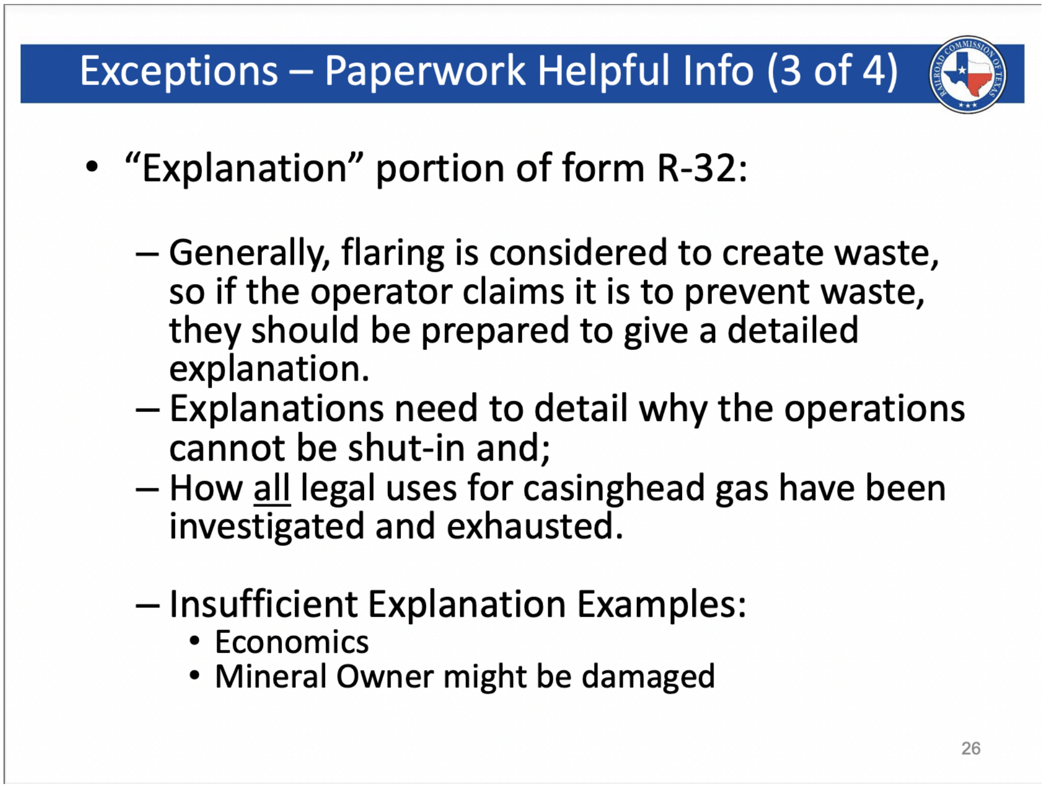

Figure B: A slide from the presentation on flaring given by the RRC on August 5th 2021.

Notably, the explanation discussion specifically states that economic pressures are not a sufficient justification for flaring. The presentation also included information on other potential grounds for denial of a permit including a failure to demonstrate effort to reduce flaring for the renewal of a permit (Nattin 2021). Since the launch of this new application system, neither academic research nor NGO publications have comprehensively analyzed implementation of Rule 32.

The ratio of permitted to unpermitted flares is difficult to ascertain because while unpermitted flares are also expected to report their annual flaring total to the RRC, there is not a clear accountability mechanism to ensure this occurs. A 2021 report published by environmental non-profit Earthworks cross referenced observed flares via helicopter flyover with Rule 32 permits (McDonald and Wilson 2021). It found that 69% of flares in its sample did not have permits. The RRC responded to this study by noting that those flares, though unpermitted, were not illegal (Volcovici et al. 2021). The RRC did not contest the study's conclusion that a large percentage of flaring in Texas was happening unpermitted (Volcovici et al. 2021). Further adding to the confusion, the RRC portrays trends in Rule 32 exception applications to be representative of flaring in general in Texas ("Flaring Regulation FAQs," n.d.; (Volcovici et al. 2021). It is unclear whether this assumption is true. However, satellite analysis conducted by the Environmental Defense Fund (EDF) has indicated that flaring volumes are double what RRC data indicates (Leyden 2019). The RRC has denied this accusation with one Commissioner noting that "We do have rules in place for flaring, and we enforce those rules" (Anchondo 2019). Colin Leyden, a senior manager at EDF, found this response unsatisfactory:

> "There has to be some sort of an explanation as to why the data is not matching up. They seem to dismiss the reports on the grounds they believe that the data they have is correct. I did not hear any sort of technical analysis of the satellite data indicating they had found any sort of flaws or errors." (Anchondo 2019)

EDF's data appears consistent with the 2021 Earthworks study in determining that a significant portion of flaring occurring in Texas is not being accounted for in RRC systems. Given that production reports are self-reported, it is likely that EDF's empirical observations are more accurate than the RRC's data, however the commission appears to be uninterested in rectifying that potential failing.

Literature Review:

Regulatory Analysis of Flaring

Analysis of flaring in Texas from a regulatory implementation perspective is scant. As noted above, several studies have analyzed the health impacts of flaring in Texas and other states

(Donaghy et al. 2023; Tran et al. 2024; Cushing et al. 2020). These studies are useful for contextualizing the importance of flaring regulation. A strong understanding of the consequences of regulatory decisions on both human health and the environment is necessary to gauge effective flaring policy. However, their methodologies do little to elucidate the motivations for flaring or the relationship between operators and the RRC. These studies have primarily focused on satellite flaring observations. Satellite data gives locations of flares and frequency, but lacks clear motive information and emission volume. Further, researchers have not attempted to tie this data to specific operators systematically, so trends in flaring behavior by operators are also obscured. In gathering a combination of emissions motivations, volumes and operator information, this paper aims to both analyze trends in those values that are not apparent in satellite data while also contextualizing those trends to state controls on flaring.

In 2020, Katherine Willyard analyzed trends in Texas flaring using a novel methodology which illuminated trends in operator motivations for flaring (Willyard 2020). Rather than using satellite imagery to identify flares, she used RRC production reports to identify which facilities in Texas were flaring and when. This method allowed the study to identify data points for flares that would not be clear through satellite data. Willyard was able to identify the distance between wells and gas gathering pipelines, well oil and gas production, and how recently a well was drilled. This supplemental data informed a better understanding of flaring motivations than would otherwise be possible. The data demonstrated several trends. Newer wells tended to flare more frequently. Wells in higher density extraction areas tended to flare less. Wells that produced more oil flared more frequently while wells that produced more gas flared less frequently. Interestingly, distance to a gas pipeline did not appear to impact flare frequency. Willyard theorized about the potential drivers of these trends. She posited that higher density areas have less flaring because a major source of flaring is completion flaring (in which gas is flared soon after the well is drilled while equipment is placed and tests are conducted on well output). Completion flaring can be avoided if portable green completion equipment is in place. This equipment allows gas to be brought to market before a permanent pipeline is installed, avoiding the need for flaring. Willyard posited that some of the costs of green completions can be defrayed across multiple operators and multiple wells in areas with high well densities. This would indicate that economic considerations are a major driver in whether operators conduct green completions and therefore avoid flaring. If economic considerations, as Willyard hypothesized, are a major driver of flaring behavior in Texas, this is difficult to reconcile with the RRC's stated policy that economics are not a sufficient explanation for flaring.

Of most relevance to this paper, she also analyzed trends related to flaring and unpermitted flaring. Unsurprisingly, she found that facilities with permits are much more likely to flare than those without permits, and that operators who had previously been caught flaring without permits were more likely to flare without permits in the future. These conclusions were not consistent with the Earthworks paper above that found that the majority of flares are unpermitted (McDonald and Wilson 2021); this discrepancy was likely a result of sampling differences. Willyard's work relied on the RRC's production data which is self-reported by operators to tally flaring. It is possible that self-reported data selects for permitted flares leading to an underrepresentation of unpermitted flaring. While useful for hypothesizing about motivations for flaring, Willyard did not analyze any of the dynamics or trends in the Rule 32 permitting process nor how the RRC interfaced with operators. Further, Willyard's analysis regarding motivations for flaring was speculative. While she was able to make strong arguments, for instance, for why flaring decreasing with well density may be related to green completion equipment, these hypotheses for motivations are untested. The variation that Willyard observed may not have been driven by the causes she identified even if her explanations are plausible. Further, Willyard's methodology was limited by its assumption that self-reported production reports are an accurate tally of flaring occurrences. As noted above, satellite analysis of flaring shows that flaring is occurring at many times higher rates than production reports may indicate. In drawing narrative explanations out of permits directly, this paper will be able to evaluate motivations for flaring and implicitly gauge the strength of some of Willyard's arguments.

While Willyard's quantitative analysis focused primarily on elucidating motivations for flaring, she has also published more qualitative work on the evolving regulatory landscape in Texas (Willyard 2019). This work is the strongest political history of flaring regulation in Texas published in an academic setting and provides tremendously useful context to the RRC's flaring rules and the political dynamics that shape RRC decision making. It is also one of the only political histories of flaring regulation published since the fracking boom. This paper will use that analysis as a foundation for understanding the RRC's decision making within a regulatory capture framework.

Willyard's teleological analysis of the evolving regulatory landscape for flaring began with the origins of the RRC as an organization to regulate railroads. She noted that in the late 1800s and early 1900s, the highly fragmented oil and gas industry worried about overproduction due to a lack of statewide production organization weakening the oil market. This led to a desire within the industry for an active and robust RRC coordinating production but strong disagreement on the mechanisms for that coordination. Willyard argued that this political dynamic led to the RRC arbitrating conflicts between royalty owners and producers. One of the early areas of conflict between these groups was flaring. Producers wanted rapid deployment and extraction of high volumes of oil unfettered by strong flaring controls requiring investment of time and money in gas gathering infrastructure. Royalty owners, who are not entitled to compensation on flared gas, wanted intense control of flaring. The state also wanted stricter control because flared gas is not taxed, and refineries wanted stronger regulations because their profits are a function of gas volume processed. Ultimately, the resolution to these conflicts was to ban flaring after the first 10 days of production for a new well and to empower the RRC to regulate "waste". While some industry leaders supported these reforms, others rebelled, leading to the governor of Texas declaring martial law ("Flaring Burns Texas Economy" 2020).

In the 1930s, Willyard argued, the continued division of oil industry interests allowed the RRC to advance its legislative mandate of reducing the waste of natural gas. With continued conflict between industry segments, the RRC was able to build a coalition between pipeline companies, refineries and mineral owners to pressure the Texas legislature. While the coalition allowed the RRC to continue to strengthen flaring regulations particularly at gas wells, rival industry segments were able to coalesce to defend the practice of flaring at oil wells. After the passage of several bills in this period, flaring regulation reached a stasis. This stasis period was characterized by three policies:

> "(1) the state legislature explicitly banned flaring gas as gas wells without mention of flaring at oil wells,
>
> (2) TRC held the authority to regulate production and waste in the oil and gas industry, and
>
> (3) state courts provided legal precedence for TRC to shut down wells that fail to cease wasteful practices (such as routine flaring), regardless of the well's classification as an oil or gas well." (Willyard 2019)

These policies were in place until the 1960s. During the 1960s, Willyard argued, the RRC's political power waned. She posited that as a result of "busts, increased regulatory completion, and industry cohesion since the 1960s, TRC [RRC] policy became increasingly influenced by capitalists by the 1990s" (Willyard 2019). This dynamic, she argued, manifested itself in the eventual crystallization of flaring policy in Rule 32. Industry interests made substantial campaign contributions to the RRC Commissioner elections while Rule 32 was being drafted, and Willyard argued that their influence led to the RRC adopting industry rhetoric on flaring:

> "Rather than framing the development of Statewide Rule 32 as a conservationist policy, it was framed as necessary to reduce regulatory costs. Statewide Rule 32 was passed, "to provide needed flexibility in gas operations." (Willyard 2019)

Since Rule 32 was implemented, the Texas legislature has continued to pass laws undermining the RRC's Rule 32 enforcement. When Rule 32 was initially passed the RRC was empowered to shut down wells found violating Rule 32, but later laws set the maximum punishment for flaring violations as fines.

Willyard framed the general trajectory of flaring regulation in Texas as controlled by the influence of industry. Even during eras where conservationist policies dominated the RRC, those policies arose because splinters of industry interests supported them. However, these splinters did not last. Where previously separate companies controlled extraction, gathering, and processing, individual companies began to vertically integrate. These companies controlled multiple steps in the supply chain, unifying the industry under larger energy companies with similar interests. These large vertically integrated companies, Willyard argued, preferred limited flaring regulation and wielded significant political power. Willyard posited that as the industry consolidated, the RRC lost the ability to draw on industry support for more conservationist policies. Willyard identified a variety of mechanisms by which the increasingly consolidated oil and gas industry sapped the RRC's strength: campaign contributions for Commissioners, lobbying to the state legislature, and desire to maintain economic prosperity from the boom era.

Willyard's identification of the slow process by which the oil and gas industry unified to ultimately leverage significant power against the RRC, leading the RRC to become an increasingly cooperative regulator, is a useful framing mechanic for this paper's analysis of the Rule 32 permitting mechanism. However, Willyard conducted little implementation analysis, instead focusing on the evolution of Texas law and administrative code. Taking Willyard's theoretical arguments about changes in RRC behavior, this paper will evaluate how the RRC has implemented Rule 32.

Regulatory Capture and Fossil Fuel Extraction

While Willyard does not explicitly use the term regulatory capture, the degradation of the RRC's conservationist mission regarding flaring as the oil and gas industry united its political goals is best understood through a lens of regulatory capture theory. Regulatory capture theory arose out of what Sam Peltzman in 1976 identified as:

> "a growing disenchantment with the usefulness of the traditional role of regulation in economic analysis as a deus ex machina which eliminated one or another unfortunate allocative consequence of market failure. The creeping recognition that regulation seemed seldom to actually work this way, and that it may have even engendered more resource misallocation than it cured, forced attention to the influence which the regulatory powers of the state could have on the distribution wealth as well as on allocative efficiency" (Peltzman 1976, 211)

While the problem Peltzman described is intuitive, defining what exactly regulatory capture is has been extremely contentious in the literature. Early and influential work in this field from George Stigler focused primarily on regulation as a rational economy (Stigler 1971). Within Stigler's framework, demand is set for regulations by an industry to increase rents for entry into the industry, thus pricing out newcomers from entering the market. While valuable and strongly empirically founded, Stigler's work largely disregarded the possibility for firms to work to lower their own rents. Later works have allowed for the possibility of firms working towards rent lowering, while maintaining Stigler's fundamental assumptions about regulation acting as a rational supply and demand economy (Ramanna 2021).

Stigler's regulatory paradigm has been criticized and elaborated on from a variety of perspectives; this paper will focus on two of them: the lack of consideration of information asymmetry and the possibility of rent lowering capture.

One of these elaborations comes from Laffont and Tirole's 1991 work which argued that Stigler's paradigm was not agent-theoretic in that it ignored information asymmetries, which they argued were necessary for a regulating entity to deviate from the public interest without retaliation from the legislature (Laffont and Tirole 1991). Laffont and Tirole contended that the fundamental relationship that makes regulatory capture possible is that the regulating agency is able to mediate information to the legislature:

> "In contrast to Congress, the agency has the time, resources and expertise to obtain information about the firm's technology. Congress relies on information supplied by the agency. The agency's expertise allows it to hide information from Congress in order to identify either with the industry or with consumer groups affected by the price (output)

> decision. That is, these interest groups can bribe the agency to retain specific kinds of information" (Laffont and Tirole 1991, 1092).

This informational asymmetry provides a mechanism to rectify dissonance between regulator public statements and actual regulatory implementation by interpreting incongruous behavior and statements as agencies leveraging their informational rent.

This paper will also deploy criticism of Stigler's work through the concept of corrosive capture. While Stigler envisioned firms primarily wielding regulatory influence to levy higher rents on competitors, there is significant empirical evidence that in some regulatory economies firms have wielded their influence to levy lower rents across the industry. Stigler's model struggled to conceptualize this circumstance because he noted that the benefits of such rent decreases, or even direct subsidies, would quickly be defrayed by new entries into the industry. However, subsequent scholars have taken this possibility more seriously, noting that in some industries, firms may determine that their decreased costs from lowered rent are greater than the decreased profits from greater competition. In their 2014 book, *Preventing Regulatory Capture*, Carpenter and Moss noted that the majority of literature on regulatory capture in the 21st century has focused on rent-lowering capture (Carpenter and Moss 2013). To distinguish this type of capture from the capture Stigler and his contemporaries focused on, Carpenter and Moss proposed a new subcategory of regulatory capture:

> "Corrosive capture occurs if organized firms render regulation less robust than intended in legislation or than what the public interest would recommend. By less robust we mean that the regulation is, in its formulation, application, or enforcement, rendered less stringent or less costly for regulated firms (again, relative to a world in which the public interest would be served by the regulation in question)" (Carpenter and Moss 2013, 16).

Carpenter and Moss defined corrosive capture as an alternative to traditional capture, which describes Stigler's model of capture. Carpenter and Moss noted that simply observing deregulation is not sufficient to verify corrosive capture. As Justin Rex at Bowling Green State University has emphasized, "it is possible that what looks like a pattern of deference to the industry is really the product of the agency being responsive to public attention, Congressional legislation, or presidential appointments that indicate "electorally sanctioned pro-business governance" (Rex 2018). Corrosive capture can only occur when the regulating agency becomes decoupled from the electorate, likely due to deference from the legislature to which the agency reports.

In evaluating the state of regulatory capture at the RRC, this paper will deploy two other frameworks from Carpenter and Moss. First, as noted above, outlining a rigorous methodology to identify capture has been contentious in the literature. Carpenter and Moss argued that most academics are too willing to accuse agencies of being captured without a rigorous evaluation. In response to that problem, they presented a checklist. If a regulatory economy fulfills all planks of the checklist then the regulator can confidently be described as captured:

> "To claim capture, an argument ought to: Provide a defeasible model of the public interest. Show a policy shift away from the public interest and toward industry (special) interest. Show action and intent by the industry (special interest) in pursuit of this policy shift sufficiently effective to have plausibly caused an appreciable part of the shift" (Carpenter and Moss 2013, 15).

The primary aim of this paper is to evaluate the latter two criteria through an analysis of the implementation of Rule 32 regulations in Texas, but to make a strong claim about regulatory capture under this framework, a schema for interpreting public interest should be demonstrated. Carpenter and Moss acknowledged that gauging the public interest is complicated:

> "Some would maintain that the repeated actions of democratic citizen majorities (or the repeated actions of the elected representatives of those citizens) constitute the most legitimate measure of the public interest[4]. Others would argue that calculations rooted in welfare economics should serve as the measure[5]" (Carpenter and Moss 2013, 14).

Like Carpenter and Moss, I will not opine on the relative strength of these arguments, particularly in the messy interplay between economic welfare and climactic or medical welfare that natural gas flaring sits within. Instead, this paper will draw from both public opinion data, regulator statements, and industry commitments. This combination of evidence approximates at least to a crude degree the public interest in the issue area.

While public opinion data on flaring in Texas is scant, some does exist. In 2023, a coalition of NGOs commissioned Global Strategy Group to conduct public opinion surveying to evaluate the desire for a variety of oil and gas regulatory policies in Texas. One of these policies was an end to routine flaring. The poll determined that 58% of Texans support EPA action to end routine flaring (Baumann 2023). Unfortunately, the sample mechanics of the poll are not well documented and there is little other data to confirm its conclusions. However, when coupled with public commitments to end routine flaring by Shell, Exxon, BP and a slew of other smaller companies and the public statements from the Texas RRC about tightly controlling flaring, it is clear that the public interest is in controlled flaring ("Flaring: Zero Routine Flaring by 2025," n.d.; Gjervik 2020; "BP Aims for Zero Routine Flaring in US Onshore Operations by 2025" 2021). While Texas may be a state that generally supports "electorally sanctioned pro-business

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[4] Carpenter and Moss note the Federalist Papers as a proponent of this model.

[5] While Carpenter and Moss do not give any examples of this argument in scholarship it is apparent in Kenneth Arrow's work on welfare economics.

governance" (Rex 2018), specifically in the case of flaring, the public interest appears to be in reducing flaring. There could be a variety of reasons for this. Determining why is beyond the scope of this paper, though the motivation is likely related to flaring being perceived as a waste of Texan natural resources coupled with environmental concerns — creating a rare area of bipartisan agreement about control. Using this formulation of the public interest, policy implementation that actively reduces flaring would be consistent with the public interest while policies that fail to curtail flaring would not be. Given this "defeasible model of the public interest" (Carpenter and Moss 2013), the following sections of this paper serve primarily to evaluate the other two aspects of Carpenter and Moss's regulatory capture framework.

Finally, Carpenter and Moss argued that capture can take on different levels of severity which warrant differing policy remediations. Weak regulatory capture "occurs when special interest influence compromises the capacity of regulation to enhance the public interest, but the public is still being served by regulation, relative to the baseline of no regulation" (Carpenter and Moss 2013, 12). Carpenter and Moss noted that some level of weak regulatory capture is likely universal in regulation, but severe instances of weak capture can still warrant policy interventions. Weak capture was contrasted against strong capture in which regulation implementation:

> "violates the public interest to such an extent that the public would be better served by either (a) no regulation of the activity in question – because the benefits of regulation are outweighed by the costs of capture, or (b) comprehensive replacement of the policy and agency in question" (Carpenter and Moss 2013, 11).

Thus, the full extent of Carpenter and Moss's framework leads to five possible outcomes:

1. No regulatory capture

2. Weak traditional capture
3. Strong traditional capture
4. Weak corrosive capture
5. Strong corrosive capture

Willyard's work implied that in the context of flaring some form of corrosive capture is occurring, but does not stake a strong claim about whether that is strong or weak. That environmental regulation is often corrosively captured has been addressed in other studies. One paper published by Terry Fitzgerald at Texas Tech in 2023 analyzed the development and regulation of oil and gas in North Dakota through the lens of regulatory capture (Fitzgerald 2024). It concluded that as oil and gas development expands, environmental regulators increasingly behave in ways consistent with corrosive regulatory capture; it further notes that this is likely true in other regions of increasing oil and gas development. Using Carpenter and Moss's framework, I aim to evaluate which (if any) of these capture categories the RRC falls within. That capture understanding will then inform my policy recommendations.

Data & Methods:

Since 2021, the Texas Railroad Commission has required all Rule 32 exceptions be submitted through the RRC Online System. Tied to the online system, the RRC maintains a Rule 32 Exception Query. This searchable database records every Rule 32 exception from May 2nd, 2021 to present. Each database entry includes the operator, the submission data, the time period for the permit, the well's hydrogen sulfide status and the permissible daily volume of emissions. Alongside these indexed data points, each database entry also includes all of the supplemental forms submitted by the operator to the RRC. These forms typically include the actual permit application document, a summary of the well's production in the lead up to the flaring incident and a supplementary form describing the explanation for the flaring incident.

While the database is searchable, the RRC does not allow all of the indexes to be searched or filtered. Further, the database cannot be exported nor downloaded and can load no more than 500 entries at a time. It also has no clear API backing system to access. To enable easier sorting of the entire database, all 13,031 entries from May 2nd, 2021 to September 19th, 2024 were copied and then pasted in 500 entry blocks into a CSV file. While this CSV file allows all of the permits applied for from the beginning of the database until September 19th, 2024 to be examined together, it does not provide all of the information categories available for a given permit (Figure C).

	Excep/Seq No	Submittal Dt	Filing No	Status	Filing Type	Operator No	Operator Name	Property	Effective Dt	Expiration Dt	F/V District
Actions	61861-1	11/18/2024	26498	Approved	New Exception	217012	DIAMONDBACK E&P LLC	Commingle Permit-08-10330	11/09/2024	11/11/2024	08
Actions		11/18/2024	26496	Under Review	New Exception	216378	DEVON ENERGY PRODUCTION CO,	Commingle Permit-02-5466			02
Actions	61859-1	11/18/2024	26495	Approved	New Exception	942623	WPX ENERGY PERMIAN, LLC	Commingle Permit-08-9818	11/04/2024	12/03/2024	08
Actions	61858-1	11/18/2024	26494	Approved	New Exception	217012	DIAMONDBACK E&P LLC	Oil Lease-08-38895	11/12/2024	11/12/2024	08

Figure C: This image depicts the information available in list form from the Rule 32 Query.

When "Actions" is selected on a given application the user is redirected to a permit specific entry which gives more information and includes links to the supplemental documents for the permit (Figure D).

Application for Exception to Statewide Rule 32

Filing Information

Filing Number: 26490 **Exception Number:** 61855 **Sequence Number:** 1
Exception Status: Approved **Prior Exception No:** **Operator:** TRINITY OPERATING (USG), LLC
Submitted Date: 11/18/2024 **Filing Type:** New Exception **Cumulative Days Authorized (incl. prev. periods from mainframe):** 9

Exception Information

Previous exception number not in the online system **Site Name:** Glasscock Ranch C AB CTB
Is the operator aware of the "Recommended Practice" related to flaring in the February 2019 Notice to Operators? Yes **Hearing Requested:** No
Exception is for a full or partial shut-down of a gas plant, gas gathering system, etc. as provided for in SWR 32 (h)(8): No **Permanent Exception Requested (Hearing required if volume is greater than 50 MCF/Day):** No
Requested Effective Date: 11/06/2024 **Requested Expiration Date:** 11/14/2024 **Number of Days (this request):** 9
Release Requested for:
Every day of the calendar month: Yes **Days per month:**
Is this oil and/or gas property connected to a gas gathering or transmission system? Yes **Distance to nearest pipeline:**

Property

Property Type: Oil Lease **District:** 01 **Property ID:** 20777 **Lease Name:** GLASSCOCK RANCH C
Requested Release Rate (mcf/day): 341
Gas Measurement Method Orifice Meter **Other Meter**

Flare/Vent Locations

Flare or Vent Name: FL-1 **County:** ZAVALA **District:** 01
Release Location Outside of Texas: No **Release Type:** Flare **Release Height (ft above ground):** 40
Format: Decimal Degrees **GPS Datum:** NAD 27
Degrees (Latitude): 28.695017 **Degrees (Longitude):** -99.492259

Is the flare/vent facility is subject to SWR 36 (hydrogen sulfide (H2S) area): Yes **H-9 Certificate No.:** 124808
H2S Concentration (ppm): 38
If subject to SWR 36 (H2S area), distance to public area (ft.): 2743
Public Area Type: Other **Other Public Area:** Production Facility

Exception Reasons

1. Other

Figure D: Permit Application information for Filing Number 26490.

This database format means that information such as flare location, hydrogen sulfide concentration, and Requested Release Rate cannot be accessed from the list form of the database and must be accessed by selecting each permit manually. To manually acquire this information for all 13,031 applications would be prohibitively time intensive, so I developed a Python script to scrape this information from the database so that it could be analyzed (Appendix I). This script generated an autonomous internet browser window which could navigate to the database page and enter each filing number from the csv file referenced above into the database. The scraper then copied and pasted these indexes into a separate Excel spreadsheet, generating a systematic survey of all of the permits in the database.

However, because the explanations for flaring provided by operators, which are the primary unit of interest for this project, are only available in the supplementary documents, the data recorded through these methods is not sufficient to fully gauge the variables potentially impacting permit outcomes. Because the supplementary files do not have standardized formatting or file names, a web scraping approach was determined to be impractical. Instead, data was collected manually. Since evaluating all 13,031 applications would require time beyond the scope of this project, a simple random sample was collected. To generate this random sample, each permit was assigned a random number between 0 and 1 using the =Rand() function. The entries were then sorted in ascending order and the first 700 (~5%) were taken as a random sample. Each permit in the random sample was read in its entirety with its supplementary documents and notes were taken on each one for later reference.

For each application in the random sample, the hydrogen sulfide status of the well, flare location, flaring volume (both daily and monthly limits), the name of the site, operator, permitting dates and a summary of the explanation for the flaring were recorded. In addition to drawing implementation conclusions from the flaring explanation narratives for each site in the sample, the other data points were used to verify that the scraper was working as intended by cross referencing data points across both the manual and systematic samples.

Accompanying this random sample were two nonrandom samples that explored specific application groups that may illuminate broader trends. First, a manual sample was taken of all 190 flaring permits submitted by the operator Endeavor Natural Resources that have been accepted for permanent flaring with no end to the permit. Given that official RRC policy is to discourage routine flaring, permanent flaring permits are anomalous and are likely to have a disproportionate number of unique information in them. Endeavor has received a disproportionately high number of permanent flaring permits (44% of all permanent flaring permits). Endeavor thus represents a unique case for examining operator motivations for applying for permanent flaring. Second, a manual sample was taken of all 53 permits the RRC has rejected since the beginning of this database in May 2021. Since the driving motive for this paper is to explore how explanations affect permit outcomes to inform an evaluation of potential regulatory capture at the RRC, analyzing the rejected permits to compare against the other samples allows a more comprehensive evaluation of explanations that have previously been rejected by the RRC. This strategy was necessary because of the 241 to 1 ratio between approved and rejected permits; the data required a nonrandom sample to adequately compare the rejected permits to non-rejected permits.

Unfortunately, the RRC Rule 32 Query system does not give the RRC's reason for rejecting a given permit. To augment the Query data, the RRC was also contacted to request the explanations given to each operator for their permit being rejected. These explanations are only stored in the RRC Online System which is not publicly available. The RRC Public Information Request office was unable to provide information from the database, but did give contact information for the team in charge of the Online System. After several contact attempts without a callback, I called the central oil and gas phone line, which directed me to another staff member. That staff member was also unable to provide any systematized method for receiving information about permit rejections, but did send screenshots of the Online System rejection explanations for each of the rejected sites. I paired these screenshots with the Query data to better understand the rejected permits.

Once the corpus of data was collected, each permit variable was analyzed for trends. What types of explanations have been approved? Are approved explanations congruent with stated RRC policy? Are there explanations that reliably lead to permits being rejected? Is there any other factor that leads to permits being rejected such as location, permit duration, requested volume? Alongside these broader trends, the analysis presented below also includes individual case studies that more deeply explore individual permits that are unique either in explanation or application circumstances.

Out of the 13,031 permits recorded to the original CsV file in September 2024, 12,962 permits were recorded by the systematic survey. The difference of 69 between the two is due to 49 permits that were duplicated in the database for unknown reasons, and 20 permits that disappeared from the Query database between the recording of the CSV information and the scraper running in January 2025. It is unclear how those permits disappeared from the database but they were all manually checked to ensure that their disappearance was not the result of an error in the scraper (Appendix II).

Results:

Out of the 12,962 permits for which the outcome is known, 12,421 were approved, 53 were rejected, 239 were cancelled by the operator, 29 had pending Commissioner hearings, and 220 were returned to operators[6] (Figure E). Based on these data, I evaluated a series of potential factors that may be driving permit outcomes. This evaluation found that the only variable that has any bearing on permit outcome is clerical accuracy. Explanations for permitting, if included at all, had no impact on permit approval even if the provided explanation was directly at odds with the list of acceptable explanations provided by the RRC. Similarly, requested volume, permit duration, and proximity to residences were all found to have no effect on permit outcome. Operators were also found to routinely receive permits for flaring at new wells where flaring was

[6] Returned permits are particularly difficult to analyze because the RRC does not record any information publicly about why a permit was returned. Further, operators may simply choose not to alter their application in the way requested by the RRC, either to provide more information or to alter the specifics of the request, in effect cancelling the permit though it is recorded in the database as a returned permit. Alternatively if an operator makes whatever change the RRC is requesting the permit is then recorded as approved with no indication that it was ever returned.

only necessary because the operator was unwilling to invest in gathering infrastructure. Permit extensions were even granted to operators who had drilled new wells at already overpressurized sites even though the operator was actively exacerbating their need for flaring. While most permits were approved administratively and therefore not evaluated personally by the sitting Commissioners, those that were subject to Commissioner hearings were approved with similarly little rigor even when the permit contravened the commission’s public statements on flaring. Due to the dearth of rejected permits, strong statistical arguments for variation between the rejected permits and the approved permits were difficult to verify. Instead, most of this analysis focused on using extreme examples of approved permits to bound what the RRC was willing to approve on a permit. While many variables were ultimately determined to have no effect on permit outcomes, the variance within some of them is itself worthwhile to analyze from a policy implementation perspective and strengthens the utility of these findings in evaluating potential regulatory capture.

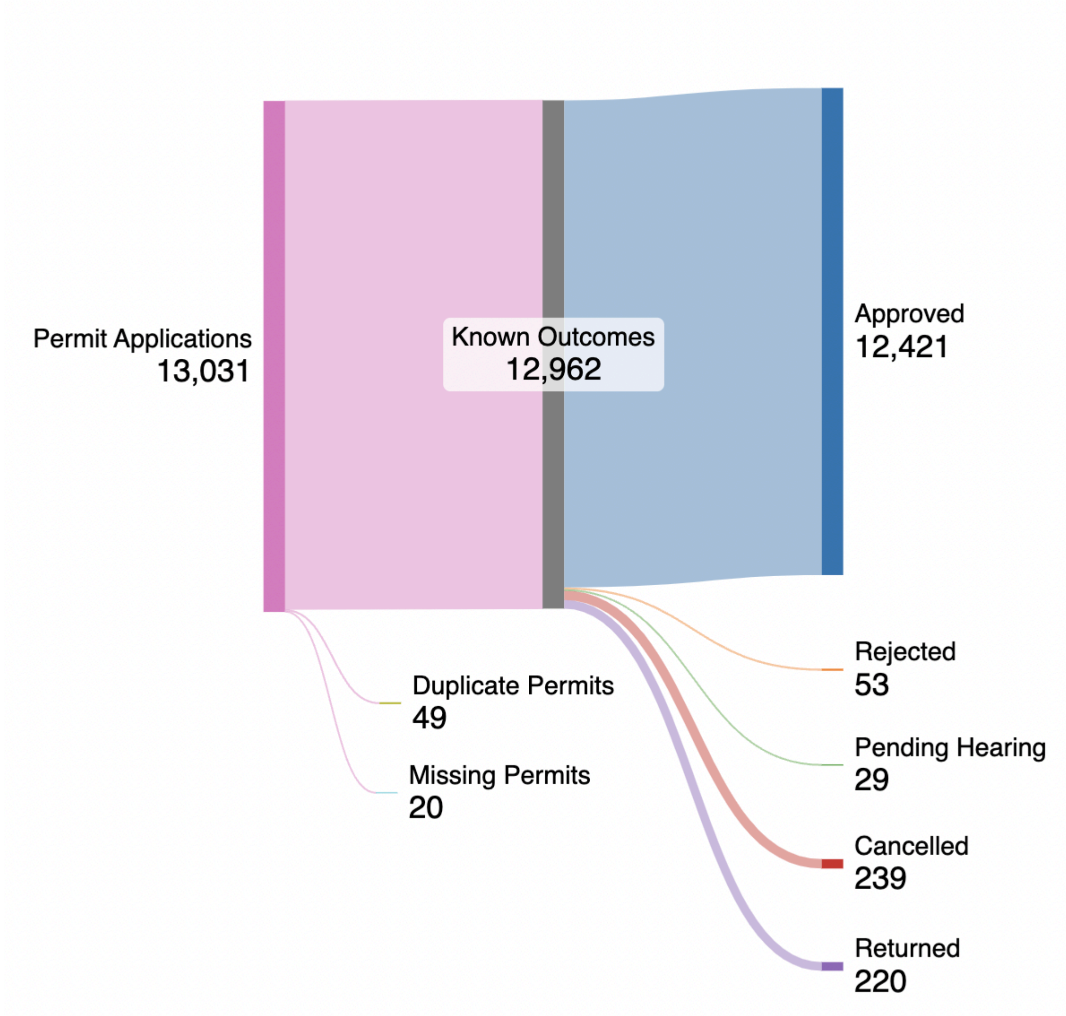

Figure E: This Sankey diagram shows the relative abundance of various permit outcomes

Clerical Problems:

To directly evaluate variables driving permit rejections a public information request was submitted. While no formal system apparently collects this data, an RRC employee, when provided the list of rejected filing numbers, was willing to query the operator side of the Rule 32 database that the public cannot access; they agreed to screenshot each rejection. Two rejections did not include explanations for the decision, while the other 51 did. Using this data, the driving force in permit outcomes was clear.

All 51 permits for which rejections were explained were rejected for a clerical problem with the application paperwork itself. 37 were rejected for missing the filing deadline for the permit. Despite public statements that applications must be submitted no more than 24 hours after flaring begins (Nattin 2021), the rejection information provided by the RRC indicates that actual RRC policy is to backdate permits by up to 2 weeks after the beginning of the flaring. These permits were all submitted more than two weeks after flaring began, violating this policy and causing their rejection.

Another eleven rejections occurred because the permit could not be approved administratively and required a hearing with the Commissioners. Every one of those rejections was invited to resubmit with a hearing request letter. The RRC does not list in the rejection reason why a hearing request is needed, but because Rule 32 outlines explicitly under what circumstances operators need hearing requests, the trigger for the hearing request can be deduced. Two rejections required a hearing because the operator was attempting to extend a permit of over 50 mcf by more than 90 days. The other nine were because the operator requested to have permits backdated by upwards of two years to retroactively permit flares for which the operator was issued a violation for unpermitted flaring. The operator making this request apparently requested a hearing in the permit application but did not include the supplemental form to schedule the hearing and was invited to resubmit.

It is not clear why some of the rejections for backdating were told to request a hearing and others were not, but in total 46 of the 52 rejected flaring permits were rejected for attempting to backdate by more than two weeks. Overall, 46 permits were rejected for some backdating issue, two permits were rejected for attempting to extend a permit beyond 90 days without submitting a hearing request, two were rejected for grouping multiple disparate disturbances affecting multiple facilities onto one permit (and were told to resubmit as separate permits), and one was rejected for submitting in their documentation a production record that was inconsistent with the production record the operator had previously submitted to the RRC. The last rejection is the most interesting as it indicates that some sort of actual analysis of the permit had occurred which uncovered the error. However, the operator was not cited for apparently previously misrepresenting their venting from the facility to the RRC. Even that operator was invited to resubmit the permit with corrected data.

That backdating issues appear to be the primary driver of permit rejections is itself surprising. Despite the RRC publicly claiming that permits will not be accepted if they are submitted more than twenty-four hours after flaring begins, the median approved permit is backdated by 10 days. Only 1,825 of the 12,421 approved permits were actually submitted within twenty four hours. 1,324 permits were submitted more than fourteen days after flaring began, apparently violating even the RRC's nonpublic but seemingly official backdating policy. Over 399 permits were backdated by more than a month. 64 permits were backdated by more than three months. One was backdated by over a year. Rejections are not clustered temporally so it appears unlikely that RRC made an internal policy decision to increase enforcement of the backdating requirements that led to the rejections. Interspersed between permits rejected for being submitted more than fourteen days after flaring began are permits that were approved for flaring despite being submitted even longer after flaring began than those rejected. If rejection explanations followed similar linguistic patterns from permit to permit it would appear that there is one employee in the Rule 32 permitting department who is more zealous about enforcement; however, the verbiage used to tell operators that they missed the deadline varies widely. It is difficult to explain these rejections as anything other than capricious or as a calculated effort to reject some number of flaring permits to present the auspices of effective enforcement. Clerical issues like backdating appear to be the sole driving force in determining permit outcomes. This is disheartening given the wide variance in other permit variables, many of which are approved despite appearing to be noncompliant with stated RRC policy.

Explanation for Flaring:

When applying for a Rule 32 exception, operators are expected to provide an explanation for their flaring, explaining why it is necessary and how they have exhausted alternative uses for the gas that they are asking to flare. As noted above, the RRC has provided guidance to operators explaining both what is required for an explanation to be sufficient and what would make an explanation insufficient. This is a uniquely well explained variable in the flaring permit application, because it is the only portion of the form for which the RRC has explicitly given a detailed schema of sufficient and insufficient permit criteria. Given this posture, explanations were presumed to be a critical determinant of permitting outcomes. However, the random sample indicated that explanations have no bearing on permit outcome whatsoever. Despite public claims to the contrary, permits are routinely granted for explanations which ought to be considered insufficient or omit explanations altogether.

Since analysis of flaring explanations required manual analysis of the primary source documents submitted by operators, analysis of flaring explanations was limited to the 700 permit random sample and the targeted analysis of rejected permits. 40 permits in the random sample were granted by the RRC despite not including an explanation for the flaring, either by omitting a document entirely or submitting language with no specific information about the incident. Some permits that did include explanations were incoherent or left significant portions of the form blank (Figure F). Ten explanations were called “blanket explanation” in the file name and were textually identical despite spanning two years, seemingly indicating that the operator submitting these permits was using a generic explanation submitted whenever they flared.

Before an exception can be granted, the following information must be submitted with this data sheet:

* Explanation as to why the operations cannot be shut-in and the gas must be vented or flared

    - The well that's making the gas is a lease holder

* If gas is vented, explain why the gas cannot be safely and continuously burned and that the gas can be safely vented

    - It's flaring

* Explanation of how **all** legal uses for casinghead gas have been investigated and exhausted

*

* Distance to nearest pipeline and operating conditions (e.g. sweet or sour, line pressure, etc.

    - *1.2 miles

Figure F: This explanation was provided for a permit submitted by Diamondback E&C LLC. This permit was approved for 31 days with a total requested volume of 105,000 cubic feet of gas. It is unclear what the explanation means, but it was not clarified.

Explanations, when given, varied widely, but the most common explanation given by operators was some form of high line pressure — which was cited explicitly in 260 out of the 700 applications in the random sample. Sources of this high line pressure varied drastically, from issues with the gathering plant to overproduction at the site. However, some permits were granted without giving a direct explanation for the source of the high line pressure, which apparently indicated that the actual origins of the high line pressure were not a determining factor in permit approval.

Beyond pressure issues, operators frequently reported flaring due to gas composition that was out of specification with the tolerances of their pipelines; 28 permits cited elevated oxygen levels in their gas stream as a justification for flaring. 42 permits cited elevated hydrogen sulfide levels in the gas stream as an explanation for flaring. This was particularly concerning because fifteen of those permits were at facilities that marked that they did not have to comply with hydrogen sulfide controls. In one particularly egregious example, an operator told the RRC that flaring was necessary because hydrogen sulfide levels were so high that they could not find a gatherer willing to take their gas. That explanation noted that they would not vent the gas (instead opting to flare it), but the permit application said that they would be venting the gas. It does not appear that the RRC ever clarified the discrepancy; it did approve the permit. In another example an operator simultaneously claimed that they were flaring due to elevated hydrogen sulfide from the well, but noted on the application form that they were flaring due to a purchaser upset and that the well does not produce hydrogen sulfide. Again, the RRC approved the permit without clarifying the discrepancy. Another well produced such a high concentration of hydrogen sulfide that they worried that being unable to release gas would corrode the wellhead. That operator was permitted to vent the well without flaring, releasing hydrogen sulfide directly into the atmosphere.

Seventeen permits were for new wells. Thirteen of those wells were experiencing a capacity constraint either because the new well was not attached to a pipeline or because the pipeline the well was attached to did not have enough capacity to process the new volume of gas. Despite the RRC’s public statement that economic considerations are not sufficient to justify flaring permits, operators frequently cited economic considerations when explaining why the well is not attached to a pipeline. For instance, Trinity Operating submitted a request to flare at two wells they recently acquired that were not attached to a gathering line. Trinity noted that it would be uneconomic to attach them to one, but that the company was at the time drilling two new wells and if the production of those two wells is high enough they may reconsider and pay for a salesline (Figure G). It is difficult to conceive of how such an explanation is not an "economics" explanation as outlined by the RRC yet it was approved.

TRINITY OPERATING

Application for Exception to Statewide Rule 32
Required Documentation

Specify the necessity for the release pursuant to SWR 32(f)(2):

1. Provide an explanation of why the operations cannot be shut-in and the gas must be released. Explain how all non-wasteful uses, including sales of gas and other beneficial uses, have been investigated and exhausted.

   KM Ranch 1H/2H RRC Lease ID #15631 was acquired in December 2022. Flaring due to not being connected to a sales line and not economic to connect these wells to sales line 5 miles away.

   Note: The 60-day gas production shows flaring from 1/19 - 27/2023. The daily flare report that I received did not show flaring from 1/19-27, 2023; otherwise, the flaring exception would have been submitted sooner. I reported it and reported that on 1/19/2023 that it flared, but didn't show any production.

2. Provide preliminary production data for the past 60 days to document the current production and disposition of gas from the producing property. For new wells producing for less than 60 days, document the production history to date. Preliminary production data is not required for gas plant exceptions.

   Attached is the past 60-day production for the lease.

3. Provide documentation of gathering/transmission pipeline availability, capacity and/or reliability limitations. Include plans to secure pipeline and/or gas plant capacity and provide evidence of good faith efforts to obtain the same, which may include an economic analysis assessing gas marketability including treatment, compression and pipeline costs.

   We will frac wells in June which may impact KM Ranch 1H and 2H wells. Plans are to evaluate the wells after the frac. There are no plans to connect until we see post-results.

   After acquiring the wells from Contango, WTG sent Trinity Operating (USG), LLC a notice they were deactivating the line for gas sales. This is the pipeline that the wells were connected to.

   Should you have any questions or need additional information, please contact me at Julie.ward@trinityoperating.com. Your assistance is greatly appreciated.

Sincerely,

Julie Ward

Julie Ward
Regulatory Specialist

Figure G: Trinity's explanation for their flaring.

In four instances, an operator noted in their explanation that if the flaring permit was not approved and the operator determined that the well was uneconomical they would abandon the well. Abandonment is an industry term and can be used either to refer to a well that has been plugged by an operator who is ceasing production or to a well that was orphaned by its operator who has not taken necessary steps to plug the well, frequently leaving government actors to spend money to properly plug the well ("Orphaned, Abandoned, and Marginal Well Plugging," n.d.). This latter is illegal in some circumstances. While not a certainty, discussing such behavior in a document submitted to the state agency that would be responsible for dealing with an abandoned well could be construed as a threat. Whether the RRC interpreted the language as a threat or not, all four permits were approved. Other operators seemed to rely on economic considerations in their flaring arguments but more deftly avoided using the word economics in their permit applications. One operator said that their gatherer was down for maintenance and they wanted to flare rather than use some other solution because they did not want to lose revenue by halting oil production. That argument is implicitly economical but avoids explicitly using the word uneconomical.

Like economics based arguments, the RRC has noted that damage to the mineral owner is not a sufficient explanation for flaring. Despite not being a sufficient explanation, several operators cited their mineral leases as justification for flaring. One particularly strange explanation stated that "waste gas must be flared in order to maintain oil production and lease obligations." While the language is strained, this explanation is clearly premised on avoiding damage to the mineral owner, yet it was approved. Further, that waste gas needing to be flared would be integrated into the operator's lease obligations would be a strange decision if an operator genuinely believed that the RRC may deny flaring permits. Several operators presented the dilemma of either flaring or having to shut in a well and opting to flare in order to keep the lease active.

Operators also frequently submitted permits that listed a variety of explanations. These permits were frequently for long durations and appeared to indicate that an operator was seeking a permit to have on hand in the case of upset conditions or for routine flaring rather than as a response to an incident. Despite seemingly flouting the intent of the explanation system to give specific flaring circumstances, some of these permits were approved directly by the Railroad Commissioners during a public hearing. For example, BTA Oil Producers applied for a flaring permit for a facility that had already been permitted for 1538 days to extend the permit by another 365 days, which would require a hearing. The RRC agency review determined that "Flaring is primarily due to gas plant or compressor downtime, plant upsets, and high line pressure" all of which are intermittent upsets. It is not clear why BTA could not apply for permits as needed though a permit structured in this manner does allow routine flaring. Further, though operators are required to demonstrate that conditions have not improved in order to extend the permit, the operator appeared to be actively making the problem worse. During the time since the permit was last extended, the operator had brought six wells online on the same gathering system, which only exacerbated the high line pressure for which the initial flaring permit was granted.

A nearly identical situation occurred with Riley Permian Operating Co. which applied for a permit extension at a site that had already been permitted for 1015 days. The permit was extended for another full year by the Commissioners after agency review determined that flaring was due to "high line pressure, gas plant maintenance, and limited capacity", again a non-specific series of explanations that would justify intermittent flaring but is being permitted continuously for years. Like with BTA, since the permit had been approved, Riley Permian Operating Co. had continued to drill new wells on site, doubling production for one of the sites on the flaring permit.

When examining the explanation information from the targeted analysis of rejected permits, only ten of the 53 permits did not have clear analogue explanations in the random sample's approved permits. All nine explanations unique to the rejected permits were for flaring incidents that occurred due to mechanical failures. While mechanical failures were common among approved permits, these were the same nine permits that specifically noted that the operator had already been fined for unpermitted flaring for these releases but that it wanted retroactive permits so that it could avoid the fines. All nine were submitted in excess of two years after the flaring incidents took place. While it is not surprising that the applications for flaring that happened two years prior and was already fined was rejected, the explanations given in other rejected permits do little to elucidate why the RRC rejected the permits.

Hydrogen Sulfide:

Hydrogen sulfide is a deadly chemical that is frequently found in oil reserves and has caused numerous oilfield deaths and some residential deaths in Texas. After an incident in 1975 where a Texas oil well released a cloud of hydrogen sulfide that traveled to a nearby home and killed nine people, the Texas legislature worked with the RRC to implement Statewide Rule 36 (McDonald and Wilson 2022). As part of Rule 36, the RRC determined an average concentration of hydrogen sulfide for every oilfield in the state. Different wells in the same field may yield different amounts of hydrogen sulfide, so Rule 36 requires that every well that is drilling into a field with an average hydrogen sulfide concentration of at least 100 ppm test the well's specific hydrogen sulfide output and report it via a form called an H9 ("Statewide Rule 36 - Hydrogen

Sulfide Safety," n.d.). Depending on the concentration reported on the H9 and the proximity to public spaces, Rule 36 outlines additional safety regulations that operators are bound by to protect both their own employees and the public.

Hydrogen sulfide is a particularly relevant issue in the context of flaring because inefficient flaring may lead to direct hydrogen sulfide release and even when hydrogen sulfide is successfully burned in a flare, it breaks down into sulfur dioxide (SO_2) which is also a pollutant and has been linked to respiratory distress (Khalaf et al. 2024). Due to these considerations, the Rule 32 flaring permit application asks operators to indicate whether the facility in question is in a sour gas field and therefore bound by additional regulations under Rule 36. If it is, the form asks that operators submit their H9 number, hydrogen sulfide concentration and distance to the closest public road or building. Since permits can cover more than one flare stack and different flare stacks may be attached to wells yielding different levels of hydrogen sulfide, Rule 36 information on the permit is included for every flare stack rather than just for the overall permit.

Out of the 16,842 flare stacks permitted under the 12,421 approved permits, 7,384 were in fields producing more than 100 ppm of hydrogen sulfide and therefore bound by Rule 36. Some of these permitted flares were surprisingly close to public locations, which does not appear to have deterred the RRC from approving permits. Six flares were less than 90 feet from a "Public facility such as school or business location." Those flares were all producing nearly 10x the minimum threshold to be considered a sour gas facility, and more than triple what the RRC continues a lethal concentration if gas from the facility were inhaled undiluted. The H9 for these flare stacks indicated that that public facility is within the radius at which a gas release from the facility is expected to exceed 100 ppm, more than double the short term peak safe exposure limit for hydrogen sulfide outlined by OSHA ("Hydrogen Sulfide - Overview | Occupational Safety and Health Administration," n.d.), meaning that if a strong gust of wind blew out the flare the school or business would be exposed to dangerous levels of hydrogen sulfide. The permits for twelve flare stacks listed their distance to the closest receptor as only one foot. One of these was for a residence and five were for golf courses. While it is likely that these operators misunderstood the application and interpreted the form as asking for distance to the closest receptor in miles, such clarification was never made by the RRC. The RRC approved permits for 613 flaring stacks within a mile of a residence that were also in a sour gas field. Four of those facilities are within less than 2000 feet of a residence and were producing more than 1500x the sour gas threshold concentration.

Further, some operators are apparently comfortable misleading the RRC about their hydrogen sulfide production. The targeted analysis of facilities operated by Endeavor Energy Resources that applied for permanent venting permits included 34 facilities that marked that the facility was not in a sour gas field despite the facility's H9 indicating otherwise.[7]

Hydrogen sulfide exposure was responsible for dozens of oilfield deaths in the past decade, yet the RRC appears willing to allow operators to release it into the atmosphere, near residences, with little oversight. Many of these facilities are producing so much hydrogen sulfide that Rule 36 requires that they maintain an emergency preparedness plan for any gas release, that onsite employees carry air monitors and gas masks, and that facilities maintain security to

[7] While this falls beyond the direct research intentions of this report, that facilities were able to receive permits to release hydrogen sulfide uncombusted while misleading the RRC about their permitting information is concerning regardless of whether the deceit was intentional. It is particularly concerning because the information disconnect was determined solely using RRC data, indicating that the permitting approval process is failing to verify applications with other information the RRC has on file for the facility. Unfortunately, systematizing this analysis would require a new code base to extract information from the H9 database. While that is a simple modification of the existing code used for this paper, the code is limited by the speed of the RRC's query systems and would require more than a month of management to run.

prevent civilians from accessing the site. Some facilities even have calculations included in their H9 indicating that were an hydrogen sulfide release to occur, nearby homes would be exposed to hydrogen sulfide concentrations far in excess of safe levels. Yet, the RRC approved these facilities to deliberately release hydrogen sulfide without even notifying nearby homes.

Venting:

Venting describes the release of uncombusted gas directly into the atmosphere. In releasing methane directly into the atmosphere this practice is significantly more impactful on the climate and in releasing uncombusted hydrogen sulfide this practice is also significantly more dangerous for nearby residents. The RRC did not reject any venting permits. It approved 322 vents across the state. 53 of those vents were in sour gas fields and were releasing hydrogen sulfide directly into the air. 31 of those vents were within one mile of a public area. Two vents were less than three quarters of a mile from a home. One of those two was producing sour gas at sixteen times the concentration to be considered sour.

Permitted Length:

The length for which flaring permits are active varies significantly. Presumably, permit length is a function of the reason the flaring is occurring with problems like power outages leading to shorter permits while infrastructural issues, such as lacking a pipeline connection, leading to longer permits. Since longer permits have greater effects on the climate and local health and are by definition greater wastes of gas, long permits would appear more odious to the RRC and therefore more likely to be rejected. However, in practice, permit length appears to have no impact on permit outcomes.

Permit lengths were evaluated as part of the systematic survey. Across the 12,421 approved permits, the median permit length was twelve days. The shortest permits were just one day (N=711), while the longest permit had a cumulative length of 6,300 days — more than seventeen years. The upper quartile began at 30 days, so while there were permits active for years, they were a minority of overall permits. 334 permits were approved for permanent flaring. Among rejected permits, the median permit length was eight days, which appeared to generally be consistent with approved permits. Further, only six of the 53 rejected permits exceeded 100 days and the longest of those was only two years, significantly shorter than some permits that had been approved by the RRC in other circumstances. Like with flaring explanations, it does not appear that variance in permit length is predictive of approval for a flaring permit.

Permanent Exceptions:

The RRC approved 334 permanent exceptions, exceptions with no expiration that allow operators to flare indefinitely. It rejected two. While many operators have some permanent exceptions, 189 of the 334 permanent exceptions were granted to Endeavor Energy Resources. While Endeavor was a large operator (they were recently acquired by Diamondback Energy), they were far from the largest operator in Texas, yet they were responsible for nearly two-thirds of permanent exceptions. Given this anomalous behavior, and as a relic of the initial research that motivated the rest of the project, a targeted analysis was conducted to gather explanations provided for all 189 of Endeavor's permanent exceptions. 159 of these permanent exceptions were granted for venting rather than flaring, indicating direct methane and uncombusted hydrogen sulfide release into the air. 150 of the 189 explanations cited some sort of economic justification for flaring. Most explanations involved the operator requesting to vent because the well did not produce enough gas to justify attaching a gathering line, and was not producing enough oil to pay to install a flare stack. Consistent with this narrative, these facilities produced little gas, the largest being only 50 mcf. However, as noted above, many of these facilities were producing hydrogen sulfide, so the RRC's decision to approve venting in lieu of flaring risks exposure for both workers and, potentially, residents.

While the systematic survey did not collect explanation information, it did collect some useful information for evaluating the permanent exceptions not covered by the targeted analysis of Endeavor. 26 facilities were approved for permanent flaring for daily volumes exceeding 1,000 mcf. The largest of these volumes was for the West Karnes Central Gathering Facility operated by Marathon Oil, which is one of the largest gathering facilities in the Permian Basin. It was permitted to release 32,150 mcf per day. Further, this flaring appeared to be routine as the permit application simply cites "system upsets". Despite definitionally being transient, system upsets were cited for 34 of the permanent exceptions. Operators either used transient events as a pretense for longer permits to flare later on or the RRC granted permits prophylactically for future potential upsets. In either case, the RRC was willing to grant extremely large permitting volumes for what appears to be routine flaring, even if most permanent flaring permits were much smaller.

The analysis of permanent flaring permits also indicated that the RRC approved some permits administratively that were required by Rule 32 to be approved through a Commissioner hearing. Rule 32 requires that permits for volumes larger than 50 mcf and for longer durations than 90 days be evaluated via Commissioner hearing. The approval of these flares appears to be a clerical error but it also directly contravenes Rule 32.

Permitted Volume:

Like with permit length, larger volume permits have more potent effects on the climate and local health and are, arguably, more wasteful. Thus, larger permit volumes would appear less likely to be approved by the RRC. However, these findings indicate that volumes are not connected to permit outcomes.

Flaring volumes must be caveated that an approved flaring volume does not necessarily equate to the actual volume of flaring that occurs. Operators frequently request flaring permits for larger volumes or more days than necessary to ensure they do not risk flaring beyond the permit if production spikes, though such practice arguably encourages more flaring. Thus, multiplying the daily permitted flaring volume by the length of each permit and aggregating it across the database is useful for conceptualizing the amount of emissions being permitted, but does not necessarily reflect the amount of actual flaring. Further, the RRC database tabulates requested permit volumes rather than final approved permit volumes which may be slightly lower if for example a permit was returned by the RRC and then modified by the operator.

The median requested single day volume for approved permits was 640 mcf. To contextualize that number, the American Petroleum Institute (API) estimated that homes consume about 100 mcf of gas per year (ICF 2017). Using that API estimate, the median permit releases in one day enough gas for more than six homes for a year. The largest approved requested daily permitted volume was 291,555 mfc, enough gas burned in one day to supply almost three thousand homes for a year. The largest requested volume among rejected permits is 17,155, about 1/17th the largest approved volume. The median among rejected permits is 782 mcf which while slightly higher than the median for rejected permits does not appear high enough to be a determining factor for permitting approvals.

While cumulative permitted flaring is not directly useful for evaluating permitting outcomes, it is useful in contextualizing the scale of the flaring problem in Texas. Since May 2021, the RRC has approved permit requests for 661,387,855 mcf of flaring and venting. This number was calculated by aggregating daily requested permit volumes for the length of every approved permit. Some permits also include specifications about flaring only a certain number of days each month. Those facilities were factored into the aggregate calculation by determining how many months the permit was active for, multiplying that value by the number of days of allowed flaring each month and finally multiplying that value by the daily requested permitted release volume. Using that estimate, Texas regulators allowed flaring and venting approximately equivalent to the consumption of about 6.6 million homes for a year.

Access to a Pipeline:

Without a pipeline the only way a facility producing gas can completely avoid flaring and venting is using all of its gas onsite to power equipment.[8] While this does happen, many facilities are not equipped to utilize their own gas and even for those that do, any volatility in gas production leads to flaring. Thus, these facilities are virtually always routine flaring sites. 557 permits were approved for facilities that marked that they were not attached to a gathering pipeline. However, only 129 of the 557 permits were permanent. While initially this seemed to be evidence that these unconnected facilities had less routine flaring than expected, 114 of the facilities without permanent permits were permit renewals extending existing permits. Further, among the new permits, 236 were for at least three months of flaring. Unsurprisingly, this permitting information indicated that facilities without pipeline connections were significantly more likely to engage in long term routine flaring. Over the last three years, the RRC has not rejected any permits for facilities that marked that they did not have a pipeline connection. Further, the frequency of new wells being drilled that received flaring permits because the well did not produce enough gas to afford a pipeline connection indicates that the RRC is sheltering

[8] This is spurring a burgeoning industry of crypto-mining and data center operations that aim to reduce flaring by using casinghead gas to power computers.

poor investments in low producing wells by exempting operators from Rule 32's ban on flaring. The RRC appears to prefer this tactic to requiring operators who have drilled unprofitable wells to plug their wells.

Unfortunately, the true number of facilities not attached to pipelines is uncertain. The random sample of flaring explanations indicated that some operators have been approved to flare due to not having pipeline access that did not mark that they were not attached to a pipeline on the form. Gauging the true scope of this behavior is nearly impossible due to the limitations in sampling explanations for flaring permits.

Flare Stacks:

As noted above, Rule 32 permit applications allow operators to lump multiple flare stacks together under one permit. Rule 32 requires that this only be used by operators that own multiple facilities that are attached to the same gathering line. If a gatherer upset occurs, the operator can then request one permit for all of the affected facilities simultaneously. While logical in terms of implementation, this practice can confuse trends about flaring. RRC publicizes how few permits are approved each year relative to the number of active wells in the state, but this information is presented using permits rather than flare stacks. There are about 35% more permitted flare stacks than there are permits from May 2021 to present.

This is one of the few data categories for which a rejected permit exceeds the most extreme approved permit. The highest number of flares submitted on one application was 63, and that permit was rejected. The second highest number of flares submitted on one application is 58, which was approved. However, those 58 stacks were permitted for more than 20 times more volume than the 63 stack permit, so it seems unlikely that the additional 5 stacks on the rejected permit were what caused it to be denied. Further, only five other rejected permits applied for more than one flare stack and they were all less than ten flare stacks. Thus, it is unlikely that stack number is a determining factor in permit rejections.

Location:

Operators are asked to include in their application the coordinates of each flare stack for which they are applying for a permit. Potentially, the RRC may make permitting decisions based on proximity to residences or others that may view the flaring as a nuisance. However, the RRC approved permits for 564 flare stacks that left the location of the facility blank. Given that high number, it does not appear that the RRC is rigorously evaluating location data in making permitting decisions.

While location information does not appear to guide the RRC's permitting decisions, the distribution of flare stacks across the state is notable. Texas has three major onshore oil fields: the Barnett shale, the Permian basin, and the Eagle Ford shale. The Permian Basin is one of the largest oilfields in the world and is where the bulk of production in Texas occurs. Based on production data from the RRC for October 2024 ("Texas Oil and Gas Production Statistics for October 2024" 2025), the Permian Basin which includes Districts 8, 8A, and 7C produced a total of 104,083,889 barrels of oil in one month. During the same month, the Eagle Ford shale which includes Districts 1-6 produced 28,273,734 barrels of oil. The Barnett shale which includes Districts 5, 7B and 9 produced 1,708,176. For both rejected and approved permits, the overwhelming majority were located in the Permian Basin with a few on the Eagle Ford and the Barnett Shales.

Oil production is a crude approximation of flaring, especially for the Barnett Shale which has significant gas production that is obscured by using oil production data, but it is preferable to measurements of gas production because wells that primarily produce gas are significantly less likely to flare, so flaring is likely to scale more consistently with oil production than with gas production. Unexpectedly, permitted flaring is significantly out of proportion with production. The Barnett Shale has received permits for 111 flare stacks. The Eagle Ford Shale has received permits for 2,414 flare stacks. The Permian has received permits for 14,396 flare stacks. Despite only producing about 200% more oil than the Eagleford shale, the Permian Basin has permits for about 500% more flares. Similarly, if flaring scaled linearly with increased production then using Barnett Shale flaring as a basis the expected Permian flaring would be just under 7,000 flare stacks, less than half of what actual observed flaring is.

There are a variety of potential reasons for this variance. As a primarily gas play, the Barnett Shale has more takeaway capacity per well than the Permian does. That takeaway capacity likely decreases the frequency of high line pressure issues. Further, with that takeaway capacity, the prices of natural gas are generally higher in the Barnett Shale and Eagle Ford Shale than in the Permian Basin. While there are too many variables that may cause flaring for a strong argument to be made about exactly why there seems to be much more flaring in the Permian Basin than in other fields in Texas, this data indicates that flaring in the Permian is at least potentially avoidable with some combination of increased takeaway capacity and tighter regulation. This also seems to rebuff the broader industry narrative that flaring is an unavoidable aspect of the production process. While this may be the case under narrow circumstances, it seems that significantly more flaring is occurring than is truly unavoidable.

Application completeness:

Beyond the omission of location data noted above, operators also routinely failed to include other data requested by the RRC. 198 permits were approved without including the name of the facility being permitted in the site name field on the Rule 32 form. The permit application form also asks that operators list the cumulative length of their flaring permit. For new permits this value equals the length of that permit, but for renewals or amendments to existing permits this value tells the RRC how long the facility has been continuously permitted to flare. 256 permits were approved despite leaving this field blank. Six of those permits were for renewals or amendments. For renewals, operators are also expected to include the prior exception permit number. 1,310 approved renewals out of a total of 1,465 renewals left that section of the permit form blank. This data implies that the RRC is not evaluating permits in the context of the operator's prior permits.

That omitting major aspects of the flaring permit is not sufficient for a permit to be rejected is surprising. Given that missing the filing deadline or failing to request a hearing where needed are apparently the only ways for a permit to be rejected, it would make sense that submitting incomplete documents would similarly lead to a rejection. However, it seems that the RRC would rather receive and approve incomplete permit applications than potentially receive information in a permit that would legally obligate it to reject the permit.

Discussion:

The RRC only rejecting permits for clerical issues with the permit application itself is concerning. Since overhauling the Rule 32 system to allow the RRC "to collect the information it needs to better determine who is following the rules when it comes to flaring and who is not" per Commissioner Christian (Dubee 2020b), the RRC has approved scores of permits that have omitted required information from the application. Operators have failed to disclose the reason for the flaring, the name of the facility, the location of the facility and even their production of deadly toxins.

Despite public posturing about "insufficient explanations," the RRC has not determined any explanation to be insufficient. Explanations from operators range from reasonable need to flare due to temporary mechanical problems to completely incoherent sentence fragments, if an explanation was submitted at all. Even explanations that explicitly fall into what the RRC considers to be insufficient such as purely economic justifications or citing only concern about mineral leases are routinely approved.

Despite two Commissioners publicly advocating for ending routine flaring, nearly 300 permanent flaring permits have been granted during the last three years, several of which were for major processing facilities. The largest of these production facilities under a permanent flaring permit is permitted to, each day, release enough gas to fuel 35 homes for a year. 1,866 permits are cumulatively in excess of two months. While some upset conditions do occur that last days or weeks, the more than 400 permits (excluding permanent permits) approved for over a year of flaring are difficult to justify as anything other than routine flaring. Coupled with this problem, the random sample indicated that permits are routinely granted prophylactically to allow flaring should upset conditions occur. Even if routine flaring is not the intent of such permits, these long-term permits put the onus on operators to decide when flaring ought to be allowed, in effect shifting the responsibility for determining what flaring is routine from the RRC to operators.

The justifications given by the RRC for rejections are also elucidating of the actual effect that such controls have on flaring. By definition, the permits requesting backdated permits have already been flaring, so the approval or rejection of the permit is purely a compliance issue. Further, every permit that was rejected for something other than backdating was invited to resubmit the application. In practice, this means that RRC rejecting a flaring permit does not appear to have stopped any operator from flaring since 2021. More broadly, this means that the RRC's implementation of Rule 32 does not appear to have had any control over flaring across the state.

Given how many permits have been approved despite including incomplete or incoherent information, it appears that the RRC's standard practice in implementing flaring regulation is to approve every permit unless the permit either misses the filing deadline or fails to request a hearing when needed. Both of these are objective criteria, so the effect of this practice is that the RRC has not exercised its discretion in evaluating permits to ever reject a permit. Further, both of these criteria appear to only be sporadically enforced, with hundreds of permits approved long after filing deadlines or out of compliance with hearing or administrative approval rules. It appears that unless the information provided to the RRC for a flare is overtly illegal, the RRC will take no action to interfere with operator flaring, preferring even to receive permits with no information at all.

This problem is not just a theoretical exercise in regulatory implementation; it has led to Texas permitting oil and gas operators to light on fire and release into the atmosphere enough gas to fuel 12% of Texas's annual gas consumption. Using the EPA's Greenhouse Gas conversion equivalencies and assuming 100% combustion efficiency (which is an overestimate that will lead to this calculation yielding a lower than actual value) ("Greenhouse Gas Equivalencies Calculator - Calculations and References" 2015), Texas has permitted the release of about 36,000,000 metric tons of CO_2 directly into the atmosphere without verifying its necessity. This is about 2% of overall U.S. CO_2 emissions from the energy sector released before any oil or gas is burned for useful purposes ("Frequently Asked Questions (FAQs)" 2023).

Evaluation of Regulatory Capture:

While this data appears to indicate a categorical failure of flaring regulations in Texas, it is still useful to deploy Carpenter and Moss's framework for identifying a captured regulator to evaluate the RRC. Under that framework three propositions must be verified to identify regulatory capture:

1. "Provide a defeasible model of the public interest.
2. Show a policy shift away from the public interest and toward industry (special) interest.
3. Show action and intent by the industry (special interest) in pursuit of this policy shift sufficiently effective to have plausibly caused an appreciable part of the shift." (Carpenter and Moss 2013, 14)

Beyond acting as a diagnostic criteria, Carpenter and Moss argue that the mode and degree of capture as ascertained by their schema ought to guide policy considerations which will inform the recommendations made in this paper.

The first proposition was evaluated through the literature review. Public opinion polling indicates support for regulation of routine flaring among Texas voters, Commissioners have publicly claimed that they want to both end routine flaring and lower overall flaring rates and major industry operators have made public commitments to reduce flaring. While evaluating the public interest in a policy space where economic considerations are potentially at odds with climatic considerations is difficult, it is clear that, at the minimum, public opinion and very likely the public interest are aligned against widespread flaring.

The brunt of the data collected for this paper is useful for evaluating the second claim. If the public interest is in reduced flaring with a particular emphasis on ending routine flaring, then it is clear that a policy shift away from the public interest has occurred. Permits for what appears to be routine flaring are nearly universally approved. Permits are approved for large amounts of emissions, even as explanations for why that flaring is necessary are incoherent or omitted entirely from applications. Perhaps the strongest evidence of this shift is the RRC's repeated approval of long-term high volume prophylactic permits which allow operators to decide when they wish to flare. In doing so, the RRC allows operators to flare at will with the only limit on routine flaring being the operator's desire to do so. In effect, the RRC is ceding regulatory control of routine flaring, a policy area with significant public interest in strong control, to the industry responsible for the harm the public's interest is in ameliorating.

While the formal ceding of routine flaring control to operators is the most obvious example of the RRC turning towards special interests, that the RRC has never stopped a flaring incident statewide since the 2021 regulatory overhaul is likely demonstrative that the RRC is also informally ceding control of flaring in general to the industry. Rather than exerting its discretionary power to control flaring by rejecting permits, the RRC approves virtually every permit, allowing operators to unilaterally control when flaring occurs, again ceding regulatory control to the regulated industry.

That the RRC is assumed by operators to approve every permit is evident in several aspects of the process. Backdating practices mean that operators frequently flare, expecting that when they eventually apply for a permit, often weeks later, the RRC will not reject it. If operators genuinely risked not having their permits approved, then operators would likely be much less willing to submit backdated applications that (if rejected) could be used as evidence of unpermitted flaring in enforcement proceedings. Similarly, operators like Endeavor submitting easily disproved false information about hydrogen sulfide then being approved indicates both that at least some operators are confident that their permits will not be rigorously evaluated and that those operators are correct to assume the RRC will not rigorously evaluate their application. Further, the over five hundred permits approved for wells without pipelines, many of which were for new wells, indicate that operators are drilling wells assuming that applications to flare will be approved. Based on the random sample, many of these wells without pipeline connections are low-producing wells that do not produce enough oil to afford to install a pipeline connection, yet many of these are new wells or newly acquired wells. It appears that operators are so confident that their flaring permits will be approved, even for the routine flaring that is necessary without a pipeline, that they are willing to invest money into these low-producing wells. The RRC has also frequently approved extensions to flaring permits where the operator has drilled new wells at the site, demonstrably exacerbating the need for flaring, another practice that would not be conducted if operators believed the RRC may reject their permit. In effect, the RRC appears to be using its power to exempt operators from the flaring ban outlined in Rule 32 to protect poor investments from operators that would be unprofitable without flaring permits. It is clear both that the public interest is being contravened and that it is being contravened in large part by the RRC ceding flaring control to the industry it is supposed to be regulating, verifying Carpenter and Moss's second proposition.

The third proposition is the most difficult to prove, a problem that Carpenter and Moss note is frequently true. Per the authors, neither motive that an industry would want to manipulate regulatory implementation nor functionalist evidence that the industry benefits from the current implementation of a regulation are sufficient to demonstrate regulatory capture. Further complicating this issue in the context of flaring regulation, many of the most influential leaders in the oil and gas industry have publicly condemned routine flaring and have made commitments to end the practice in their operations. However some operators, like BP p.l.c, that have publicly committed to ending routine flaring have applied for flaring permits with durations of over a year seemingly designed to enable routine flaring. With public declarations that are inconsistent with actions taken by operators it is particularly difficult to demonstrate intent by the regulated entity to enact change. In principle, operators may be publicly advocating for reducing flaring while simultaneously privately lobbying for weaker flaring regulations. Such behavior would be difficult to prove, but it would be consistent with the broader industry narrative that improvements in flaring have and will primarily arise from industry-led initiatives rather than stricter regulatory enforcement. Further, even as operators publicly condemn flaring practices, deregulation of flaring grants them more operational freedom. While flaring due to mechanical upsets may be inevitable regardless of deregulation, easier permitting enables operators to drill wells that would otherwise be unprofitable, as well as flare gas when the gas market is negative to avoid incurring losses.

One of the central advantages the RRC's organizational structure confers in evaluating the third plank of Carpenter and Moss's schema is that its leadership is elected. As noted above, contributions to incumbent Commissioners are significantly higher than in comparable statewide elections. This money gives a mechanism for operators to leverage potential future contributions on desired actions taken by Commissioners. However, without being privy to communications between the Commissioners and their donors, it is difficult to evaluate the effect of those contributions, especially because they are not differentiated by issue area. In principle, operators may be donating money specifically to galvanize favorable flaring policies, but it is more likely that the money aims to galvanize a generally favorable RRC across issue areas. Still, major campaign donations could certainly meet Carpenter and Moss's criteria that such influence be "sufficiently effective to have plausibly caused an appreciable part of the shift" (Carpenter and Moss 2013, 15).

Demonstrating that the shift in flaring policy is the result of action specifically with intent to reduce flaring regulation is the most difficult aspect of fulfilling Carpenter and Moss's paradigm. It is clear that policies have appreciably shifted away from the public interest and that industry interests are exerting influence on the Commission's behavior. It is less clear that in this specific issue area reduced flaring regulation is an issue area that the industry has intentionally exerted influence. This ambiguity is unlikely to be resolved, because if such evidence that such influence is intentional exists it is almost certainly through unofficial channels.

Industry motive to induce deregulation of flaring is clear. The functionalist argument that operators are demonstrably benefitting from the diminished oversight is also clear, but neither of these arguments are sufficient under Carpenter and Moss's paradigm to fulfill the final proposition of their argument to reduce regulatory capture. However, alongside the motivation and functionalist arguments, campaign contributions serve as a demonstrable mechanism by which the industry can and has leveraged influence on RRC policy. Further, Willyard's work serves as a comprehensive evaluation of evidence that the oil and gas industry has exerted significant force to shape flaring regulations in Texas for over 100 years (Willyard 2019). She cites a variety of mechanisms including campaign contributions, lobbying to the Texas legislature, and cultural pressure. Most importantly, she provides significant evidence that the 21st century has been a paradigm shift as the RRC and industry have cultivated an increasingly cooperative relationship. Most relevant to evaluating the current state of regulatory capture at the RRC, she provides an extensive evaluation of the Eagle Ford Shale Task force which was tasked in 2011 with developing mechanisms to reduce flaring. In keeping with this increased emphasis on cooperation between the RRC and industry, the RRC staffed the taskforce with both RRC staff and industry representatives. When the taskforce reported on their findings in 2013, they argued paradoxically that the most effective way to reduce flaring was to decrease strictures on flaring and increase the speed at which permits were granted. These findings were endorsed by the commission. In the context of motivation, functional benefit, levers for influence, a prior history of influence, and demonstrable substantial influence on policy in the past decade, it seems clear that Carpenter and Moss's final proposition is fulfilled.

Having demonstrated that the RRC fulfills all three propositions of Carpenter and Moss's formula for identifying regulatory capture, I argue that the RRC is a captured regulator. As noted above, among captured regulators, capture can either be corrosive or traditional, and can either be weak or strong.

To the extent that this paper documents regulatory capture, it is clear that such capture is corrosive capture. Rents are significantly lower than is in the public interest, lowering the barrier of entry into the industry while also lowering costs for operators. Making approval of flaring permits a near certainty lowers the production necessary for wells to be profitable while also decreasing administrative costs to operators that would otherwise have to deal with enforcement actions for unpermitted flaring.

Whether the capture is strong or weak is more ambiguous. To be considered strong capture, the public interest must be so thoroughly subverted that the public interest would be better served by no regulation at all or by a comprehensive replacement of the agency and policy being evaluated. Since 2021, the RRC has only rejected 53 flaring permits and none of the 53 rejections actually stopped the flaring that was occurring. Given the demonstrable public interest in both reducing flaring generally and limiting routine flaring, it seems that the public interest is not being served by the Rule 32 permitting process at all. Further, even with the apparently cursory examination of each permit application, this program incurs administrative costs for the RRC that would potentially be utilized more effectively by other programs. The program also incurs political costs in that it misleads the public into believing that flaring is being effectively regulated, placating the political appetite for policies to control flaring without actualizing policy change. Further, such systematic ineffectiveness that has been entrenched in the agency for more than a decade makes a strong case that the public interest, at least in this policy area, may benefit from a comprehensive replacement of the RRC.

However, the creation of the dataset that this paper analyzed is itself arguably a public good which may indicate that the RRC is only weakly captured. While there is significant interest from NGOs in satellite analysis of flaring and venting, such analysis is unable to elucidate the causes of release or some physical details of the emissions release such as hydrogen sulfide concentration or cumulative flaring volume. The application process collects this data into one database, even if the database is poorly designed for analysis and requires external code. Such a dataset could potentially be used to inform updates to flaring policy at the federal level. Unfortunately, it is unclear if this data is actually being used to inform any policy decisions regardless of the Commissioners' statements claiming that it does.

The application process has also likely constrained the duration and volume of some permits. Many approved permits are for just under the threshold to require a hearing for approval, indicating that even if operators do not expect permits to be rejected, the administrative (or potentially public perception) burden of submitting to a public hearing is an effective check on permit durations and volumes (Figure H). This effect is most pronounced for permanent permits which are by definition longer than 90 days and therefore Commissioner hearing requirements are controlled solely by permit volume. To the extent that this behavior leads to a check on industry flaring practices, the policy may be actualizing a benefit towards the public interest. However, outside of permanent permits this effect appears to be minor (Figure I), and operators routinely submit to public hearings (N=451). The degree to which this behavior actually constrains flaring is also unclear. It is possible, and likely, that operators apply for the largest and longest permits they can easily acquire to create a buffer between expected flaring and permitted flaring. If this is the case, then lowering the threshold to submit to a hearing may lower permitted volumes and lengths, but not impact actual volumes and lengths.

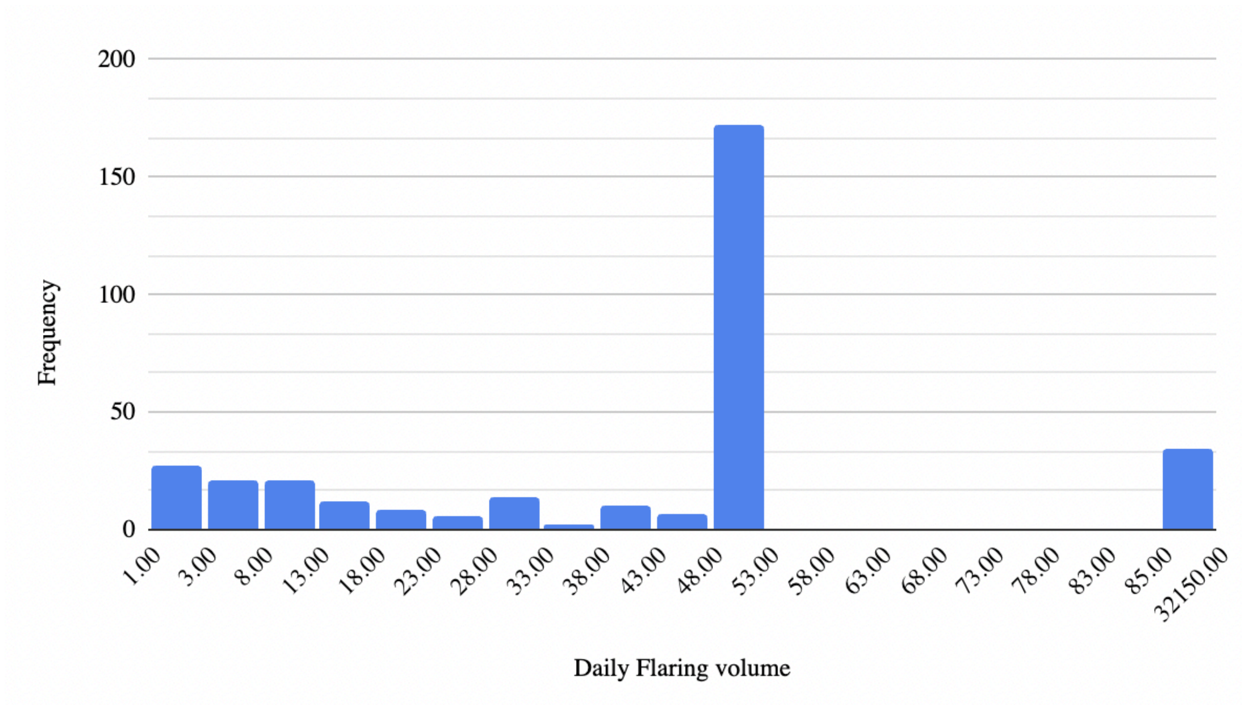

Figure H: This histogram depicts the frequency of different daily flaring volumes for permanent flaring permits with an outlier percentile of 10%[9]*. This frequency distribution shows significant clustering of permits just below the 50 mcf threshold to require a Commissioner Hearing.*

[9] Selected to scale histogram for maximum visibility at 50 mcf.

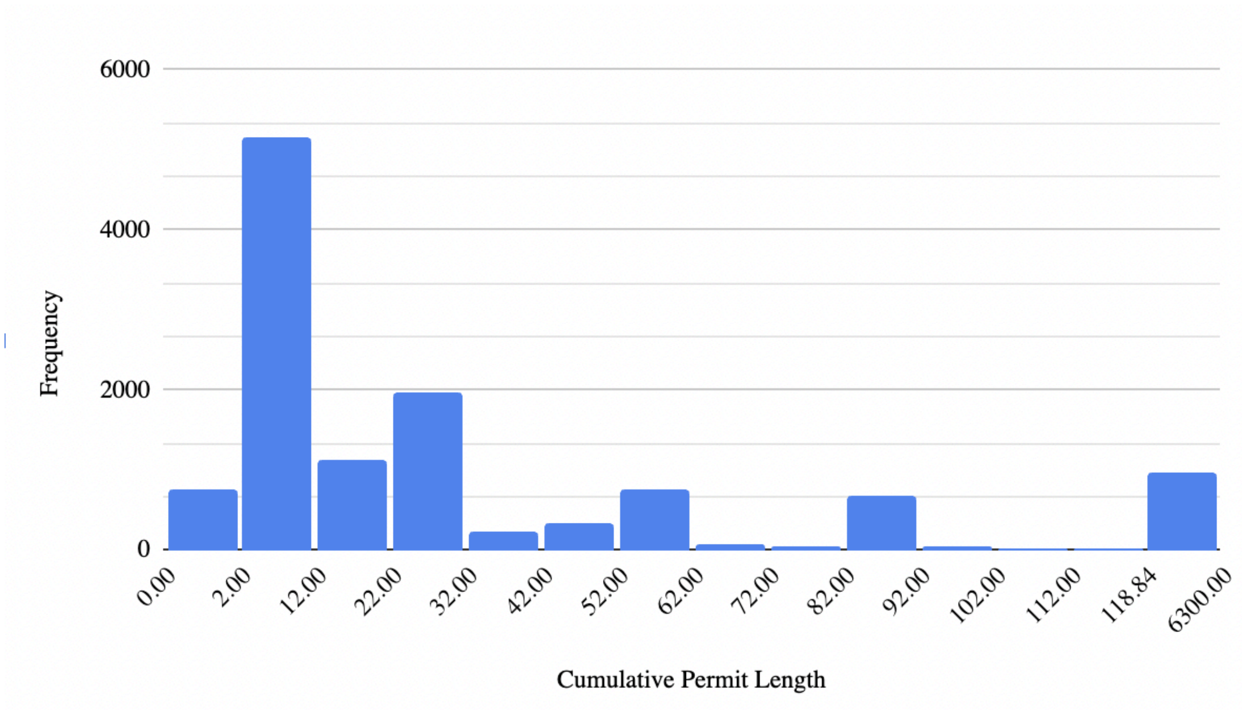

Figure I: This histogram depicts the frequency of different cumulative permit lengths for all approved flaring permits with an outlier percentile of 8%.[10] *This frequency distribution shows clustering at the 90 day permit length, the maximum length at which a permit can be approved administratively if it is over 50 mcf. While still present this clustering effect is significantly less intense than for permanent flaring volumes.*

While creation of useful public data and administrative hurdles to long-term or high volume flaring may actualize some public interest, neither of these benefits are the result of the RRC's processes for approving permits. The public data is collected before a decision on the permit is made and public hearings are explicitly required by Rule 32 itself. Neither benefit is reaped by active implementation by the RRC and every aspect of the implementation process where the RRC makes active choices, the RRC has subverted the public interest. Weighing these minor public benefits against the negative results of the administrative cost to the RRC of the

[10] Selected to scale histogram for maximum visibility at 90 days.

program and the placating of political environmental concerns is difficult. However, the systematic unwillingness of the RRC to take meaningful action to limit flaring despite public desire to do so indicates that the public interest would be better fulfilled by "comprehensive replacement of the policy and agency in question" (Carpenter and Moss 2013, 11) which is demonstrative of strong regulatory capture.

Using the framework laid out by Carpenter and Moss, the RRC appears to be a strongly corrosively captured regulator. Pushback against this argument would likely emphasize that the Railroad Commissioners are elected officials which by definition ensures that they are coupled to public interest, or at least as coupled as the legislature. Most regulatory capture theory presumes that the regulated agency reports to an elected legislature. Through these intermediaries the agency can become decoupled from public interest, leading to capture. While the RRC does also report to the legislature,[11] the Commissioner election could arguably ensure stronger coupling between the RRC and the electorate by ensuring that Commissioners who subvert the public are not reelected. Within this argumentative framework, the significant number of long-term-high-volume flaring permits approved by the Commissioners directly through a public hearing would be evidence that the electorate desires or is at least indifferent to lax regulation of flaring. If this were the case, the infrequency of permit rejections by the administrative arm of the RRC would be evidence of strong coupling between public interest and the regulator.

This argument is legitimate from an agential perspective in noting that the RRC's unique structure functionally creates a three tiered system between the administrative staff of the RRC, the elected Commissioners and the Texas State legislature with opportunities for direct public input for both the Commissioners and the legislature. However, it is a poor evaluation of public

[11] In fact, the father of Commissioner Christi Craddick, Rep. Tom Craddick is on the Texas Energy Resources committee which oversees the RRC.

interest in the context of flaring. Here, Laffont and Tirole's arguments about an agent theoretic model for understanding regulatory capture are useful. They argue that the primary role that a regulator has in the regulatory apparatus is as a mediator between the legislature and the firms being regulated. The regulator is specialized and can dedicate time, resources and expertise to gathering information about the regulated industry. The legislature is generalized and does not have the capacity to do this. The regulator when reporting on regulation enforcement can withhold information from the legislature and by extension the public. This asymmetry makes capture possible. The Commissioners occupy a unique position within this framework in that they are elected like the legislature, but benefit from the same information asymmetry that arises from regulatory specialization. This position allows them to mediate industry information not just to the legislature but directly to the electorate during elections. In effect, this allows Laffont and Tirole's model to be actualized regardless of the behavior of the legislature.

This asymmetry is critically important to evaluating the regulatory capture at the RRC because it provides a mechanism to explain the seemingly wide gap between public statements by the RRC and the Commissioners and actions of the RRC on permitting flares. With that gap resolved, the objections to characterizing the commission as captured because of the election of the Commissioners can be refuted. The Commissioners are likely cognizant that the public interest is in limiting flaring, but due to the capture dynamics outlined above are attempting to deregulate flaring. The counter argument to capture at the RRC would argue that the RRC's actions are electorally sanctioned and therefore coupled to the public interest. However, like in Laffont and Tirole's model, the Commissioners are able to utilize information asymmetry to obscure how they actualize regulation. The Commissioners are able to reap the political benefits of publicly advocating for an end to routine flaring, even garnering praise from environmental activists (Pabst 2021). However, because the actual data for Rule 32 permits is so difficult to access, these commitments are never meaningfully validated. Alongside reaping the political benefits of public posturing consistent with the public interest, the Commissioners can also use these statements both in formal and informal settings to influence the legislature. In doing so, the Commissioner's posturing takes on the twofold purpose of garnering political favor while also fulfilling Laffont and Tirole's framing of the regulator as an information mediator to the Texas legislature.

Perhaps the most potent example of this phenomenon occurred in 2021 when two Commissioners publicly declared that they wished to end routine flaring, garnering positive media coverage. Despite that proclamation, flaring increased in 2022, 2023, and as of data collection for this paper is also on track to be greater in 2024 than it was in 2021. Information asymmetry allows the Commissioners to accrue political benefit from public proclamations consistent with the public interest while privately subverting those interests. The RRC is apparently cognizant that the political boon its Commissioners enjoy relies on this asymmetry. The RRC hosts a frequently asked questions page about flaring on their website. One of the questions the page answers is how many flaring exceptions are granted each year by the RRC. As of publication of this paper in 2025, the page does not include the numbers for 2023 or 2024, seemingly because these numbers would affirm that flaring has actually increased since the 2021 overhaul ("Flaring Regulation FAQs," n.d.).

In utilizing this information asymmetry, the RRC is able to decouple its regulatory implementation without facing significant political consequences. This framework allows the strongly corrosive regulatory capture outlined above to occur even as Commissioners are engaging in electoral politics.

Policy Recommendations:

The aim of these policy recommendations is to bring Texas flaring policy into accordance with the public interest which in this case appears to be curtailing flaring generally and halting routine flaring. The current Rule 32 permitting framework largely relies on the good faith implementation of Rule 32 by the RRC. It is evident from this analysis that where given discretion, the RRC is strongly inclined to displace responsibility for curtailing flaring to operators. Unfortunately, Rule 32's structure grants significant discretion in implementation to the RRC. Constructing a flaring system that does not rely on the regulatory agency to make permitting decisions would require a novel system seen in no other oil and gas producing state and is unlikely to be political viable, so the recommendations in this section will primarily focus on policy amendments to limit the RRC's discretion in approving permits and ancillary policies to decrease operator requests to flare. The working assumption of this section is that unless the requested flaring is overtly illegal under Rule 32 the RRC will always approve requested permits. It is likely that these steps to reduce flaring may lead to reductions in oil production, but the aim of these recommendations is to align flaring policy with the public interest, determining the exact scope of impacts on production is beyond the scope of this work.

Restoring Rule 32:

As Willyard notes, Rule 32 has been weakened through numerous amendments since its passage in 1978. The original text of Rule 32 did not include the provision listing "unavailability of a pipeline or other marketing facility, or other legal uses" in its examples of legitimate explanations justifying a permit (Willyard 2019). This language was added in 1990. With over 500 flaring permits being granted to facilities that do not have access to pipelines, and likely others that are not connected to pipelines but failed to report it on the application, this amendment has led to significant flaring. Further, as the public has become increasingly interested in curtailing routine flaring, targeting facilities that in most cases must flare the entirety of their gas production for their lifetime is an obvious choice. The assurance that this language grants operators that the RRC is unlikely to reject their flaring permits for these often low producing marginal wells emboldens operators to make riskier investments in wells. The random sample of explanations indicated that at least some operators drill new wells and then gauge well output before making a decision to attach a pipeline, relying on a flaring permit should the operator decide that a pipeline connection is uneconomical to install. In effect, this provision has forced the public to shoulder the risk that these operators incur by drilling these low producing wells. What prior to 1990 would have been unprofitable wells that would either never be drilled at all or would be plugged after the low production was clear are now operating functionally subsidized by the RRC. The 1990 Rule 32 amendments also create confusion with how the RRC defines “economic” explanation for flaring. While the RRC has publicly stated that it will not accept Rule 32 permit applications that only cite economic explanations for flaring, unavailability of a pipeline is codified as an example of an acceptable justification in Rule 32. While pipeline availability is not explicitly an economics problem, nearly every well without a pipeline for gathering gas in the random sample stated that a pipeline was not in place due to economic considerations. Amending Rule 32 to return to the language from prior to 1990 would both clarify confusion about economic explanations for flaring and would likely be a significant step in limiting routine flaring if not flaring overall.

Since its implementation, Rule 32 has also been amended to ease the burden of permitting requests on the Commissioners by shrinking circumstances where a Commissioner hearing is required, shifting burden to administrative staff. When Rule 32 was passed, permits could only be granted administratively up to 90 days with longer permits requiring direct approval from the Commissioners. The original text created a de minimis exception allowing permits to be approved administratively indefinitely so long as the permit was for no more than 5 mcf per day. That number has been increased multiple times and is now 50 mcf (Willyard 2019). While permits are likely to be approved even if they go before the Commissioners, these amendments have allowed 266 permanent flaring permits to be approved administratively that would have required Commissioner approval under the original text of Rule 32. The Commissioners have only had to evaluate 34 permanent exceptions since 2021. Increasing that number by nearly eight fold and putting significantly more permanent permits on the monthly public docket which is frequently covered in the media and by political operatives may aid in resolving some of the information asymmetry between the Commissioners and the public, strengthening coupling between the two and likely leading to more rejected permits. While returning this portion of Rule 32 to its original language would certainly increase the burden on the Commissioners, its benefits likely outweigh the consequences of such burden, particularly if this proposal is accompanied by others that aim to reduce flaring permit applications in general.

Other changes to Rule 32 have been informal, per Willyard, enforcement of Rule 32 was much harsher from 1978 to the early 1990s (Willyard 2019). During that period unpermitted flaring was often punished by severance. Severance is the most harsh penalty the RRC can levy on a well and involves the well being literally severed from its gathering line, cutting off its access to market and effectively forcing it to cease production. Per Willyard, the RRC has largely stopped severing wells for flaring noncompliance. Instead, the RRC relies on financial penalties. However, the penalty is limited to no more than $10,000 per day regardless of the size of the release. Further, per Willyard, the RRC virtually never actually issues these fines. Instead, its primary enforcement tactic is to threaten to levy a fine unless an operator applies for a permit. Since permits are virtually always approved this tactic allows operators to avoid consequences for unpermitted flaring entirely. While enforcement proceedings rely on the RRC discretion that this paper is highly skeptical of, increasing the limit on fines or potentially mandating severance for repeat offending unpermitted flares could potentially reduce flaring via a chilling effect even if the RRC implements those rules only rarely .

The cumulative effect of these historical changes on Rule 32 has been a significant expansion of flaring practices that are legitimized by Rule 32. These practices have normalized routine flaring. In amending Rule 32 to restore its original requirements, these practices would be more difficult. While RRC discretion could allow similar flaring in the future, such changes would both increase administrative costs for permanent flares and soften the assurance to operators that encourages the drilling of low production marginal wells. This chilling effect is particularly important for the marginal well issue. Even if the RRC continues to approve most permits for wells that do not have pipeline connections through other permitting justifications, the diminished assurance would still be likely to deter risky investments by operators.

Amending the W1 requirements:

Every well in Texas is required to apply for a drilling permit with the RRC called a W1 to operate. The application collects information about a variety of different regulatory compliance requirements for the well. Permits are approved administratively and the Texas legislature requires that such applications are processed in no more than three days. The RRC advertises on its website that it averages a processing time of two days (Dubee 2020a). Analyzing the rigor with which W1 applications are evaluated falls beyond the scope of this project but it is noteworthy that the W1 form does not require operators to demonstrate gathering capacity. While the contribution of wells not attached to gathering lines to flaring has already been noted, it is also worth noting that high gathering line pressure is one of the most common flaring explanations found in the random sample. Even operators that do have pipeline connections frequently experience capacity issues leading to high line pressure and flaring. Such issues can and should be resolved by increasing gathering capacity at wellheads, but doing so goes beyond the scope of Rule 32. Instead, as part of the W1 process operators should be required to affirm that they have contracted sufficient gathering capacity for their new facility. Doing this would limit the possibility of routine flaring from new marginal wells. It would also limit flaring in general by decreasing the frequency of high line pressure events. This proposal would allow flaring to be curtailed not by increasing the rejection rate of permits but by decreasing the number of flaring permit applications generally. While not a certainty, hinging approval of W1s on demonstrating gathering capacity would be likely to significantly decrease flaring even if the RRC's implementation of such a requirement would be dubious.

Pushback against such a proposal would likely focus primarily on the Permian Basin. As noted above, the Permian Basin receives significantly more flaring permits per barrel of oil than any other oil field in the state. These elevated flaring rates are likely the result of a variety of factors, but one of the largest is that the Permian Basin has significant takeaway capacity constraints. Arising in large part from the rapid build out of production equipment during the fracking boom, the Permian Basin does not have enough major pipelines to move all of its gas production to market, causing the occasional negative prices noted above. Requiring that operators demonstrate gathering capacity to receive a drilling permit would likely have two countervailing effects on the Permian Basin. First, build out of gathering equipment would likely be accelerated as demand for takeaway capacity is increased, potentially resolving the negative gas prices that currently plague the Permian Basin. Second, oil production from the basin would likely be depressed, at least in the short term, as marginal wells that cannot afford to install pipeline connections are no longer drilled. It is difficult to gauge the scope of this depression because the wells that are most likely to be impacted by this proposal are marginal wells that produce small quantities of oil. Marginal wells only produce about 7% of United States oil ("Marginal Conventional Wells" 2024), and the threshold for being a deemed a marginal well (15 bbl per day) is high enough that even some marginal wells would likely be able to afford takeaway capacity, particularly in areas with tighter well clusters where connection lengths required to access a gathering pipeline are shorter. Some marginal wells are older wells that have seen declines in production and may no longer be able to afford a pipeline contract that was once in place; this new requirement would not impact these wells as they have already received W1s.

While this proposal may seem extreme it does have precedent in the United States. Largely as a response to flaring in the Bakken Shale, which at the time was flaring upwards of 26% of its gas production, North Dakota implemented a similar requirement ("United States: North Dakota" 2023). In 2014, North Dakota implemented Order 24665. This order requires:

> "upstream operators to submit a gas capture plan with every drilling permit application to the NDIC. Gas capture plans must include information on area gathering system connections and processing plants, the rate and duration of planned flowback, current system capacity, and a timeline for connecting the well. They must also include a signed affidavit verifying that the plan has been shared with area midstream companies" ("United States: North Dakota" 2023).

Notably, in requiring a timeline for connecting the well to a gatherer, the NDIC forced operators to commit to attach to a gathering line, even if there would be a delay before the gathering line was physically attached. Several flaring explanations in the random sample were from operators that noted that they had a contract in place for gathering but that crews to install new pipeline connections are in high demand and were not available for several weeks after the well was drilled. Using the NDIC requirements as a template, Texas could implement an analogous system that requires operators to demonstrate that they have contracted gathering capacity even if that gathering capacity is not immediately available, ensuring that operators like those noted here which are acting in good faith are not harmed by the proposal. Such a procedure would ensure that whatever flaring does occur in the state arises from mechanical necessity rather than economic considerations around takeaway capacity. Implementing this proposal in a similar manner to North Dakota is also unlikely to cause a significant administrative burden for operators and the RRC as it is functionally a small addendum to the W1 form which operators must file regardless.

Taxing Flared Gas:

The simplest way to decrease demand for flaring permits is to increase costs to operators for flaring. That increase in cost can take a variety of forms. In 2024, the federal government implemented a Waste Emissions Charge (WEC) for large facilities that sets a fee per metric ton of flared or vented gas. However, the program only applies to facilities bound by the EPA's Greenhouse Gas Reporting Program which are only about 8,000 of the largest emitting facilities in the country, and in March 2025, a joint congressional resolution disapproved the WEC ("Waste Emissions Charge" 2025). Still the WEC can be used as a model for a Pigouvian tax on flaring and venting. Determining an acceptable rate for such a tax falls beyond the scope of this paper but to the extent that flaring in the Permian Basin is at least partially driven by chronic negative prices, the tax should aim to generally be greater than the Permian's negative price. The average spot price of natural gas in 2024 was $2.10 per mmBtu (Iraola 2025). In August 2024, the Permian hit an all time low price of -$4.80 per mmBtu (Reuters 2024). While the WEC deals with larger facilities than most of the facilities applying for flaring permits when converted to a per mmBtu, it amounts to a tax of about $17.08 mmBtu. A general flaring tax in Texas could be set to $5.00 and ensure that flaring is virtually always more costly to the operator than bringing gas to market while still taxing at just a third of the WEC rate. While this would not stop flaring completely, it would ensure that it is always in the operator's best interest to curtail flaring where possible. Under the status quo, this is not the case when gas prices dip into the negative.

Pushback against such a proposal would rightly note that such an action would likely raise operating costs for operators. Further, the tax would lead to operators being taxed even for flaring that truly is unavoidable due to mechanical issues. These are legitimate critiques and resolving them would require modeling beyond the scope of this paper alongside a general policy discussion of the degree to which Texans are willing to depress production in order to control flaring. The answer to that question is likely very little, but any willingness to do so is an opportunity for an effective deployment of a Pigouvian tax even if such a tax ends up being far below the all-time low price in the Permian Basin.

Alternatively, Texas could pass legislation requiring that royalty owners receive their royalty even on flared gas. Currently, no such requirement exists for private mineral owners. However, Texas state law does require that operators operating on public state lands pay their gas royalty to the state even for flared gas. Extending this requirement to include private mineral owners is a logical way to increase the operator cost of flaring. It is also likely the most politically viable recommendation in this section as it frames flaring not as an environmental issue but as wastage of someone's property. However, state royalties and most private royalties are set as a percentage of the market value of the gas. The statutory minimum royalty is 12.5%, though some leases are higher (*NATURAL RESOURCES CODE*, n.d.). Given the low prices of gas in the Permian and the relatively low royalty rate, the royalty requirement on flared gas is significantly lower per mmBTU than the WEC or even the flaring tax proposed above. Requiring royalties be paid on flared gas may have a small impact on flaring, but such a policy is likely to be substantially less effective than other policies proposed in this paper.

Conclusion:

The data presented in this paper makes clear that the RRC has completely divested itself of responsibility for controlling natural gas flaring across the state. Despite public statements to the contrary, the permitting system clearly works as a rubber stamp. In aggregate, the volume of permitted release and the number of flare stacks across Texas are concerning and are non-negligible in evaluating the United States' overall climate contributions. Large quantities of greenhouse gasses are being emitted into the atmosphere at the same time that both regulators and industry representatives are voicing opposition to the practice.

To some degree, these conclusions are not shocking. The Texas government has been a leading voice in resisting federal efforts to control greenhouse gasses, so business practices that preserve industry interests to the detriment of the climate are routine. However, flaring is an issue that goes beyond climate concerns. The RRC is allowing vast quantities of natural gas, a commodity and state natural resource, to be burned to little benefit to Texas. Operators apparently do not even need to provide a justification for the burning and the RRC will approve the permit. Such behavior is obviously wasteful and flouts the mission statement of the RRC yet it is allowed to continue. Even worse, operators are actively taking advantage of this lax regulation, apparently using this knowledge to hedge their investments in wasteful marginal wells. Beyond concerns about waste, flaring is also a public health issue. Residents who live near flares suffer from a variety of health impacts, yet the RRC is approving permits that are near homes and businesses. Even worse, the RRC is also approving permits for facilities that do not submit a location. Wells are also routinely permitted to vent uncombusted hydrogen sulfide into the atmosphere despite hydrogen sulfide being one of the deadliest compounds in oil production. Those hydrogen sulfide releases add an additional valence of human health impact that the RRC is failing to control.

This paper uses permitting data and existing scholarship on regulatory capture theory to argue that the RRC is a strongly captured entity that is corroding regulation of flaring. Unfortunately, while this paper focuses specifically on flaring it is highly likely that parallel capture behavior occurs in other policy areas that the RRC also regulates. Without similar research into other policy spaces this paper will not make a claim about whether the agency more broadly can be salvaged from capture, but work from various NGOs has indicated that capture pervades every facet of the RRC (McDonald and Wilson 2022; Biven and Palacios 2022; Wheat and Palacios 2021). Without altogether disassembling the agency, alterations to the system must work within a captured regulatory environment limiting change and actively subverting existing regulation.

The scale of regulatory capture documented in this paper is particularly disheartening in the context of the RRC's historical record as an effective regulator. Even the rhetoric advocating for stronger flaring used by the RRC is demonstrative of this shift. In the 1980s, the RRC considered no flaring to be necessary and issued "no flare" orders for oil fields throughout the state, limiting production until flaring stopped (Willyard 2019). Now, the organization that in years passed would shut down wells for flaring without permits is focused on routine flaring.

Industry rhetoric about flaring as necessary has dragged the RRC so far from its history that its strongest regulatory proposals are still weaker than its standard practices in prior decades (Willyard 2019). Rule 32 bans flaring in Texas in nearly all circumstances. The RRC's administration of exceptions to Rule 32 has turned flaring into such a prolific issue that Commissioners can gain political capital by advocating for ending routine flaring, a practice that only exists because of their actions.

This paper aims to draw useful conclusions about the flaring permitting process, but it does not evaluate unpermitted flaring. Data from multiple sources has indicated that a significant portion of flaring in Texas, potentially the majority, is occurring unpermitted. Without deeper analysis of unpermitted flaring this research is primarily limited to regulatory implementation. Further research into unpermitted flaring, likely using satellite data, could illuminate the true volume of flaring happening across the state and therefore its climate impact. Without that data, every number in this paper is presumably an underestimate. Unpermitted flaring is a particularly interesting area of policy analysis because this data indicates that operators virtually never have their permits rejected, so operators opting to illegally flare is confusing. It could be the result of expected fines for such behavior being so low that some operators would rather risk a fine than pay the application fee for a permit, but until more data is collected that can only be conjectured.

The Rule 36 information collected in the targeted Endeavor sample is also noteworthy and may indicate a broader trend of operators misrepresenting their hydrogen sulfide production in flaring applications. Prior research has been conducted that shows that operators frequently fail to report hydrogen sulfide concentrations to the RRC even when required to do so (McDonald and Wilson 2022), but research has not been done on how widespread that practice is in flaring applications. Hydrogen sulfide is a particularly dangerous oilfield pollutant and the possibility that the RRC is allowing operators to flare or even worse vent it without realizing it is both interesting from a policy implementation perspective and an important public safety issue. Further research on this could use the code system written for this project slightly modified to query the Rule 36 database instead of the Rule 32 database.

Widespread flaring is a solvable problem, and it is clear that there is public appetite for solving it. Regardless of the outcomes of these areas for further research, the data presented here identifies concrete shortcomings of the RRC that can and should be remedied. Resolving them is a public health and environmental imperative.

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Appendix I:
For replication purposes, the full code used to deploy the automated web scraper utilized in collecting data for the systematic sample is included here. The code is fully commented (in green) and was run using VScode through a jupyter file.

```
import pandas as pd
from selenium import webdriver
from selenium.webdriver.common.by import By
from selenium.webdriver.common.keys import Keys
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import expected_conditions as EC
from selenium.common.exceptions import NoSuchElementException
import time
import openpyxl

#Load the Excel file
file_path = '/Users/jack_/Downloads/Flaring report data Mannual.xlsx'

#Read the Excel file
df = pd.read_excel(file_path, sheet_name='All permits')

#Extract the Filing Number
filing_numbers = df['Filing number'].dropna().values

#Convert to a list
filing_numbers_list = filing_numbers.tolist()
#Open Safari Driver
driver = webdriver.Safari()

#Define a conversion to ensure all coordinates are in decimal format
def dms_to_decimal(degrees, minutes, seconds):
  decimal = degrees + (minutes / 60) + (seconds / 3600)
  return round(decimal, 5)
#Ensure that if a value is not found the script continues to run
def get_element_text_safe(driver, by, value, default_value="N.A."):
  try:
     element = driver.find_element(by, value)
     return element.text
  except NoSuchElementException:
     return default_value

#Open Excel document for storing data
```

```
file_path = "/Users/jack_/Downloads/data_points.xlsx"
wb = openpyxl.load_workbook(file_path)
ws = wb["Permitting"]
ws2 = wb["Flaring"]

#Create a loop to iterate through filing numbers on the filing number list
try:
    #Set page load timeout
   driver.set_page_load_timeout(180)
   for Filing_Payload in (filing_numbers_list):
       #Open the website
       driver.get("https://webapps.rrc.state.tx.us/swr32/publicquery.xhtml")
       wait = WebDriverWait(driver, 120)

       #Find the search field and enter a filing number from the filing number list
       search_field = driver.find_element(By.ID, "pbqueryForm:filingNumber_input")
       search_field.send_keys(Filing_Payload)
       search_field.send_keys(Keys.RETURN)
       time.sleep(5)  #Allow initial loading time

       #Ensure the dropdown menu is interactable
       dropdown_menu = wait.until(
           EC.presence_of_element_located((By.ID, "pbqueryForm:pQueryTable:0:j_idt148"))
       )
       driver.execute_script("arguments[0].style.display = 'block';", dropdown_menu)
       driver.execute_script("arguments[0].click();", dropdown_menu)
       time.sleep(2)  #Allow time for the menu to appear

       #Click View Application
       view_application_button = wait.until(
           EC.presence_of_element_located((By.XPATH, "//span[text()='View Application']/ancestor::a"))
       )
       driver.execute_script("arguments[0].click();", view_application_button)

       #Wait for the final page to fully load by waiting until the site name field loads
       site_name_element = wait.until(
           EC.presence_of_element_located((By.ID, "pbviewForm:j_idt48"))
       )
       #Identify variables of interest for permit
       site_name = site_name_element.text
       operator = driver.find_element(By.ID, "pbviewForm:j_idt33").text
       exception_status = driver.find_element(By.ID, "pbviewForm:j_idt29").text
```

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    submitted_date = driver.find_element(By.ID, "pbviewForm:j_idt36").text
    filing_type = driver.find_element(By.ID, "pbviewForm:j_idt38").text
    cumulative_days = driver.find_element(By.ID, "pbviewForm:j_idt40").text
    filing_number = driver.find_element(By.ID, "pbviewForm:j_idt22").text
    exception_number = driver.find_element(By.ID, "pbviewForm:j_idt24").text
    prior_exception = driver.find_element(By.ID, "pbviewForm:j_idt31").text
    hearing_request = driver.find_element(By.ID, "pbviewForm:j_idt53").text
    full_partial_shutdown = driver.find_element(By.ID, "pbviewForm:j_idt56").text
    permanent_exception = driver.find_element(By.ID, "pbviewForm:j_idt58").text
    requested_effective_date_label = driver.find_element(By.ID, "pbviewForm:j_idt60")
    requested_effective_date = requested_effective_date_label.find_element(By.XPATH, "./following-sibling::span").text
    requested_expiration_date_label = driver.find_element(By.ID, "pbviewForm:j_idt62")
    requested_expiration_date = requested_expiration_date_label.find_element(By.XPATH, "./following-sibling::span").text
    number_of_days = driver.find_element(By.ID, "pbviewForm:j_idt65").text
    every_day_calendar = driver.find_element(By.ID, "pbviewForm:j_idt70").text
    days_per_month = driver.find_element(By.ID, "pbviewForm:j_idt72").text
    connected_to_system = driver.find_element(By.ID, "pbviewForm:j_idt75").text
    nearest_pipeline_distance = driver.find_element(By.ID, "pbviewForm:j_idt77").text
    other_meter = get_element_text_safe(driver, By.ID, "pbviewForm:pbactiveprop:0:j_idt112")
    exception_reasons_list = driver.find_elements(By.CSS_SELECTOR, "#pbviewForm\\:pbexcprsn_list li span")
    exception_reasons = ", ".join([reason.text for reason in exception_reasons_list])
    drilling_permit_list = driver.find_elements(By.CSS_SELECTOR, "#pbviewForm\\:pbactiveprop_list li .ui-outputlabel")
    drilling_permit_values = ", ".join([permit.text for permit in drilling_permit_list])
    total_flaring = driver.find_element(By.ID, "pbviewForm:pbactiveprop:0:j_idt102").text

    # Store the data in a list and append it as a row on the Permit sheet of the Excel document
    row = [
        site_name, operator, exception_status, submitted_date, filing_type, cumulative_days, filing_number,
        exception_number, prior_exception, hearing_request, full_partial_shutdown, permanent_exception,
        requested_effective_date, requested_expiration_date, number_of_days, every_day_calendar, days_per_month,
        connected_to_system, nearest_pipeline_distance, other_meter, exception_reasons, drilling_permit_values, total_flaring]
    ws.append(row)
    # Identify variables of interest for flare stacks
    flare_list = WebDriverWait(driver, 50).until(EC.presence_of_all_elements_located((By.CSS_SELECTOR,
"#pbviewForm\\:pbactivefv_list .ui-datalist-item")))
    print(f"Number of flares found: {len(flare_list)}")
    flare_index = 0
    for flare in flare_list:
        flare_name = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt144')]").text
        county = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt148')]").text
        flare_district = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt152')]").text
        release_outside_texas = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt156')]").text
```

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        release_type = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt160')]").text
        release_height = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt164')]").text
        rule_36_subject = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt251')]").text
        h9_number = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt255')]").text
        hydrogen sulfide_concentration = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt259')]").text
        distance_to_public = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt262')]").text
        public_area_type = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt265')]").text
        other_public_area = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt268')]").text

        try:
            latitude_decimal = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt242')]").text
            longitude_decimal = flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt246')]").text
        except:
            try:
                latitude_degrees = int(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt196')]").text)
                latitude_minutes = int(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt204')]").text)
                latitude_seconds = float(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt212')]").text)
                longitude_degrees = int(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt200')]").text)
                longitude_minutes = int(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt208')]").text)
                longitude_seconds = float(flare.find_element(By.XPATH, f".//label[contains(@id, '{flare_index}:j_idt216')]").text)
                latitude_decimal = dms_to_decimal(latitude_degrees, latitude_minutes, latitude_seconds)
                longitude_decimal = dms_to_decimal(longitude_degrees, longitude_minutes, longitude_seconds)
            except NoSuchElementException:
                latitude_decimal = ""  # Leave blank if no data found
                longitude_decimal = ""
        # Store the data in a list and append it as a row on the Flares sheet of the Excel document
        row2 = [Filing_Payload, longitude_decimal, latitude_decimal, flare_name, county, flare_district,
                release_outside_texas, release_type, release_height, rule_36_subject, h9_number,
                hydrogen sulfide_concentration, distance_to_public, public_area_type, other_public_area, flare_district]
        ws2.append(row2)
        wb.save("/Users/jack_/Downloads/data_points.xlsx")
        flare_index=flare_index+1

finally:
    driver.quit()
```

Appendix II:

After running the scraper included in Appendix I, it was apparent that some permits that were included in the CSV file used to guide the scraper had disappeared from the Rule 32 Online Query system. This troubleshooting code was developed to identify the missing values so that they could then be checked manually to make certain that they had actually been removed from the database.

```
# Load the Excel file
file_path = '/Users/jack_/Downloads/data_points.xlsx'

# Read the Excel file
df = pd.read_excel(file_path, sheet_name='Permitting')

# Extract the Filing Number column from the scraper data
scraped_numbers = df['filing_number'].dropna().values  # Remove any NaN values

# Convert to a list
scraped_numbers_list = scraped_numbers.tolist()

#Compare scraper data filing numbers with original CSV file numbers
unique_values_list = list(set(filing_numbers_list).symmetric_difference(scraped_numbers_list))
print(unique_values_list)
print("Number of unique values:", len(unique_values_list))
```