



Original research article

Critical energy justice in US natural gas infrastructuring

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ABSTRACT

We employ infrastructuring as a verb to highlight contested processes of infrastructure expansion to extract, store, transport, and transform natural gas (into liquefied natural gas, LNG). As faculty members and students embedded in mid-Atlantic universities in the United States (US), we conducted participatory action research to record nearby infrastructuring for Dominion Energy's Cove Point LNG Export Terminal and Atlantic Coast Pipeline. We documented how frontline and impacted populations seized opportunities when infrastructuring was visible to challenge and erode the excessive economic and political power of Dominion, one of the US's largest energy providers, who sought to maintain regulatory privilege through lobbying, campaign contributions, and delegitimization of public health and environmental risks. Extending Tsing's concept of frictions (i.e., engagement in difference-based encounters), we highlight (1) coalition-building among unlikely allies (collective encounters), and (2) conflictive interactions between proand anti-gas stakeholders (oppositional encounters). Impacted populations collaborated with proximate and distant allies to publicize and legally challenge distributional, regulatory, racial and other forms of injustice from gas infrastructuring. Our critical energy justice (CEJ) framework helps to identify and defend interconnected components of justice under threat due to profit-oriented global gas infrastructuring based upon reckless disregard for climate science and public health.

1. Introduction

Natural gas, once considered a throwaway byproduct of oil exploration, has displaced coal to become the dominant energy source in the United States (US). In this paper, we show how the expansion of gas infrastructure generates friction and social conflict, drawing on case studies from the mid-Atlantic region. Within this region, firms are establishing contested routes and hubs to take advantage of shale gas markets. The conflictive infrastructure projects we analyze transport Marcellus gas, which is natural gas extracted by hydraulic fracturing in the Marcellus geological formation found predominately in the states of New York, Pennsylvania, Ohio, and West Virginia, to domestic markets in Virginia and North Carolina and international markets in Japan and India.

The expansion of natural gas is transforming the mid-Atlantic region. Considered 'Coal Country' until recently, the region now hosts gas facilities owned and operated by a series of consolidated energy giants, such as Dominion Energy and Duke Energy, with records of pollution in

communities of color [1,2]. In the midst of industry efforts to promote gas as clean, safe, and sustainable, citizens are disturbed by what they perceive as procedural injustices ignoring public health and safety risks, ecological impacts, and climate disruption associated with natural gas infrastructure [3–7]. Concerned populations are mobilizing in opposition to Dominion Energy, the focus of this research,¹ who started planning the 600-mile interstate Atlantic Coast Pipeline (ACP) in 2013 (Fig. 1).² In the same year, Dominion proposed expansion of its Cove Point terminal in Lusby, Maryland to ship Liquefied Natural Gas (LNG) loaded on to tankers in the Chesapeake Bay to export markets.

Focusing on two projects, one now completed and the other in planning stages, we describe frictions observed during participatory action research as members of regional environmental coalitions. Building off Tsing [8], who describes frictions as engagement in difference-based encounters, we use frictions as a metaphor for (1) coalition-building among unlikely allies (collective encounters), and (2) for conflictive interactions between pro- and anti-gas stakeholders during the embedding of new gas infrastructure (oppositional encounters). We

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¹ Dominion Energy, a Fortune 500 company with total assets over \$75 billion dollars, is one of the US's largest energy providers and transporters with over 26,000 megawatts of generation and 15,000 miles of natural gas transmission, gathering, and storage pipelines.

² With 45% of holdings, Dominion is the main owner of the ACP alongside Duke Energy (40%), Piedmont (10%), and Southern Company (5%).

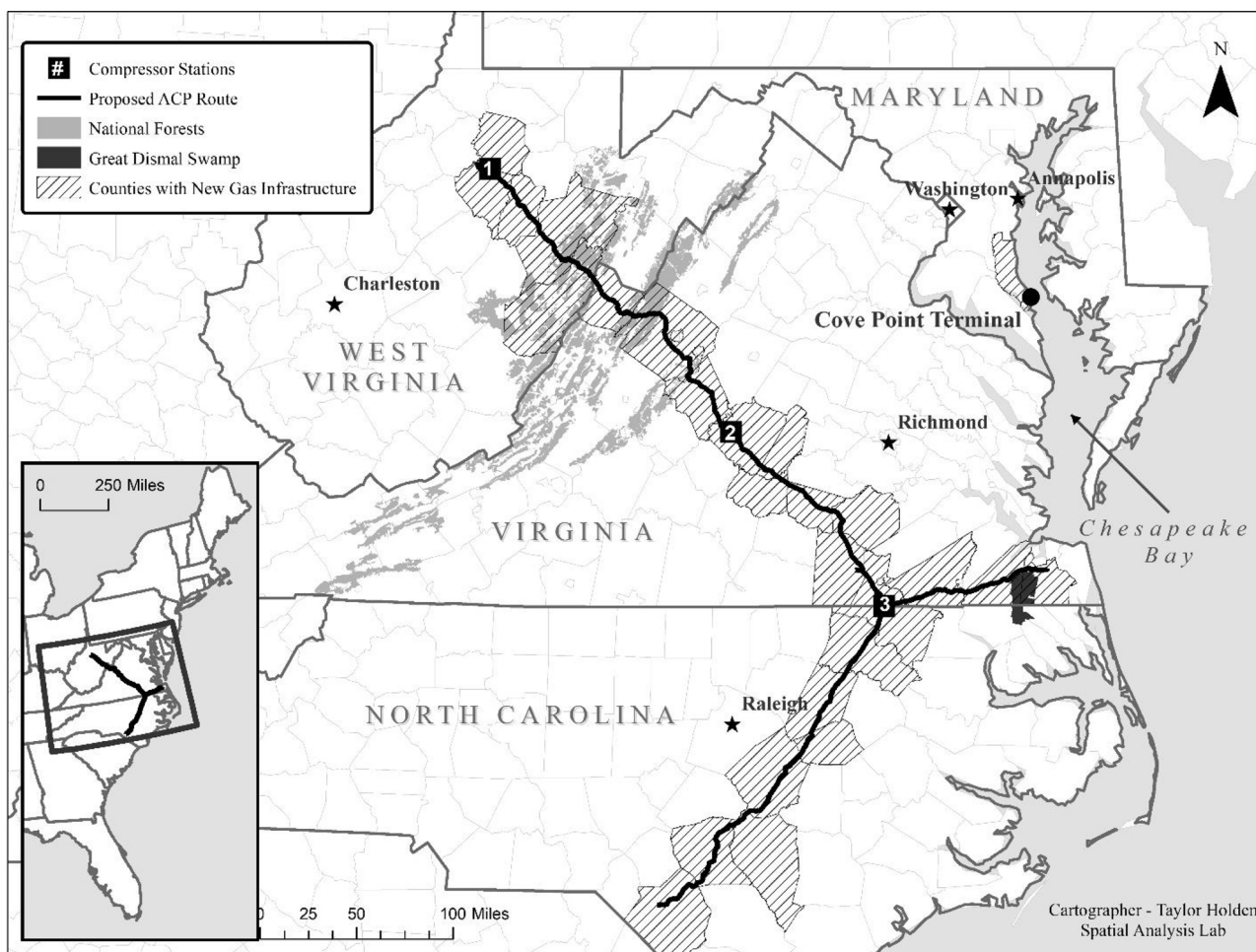


Fig. 1. Mid-Atlantic Case Studies.

employ *infrastructuring* as a verb³ to highlight the process of contested gas expansion as infrastructures for extracting, storing, transporting, and transforming gas (into LNG) unfold across time and space to enable US corporate access to global destinations and realize market value. We suggest collective and oppositional frictions contribute to energy justice by publicizing risks for impacted populations created by their exclusion during regulatory processes. We propose a framework for *critical energy justice* (CEJ) premised on recognition of interconnections between types and locations of injustice. We suggesting that without understanding and acting on these connections, long-distance gas infrastructuring permits powerful companies like Dominion to pit different groups and places against each other to their detriment, while also causing harm to ecosystems, species diversity, and even future generations.

Section 2 explains our participatory research methods as faculty members and students from Virginian universities supplied by Dominion, who sought to understand our own embeddedness in energy assemblages. Section 3 presents our critical energy justice framework and links injustices to frictions during oil and gas (O&G) infrastructuring. Section 4 reviews relevant literatures, including regulatory and political contexts and multi-faceted risks. Section 5 analyzes two illustrative cases of sites of compound frictions. The conclusion highlights our findings, discusses limitations to our results, and points to the relevance of our work for international O&G infrastructuring.

2. Research methods

In this section, we present our methods and discuss our positionality as researchers conducting participatory action research (PAR).⁴ While PAR methods are wide-ranging and vary by participants and discipline, a common element is an experiential orientation to knowledge-making and to social change in which researchers utilize lived experience to inform their work. Community-based PAR encourages long-term collaboration leading to more holistic understandings of problems and solutions through exchanges of technical and frontline perspectives [10,11]. PAR scholars benefit from an evolving relationship between practice and academic theorizing [12]. PAR can prepare students through active learning pedagogy to solve difficult human-environment challenges.

Our case analysis focuses on midstream infrastructure (i.e., for gas treatment or liquefaction, transportation, and storage) as distinct from upstream extractive infrastructure or downstream petrochemical manufacturing infrastructure. While hydraulic fracturing, or fracking, has been extensively researched [i.e., 13–15] social conflicts surrounding mid-stream gas infrastructuring receives insufficient scholarly attention and mid-Atlantic processes are rarely covered [but see 16,17].

Our research seeks to highlight oft-ignored frontline experiences

⁴ Energy infrastructure is a focus of field investigations in the Department of Geography at the University of Richmond, where Finley-Brook teaches. In fall of 2015, a group of Finley-Brook's students conducted interviews with commissioners who approved the Cove Point project and with local opponents. Jaromin, a student researcher, analyzes lawsuits and other procedural frictions in pipelines. Williams teaches at Virginia Commonwealth University and Sheppard is faculty emerita at Norfolk State.

³ See also [9].

Table 1
Mid-Atlantic Groups Opposing Gas Infrastructuring.

Location	Frontline and Grassroots Organizations	Allies
Maryland	Calvert Citizens for a Healthy Environment	We Are Cove Point
North Carolina	Concerned Citizens of Tillery, Haliwa-Saponi Indian Tribe, Northampton Branch of the NAACP (National Association of the Advancement of Colored People)	Clean Air Carolina, Clean Water for North Carolina, Frack Free NC, North Carolina Environmental Justice Network, North Carolina NAACP
Virginia	Augusta County Alliance, Cowpasture River Preservation Association, Free Nelson, Friends of Buckingham, Friends of Nelson County, Friends of Wintergreen, Highlanders for Responsible Development, Voices from Bath	Central Virginia 350.org, Shenandoah Valley Network, Virginia Organizing, Virginia River Healers, Virginia Chapter of the Sierra Club, Virginia Interfaith Power and Light, Virginia, Wilderness Committee, Wild Virginia
West Virginia	Greenbrier River Watershed Association, Mountain Lake Preservation Alliance, Preserve Monroe	West Virginia Highlands Conservancy
Two or more mid-Atlantic states	–	Allegheny-Blue Ridge Alliance, Appalachian Mountain Advocates, Appalachian Voices, Blue Ridge Environmental Defense League, Chesapeake Climate Action Network, Dominion Pipeline Monitoring Coalition, Mid-Atlantic Responsible Energy Project, POWHR Coalition: Protect our Water, Heritage, Rights, Southern Environmental Law Center, Stopping Extraction and Exports Destruction (SEED)

that form a base of anti-gas mobilization. Impacted populations and grassroots organizations directly confront gas infrastructuring in their local area while engaging in collective encounters with allies from geographically broader anti-gas networks (i.e., academics, lawyers, public health officials, watchdog organizations, etc.). A common assumption is contestation originates from outside agitators and professional organizations acting from a distance. In contrast, we document leadership and agency of impacted residents, while recognizing important collaboration with allies (Table 1), and acknowledging some hybridity in terms of individual frontline actors participating in ally groups.

In addition to a dozen interviews (2015-present) and ongoing discussions with stakeholders, our primary sources include Federal Energy Regulatory Commission (FERC) archives, state environmental impact assessments, and litigation proceedings. We supplement scholarly and news databases with websites and social media.⁵ Industry sources include responses to permitting decisions, project specifications, industry newsfeeds, and observation of a Dominion shareholder meeting.

In addition to the ACP, we analyze five Marcellus gas pipelines in planning or construction phases to understand injustices and frictions in other locations. Given the large number of potential cases to assess, our six pipelines were selected based on the amount of media coverage on LexisNexis database, which includes government announcements, press releases, news reports, and opinion pieces, all of which we took as evidence of infrastructuring. Selected pipeline cases garnered several hundred more citations than those not selected. We contextualize Dominion's Cove Point LNG Terminal by drawing comparisons with five US LNG export terminals under development.

3. Conceptual framework and literature review

This section presents our framework for analyzing O&G infrastructuring and reviews relevant literatures. In our conceptual framework, we (1) introduce Tsing's [8] general notion of frictions and rework it to delineate specific types of frictions related to infrastructuring, (2) develop a critical energy justice (CEJ) framework, and (3) draw connections between structural inequalities (i.e., uneven regulatory and financial power) and frictions (i.e., public agency) during gas infrastructuring. Our literature review examines (1) FERC permitting and other regulatory processes, and (2) pro-gas epistemic privilege. Gullion [18] identifies industry success in defining gas clean and safe while delegitimizing concerns about risks associated with O&G infrastructuring as *epistemic privilege*, noting the role of power in knowledge construction.

⁵ Social media use stems from participation in environmental movements. Finley-Brook is active in the Virginia Environmental Justice Collaborative and is a member of Virginia's Advisory Council for Environmental Justice. Williams participates in #No ACP.

3.1. Conceptual framework

Our research focuses on the socially and politically constitutive power of energy infrastructures [see also 19,20]. Power and influence may become less visible on the landscape once infrastructure is established and embedded,⁶ but is readily apparent with new projects during energy transitions, such as current natural gas and LNG expansion. Today's infrastructuring commits US society and economy to a gas-powered future because (1) investments in expensive gas infrastructure reduce public and private finance available to renewable alternatives, (2) gas infrastructure has a lifespan of multiple decades, and (3) economic forecasts based on use of embedded infrastructure feed political inertia.

Our case studies show pro- and anti-gas circles have contrasting worldviews regarding the positives and negatives of gas infrastructuring and the need for state oversight and regulation. Tsing's [8] original identification of frictions targeted cultural difference in international realms, but we propose frictional encounters also occur domestically. We suggest two types of frictions emerge with distinct causes and objectives. We document *collective encounters* (CEs) when coalition building generates from recognition of shared incompatibility with gas infrastructure, regardless of other differences. CEs fit with Tsing's concept of frictions as forming unexpected coalitions based on "awkwardly linked incompatibilities" to either universal or particular ideas [8:16]. Gas opponents, whether frontline groups, such as communities of color and private landowners, or allies in non-governmental organizations (NGOs) and civil or property rights advocacy groups, find gas pipelines and LNG terminals incongruous with their notions of justice. This leads to their involvement in another set of frictions we call *oppositional encounters* (OEs), which we further break down as involving *recognition frictions* and *procedural frictions* (Table 2). While other categories of frictional encounters could potentially exist, we develop these two types due to the agency of citizens. The realization and experience of *structural inequalities* (SI) created through biased regulatory processes and market forces advantaging 'Big Energy' (i.e., large consolidated firms) spur oppositional frictions from populations experiencing harm.

In two infrastructuring case studies, we analyze what we are calling *sites of compound frictions*. These are areas we conceptualize as hotspots with ongoing recognition and procedural frictions, where intensity builds due to willingness to build coalitions across difference as a collective response to unjust market and regulatory forces. Sites of compound frictions (1) provide opportunities to identify connections between theory, practice, and place, (2) allow us to explore linkages between different components of energy injustices as well as ties

⁶ Established infrastructure is often described as being ignored or treated as a background. This hidden characteristic, which the prefix *infra-* (i.e., below, beneath, or within) suggests [21], makes contestation more challenging after embedding occurs.

Table 2
Typology of Infrastructure Encounters, Frictions, and Forces.

Collective Encounters (CE)		Structural Inequalities (SI)		Oppositional Encounters (OE)	
Proximate	Distant	Regulatory Forces	Market Forces	Recognition Frictions	Procedural Frictions
place-based coalition-building in response to SI	networking across space in response to SI	biases in federal, state, or local permitting and regulation	profits; near-monopoly control by utilities with captive customers; corporate access to capital for advertising, legal services, etc.	public displays of agency and opposition (i.e., rallies, petitions, and civil disobedience) in response to SI	public testimonies and citizen lawsuits in response to SI

between injustices and frictions, and (3) help shed light on internal workings in anti-gas movements to explore why collective and oppositional frictions intensify and persist in some locations. Tsing [8] suggests frictions can alter on-the-ground realities creating long-term change.

Frictions during infrastructuring suggest recognition of violations of what we call critical energy justice (CEJ) (Table 3). We categorize our framework as ‘critical’ because of the influence of critical social theory recognizing race, class, gender, and other oppressions as well as the use of a linked approach to move past fragmented understandings of justice. CEJ encompasses *recognition*, *environmental*, *distributive*, and *procedural* justices as transformative sets of interrelations. CEJ asserts no one is free unless are all free and that society cannot sacrifice particular social groups, places, future generations, or species in shortsighted or narrow energy decisions.

CEJ links and interrelates components of energy justice, which are named slightly different things by various experts [see, for example, 12,23–25,27,28]. We recognize society is far from achieving an ideal such as energy justice and thus agree with Schlosberg that procedural and recognition justice are precursors to attaining other components [12,24]. After international research, Whitton et al. [29] suggest natural gas outcomes demonstrate procedural unfairness. Our findings from the mid-Atlantic support this assertion and we draw attention to the lack of capacity or political will by decision-makers to incorporate scientific evidence into rule making. *Ecological reflexivity*, a term we borrow from Schlosberg [24], requires critical engagement with the best available information.

3.2. Literature review

This section presents national context followed by details on the mid-Atlantic region, where our sites of compound friction are located. Virginia receives greatest attention as the setting of Dominion Energy headquarters and our PAR.

3.2.1. US gas markets, regulations, and epistemic privilege

Following passage of the 1938 Natural Gas Act, the federal government promoted production, transport, and sale of gas as beneficial to public interest [30]. Deregulation from the 1970s and 1990s allowed near-monopoly electric utilities with limited oversight [30,31]. Due to industry lobbying, the energy sector may be exempt from environmental laws applied to other sectors. In a well-known example, the 2005 National Energy Policy exempted fracking from the decades-old Clean Air, Clean Water, and Safe Drinking Water Acts [30].

President Obama’s Administration (2009–2017) enacted regulations to reduce pollution from fossil fuels, such as Volatile Organic Compounds (VOCs), smog, and hazardous emissions like benzene. His administration issued guidance on how to consider greenhouse gas (GHG) emissions, including methane, a major component of natural gas, in National Environmental Policy Act (NEPA) reviews by FERC and other agencies. Under President Trump (2017-present), federal agencies are reversing environmental protections, for example, by ignoring climate impacts in NEPA reviews and delaying smog and methane rules. In his 2018 State of the Union, President Trump announced an end to the US “war on [fossil] energy,” a reference to expansion of

environmental regulations under his predecessor. Plans for expanding O & G concessions and infrastructure are underfoot.

3.2.2. FERC’s procedural injustices

FERC commissioners who approve interstate pipelines and large infrastructure projects like LNG terminals are political appointees. Up to five, but no less than three, FERC commissioners examine environmental engineering, relevant policies, and public comments⁷ for each proposed project. Commissioners issue preliminary analysis for further comment followed by a final approval, at which time impacted parties in disagreement can request rehearing. If FERC’s decision stands, proceedings may be challenged in court.

Commissioners are frequently industry insiders and FERC’s record demonstrates bias [30], with 250 gas pipeline approvals in the past decade and only three rejections [7]. When reporting, commissioners must acknowledge concerns submitted in comments, but they frequently dismiss these as lacking credibility. We identified two main patterns of dismissal when analyzing FERC reviews (1) with total disregard through blanket statements like “we disagree,” or (2) by citing alternative information from industry, state or other sources.

Based on our review of dozens of lawsuits and thousands of public comments, we categorize ten common complaints with FERC decisions (Fig. 2). For approval, commissioners need to demonstrate the infrastructure will have no significant negative impact. When they conclude a project is likely to cause harm, they usually still grant approval based on proposed mitigation through off-site wetland, forest, pollution, cultural, or other offsets.

FERC decisions may go to court when legal advocacy organizations like Earthjustice and Sierra Club assign lawyers and resources to cases. Impacted citizens are usually unable to pay for representation and NGO allies become overextended with large numbers of FERC approvals. Lawsuits are nearly always unsuccessful because it is difficult to prove regulatory bias or that assessments are segmented or cursory (i.e., discount upstream GHGs or discount renewable alternatives). Reviewing thousands of pages of documentation and writing hundreds of pages of review, FERC may appear to have complied with standing laws. Yet state agencies sometimes refuse to grant water permits even after FERC approval due to harm to wetlands and sensitive ecological areas or because they assess impacts to each waterbody individually (rather than the federal government’s use of blanket permits) and find excessive damage.

Public confidence in FERC is low and commissioners are targets of protest [7]. FERC meetings are supposed to be open to the public, but when vociferous complaints occur from specific groups or individuals, their access is restricted [32]. Protesters (Fig. 3) attest to the fact that they target national FERC meetings after dissatisfaction with local comment sessions.⁸ Articulating growing frustration with regulatory

⁷ Oral statements enter the record in transcripts documented at designated sites. E-comments are submitted online.

⁸ Strategic maneuvering magnifies appearance of support (i.e., busing in outside steelworkers and tradespeople to talk about job creation, or allowing prominent supporters to testify first with a full audience as opponents wait to speak late in the night). Complaints of procedural injustices from individual public comment events seldom receive attention, but we identify similar patterns between locations.

Table 3
Linked Elements in Critical Energy Justice (CEJ) [influenced by 22–26].

	Distributive Justice	Procedural Justice	Recognition Justice	Environmental Justice	CEJ
Brief Description	equitable allocation of costs and benefits	fair, informed governance, and participatory decision-making	respect, inclusion, and agency	impartial power and allocation across race and income levels	seeking liberation and wellbeing for all regardless of generation, place, scale, species, or social group
Core Elements	people and places cannot be treated as collateral damage; gains and profits need to be shared	capacity; science as essential to ecological reflexivity	intense public consultation with shared decision-making power in full project lifecycle from preliminary planning to final decommissioning; address all inputs and outputs, such as waste	plurality, intersectionality, and indispensability	connectivity of oppressions; seeking interdependent equity (i.e., international, interracial, intergenerational, interspecies, etc.)
Core Objectives	avoidance of maldistribution, such as clusters with excessive air and water pollution or exclusive prosperity	laws and institutions are just and regulations are implemented	citizen agency respected during decision-making; public concerns and viewpoints are respected and acted upon	recognition that diversity is a strength and seeking to end marginalization	recognition that no one is free until all are free; unwillingness to accept tradeoffs between harming A or B

1. Regulatory vagueness: criteria for ‘significant impact’ are unclear
2. Segmentation: impacts are not assessed cumulatively per area (i.e., multiple pipelines reviewed individually); no consideration of upstream or downstream GHG emissions
3. Lumping: specific ecosystems are not assessed individually (i.e., all impacted waterbodies are grouped)
4. Incongruent findings: different state agencies have conflicting methods or conclusions
5. Competing authority: multiple agencies create piecemeal regulation and oversight
6. Cursory consideration of alternatives: energy or infrastructure alternatives are defined narrowly and analyzed poorly
7. Public comment process is pageantry: citizen concerns enter the record but seldom influence decisions
8. Regulatory bias: propensity toward approval; statements on risk and safety echo industry
9. Preemptive harm: assumption of approval means pre-construction activities, such as tree clearing, occur prior to permitting
10. Ineffective follow-up: FERC approves mitigation but is not responsible for monitoring or compliance

Fig. 2. FERC Criticisms (compiled by authors from public comments and lawsuits).

processes, a Maryland resident states,

FERC has denied people’s rights, democratic process in community meetings....So we came here [to Washington DC] because we have no forum other than being disruptive and forcing them to listen [Norris quoted in 32].

3.2.3. Socio-ecological risks and epistemic privilege

Gas industry groups use power and money to control information access and produce idealized narratives about gas safety and sustainability [3,5]. Claims may contain partial truths, but are often misleading, such as the allegation fracking fluids are safe because some chemicals are also found in cosmetics and food products [3]. Dominion Energy promotes the safety of natural gas citing properties like a narrow range of flammability (i.e., at certain concentrations and temperatures) [33]. Dominion stresses storage, transport, and distribution within mid-stream infrastructure is regulated by state and federal agencies using stringent guidelines [33,34]. Dominion cites gas as the cleanest burning of all fossil fuels [33], highlighting how is it good for the environment and is low-carbon when compared to the coal [34]. Gas companies suggests reliable gas backup is necessary for transition to intermittent renewables, a justification made a decade ago to support building new coal plants in the US and internationally.

Firms allege public concerns about gas are unfounded [3,35]. We propose ecological reflectivity is necessary for procedural justice [24,26,37]; thus, we assess if scientific findings support citizen apprehension. We find health complaints of populations living near gas infrastructure include respiratory problems, eye and skin irritations, and elevated cancer rates (Table 4) [38]. Colborn et al. [39] research 353 chemicals used during gas operations: they find 75% could affect the skin, sensory organs, and respiratory and gastrointestinal systems; 40–50% could affect the nervous, immune and cardiovascular systems; 37% could affect the endocrine system; and 25% could cause cancer and mutations. Proximity of residence appears correlated with prevalence and severity of negative health symptoms [2]. Analysis of site-specific factors can help determines precise threat from exposures [40,41], yet projects like compressor stations can be approved without assessment of local conditions, or with only partial reporting of hazardous releases [42,43]. Permits seldom consider cumulative exposures from other proximate sources of pollution.

Research reported in Table 4 focuses on upstream extraction, although health concerns have been documented near compressor stations and export terminals [45,48–50,52]. Compressors emit VOCs and BTEX compounds [48–50,53]. LNG facilities create risks tied to containment of mercury removed from incoming gas, expulsion of vapor clouds, handling of flammable refrigerants, and much more [52,54]. Research in Table 5 on potential ecological threats suggests procedural justice requires better tracking and reporting of all chemicals used in gas extraction and transport, which is not currently required under US law.

Significant US O&G pipeline spills and leaks happen approximately



Fig. 3. FERC: Face Families You Hurt (Photo Credit: Erik McGregor).

Table 4
Public Health Threats from US Gas Infrastructure in Refereed Research.

Threats	Sources
Respiratory, gastrointestinal, endocrine, and reproductive harm	[39,44–47]
Air pollution, particularly nitrous oxides, particulate matter, BTEX (benzene, toluene, ethylbenzene, and xylenes) compounds, silica, Volatile Organic Compounds (VOCs), and precursors to ground-level ozone	[44,45,48–50]
Psychological stress (i.e., uncertainty, anxiety, anger, fear, powerlessness, distrust)	[14,44,47,51]

Table 5
Ecological Threats from US Gas Infrastructure in Refereed Research.

Threats	Sources
Hundreds of toxic chemicals released to water, land, and air	[15,39,40,44,55,56]
Greenhouse gas emissions, particularly methane	[40,45]
Increases in ground-level radium and radon	[56,57]

300 times per year according to thirty years of data (1986–2013) from the Pipeline and Hazardous Materials Safety Administration (PHMSA). Gas distribution, transmission, and storage-related incidents from 1998 to 2017 killed 299 people and injured 1190 [58]. With pressurized lines and flammable materials in populated areas, firefighters and first responders feel unprepared for gas expansion [59]. Towns and cities face safety risks with gas infrastructure, particularly LNG, due to inherent pressure and temperature changes and flammability of inputs and outputs [52,54].

3.2.4. Comparative analysis of LNG terminals and pipelines

By 2018, six US LNG export terminals were under construction (Table 6). Dozens more are approved or planned. With only one LNG export terminal in the mid-Atlantic, thus directly tied to Marcellus gas, we compare processes with infrastructuring in the southern US.

Comparing cases, we document a tendency among infrastructure developers to minimize terminal transformations for LNG export as mere expansions of existing import facilities, although risks and emissions are much greater with liquefaction (Table 7) [52,54]. Unreliable information from state agencies and corporate project sponsors is a common complaint from impacted populations. Evidence of environmental racism and income inequality connects to subsequent pipeline analysis.

Pipelines grow at a rate of ten billion cubic feet daily in the eastern US [60]. An industry survey suggests 50% of US pipeline builders feel they do not have enough customers [61]; regardless, dozens of well-resourced firms construct more pipelines (Table 8).

At the time of writing, the Constitution Pipeline is on hold, so we do not analyze it in Table 9, although project developers are appealing state rejection. The other five cases exhibit injustices: examples in Table 9 are not exhaustive and may implicate multiple types of injustice.

We do not assert direct correlations between injustices and frictions; for example, in spite of Rover Pipeline violations, there is limited local opposition. In Section 4, we contextualize ACP frictions within inter-connected political and socio-economic factors to decipher how context may influence emergence and longevity of frictionous encounters. Nonetheless, examples of oppositional frictions in Table 10 reinforce our general conclusion that impacted populations do resist.

All six cases exhibit regulatory challenges, but Energy Transfer Partner’s (ETP) Rover Pipeline stands out for the number of violations, which range from destruction of historical sites to illegally dumping waste in wetlands [7,63]. FERC ordered ETP to stop drilling and halt construction in mid-2017 [63]. Activities recommenced after fines were sent to state coffers, not to compensate the area or people harmed.

ETP owns the Dakota Access Pipeline (DAPL), where indigenous ‘water protectors’ were targets of violence [36,64,65]. DAPL fits with an international pattern of violating rights of people of color to expand O&G infrastructure [66–68], a trend we identify in the ACP, which directly impacts more Indigenous Peoples than any other US pipeline [69]. Before discussion ACP, we describe lobbying in the mid-Atlantic.

3.3. Gas markets, regulations, and epistemic privilege in the mid-Atlantic

Dominion’s actions in Virginia demonstrate a powerful company flexing its muscles [69,70,71,72,73,78]. Dominion is the largest political contributor in the state, contributing to politicians of both major political parties [73]. Virginia lags behind in solar and wind adoption, particularly distributed energy alternatives, which Dominion lobbies against [74,75]. Electricity rates increased 30% from 2006 to 2016, a period that coincides with \$11 million in political donations from Dominion to Virginia lawmakers. In 2015, legislators waved regulatory oversight of the utility allowing Dominion to keeping rates artificially high in a maneuver deceptively labeled a rate freeze.

During the 2017 Virginian primary, Dominion’s CEO sent a letter to

Table 6
LNG Export Terminals under Development.

Terminal	FERC Approval	Commence Exports	Location	Estimated Investment (\$US billion)
Cameron	yes	2019	Louisiana	\$10
Corpus Christi	pending	2018	Texas	\$11.5
Cove Point	yes	2018	Maryland	\$4
Freeport	yes; LNG expansion approval pending	2019	Texas	\$12.5
Sabine Pass	yes; LNG expansion approval pending	2016	Texas	\$20
Southern	yes	2018	Georgia	\$2

Table 7
Energy Injustices in LNG Export Terminals (compiled by authors from public comments and news coverage).

Violations of CEJ	Distributional Injustices	Procedural Injustices	Recognition Injustices	Environmental Injustices
<ul style="list-style-type: none"> ● Climate change harm to future generations (all) ● Creation of inter-community conflict (F, CP) ● Harm to wetlands and biodiversity (C) 	<ul style="list-style-type: none"> ● Proximity to existing residential areas (CP) ● Forced buy-out of homes (F) ● Use of large quantities of water for processing in area of increasing water scarcity (CP) 	<ul style="list-style-type: none"> ● Accelerated permitting due to pre-existing infrastructure for other purposes (C,CP,F,S,SP) ● Reference of liquefaction as mere expansion of existing import terminal (C,CP,F,S,SP) ● FERC did not consider O&G industry impairment (i.e., high mercury levels) of the broader region (C) 	<ul style="list-style-type: none"> ● Minimization of resident concerns before approval (CP,F) ● Harassment of and threats to protesters and opponents (CP,F) ● FERC did not comprehensively review, consider, and address landowner objections (S,F) 	<ul style="list-style-type: none"> ● Disproportionate harm to low-income, communities of color (CC,C,F)

C = Cameron.
 CC = Corpus Christi.
 CP = Cove Point.
 F = Freeport.
 SP = Sabine Pass.
 S = Southern.

Table 8
Selected Marcellus Gas Pipelines.

Pipeline	FERC approval	Status	Location	Estimated Investment (\$US million)
Atlantic Sunrise	yes	under construction	Pennsylvania	\$3
Rover	yes	under construction; more non-compliance incidences than any interstate pipeline	Ohio, Pennsylvania, West Virginia	\$4.2
ACP	yes	final permit pending; pre-construction activities initiated; multiple lawsuits	North Carolina, Virginia, West Virginia	\$5.1
Mountain Valley	yes	final permit pending; pre-construction activities initiated; multiple lawsuits	Virginia, West Virginia	\$3.5
PennEast	yes	state rejects project and requests FERC rehearing to reconsider its approval	New Jersey, Pennsylvania	\$1
Constitution	yes, but FERC later upholds state denial	state rejection	New York, Pennsylvania	\$0.925

Table 9
Injustices in Pipeline Cases (compiled by authors from public comments and news coverage).

Violations of CEJ	Distributive Injustices	Procedural Injustices	Recognition Injustices	Environmental Injustice
<ul style="list-style-type: none"> ● Climate change harm to future generations (all) ● Destruction of or harm to state historical sites (R,ACP) 	<ul style="list-style-type: none"> ● Disruption to agricultural productivity (R,PE) ● Mountain top removal (ACP) ● Armed federal marshals called in to protect developers clearing trees on private land against landowner will (PE) 	<ul style="list-style-type: none"> ● Violations of environmental laws with repeated leaks and spills (R) ● Legislators introduced a bill to fine demonstrators for law enforcement costs^a (AS) 	<ul style="list-style-type: none"> ● Forced entry into areas in conservation trust (ACP) ● Surveying or pre-construction tree clearing without landowner consent (ACP, MVP, PE) 	<ul style="list-style-type: none"> ● Compounded water pollution from several close pipelines in low-income areas (MVP) ● Air and water pollution from compressor stations in communities of color (ACP)

ACP = Atlantic Coast.
 AS = Atlantic Sunrise.
 MV = Mountain Valley.
 PE = PennEast.
 R = Rover.

^a Freedom of speech and right to assemble are constitutionally protected and discrimination based on inability to pay fines should be unlawful. While bills like these seldom pass, there has been an uptick in state and city bills proposed to deter protest.

Table 10
 Oppositional Frictions in Gas Pipelines (compiled by authors from public comments and news coverage).

Procedural Frictions	Recognition Frictions
<ul style="list-style-type: none"> ● Citizen lawsuits over forced entry in conservation trusts (AS); compensation for felled trees (C); surveying without consent (ACP,PE); from nuns alleging forced entry of the project on their land violates religious freedoms (AS)^a ● Grassroots campaign leading to municipal resolutions opposing pipeline (PE) ● Delaware Riverkeepers challenge state water permits (AS) 	<ul style="list-style-type: none"> ● On-going rallies, petitions, and marches (all) ● Protestors arrested (ACP,AS,C,MVP,PE) ● Protest encampment to monitor and/or disrupt construction (AS) ● Tree “sits” to block and protest pre-construction activities like tree felling (ACP, MVP) ● Nuns build an outdoor chapel to symbolize pipeline opposition (AS) ● Landowner blockades (C,R) ● Pipeline Fighters documentary (MVP) ● Rural producers pass out pancakes at FERC meeting to highlight loss of family-owned maple groves (C)

ACP = Atlantic Coast.

AS = Atlantic Sunrise.

C = Constitution.

MV = Mountain Valley.

PE = PennEast.

R = Rover.

^a The 115th US Congress discussed 50 bills in 2017 aimed to prevent citizen use of the courts to defend against civil right, environmental, and other violations [62].

76,000 employees, retirees, and shareholders and urged them to consider the company’s proposed pipeline when voting, since there was an anti-pipeline candidate [70]. Surrounding this same primary, the American Gas Association (AGA) financed a pro-gas campaign, presented as Virginian [76]:

Your Energy Virginia was created to speak out against a misguided movement that assaults our way of life...based on the simplistic belief that keeping our natural resources in the ground is the only solution to climate change. This isn’t just false—it’s dangerous to our quality of life, economy and energy security [77].

During the 2017 Virginian General Election, AGA pooled assets with Dominion to finance what they dubbed a campaign to elect a pipeline [78], blanketing television, radio, and the web with pro-ACP advertisements.

Near-monopolies control the transmission and sale of electricity throughout the mid-Atlantic. Dominion is the larger of two utilities in Virginia and millions of customers lack choice in utility suppliers. Dominion finances infrastructure expansion through rate hikes (i.e., raising the amount consumers pay per watt) and is allowed to receive up to 14% return on their \$5 million dollar ACP investment [69]. Dominion’s excessive political and market control unites opposition from disgruntled captive ratepayers across broader geographical areas with populations directly impacted by new infrastructure.

4. Compound frictions in the mid-Atlantic

Since 2014, Lusby, Maryland, where Dominion’s Cove Point LNG Terminal is located, is a site of compound frictions as residents work across geographical and socio-economic differences to identify broader patterns of gas injustice. Lusby organizers collaborate with populations to the north, who live among fracking pads, allies to the south near LNG terminals, and communities across the US in the path of pipelines. In our second case, Central Virginia is a hotspot of resistance to the ACP with collective encounters among dissimilar collaborators (i.e., conservationists, landowners, civil rights defenders, spiritual leaders, and anti-fossil fuel activists) due to shared non-conformance with Dominion’s plans.

4.1. Cove Point LNG export terminal

In 2013, after purchasing an existing LNG import terminal, Dominion applied for permits to switch to exports. County commissioners approved Dominion’s expansion in 2013 based on a \$25 million

payment and a projected annual income of \$55 million in tax revenue [79]. The majority of the county population lives in the north where commissioners prioritize funding, while Lusby lies along the southern tip of Calvert County. Dominion received state approval in 2014 based on a \$48 million payment for energy efficiency, clean energy, and assistance to low-income utility ratepayers [80], although few of these funds will reach Lusby residents.

Dominion was victorious against legal challenges to terminal expansion from impacted populations and professional allies (Table 11). Sierra Club challenged how the site, formerly designated as a conservation area, could host LNG processing. A second case criticized streamlining environmental assessments due to existing permits for the LNG import facility, arguing liquefaction deserves full review. A third lawsuit sought consideration of upstream and downstream GHG emissions [81].

Local resistance emerged from Calvert Citizens for a Healthy Environment (CCHE) and a local-to-regional movement called We Are Cove Point. Opponents cite 2365 homes, 19 daycares, three churches, two schools, and two shopping centers located within the two-mile blast radius from pressurized infrastructure. Dominion underreported the size of the residential population in their FERC application [82], a clear example of recognition injustice. Motivated to protest due to public health and safety concerns, a co-founder of CCHC states, “The democratic process has failed; this is a life or death situation” [Eno quoted in 83].

Dominion gives presentations at industry meetings on how to obtain permits in locations with opposition. Surrounding the FERC public comment period for the LNG export terminal, Dominion followed its own playbook and passed out 25,000 promotional booklets, made 15,000 phone calls, and sponsored an extensive social media campaign. “We advertised so often and in so many places that project opponents became annoyed that they could not escape it,” asserts a company representative [quoted in 84].

During interviews in 2015 with four county commissioners who granted project approval, procedural injustices became apparent due lack of scientific guidance. Commissioners were uncertain about emissions and lacked technical knowledge of risks, but stressed confidence in safety assurances from Dominion administrators (pers. comm., 10/12/15). Commissioners pointed to how decades earlier townspeople were warned about explosion (meltdown) risk with the nearby nuclear plant, which never occurred, as evidence of fearmongering by terminal opponents, who cite the possibility of explosion in LNG facilities.

While much public debate in Lusby focused on the lack of an adequate evacuation route in the case of an emergency, documented injustices are broader (Table 12).

Impacted residents and allies utilized direct action to publicize

Table 11
Cove Point LNG Lawsuits.

Year	Plaintiff	Defendant	Charge	Victor
2014	Sierra Club et al.	Dominion	conservation lands harmed	Dominion
2016	Accokeek, Mattawoman, Piscataway Creeks Communities Council	Maryland Public Service Commission	intensify environmental review	Maryland Public Service Commission
2016	EarthReports as Patuxent Riverkeeper, et al.	FERC, Dominion	intensify environmental review	FERC, Dominion

Table 12
Illustrative Examples of Injustices in Cove Point (compiled by authors from news reports and pers. comm. 04/05/15, 10/11/15, 10/12/15, and 05/10/17).

Violations of CEJ	Distributive Injustices	Procedural Injustices	Recognition Injustices	Environmental Injustice
<ul style="list-style-type: none"> • Contributions to climate change harming future generations • Toxic air releases with offsets in other locations 	<ul style="list-style-type: none"> • High water usage in an area of increasing scarcity • New air pollution emissions in an existing non-compliance area 	<ul style="list-style-type: none"> • Discharge of wastewater to fragile wetland, riverine and coastal ecosystems • Discharge of ship ballast water and other pollution into the Chesapeake Bay, a regional “commons” • Off-duty police hired as Dominion security guards 	<ul style="list-style-type: none"> • FERC application misrepresents number of residents in blast zone • Insufficient sound barrier and firewall to contain risk in area of dense settlement • Mistreatment and harassment of protestors by police 	<ul style="list-style-type: none"> • Threat to fisheries and fishing– food and income for lower-income residents

concerns [82]; for example, by blocking entrance of the LNG facility construction company, IHI Keiwit (Fig. 4).

Dominion started exporting fracked gas from Lusby in 2018, a year after Maryland banned hydraulic fracturing. A quantitative risk assessment (QRA) (i.e., safety study) of the LNG export terminal was never completed. Impacted populations have been demanding the QRA for years, including during 44 consecutive weeks (and counting) of Monday protests at the Governor’s mansion. The project received approval based on cursory environmental data. Dominion originally tried to evade requirements to estimate regulated pollutants like VOCs, suggesting they would be difficult to measure and requesting an exemption from numeric limits. Their permit did set an annual limit, but after terminal construction was complete, Dominion requested and received a permit amendment to exceed previously approved levels [85]. The company has a pattern of requesting permit amendments to increase allowable emissions of dangerous pollutants after new infrastructure construction is finished [85].

Lusby residents have built alliances in Maryland’s capital and traveled to the nation’s capital to draw attention to concerns about toxicity (Fig. 5). The strongest example of what we are calling distant collective

encounters (across space) includes information exchanges with LNG-impacted communities in Texas and Louisiana. In the absence of a site-specific QRA, Lusby residents turned to locations where LNG export terminals exist for answers as to what they might expect, hearing evidence of injustices we record in Table 7.

Lusby residents’ have lost faith in state regulators and trust of law enforcement has eroded [82,86]. Local police have clear connections to Dominion and several worked during off-duty hours to perform security for the firm to help protect property in its construction yard. Protesters contend procedural injustice in Lusby includes police intimidation (i.e., traffic stops, tailing, demonstrations of force) (pers. comm., 10/12/15). A serious incident occurred in 2015 during extraction of two protestors from construction cranes. Police tugged and tampered with safety harnesses and moved the crane with a protestor (a Maryland environmental educator and experienced climber) high above the ground. County commissioners subsequently give the officers a special service award for the arrest, while the second protestor (now a graduate student) served jail time for allegedly fabricating charges of endangerment against the same officers [86,87].



Fig. 4. Construction Protest (Photo credit: We Are Cove Point).



Fig. 5. Protesting at the Nation's Capital: Toxic Concerns (Photo Credit: We Are Cove Point).

4.2. The ACP

Environmental impact, racism and environmental injustice, and perceived property rights violations along the proposed ACP route created a hotspot of compound frictions in Central Virginia between the Buckingham Compressor Station (#2 on Fig. 1) and national forests. As in the previous case, opponents without a history of political organizing were mobilized by state incompetency and bias. For example, after FERC uncovered inconsistency in the ACP's draft environmental impact statement in terms of the number of river crossings, Virginia's Department of Environmental Quality (DEQ) announced allowance of a project-wide assessment procedure without reviewing individual waterbodies [88]. Citizen anger appears in Fig. 6, where text below the two-headed snake criticizes former Governor McAuliffe, a staunch ACP supporter.

ACP protests have been frequent and ongoing due to perceptions of injustice (Table 13).

4.2.1. Environmental racism in the ACP

Pipeline locations are not random or accidental. Dominion assessed 6000 miles of potential area for the ACP, made hundreds of route revisions, and added 60 miles of length to avoid fragmenting dense national forest. After processes of infrastructuring, where proposed pipeline route and compressor stations will end up in Virginia and North Carolina show who has political power, and who does not. Ewing [16] asserts the ACP targets smallholder farmers for eminent domain land takings. In Virginia and North Carolina, many counties in the ACP path have higher African Americans percentages than is representative in the state and low-income populations are disproportionately high. Native Americans are also overrepresented as frontline populations: 30,000 live within one mile of the proposed route in North Carolina [17].

Racial injustice from Northampton and Buckingham Compressor Stations is well documented [42,43,89]. The Northampton station in North Carolina falls in a census block group with 79% African American population [43]. Historically this is Haliwa-Saponi ancestral land

[2,17].⁹ According to the permit application, the compressor would emit 19 t of nitrogen oxide and 18 t of particulate matter annually, but did not cite annual emission rates for formaldehyde, ammonia, and benzene, pollutants with high health risks, commonly released during gas compression [43]. The station would sit near energy and manufacturing facilities with major air emissions and local asthma levels already supersede state averages.

In Buckingham County, Virginia, approval of the compressor station contributed to racial tension, as the majority-white local government did not acknowledge African American concerns [7,42,89]. The project represents an uneven burden for a community of color, with the compressor situated between two predominately Black churches (Fig. 7). Opponents criticize authorities' seeming disrespect for Freedman culture and historically important African American sites including cemeteries and schools [7]. Dominion bought the Variety Shades Plantation, where the compressor will sit, for \$2.5 million from a family not living in Buckingham. The absentee landowner is part of a family of former slaveholders.

A lawsuit that argued Buckingham County Supervisors' approval was arbitrary, noting supervisors voted the same night after hearing 76 public comments (69 in opposition and 7 in support), was dismissed due to a technicality [90]. The compressor application lacked site-specific data and did not mention local health risks, concerns raised publicly by residents in hearings [91,92]. With Buckingham's compressor at an intersection of the ACP and Williams Transcontinental Pipeline, gas gathers from several interstate pipelines [89].

4.2.2. Eminent domain: property takings for the public good?

Many US states have eminent domain laws allowing takings of private land for infrastructure with public benefit [16]. In Virginia, ACP developers sued property owners who blocked surveying (Table 14),

⁹ The Haliwa-Saponi are state-recognized but lack federal recognition, so FERC consultation was not required. ACP developers have not consulted the tribe about procedures if they uncover unmarked graves or artifacts.

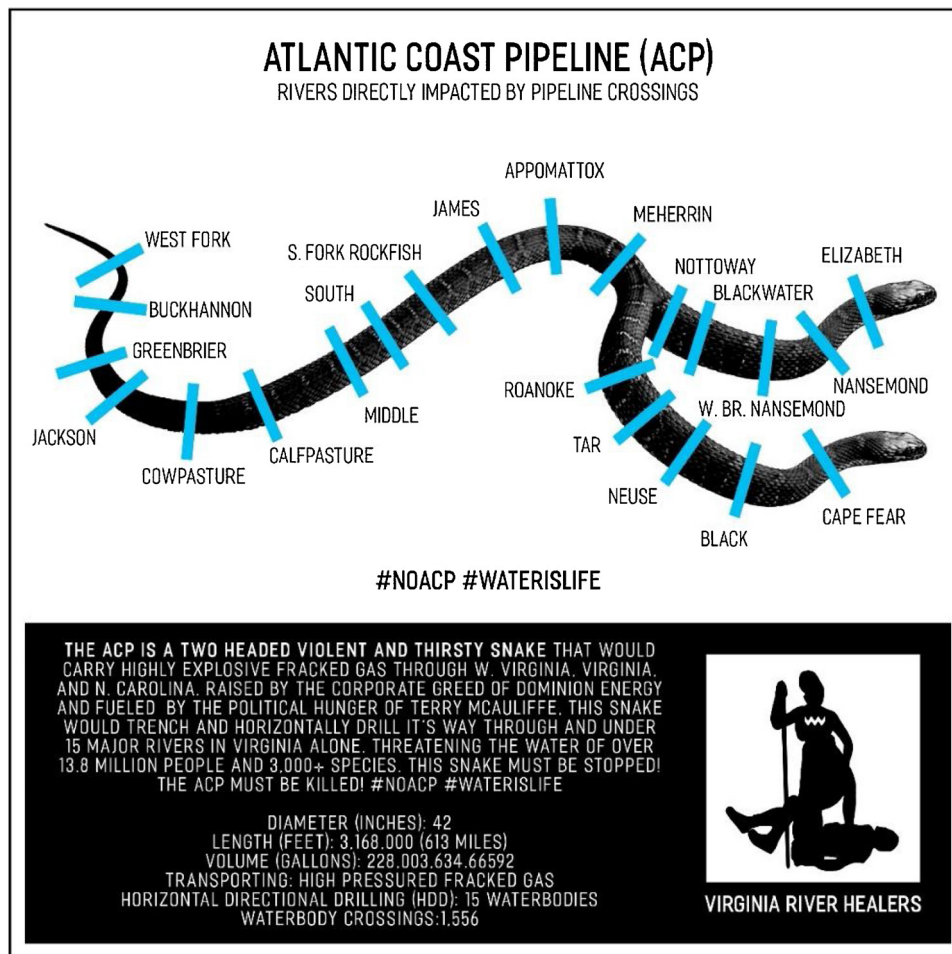


Fig. 6. ACP as a Two-Headed Snake.

but landowners contest claims of public benefit. ACP is a high-volume pipeline not suited for small interconnections and local taps are prohibitively expensive.

Resolution of court cases in favor of Dominion feeds perception of bias in procedural and legal processes. Other landowners in the path of the ACP, as with other pipelines in Tables 8 & 9, attest they would like to challenge land takings in court, but cannot afford legal counsel. When offered a settlement under threat of legal action, they feel obligated to settle. Using the courts and team of attorneys, ACP forced entry on private lands against the will of landowners, even lands held in conservation trust.

4.2.3. Collective engagement frictions in infrastructuring resistance

Impacted Virginian populations along the ACP route initially organized in grassroots groups structured around counties, such as Nelson, Augusta, and Buckingham. Over time, there was development of unlikely coalitions within counties, as exemplified by local collaboration between African American residents in Buckingham and spiritual leaders at Yogaville Ashram to share strategies to mobilize against the ACP (pers. comm., 10/21/17). These two populations live less than ten miles apart but ACP infrastructuring inspired their first collective solidarity.

Engagement also built between counties and beyond. Augusta County Alliance, one of the most vocal anti-ACP groups, first had a loose affiliation with five counties in valley-wide network. In 2018, the Alliance announced plans to merge into an even larger regional conservation coalition. As collective engagement expands so does awareness of shared experience of injustices during gas infrastructuring. At anti-ACP rallies and events, out-of-state speakers share stories of harm

when living near fracking wells or resisting DAPL. Interaction translates into consciousness-raising on shared concerns like global climate change and the corrupting political power of large utilities. Anti-pipeline activists worked hard in the 2017 general elections to support leaders who would stand up to Dominion, and a resulting change in state politics appears to be occurring.¹⁰

ACP construction appears probable, but each step of the process demonstrates contested infrastructuring. After waiting for Trump appointees, FERC recovered quorum in 2017 to make a split ACP decision (2-1), with two new appointees voting affirmatively. The dissenting commissioner was not convinced the ACP as proposed was in the public interest and recommend the ACP share a pipeline route with another proximate infrastructuring project [93]. The Southern Environmental Law Center working with coalition of grassroots and frontline communities petitioned in 2018 for a rehearing on FERC's earlier approval, now that five commissioners are appointed.

Final ACP permitting rests in state agencies. In 2017, West Virginia's Department of Environmental Protection waived the state's authority to determine if the ACP will harm rivers and streams deferring to a federal permit. A subsequent and still pending citizen and NGO lawsuit charged the state was negligent in water management duties. In 2018, North Carolina's Governor approved the ACP, spurring a still-ongoing ethics

¹⁰ In what has been described as a tectonic shift in state politics, in February of 2018, the Virginian House of Delegates passed House Bill 1588 regulating some of Dominion's use of ratepayer funds. Important votes came from freshman legislators who had campaigned in 2017 against the excessive power of Dominion.

Table 13
Examples of ACP Injustices (compiled by authors from public comments and news coverage).

Harm to Local Ecology in Violation of CEJ	Distributive Injustice	Procedural Injustices	Recognition Injustices	Environmental Injustices
<ul style="list-style-type: none"> ● Harm to biologically diverse national forests and Great Dismal Swamp ● Up to 60 ft of mountaintop ridge removal along 38 miles of pipeline 	<ul style="list-style-type: none"> ● Pipeline taps too expensive for local gas access ● Harm to nature-based tourism economies ● Compensations for eminent domain takings are low ● Restrictions along blast zones reduce productivity and safety 	<ul style="list-style-type: none"> ● Excessive corporate influence in state and local politics ● Buckingham residents expressing concerns about the compressor station at local, state and federal levels and feel they have been marginalized and ignored for four years (pers. comm. 03/28/18, 04/20/19 and 04/22/18) ● Lack of consultation with Native Americans with territorial claims 	<ul style="list-style-type: none"> ● Harm to Native American and African American cultural sites ● Eminent domain ignores property rights of landowners 	<ul style="list-style-type: none"> ● Frontline pollution for Native American and African American, and low-income populations ● Two compressor stations in communities of color ● Opportunities to testify to State Water and Air Boards require travel and time off from work to attend, making it harder for low-income, rural populations to attend



Fig. 7. Buckingham is Not a Sacrifice Zone (Photo Credit: NBC29.com).

Table 14
ACP-Landowner Lawsuits.

Year	Plaintiff	Defendant	Charge	Victor
2015	ACP	Todd and Donna Martin	force land surveying in conservation trust	ACP
2015	ACP	Evon Wadsworth, Hazel Palmer, Jean East	force land surveying	ACP
2016	ACP	Wintergreen Land Trust and landowners	force land surveying	ACP
2017	Hazel Palmer	ACP	property rights violation	ACP

investigation to ascertain if he tied funds to approval and broke the law. North Carolinians had been less vocal in ACP opposition, but a groups of protestors responded to the Governor’s approval with a hunger strike and occupation of state offices leading to arrests.

In 2017, the Virginian Water Board voted conditionally (4-3) to approve the ACP’s Water Quality Certification, while requiring additional environmental review. ACP opposition continues, but activists increasingly look to build on their foundations from anti-pipeline organizing to target broader political change. Environmental resistance in the US currently involves thousands of angered citizens with direct experience in anti-gas mobilization, whether targeting fracking, pipelines, compressor stations, LNG terminals, or other infrastructure. These local and state activists have become part of national efforts to demand climate action and pressure for political candidates to sign No Fossil Fuel Money pledges. As discussed in the conclusion, CEJ requires going beyond any singular infrastructure project to achieve civic engagement and moral leadership while recognizing global interconnectedness.

5. Conclusion

Our gas infrastructuring research suggests oppositional encounters publicize demands for recognition and procedural justice. Grassroots movements deepen and grow where people directly experience injustices and support each other in shared struggle (i.e., collective engagement), either in place-based collaboration or through networks across space. While we suggest looking at frictions paired with CEJ is helpful in understanding the agency of frontline actors and allies in contested energy projects, we make no claims to the representativeness or generalizability of our cases. A major limitation from our findings is the factor of time. Since events are currently unfolding, it is impossible to predict if collective encounters (proximate or distant) will continue, as Tsing [8] suggests can occur. At the time of writing, Cove Point LNG terminal is shipping its first exports: will the opposition movement

remain vigilant about oversight?¹¹ In Virginia, ACP opposition is transitioning into oversight as pre-construction begins.¹² Once the pipeline exists, will citizen agency remain strong?

Opposition to infrastructure is strongest during construction stages when change is most visible [94]. With gas buildout around the world, there is a window of opportunity—during an energy transition when gas infrastructuring is highly visible—to challenge structural inequalities discussed in Table 2. Collective engagement can challenge epistemic and other privileges before they become embedded in gas infrastructure. Contestation adds visibility to immediate processes of infrastructuring, but longer-term action will be necessary to challenge inequitable market and political forces. Collective encounters ultimately need to span the globe due to the spatial reach of LNG. Today fracked Marcellus gas exported from Maryland ships to Asian markets through the Panama Canal, but soon Cove Point tankers will be able to off-load in Panama's LNG import terminal, now under construction in low-income neighborhoods of Colon, where residents struggle for information about what to expect [95,96]. A giant global energy firm headquartered in northern Virginia is developing Panama's LNG project using infrastructuring funds from the World Bank [96]. To assure CEJ, it is important to get out in front of infrastructuring, when chances are highest to be able to redirect efforts. To prepare in advance with a fuel as transportable as natural gas, it is necessary understanding global markets, suggesting a key role for academic researchers wishing to contribute to CEJ. Protesting harm during or after it occurs remains necessary, but a key lesson from historical environmental justice movements is that society needs to work proactively to stop damage from happening in the first place.

Gas infrastructure contestation is a global phenomenon [66,95–98]. Concerns of Indigenous Peoples in North Carolina or North Dakota living alongside pipelines and compressor stations are fundamentally the same as Mapuche anti-gas activists in western Argentina, as all are struggling for political power, property rights, and clean water and water [36,43,96,98]. In the Western hemisphere alone, social conflict surrounds gas infrastructure in Argentina, Bolivia, Brazil, Canada, Colombia, Mexico, Peru and the US. Latin American countries have fewer regulations assuring fair treatment or environmental protections, meanwhile state violence against opposition movements is more widespread [4,96]. Yet, regardless of political context, CEJ framework can help clarify human-environment tensions as well as identify avenues for shared governance.

A holistic CEJ framework to assess O&G infrastructure is useful in the US and internationally. The CEJ framework can provide a moral compass for international, national, state, and local decision-makers by linking different types of justice (distributive, regulatory, recognition, environmental) to help clarify the extent of current and future harm imposed on communities, species, and ecosystems. Fundamentally, CEJ requires assessment beyond the local sphere and shows how we are all connected. If there are stronger environmental and human rights standards in some locations, extraction may shift to areas of fewer regulations and less participation (or lower resistance). Accepting tradeoffs problematizes CER: for example, an argument in support of mid-Atlantic pipelines is that they bring fracked gas from other states, making it possible to avoid dangerous in-state water pollution from hydraulic fracturing. Long-distance gas infrastructuring allows companies like Dominion to pit winner A against loser B in violation of the basic premise of CER.

Understanding connections in CEJ creates the obligation to act across borders. Resistance in Virginia has similarities to anti-gas

¹¹ Only time will tell if residents might leave Lusby, but low-income populations can least afford to relocate. If people depart, a decline in property values could augment distributive injustices.

¹² For example, Augusta County Alliance is pressuring the country's Board of Zoning Appeals to require Dominion to respect rural zoning when establishing a large construction yard with industrial noise and emissions.

activism in states like New York and Pennsylvania, but also speaks to elements of oppression and resistance internationally. CEJ requires information about and solidarity with populations in other locations. This is a tall order, but a takeaway from our sites of compound frictions is that identification of a shared objective can support proximate and distant collaboration toward change. With LNG, this cannot just include ties from Maryland to Texas, but must also seek and adapt lessons from Argentina, Cyprus, Australia, Qatar, and Nigeria. What if engaged global citizens could not only identify the energy future we did not want, one of racism and run-away climate change, but also what we did want, with informed consent, agency, respect, and ultimately justice? We suggest recognition of the value of proximate and distant collective engagement, along with use of oppositional frictions to demand recognition and procedural justice, are building blocks to productively advance toward CER.

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