

Carbon dioxide pipelines are disproportionately located in marginalized communities in the United States

Corresponding Author: Dr Majid Shafiee-Jood

This file contains all editorial decision letters in order by version, followed by all author rebuttals in order by version.

Attachments originally included by the reviewers as part of their assessment can be found at the end of this file.

Version 0:

Decision Letter:

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Dear Dr Shafiee-Jood,

Your manuscript titled "Pipelines of Inequity? Environmental Justice and CO2 Pipeline Infrastructure Amid Climate Policies" has now been seen by 2 reviewers, whose comments are appended below. You will see that they find your work of some potential interest. However, they have raised quite substantial concerns that must be addressed. In light of these comments, we cannot accept the manuscript for publication, but would be interested in considering a revised version that fully addresses these serious concerns.

We hope you will find the reviewers' comments useful as you decide how to proceed. Should additional work allow you to address these criticisms, we would be happy to look at a substantially revised manuscript, for example:

- address these criticisms (that is, either to incorporate the suggestions or provide a compelling argument why the point made by the reviewer is not valid, or relevant to the editorial threshold as outlined below)

AND

- meet our editorial thresholds as outlined below,

then we would be happy to look at a substantially revised manuscript.

In the following, we list our main editorial concerns.

*****Provide novel and fully supported insight into the impact of carbon dioxide pipelines on marginalized communities in the US.**

*****Provide comprehensive methodological details, including definition of disadvantaged communities, minority demography, clarify the choice of indicators and variables, and all calculation procedures, and offer standardized metrics for infrastructure risks/accidents.**

*****Discuss the limitation of your study, more specifically, the use of only one study on projected pipelines, and demonstrate that your data and analysis support your claims.**

If you choose to take up this option, please either highlight all changes in the manuscript text file, or provide a list of the changes to the manuscript with your responses to the reviewers.

When resubmitting, please provide a point-by-point response to the reviewers' comments. Please submit your responses as a separate file, distinct from your cover letter where you can add responses to the Editors' comments that you do not want to be made available to the reviewers. Word files are preferred. We recommend that any figures, tables or graphs that are included in the response to reviewers are also included in the main article or Supplementary Information.

Please bear in mind that we will be reluctant to approach the reviewers again in the absence of substantial revisions.

If the revision process takes significantly longer than three months, we will be happy to reconsider your paper at a later date, as long as nothing similar has been accepted for publication at Communications Earth & Environment or published elsewhere in the meantime.

We are committed to providing a fair and constructive peer-review process. Please do not hesitate to contact us if you wish to discuss the revision in more detail.

Please use the following link to submit your revised manuscript, point-by-point response to the reviewers' comments with a list of your changes to the manuscript text (which should be in a separate document to any cover letter), a tracked-changes version of the manuscript (as a PDF file) and any completed checklist:

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Please do not hesitate to contact us if you have any questions or would like to discuss the required revisions further. Thank you for the opportunity to review your work.

Best regards,

Viniece Jennings, Ph.D.
External Editor
Communications Earth & Environment

Martina Grecequet, PhD
Senior Editor
Communications Earth & Environment

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REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

1. The abstract lacks clear presentation of research methodology and innovation points. It would benefit from a more structured format highlighting the research methods, quantitative findings, and unique contributions.
2. The statement "the actual demographic distribution of CO2 pipelines remains unknown" should be rephrased to clearly indicate that the demographic characteristics of populations living in proximity to CO2 pipelines have not been systematically studied.
3. In the Introduction section, the terms "minority demography," "marginalized groups," and "Black communities" are used interchangeably and create confusion. Please clarify whether "minority demography" is equivalent to "marginalized groups," and explicitly state the relationship between "Black communities" and "marginalized groups."
4. Provide a detailed demonstration of the calculation process involved in Line 171-174.

Reviewer #2 (Remarks to the Author):

This manuscript contributes to a small but growing literature on potential inequities in carbon management—an important and increasingly salient policy topic. The authors present some interesting insights on this topic, but I have reservations about some of their methodological choices that will need to be addressed before this piece is ready for publication.

Major Revisions

- Some of the limitations of this study need to be made clearer in the abstract, introduction, and results sections. One of those is the reliance on the Princeton Net Zero America study as the blueprint for projected pipeline extents by 2030. While the study is rigorous and has become influential in policy circles, its projections represent one set of assumptions by one set of researchers (which is the nature of projections). I am sympathetic to the authors' use of only this study for projected pipeline infrastructure, as other projections (i.e. Baik et al. for BECCS) tend to be technology-specific. It is important, however, that the paper makes clear that this study analyzes the potential distributional impacts of that study, in addition to existing pipeline routes and routes already announced by industry (as an aside, the announcements should be individually cited with primary documents in addition to the CRS report). This allows for transparency of assumptions as well as makes clear that very few pipeline routes are set in stone at this stage and could change dramatically (toward the more or less equitable).
- The authors discuss pipeline-related accidents but are vague on the likelihood and nature of these events, especially in comparison to infrastructure the public is more familiar with, i.e. electricity transmission. While the raw count of accidents is somewhat useful, a more standardized metric (accidents per mile of infrastructure, for example) would better allow readers to compare the risks of this infrastructure with those that others pose. Pipelines can evoke emotional responses from the general public, so responsible science requires clear communication of the level of risk, the kinds of harms that can be wrought (especially in comparison to harms that readers are more likely to be familiar with), and the potential scale. As one small example, the authors refer to (presumably) CO₂ on lines 75 and 76 as a "hazardous pollutant," which is perhaps true by some definitions of the word but is not true by the legal definition of hazardous air pollutants under the Clean Air Act, which doesn't include CO₂. This is not to discount the potential risks of a CO₂ pipeline accident – the case in Sattartia, Mississippi was indeed quite scary – but precision of language is necessary to clearly communicate novel (and scary sounding!) concepts to readers. Instead of using your own descriptors for this section, you might refer to qualitative work on the subject to communicate that these are fears that community members have been found to have, i.e. Scott-Buechler et al., 2024 (on DAC, but covering perceptions about pipelines).
- The authors do not define "disadvantaged" communities, despite this being core to the paper. I suggest either using existing definitions by federal and/or state governments (which have been criticized as being too stringent and thus overlooking some dimensions of inequity) or looking to the EJ literature to more clearly explain this concept and why the authors used the indicators they did. All indicators included in the model should be clearly listed and briefly explained at the beginning of the results and then further explained in the methods and supplementary information. Other related points on the authors' indicators for disadvantaged communities:
 - o The authors use a flat cutoff of \$200,000 household income as their indicator of wealth but don't explain this. Wealth is highly contextual, and while I wouldn't expect the authors to have extremely sophisticated metrics that the census doesn't capture, i.e. reflecting generational wealth, the authors could, for example, correct for local cost of living. Further, in the methods, the authors mention two metrics based on poverty levels but don't mention these in the results. Is this because they weren't significant? If so, how would the authors explain this?
 - o The problems with the wealth indicator extend, I believe to the home ownership indicator. On first read of the results, one might be led to believe that wealthier people own more homes and so the greater incidence of pipelines with home ownership actually means that there is progressive distribution of this infrastructure. That does not appear to be what the authors are saying, however, so they should explain in the discussion.
 - o Explaining the choice of variables will also be important to clarifying why the authors report results on the proportion of Black residents in adjoining census tracts but not other races or ethnicities. If this is because they're trying to comment on a particular trend of anti-Black racism in infrastructural environmental injustices, they should say so and provide evidence (and reframe the intro and abstract to foreground this). If it's because other demographic variables weren't significantly correlated, the authors should be clear about this and explain in the discussion why they think this might be. Either way, if Blackness is being used one of the core indicators of disadvantage (which makes total sense given historic patterns of environmental racism), then figures like 4(b) and (c) should show how proportion of white residents (who have historically been privileged in infrastructure siting) compares. If possible, looking at the interaction of race, class, and rurality might lend some useful insights too. Is it, for example, the case that proposed pipeline route likelihood decreases with proportion of Black residents because the dominant predictor of siting is rurality, but that the interaction of the two indicators shows a greater likelihood of pipelines through rural census tracts with greater proportions of Black residents as compared with rural census tracts with greater proportion of white residents? Similarly, what is the interaction between low education attainment and rurality? In general, rural populations have less access to education...
 - o The effect sizes for most of the indicators are quite small. This should be reckoned with explicitly, especially in the discussion.
- The results should provide some insights onto how the projected accident incidence rate was arrived at, even if the authors go into greater detail in subsequent sections. Lines 178 – 188 are lacking necessary citations, especially for specific numeric values. Lines 305 – 309 need to be much clearer. The following paragraph needs more citations, especially for specific projects, from primary sources.
- Lines 226 – 231 are unclear to me, which I list as a "significant" revision because this is one of the primary findings statements.

Minor Revisions

- In the introduction, the authors note on lines 36 – 37 that CCS and CDR will require large networks of CO₂ pipelines. This isn't necessarily true—decision makers could choose to collocate capture and storage to minimize pipelines. This is a small but important nuance because it changes the binary choice from being lots of pipelines to no pipelines to a much broader spectrum of options. See also major revision about specifying this work is in response to Net Zero America, which does indeed assume a large network of pipelines, but is one study with one set of assumptions by the authors.
- Lines 66 – 67 describe CCS as a proposal for decarbonizing fossil fuels; while this is true, CCS has also been proposed as a necessary tool for decarbonizing industrial process emissions like those from steel and cement. This should be noted.
- Are the authors projecting demographic changes for census tracts that are expected to see pipeline proposals in the future? If not, please justify.
- As I noted above, more attention to comparing risks and accident rates to other, better-known infrastructure, i.e. electric transmission, would help contextualize findings.
- The authors' citation 27, used to justify their urbanity metric, doesn't appear to me to be an authoritative source on how to define urban versus rural communities. Better explanation is needed.

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Version 1:

Decision Letter:

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Dear Dr Shafiee-Jood,

Your manuscript titled "Pipelines of Inequity? Environmental Justice and CO₂ Pipeline Infrastructure Amid Climate Policies" has now been seen by our reviewers, whose comments appear below. In light of their advice, we are delighted to say that we are happy, in principle, to publish a suitably revised version in Communications Earth & Environment.

We therefore invite you to edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

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We hope to hear from you within two weeks; please let us know if you need more time.

Best regards,

Viniece Jennings, PhD
Editorial Board Member
Communications Earth & Environment

Martina Grecequet, PhD
Senior Editor,
Communications Earth & Environment
@CommsEarth

REVIEWERS' COMMENTS:

Reviewer #1 (Remarks to the Author):

The paper can be published

Reviewer #2 (Remarks to the Author):

Thank you for addressing my comments. I am satisfied by the revised manuscript.

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Pipelines of Inequity? Environmental Justice and CO₂ Pipeline Infrastructure Amid Climate Policies

Julia Davis, Nafiseh Salehi, Liqing Li, Majid Shafiee-Jood

Response Document

Ref.: COMMSENV-24-2893-T

Reviewer #1:

We would like to thank you for your careful assessment of our manuscript. Below, please see our responses to your comments. We have also specified what changes we made in the manuscript based on each comment. Please note that line/page, equation, figure, and table references in the responses refer to the revised manuscript.

Remarks:

- 1. The abstract lacks a clear presentation of research methodology and innovation points. It would benefit from a more structured format highlighting the research methods, quantitative findings, and unique contributions.**

We have edited our abstract to reflect the research methods, quantitative findings, and contributions of our research. In the revised manuscript, we have now added these specifications to our manuscript which we have quoted below—for clarity, we have bolded the changes to the abstract that highlight the research methods, quantitative findings, and innovation points:

*“Carbon capture and storage and carbon dioxide removal technologies are pivotal for net-zero climate goals, requiring extensive CO₂ pipeline expansion across the U.S. However, as this network grows, concerns about safety and environmental justice intensify, due to insufficient regulations that may disproportionately expose marginalized communities to risks. **This is the first study to empirically examine the environmental justice implications of existing and potential pipelines across communities. Using census-tract demographic data and pipeline spatial data, we applied LASSO regression to identify key demographic variables and incorporated them into binary logistic regression models** to uncover if the locations of, and disadvantages associated with, CO₂ pipelines are equally distributed among different demographics. **We find higher-income communities are less likely to host existing pipelines. Proposed pipelines are generally in areas with higher concentrations of Black residents, while areas with higher educational attainment show reduced likelihood.** Using the Net Zero America study’s 2030 projection of CO₂ pipelines, **we observe diminished impacts on higher-income and educated communities, although Black residents are less likely to have a pipeline in this scenario. All pipelines were more likely to be in rural areas. These findings reveal persistent demographic disparities in pipeline locations, underscoring concerns about resource accessibility and preparedness.**”*

2. **The statement "the actual demographic distribution of CO₂ pipelines remains unknown" should be rephrased to clearly indicate that the demographic characteristics of populations living in proximity to CO₂ pipelines have not been systematically studied.**

Thank you for pointing out this distinction. We have edited the manuscript to reflect this change in Lines 66-68, which now reads,

"However, the demographic characteristics of populations living in proximity to CO₂ pipelines have not yet been systematically studied."

3. **In the Introduction section, the terms "minority demography," "marginalized groups," and "Black communities" are used interchangeably and create confusion. Please clarify whether "minority demography" is equivalent to "marginalized groups," and explicitly state the relationship between "Black communities" and "marginalized groups."**

This is a great point, and Reviewer #2 raised a similar question. We agree that the interchangeable usage of these terms creates confusion. We have removed the term "minority demography" from our manuscript and instead replaced it with "marginalized groups." Further, we have defined the term "marginalized groups" as populations with long established correlations with environmental injustices in geographical and sociological research, in Lines 97-99:

"We define marginalized groups as demographic groups that have previously been found to be inequitably close to or impacted by environmental harms."

We choose to define marginalized groups based on existing environmental justice literature, as we agree with Reviewer #2's comment that existing governmental definitions may have certain limitations that overlook some dimensions of inequity, which we highlight and cite in Lines 101-120 (quoted below).

We also indicate the specific groups that we define as marginalized in relation to environmental justice, which we use as our demographic variables of interest. We specified these marginalized groups and how we define and quantify them within our analysis in Lines 193-215 (quoted below).

Lines 99-117 (in the Introduction section):

"Previous environmental justice literature indicates that racial minorities and low-income commissions are more likely to live near environmentally hazardous land uses and be exposed to harmful pollutants (Chambliss et al., 2021; Snyder Benneer, 2022; Ash & Boyce, 2018; Bullard, 1993)). Research regarding proposed natural gas pipeline routes, for instance, found that these pipelines tend to be more densely concentrated in marginalized communities (Strube et al., 2021; Emanuel et al., 2021). Further, rural areas with lower population density tend to experience more environmental damage from development projects, compared to metropolitan areas (Strube et al., 2021; Kelly-Reif & Wing, 2016; Wang et al., 2021). Areas with lower levels of environmental damage also tend to have higher housing occupation rates and a greater proportion of owner-occupied homes (Gamper-Rabindran & Timmins, 2023). In environmental justice literature, renters are often considered more vulnerable to environmental damages and the consequences of gentrification. Renters may have less incentive

or bargaining power to oppose the siting of pollutants. Moreover, once an area's environmental quality improves, renters who cannot afford higher rents are more likely to move out. A prior study, for instance, found an increase in out-migration for less-educated renters in gentrifying neighborhoods (Brummet & Reed, 2019). A 2021 report by the Environmental Protection Agency additionally found that those with low educational attainment generally experience unequal negative environmental impacts due to climate change (Environmental Protection Agency, 2021). To summarize, based on these well-formed relationships between specific demographic groups their unequal experiences with environmental harms, marginalized groups include low-income populations, non-white racial groups, lowly formally educated communities, areas with vacant or rented properties, and rural areas."

Lines 164-186 (in the Results section):

"To examine the relationship between pipeline locations and community characteristics, we identify the following variables to measure the community characteristics, establishing a complete picture of whether certain U.S. populations are more likely to live near CO₂ pipelines and face associated hazards. To measure rurality of a census tract, we use population density, defined as the number of people per square mile, as well as an urban indicator, defined as an area of at least 1,000 people per square mile (Strube et al., 2021; Kelly-Reif & Wing, 2016; Wang et al., 2021; United States Department of Agriculture, 2024). We use the following variables to determine the percentage of the population within each census tract that is a part of a specific racial group: white, Black, American Indian/Native American, Asian, and Native Hawaiian/Pacific Islander; the non-white racial groups are considered marginalized communities within our study (Chambliss et al., 2021; Snyder Benneer, 2022; Ash & Boyce, 2008; Bullard, 1993). To measure educational attainment, we use the following variables to determine the percentage of the population within each census tract that has achieved certain levels of education: no schooling completed, standard high school as the highest education level, GED or alternative credential as the highest education level, some college experience as the highest education level, an Associate's degree, a Bachelor's degree, or a Master's, professional school, or Doctorate degree as the highest education level; we consider those with their highest education level as high school, GED or alternative credential, or less, as a marginalized group (Brummet & Reed, 2019; Environmental Protection Agency, 2021). To measure income and poverty, we use the following variables to understand the rates of each census tract's population that has specific levels of income and poverty: high-income households, defined as households with an income of at least \$200,000; high poverty, defined as an income to poverty ratio of under 0.5; and low poverty, defined as an income to poverty ratio of at least 2 (Snyder Benneer, 2022). We use the following variables to measure housing occupancy: homeownership rates, and vacancy rates. We consider marginalized communities as those with relatively lower homeownership rates and higher vacancy rates (Gamper-Rabindran & Timmins, 2023; Brummet & Reed, 2019)."

4. Provide a detailed demonstration of the calculation process involved in Line 171-174.

We have provided a detailed calculation process in our Supplementary Information, as well as clarified this process in the Manuscript. Specifically, the following calculations are described on Page 6 in the Supplementary Information document, which is then referred to in Lines 257-265 within the main Manuscript:

Given 121 accidents over 30 years and 5,300 cumulative existing pipeline miles:

$$\frac{121 \text{ accidents}}{5,300 \text{ miles}} = 0.0228 \text{ accidents per mile over 30 years}$$

Applying this rate to the proposed pipeline network:

$$0.0228 \text{ accidents per mile} \times 3,580 \text{ cumulative proposed miles} \\ = 81.732 \text{ accidents over 30 years}$$

$$\frac{81.732 \text{ accidents}}{30 \text{ years}} = 2.7 \text{ accidents per year along proposed network}$$

Applying this rate to the 2030 projected pipeline network:

$$0.0228 \text{ accidents per mile} \times 11,800 \text{ cumulative projected miles} \\ = 269.396 \text{ accidents over 30 years}$$

$$\frac{269.396 \text{ accidents}}{30 \text{ years}} = 9 \text{ accidents per year along projected network}$$

Reviewer #2:

This manuscript contributes to a small but growing literature on potential inequities in carbon management—an important and increasingly salient policy topic. The authors present some interesting insights on this topic, but I have reservations about some of their methodological choices that will need to be addressed before this piece is ready for publication.

We would like to thank you for your positive feedback and careful assessment of our manuscript. Below, please see our responses to your comments. We have also specified what changes we made in the manuscript based on each comment. Please note that line/page, equation, figure, and table references in the responses refer to the revised manuscript.

Remarks:

- 5. Some of the limitations of this study need to be made clearer in the abstract, introduction, and results sections. One of those is the reliance on the Princeton Net Zero America study as the blueprint for projected pipeline extents by 2030. While the study is rigorous and has become influential in policy circles, its projections represent one set of assumptions by one set of researchers (which is the nature of projections). I am sympathetic to the authors' use of only this study for projected pipeline infrastructure, as other projections (i.e. Baik et al. for BECCS) tend to be technology-specific. It is important, however, that the paper makes clear that this study analyzes the potential distributional impacts of that study, in addition to existing pipeline routes and routes already announced by industry (as an aside, the announcements should be individually cited with primary documents in addition to the CRS report). This allows for**

transparency of assumptions as well as makes clear that very few pipeline routes are set in stone at this stage and could change dramatically (toward the more or less equitable).

We thank you for your comment and have revised our manuscript to add clarity to the limitations of our study. We have cited the proposed pipeline route announcements and have stated our limitations clearly, specifically in the abstract, introduction, and results sections.

The first limitation of our findings is in regard to the spatial distribution of the 2030 projected pipeline network. In the revised Manuscript, Lines 136-136 in the Introduction and Lines 332-338 in the Discussion, we describe that:

Lines 134-136: “While our analysis incorporates future pipeline routes, it is important to acknowledge that these placements are not guaranteed, particularly in the 2030 projection scenario, which is based on Net Zero America study projections rather than actual pipeline company plans (Larson et al., 2021).”

Lines 332-338: “...the placement of the future pipeline routes in our analysis is not guaranteed, both in general and in the same place as where they are in our analysis. This is especially true in the 2030 projected scenario, where we have relied on the Net Zero America report for pipeline routes (Larson et al., 2021); however, these pipelines have not actually been planned by pipeline companies, and there are currently no publicly known formal plans to construct pipelines in the exact projected places. Therefore, our estimated correlations between the placement of these routes and demographic variables may not hold true for the actual future pipelines.”

We further reference this limitation within the abstract, where we indicate that the future pipelines are “potential” routes on in Lines 19-20. We are limited to dive deeper into a description of our limitations within the abstract due to the word count restriction.

Within the results section, we have edited the following sentence in Lines 161-163. Our changes are bolded below for clarity:

*“However, the 2030 projected pipeline network is dependent on the physical practicality of route options, **which may not come to fruition due to practical and political feasibility, even if pipeline companies choose to initially adopt these paths in their future proposals.**”*

The second limitation we discuss is the fact that we have not projected future demographic makeups of the counties that have a 2030 projected pipeline, which we reference in Lines 136-139:

“Additionally, while we do not account for possible demographic changes between 2017-2021 and 2030 that could influence our findings of demographic disparities along future pipeline routes, we mitigate this by focusing on a nearer-term projection rather than later decades.”

We further argue for our reasoning behind choosing to not project future demographics in Lines 338-350:

“Even with the assumption that these possible future pipeline routes are constructed, by the time that is complete, the demographic makeup of the census tracts surrounding the pipeline may be significantly different from the

demographic makeup between 2017-2021, which we used for our analysis. We do not project future the demographic makeup of census tracts surrounding the future pipeline routes because of concern that these projections may not be accurate: the future pipeline policy itself might change demographic makeup in ways we wouldn't normally project from past trends. Therefore, a limitation of our analysis is that we assume that the demographic makeup of our studied areas will not significantly change from the 2017-2021 average to 2030. We attempt to mitigate the error produced by this limitation by assessing the 2030 projected pipeline routes, as opposed to a later dated projection, such as 2050 or 2100; 2030 projections are relatively closer to 2017-2021, therefore the demographic makeup of relevant areas in our study are likely to be more similar to the 2017-2021 average."

To address this limitation within our abstract section, we indicate that our findings describe correlated, not causal, relationships.

We further argue that these limitations do not necessarily discredit our findings of an unequal distribution of CO₂ pipelines along demographic groups. Specifically, we briefly mention these arguments in Lines 139-145 in the Introduction, which we discuss further in Lines 353-381 in the Discussion:

Lines 139-145: "Despite these uncertainties, we argue that the broader pattern of inequitable pipeline placement is unlikely to disappear. If future routing decisions are influenced by local opposition, marginalized communities—who often face barriers to effective resistance—may remain disproportionately affected (Botelho et al., 2005; Harding et al., 2003; Haiar, 2023a; Haiar 2023b; Marquez, 2023). Furthermore, past research suggests that demographic shifts following infrastructure development could result in marginalized groups moving closer to these pipelines over time, reinforcing existing disparities (Rüttenauer & Best, 2021; Diamond & Gaubert, 2022)."

Lines 353-381: "Despite the limitations of this study, we argue that the unbalanced distribution of projected pipelines would likely not disappear, should more CO₂ pipelines be built in the future. The projected pipeline routes used in our analysis have not yet been affected by opposition from local communities; at the same time, proposed pipelines, whose routes have been shaped by socio-political influences, are more likely to be located in Black communities, because local communities played a role in the siting process. This narrative aligns with the environmental justice literature, suggesting environmental injustice through siting decisions by firms and through bargaining between firms and communities. In other words, if pipeline companies propose these 2030 projected routes in the future, the placement of these pipelines will likely be influenced by local voices; it is possible that the unequal distribution of pipeline locations could worsen for some marginalized communities, who typically have lower bargaining power to effectively oppose a CO₂ pipeline in their communities (Botelho et al., 2005; Harding et al., 2003). While pipeline companies may use eminent domain to enforce their routing decisions, effective pushback from formal community

opposition has proven limited effectiveness in thwarting proposed pipeline routes in the past (Haiar, 2023a; Haiar 2023b; Marquez, 2023). These successful community resistances to CO₂ pipeline proposals required significant time, money, and education and awareness for legal fees, lobbying efforts, and public outreach—resources that are generally more abundant in non-marginalized communities.

Additionally, while we do not account for the change of demographic composition for the communities surrounding proposed and projected routes, we also argue that the makeup of these areas may change due to pipeline placement in a manner where marginalized groups may end up moving closer to these pipelines, should they be constructed. Past research on the theory of residential sorting indicates that non-marginalized groups distribute themselves across geographic areas void of environmental risks, leaving marginalized groups more likely to be displaced and move closer to these areas Rüttenauer & Best, 2021; Diamond & Gaubert, 2022). Thus, without the urgent and sufficient integration of environmental justice considerations into climate policy development along the expansion of CO₂ pipelines, the projected routes could shift to slightly different areas with higher shares of Black residents, further raising concerns about the inequitable distribution of pipeline infrastructure (Rüttenauer & Best, 2021; Diamond & Gaubert, 2022). ”

Lastly, we have addressed the limitations of our estimated impacts of future pipeline accidents in Lines 259-260, 399-404, and 577-580, by explicitly stating that these estimates are dependent on the actuality of estimated future pipeline mileage. Specifically, we assume that (as stated in Lines 399-404):

“...future pipelines are constructed, operated, and maintained in the same manner and under the same built and natural conditions both built and natural as the existing pipeline infrastructure between 1994 and 2023, which may not be the case... still, the proposed and projected pipelines are routed in varying and different geographical areas from the existing routes, thus the pipelines likely would experience different impacts that may affect their accident rates. ”

- 6. The authors discuss pipeline-related accidents but are vague on the likelihood and nature of these events, especially in comparison to infrastructure the public is more familiar with, i.e. electricity transmission. While the raw count of accidents is somewhat useful, a more standardized metric (accidents per mile of infrastructure, for example) would better allow readers to compare the risks of this infrastructure with those that others pose. Pipelines can evoke emotional responses from the general public, so responsible science requires clear communication of the level of risk, the kinds of harms that can be wrought (especially in comparison to harms that readers are more likely to be familiar with), and the potential scale. As one small example, the authors refer to (presumably) CO₂ on lines 75 and 76 as a “hazardous pollutant,” which is perhaps true by some definitions of the word but is not true by the legal definition of hazardous air pollutants under the Clean Air Act, which doesn’t include CO₂. This is not to discount the potential risks of a CO₂ pipeline accident – the case in Satartia, Mississippi was**

indeed quite scary – but precision of language is necessary to clearly communicate novel (and scary sounding!) concepts to readers. Instead of using your own descriptors for this section, you might refer to qualitative work on the subject to communicate that these are fears that community members have been found to have, i.e. Scott-Buechler et al., 2024 (on DAC, but covering perceptions about pipelines).

We thank you for your feedback—we agree with your concern about the clear communication of CO₂ and related pipeline infrastructure. In the revised manuscript, we have provided more precise information and language regarding CO₂ pipelines. Specifically, we have included a clearer accident rate comparison between CO₂ pipelines and other similar infrastructure in Lines 265-269:

“While these numbers are small in comparison to the over 2,000 previous natural gas pipeline accidents, the rate of CO₂ pipeline accidents per mile are over twenty times that of natural gas pipelines, which are more heavily regulated: there are an estimated 187 accidents per 10,000 miles of CO₂ pipelines, but only 8 accidents per 10,000 miles of natural gas pipelines (FrackTracker Alliance, 2023).”

We have also forgone the wording of “hazardous pollutant,” instead replacing it with CO₂, and included a less emotionally charged description of CO₂, supported by qualitative research, polls, and reports (including a 2024 Global CCS Institute report on community concerns and engagement with respect to CO₂ pipelines within the United States), in Lines 83-95:

“Prior research indicates that community members are especially concerned about the unsafe operation, disruption, and risks that CO₂ pipelines may bring to their area (Gough et al., 2014). While CO₂ is not legally defined as a hazardous air pollutant under the Clean Air Act, this chemical compound can pose potential severe health, economic, and environmental dangers in high concentrations (Lu et al., 2020; Lu et al., 2023; Wilday et al., 2009; FSIS Environmental Safety and Health Group, n.d.; United States Congress, 1970). The pipelines that transport CO₂ are underregulated at both state and federal levels, posing severe health, economic, and environmental dangers due to the CO₂ pollutant the pipelines transport (Lu et al., 2020; Lu et al., 2023; Wilday et al., 2009). A 2020 CO₂ pipeline accident in Mississippi, for example, saw 45 residents hospitalized and hundreds evacuated due to a CO₂ pipeline accident (Simon, 2023). Community opposition is strong, particularly against property laws like eminent domain that favor pipeline companies; recent polls indicate that over three-quarters of Iowa residents oppose using eminent domain to build carbon-capture pipelines, but the federal government has allowed it (Mediacom, 2023; Supreme Court of the United States, 2021). As routes are expected to expand, more people will be exposed to related safety and regulatory complications.”

- 7. The authors do not define “disadvantaged” communities, despite this being core to the paper. I suggest either using existing definitions by federal and/or state governments (which have been criticized as being too stringent and thus overlooking some dimensions of inequity) or looking to the EJ literature to more clearly explain this concept and why the authors used the indicators they did. All indicators included in the**

model should be clearly listed and briefly explained at the beginning of the results and then further explained in the methods and supplementary information.

We thank you for your feedback, and we agree with your concern over the lack of clarity defining marginalized communities. Reviewer #1 has similarly raised concerns over the lack of definition of marginalized communities in Comment #3. In our revised manuscript, in Lines 97-99, we have added the following statement:

“We define marginalized groups as demographic groups that have previously been found to be inequitably close or impacted by environmental harms.”

We have additionally given and cited our reasons behind the choices of our indicator variables in Lines 99-117, based on findings from environmental justice literature:

“Previous environmental justice literature indicates that racial minorities and low-income communities are more likely to live near environmentally hazardous land uses and be exposed to harmful pollutants (Chambliss et al., 2021; Snyder Benneer, 2022; Ash & Boyce, 2018; Bullard, 1993). Research regarding proposed natural gas pipeline routes, for instance, found that these pipelines tend to be more densely concentrated in marginalized communities (Strube et al., 2021; Emanuel et al., 2021). Further, rural areas with lower population density tend to experience more environmental damage from development projects, compared to metropolitan areas (Strube et al., 2021; Kelly-Reif & Wing, 2016; Wang et al., 2021). Areas with lower levels of environmental damage also tend to have higher housing occupation rates and a greater proportion of owner-occupied homes (Gamper-Rabindran & Timmins, 2023). In environmental justice literature, renters are often considered more vulnerable to environmental damages and the consequences of gentrification. Renters may have less incentive or bargaining power to oppose the siting of pollutants. Moreover, once an area’s environmental quality improves, renters who cannot afford higher rents are more likely to move out. A prior study, for instance, found an increase in out-migration for less-educated renters in gentrifying neighborhoods (Brummet & Reed, 2019). A 2021 report by the Environmental Protection Agency additionally found that those with low educational attainment generally experience unequal negative environmental impacts due to climate change (Environmental Protection Agency, 2021). To summarize, based on these well-formed relationships between specific demographic groups their unequal experiences with environmental harms, marginalized groups include low-income populations, non-white racial groups, lowly formally educated communities, areas with vacant or rented properties, and rural areas.”

- 8. The authors use a flat cutoff of \$200,000 household income as their indicator of wealth but don’t explain this. Wealth is highly contextual, and while I wouldn’t expect the authors to have extremely sophisticated metrics that the census doesn’t capture, i.e. reflecting generational wealth, the authors could, for example, correct for local cost of living. Further, in the methods, the authors mention two metrics based on poverty levels but don’t mention these in the results. Is this because they weren’t significant? If so, how would the authors explain this?**

Thank you for your comment. We attempt to account for contextual wealth by including variables of high-income household rates and income to poverty ratios. As past environmental justice research has well established that income is well correlated with reduce environmental injustices and concerns, we found it important to include a variable that captures the share of high-income households within a given community; we use a \$200,000 threshold to define households as high-income. A recent Pew Research Center analysis, for example, recently found that high-income households in the US had incomes of greater than \$169,000 (Pew Research Center, 2024). Given the intervals of household incomes within our available demographic data, we chose to represent these high-income households as those making at least \$200,000 per year.

Income to poverty ratio variables help to capture a more nuanced understanding of the distribution of economic well-being across a population, as well as allows us to better evaluate impacts on low-income households beyond those officially classified as “in poverty.” Further, the Census Bureau does not adjust for varying costs of living across different geographic areas, and income to poverty is commonly used as an indicator variable in environmental justice studies (U.S. Census Bureau, 2023; U.S. Environmental Protection Agency, 2024).

Further, we chose not to include the two metrics based on poverty levels within the results section because they were removed from our models, likely due to collinearity, in our LASSO regression analysis.

9. Explaining the choice of variables will also be important to clarifying why the authors report results on the proportion of Black residents in adjoining census tracts but not other races or ethnicities. If this is because they’re trying to comment on a particular trend of anti-Black racism in infrastructural environmental injustices, they should say so and provide evidence (and reframe the intro and abstract to foreground this). If it’s because other demographic variables weren’t significantly correlated, the authors should be clear about this and explain in the discussion why they think this might be. Either way, if Blackness is being used one of the core indicators of disadvantage (which makes total sense given historic patterns of environmental racism), then figures like 4(b) and (c) should show how proportion of white residents (who have historically been privileged in infrastructure siting) compares. If possible, looking at the interaction of race, class, and rurality might lend some useful insights too. Is it, for example, the case that proposed pipeline route likelihood decreases with proportion of Black residents because the dominant predictor of siting is rurality, but that the interaction of the two indicators shows a greater likelihood of pipelines through rural census tracts with greater proportions of Black residents as compared with rural census tracts with greater proportion of white residents? Similarly, what is the interaction between low education attainment and rurality? In general, rural populations have less access to education...

We only report significant coefficients here due to space limitations. Results for other races are not included in the main Manuscript because they are statistically insignificant, but we now have included their results in Supplementary Table S4. We have made the following clarifications in the revised manuscript:

Lines 207-210 for the existing pipeline network analysis:

“The other demographic variables included in the model, but not reported here, are not statistically significantly correlated with the presence of an existing

pipeline at the 95% level and are included in Supplementary Eq. S3, Note S2, and Table S4.”

Lines 228-230 for the proposed pipeline network analysis:

“Supplementary Eq. S4, Note S2, and Table S4 contain the other demographic variables included in the model that are not statistically significantly correlated with the presence of a proposed pipeline at the 95% level.”

Lines 251-255 for the 2030 projected pipeline analysis:

“The other demographic variables included in the model that are not statistically significantly correlated with the presence of a projected pipeline at the 95% level are included in Supplementary Eq. S5, Note S2, and Table S4. The regression coefficients and marginal effects for the relevant variables within the three datasets are presented in Supplementary Table S4 and Table S6.”

The lack of statistical significance for certain variables within each dataset indicates that the proportion of these groups in a census tract does not have a strong or consistent association with the respective pipeline location. There are many possible reasons for the insignificant correlations between some demographic variables and the presence of an existing or future (possible) pipeline. For example, there may be little variation in the share of these demographic groups across census tracts with and without existing or future CO₂ pipelines. Thus, there may not be a systematic relationship between the presence of these groups and pipeline siting decisions. Additionally, the lack of statistical significance could arise because pipeline routes are often influenced by geographic and economic factors that align differently with the residential patterns of these populations. If a demographic group is highly clustered in a few specific areas rather than evenly distributed across the study region, this can create challenges for analysis. Clustering might make it harder to disentangle whether observed patterns are due to the demographic group's presence or other local factors specific to those clusters, such as geographic or economic conditions. This can weaken the significance of the correlations between the presence of a pipeline and our un-reported demographic variables.

We have considered the interaction between marginalized racial demographic variables, and we have generally found insignificance in these interactions. For example, we interacted population density with black race, and we found no significance along the interaction term.

10. The effect sizes for most of the indicators are quite small. This should be reckoned with explicitly, especially in the discussion.

Thank you for your comment. In our original manuscript, we failed to convert the odds ratios to marginal effects within our binary logistic regression models for clearer interpretation. We have revised our results section to report the marginal effects of the significant demographic variables on the probability of the presence of an existing or possible future pipeline in Lines 221-234, 239-255, and 259-278, allowing for a clearer interpretation. We have also updated Figure 4 to display the marginal effects of the highly significant variables for each pipeline network. Below, we have indicated these edits in bold:

Lines 194-207:

“Within the existing CO₂ pipeline network logistic regression model, high-income-household areas ($\beta = -0.042$) are negatively associated with a presence

of a pipeline – **a one percentage point increase in the share of households with a yearly income of at least \$200,000 within a community is associated with a 0.24 percentage point decrease in the probability of having a pipeline in their census tract** (Fig. 1). We also find that rurality, population density, and homeownership rates are significant predictors of an existing pipeline presence (Fig. 4a); urban areas ($\beta = -1.276$) and population density ($\beta = -0.00058$) are negatively associated with the presence of a pipeline, such that **being in an urban area, as opposed to a rural area, is associated with a 7.42 percentage point decrease in the probability of having a pipeline in your census tract, and an increase in 1,000 people per square mile is associated with a 4 percentage point decrease in the likelihood of having a pipeline exist in that census tract**. Homeownership rates ($\beta = 0.0256$) are positively associated with the presence of a pipeline, i.e., **as homeownership rates within a census tract increase by one percentage point, the likelihood that the census tract has an existing pipeline increases by 0.15 percentage points.**”

Lines 212-228:

“Results from our logistic regression analysis of the proposed CO₂ pipeline routes show that Black residents ($\beta = 0.130$) are more likely to reside in a census tract where there is a pipeline proposed, such that **a one percentage point increase in the proportion of Black residents in a census tract is correlated with a 1.14 percentage point increase in the probability of having a pipeline proposed in that area** (Fig. 2). We also find a significant correlation between education levels and the presence of a proposed pipeline—as the share of people with high school ($\beta = 0.100$), or an associate’s or bachelor’s degree ($\beta = 0.090$), as their highest education level increases by one percentage point, so does their likelihood of having a pipeline proposed in their area by 0.88 and 0.79 percentage points, respectively. Additionally, there are significant correlations between a proposed pipeline in a census tract and the population density and homeownership rates in that census tract (Fig. 4b). Population density is negatively associated ($\beta = -0.00025$), with the presence of a pipeline, such that **with every increase in 1,000 people per square mile, the probability of a proposed pipeline in that census tract decreases by 20 percentage points**. Homeownership rates, similar to the existing pipeline network, are positively correlated ($\beta = 0.034$) with the presence of a pipeline, meaning that **as an area increases their homeownership rates by one percentage point, they are more likely to see the proposal of a CO₂ pipeline by 0.30 percentage points.**”

Lines 232-251:

“Within the 2030 projected CO₂ pipeline network, we find a significant negative correlation between the share of high-income households in a census tract ($\beta = -0.025$) and the presence of a projected pipeline by 2030—**a one percentage point increase in the share of households with a yearly income of at least \$200,000 within a community is associated with a 0.20 percentage point decrease in the probability of having a pipeline in their census tract** (Fig. 4c). Within a given census tract, **a one percentage point increase in higher education levels, specifically the share of people with college as the highest education level**

*($\beta = -0.015$), are associated with a 0.12 percentage point decrease in the likelihood of having a projected pipeline in the census tract, while a one percentage point increase in lower education levels, specifically the share of people with high school as the highest education level ($\beta = 0.009$), are associated with a 0.07 percentage point increase in the likelihood of having a projected pipeline in the census tract (Fig. 3). Surprisingly, as the share of Black residents in a census tract increases by one percentage point ($\beta = -0.017$), the likelihood of having a projected pipeline in the tract decreases by 0.08 percentage points, i.e., Black residents are less likely to have a pipeline projected in their area by 2030. We find that urban areas ($\beta = -0.908$) and population density ($\beta = -0.00012$) are negatively associated with the presence of a projected pipeline, such that **being in an urban area, as opposed to a rural area, is associated with a 7.13 percentage point decrease in the probability of having a pipeline projected in your census tract, and an increase in 1,000 people per square mile is associated with about a 1 percentage point decrease in the likelihood of having a pipeline projected in that census tract.**"*

To further assess if our marginal effect sizes are small, we compared the effect sizes with their respective baseline probabilities. We utilize the standard deviations (SD) in our comparison, as one SD change in variable *X* can represent a typical change in our data. Therefore, we can estimate how much the predicted probability of variable *X* changes by observing a one SD change in variable *X*—this predicted probability change, or effect size for one SD, is then compared to the baseline probability of variable *X* to determine if the effect size is small or large. Upon reflection, we determine that the marginal effect sizes for the statistically significant variables range from small to large. For clarity and convenience, we have added a Supplementary Table S6 of the statistically significant variables within each pipeline network, their marginal effects, standard deviations, and baseline probabilities. This table is included below:

CO₂ Pipeline Network	Variable	Marginal Effect (percentage point change)	Standard Deviation	Baseline Statistic (percent)
Existing	High-Income Households	0.24	0.0035	7.57
	Urban Indicator	7.42	0.1078	66
	Population Density	4 (per 1,000 people per sq. mile)	0.00005	3440.88 (people per sq. mile)
	Homeownership	0.15	0.0022	63.67
Proposed	Black race	1.14	0.0125	3.25
	High School Education	0.88	0.0097	26.12

	<i>Associate's/Bachelor's Degree Education</i>	0.79	0.0087	42.74
	<i>Population Density</i>	20 (per 1,000 people per sq. mile)	0.0002	1635.57 (people per sq. mile)
	<i>Homeownership</i>	0.30	0.0033	70.28
2030 Projected	<i>High-Income Household</i>	0.20	0.0018	9.10
	<i>College Education</i>	0.12	0.0011	20.29
	<i>High School Education</i>	0.07	0.0006	22.38
	<i>Black Race</i>	0.08	0.0008	9.49
	<i>Urban Indicator</i>	7.13	0.0649	0.74
	<i>Population Density</i>	1 (per 1,000 people per sq. mile)	0.000008	5307.22 (people per sq. mile)

11. The results should provide some insights into how the projected accident incidence rate was arrived at, even if the authors go into greater detail in subsequent sections. Lines 178 – 188 are lacking necessary citations, especially for specific numeric values. Lines 305 – 309 need to be much clearer. The following paragraph needs more citations, especially for specific projects, from primary sources.

Thank you for your recommendation. We have added necessary citations to the numeric values within Lines 271-281 (original lines 178-188), to indicate their derivations, which were either from the PHMSA dataset or from our calculations detailed in our Supplementary Note S3 and referenced in Lines 258-265 (original lines 171-174). Below, we have quoted Lines 300-310 to reference, and we have highlighted the necessary citations:

*“Areas that have experienced pipeline accidents have been exposed to a total of over 17.4 million gallons of CO₂ emissions between 1994 and 2023 **(PHMSA, 2024)**. **Based on our calculations**, we expect that over 11.7 million and 38.7 million gallons of CO₂ emissions would likely be released from proposed and projected pipeline accidents over a similar time period **(Supplementary Note S4)**. There are also considerable costs resulting from pipeline accidents, totaling to about \$7.3 million in damage from accidents along existing pipeline routes **(PHMSA, 2024)**. Therefore, along the proposed and projected routes, **our calculations** show that pipeline accidents would cause an estimated additional \$4.9 million and \$16.2 million, respectively, in total costs over a 30-year period **(Supplementary Note S6)**. **Further breakdowns of the accident impacts are***

described in Supplementary Notes S3-S7, Supplementary Table S1, and Supplementary Fig. S3.”

We rewrote Lines 455-462 (original lines 305-309) to provide more clarity:

“In addition, we utilized CO₂ pipeline accident data from PHMSA to assess the frequency, rates, and economic and environmental impacts of previous CO₂ pipeline accidents along existing pipeline routes. We also estimated these impacts for the possible future pipeline routes by extrapolating this existing pipeline accident assessment to the mileages of the proposed and 2030 CO₂ pipeline networks. Due to the concerns associated with CO₂ pipeline safety, we found it worthwhile to determine not only the previously experienced costs associated with CO₂ pipelines, but the potential future expenses, should more pipelines be constructed without more thorough oversight and regulations.”

When describing the three pipeline networks in the paragraph following original lines 305-309, we added direct citations of proposed pipeline route announcements from Summit Carbon Solutions, Navigator CO₂ Ventures, and Wolf Carbon Solutions in Lines 467-475—the three CO₂ pipeline companies responsible for the proposed pipeline projects in our analysis, which we have bolded below:

*“The proposed pipeline infrastructure encompasses the locations of current and ongoing plans for newly constructed CO₂ pipeline paths; there are three proposed pipeline routes from the following companies: Summit Carbon Solutions, Navigator CO₂ Ventures, and Wolf Carbon Solutions (Parfomak, 2023). In 2021 Summit Carbon Solutions proposed 2,000 miles of new pipelines across the West North Central Midwest census region (U.S. Census Bureau, n.d.); in the same year, Navigator CO₂ Ventures proposed about 1,300 miles of pipeline infrastructure stretched across the Midwest; in 2022, Wolf Carbon Solutions proposed almost 300 miles of pipeline construction, that would span from Iowa to Illinois (Parfomak, 2023; **Wolf Carbon Solutions, 2022; Navigator Ventures, 2021; Summit Carbon Solutions, 2021**).”*

12. Lines 226 – 231 are unclear to me, which I list as a “significant” revision because this is one of the primary findings statements.

We hope to add clarity to this finding statement by re-writing these lines in our revised Manuscript, in Lines 319-326:

“A clear difference emerges among the relationship between race and pipeline planning, when comparing the two different future pipeline networks. Census tracts with higher proportions of Black residents are significantly more likely to be associated with proposed pipeline projects, highlighting demographic disparities in pipeline siting. However, Black communities are less likely to have pipelines projected within their census tracts by 2030, reducing their potential exposure to future pipeline-related issues. This contrast suggests a complex and nuanced relationship between race and pipeline planning and indicates a notable difference in the spatial placements between the proposed and projected pipeline networks in relation to Black communities.”

We add potential explanations behind these differences, and their potential implications, in the following paragraph of the Manuscript, in Lines 351-381:

“While further analysis is necessary to fully understand the different directions of associations between these networks, our findings are suggestive that an unbalanced distribution does not stem from physical conditions (e.g., areas suitable for pipelines). Despite the limitations of this study, we argue that the unbalanced distribution of projected pipelines would likely not disappear, should more CO₂ pipelines be built in the future. The projected pipeline routes used in our analysis have not yet been affected by opposition from local communities; at the same time, proposed pipelines, whose routes have been shaped by socio-political influences, are more likely to be located in Black communities, because local communities played a role in the siting process. This narrative aligns with the environmental justice literature, suggesting environmental injustice through siting decisions by firms and through bargaining between firms and communities. In other words, if pipeline companies propose these 2030 projected routes in the future, the placement of these pipelines will likely be influenced by local voices; it is possible that the unequal distribution of pipeline locations could worsen for some marginalized communities, who typically have lower bargaining power to effectively oppose a CO₂ pipeline in their communities (Botelho, 2005; Harding, 2003). While pipeline companies may use eminent domain to enforce their routing decisions, effective pushback from formal community opposition has proven limited effectiveness in thwarting proposed pipeline routes in the past (Haiar, 2023a; Haiar, 2023b; Marquez, 2023). These successful community resistances to CO₂ pipeline proposals required significant time, money, and education and awareness for legal fees, lobbying efforts, and public outreach—resources that are generally more abundant in non-marginalized communities.

Additionally, while we do not account for the change of demographic composition for the communities surrounding proposed and projected routes, we also argue that the makeup of these areas may change due to pipeline placement in a manner where marginalized groups may end up moving closer to these pipelines, should they be constructed. Past research on the theory of residential sorting indicates that non-marginalized groups distribute themselves across geographic areas void of environmental risks, leaving marginalized groups more likely to be displaced and move closer to these areas (Rüttenauer & Best, 2021; Diamond & Gaubert, 2022). Thus, without the urgent and sufficient integration of environmental justice considerations into climate policy development along the expansion of CO₂ pipelines, the projected routes could shift to slightly different areas with higher shares of Black residents, further raising concerns about the inequitable distribution of pipeline infrastructure (Rüttenauer & Best, 2021; Diamond & Gaubert, 2022).”

Minor Revisions:

- 13. In the introduction, the authors note on lines 36 – 37 that CCS and CDR will require large networks of CO₂ pipelines. This isn't necessarily true—decision makers could choose to collocate capture and storage to minimize pipelines. This is a small but important nuance because it changes the binary choice from being lots of pipelines to no pipelines to a much broader spectrum of options. See also major revision about specifying this work is in response to Net Zero America, which does indeed assume a large network of pipelines, but is one study with one set of assumptions by the authors.**

Thank you for this comment, and we agree that this distinction is necessary. We have clarified this nuance in Lines 40-46:

“Currently, the effective deployment of CCS and CDR technologies has heavily relied on carbon dioxide (CO₂) pipelines to transport captured CO₂ to either geological formations that are suitable for permanently storing CO₂, or to locations where it can be converted into valuable by-products; while future decisions regarding CCS and CDR technologies could be implemented in ways that reduce the need for future CO₂ pipelines, current net models indicate significant dependence on new CO₂ pipelines to safely and reliably transport larger amounts of CO₂ (UNEP, 2017; Global CCS Institute, 2024; U.S. Department of Energy, 2023; Larson et al., 2021)”

Additionally, we have addressed the inherent assumption we make by using Net Zero America's 2030 projection of CO₂ pipeline routes, which we discussed in the major revision Comment #5 above.

- 14. Lines 66 – 67 describe CCS as a proposal for decarbonizing fossil fuels; while this is true, CCS has also been proposed as a necessary tool for decarbonizing industrial process emissions like those from steel and cement. This should be noted.**

Thank you for this comment, and we agree that this distinction is necessary. We have added a more well-rounded description of CCS in Lines 74-76:

“Proponents argue CCS is essential to meet international climate goals by decarbonizing the fossil fuel industry and decarbonizing the production of materials such as iron and steel and cement (UNEP, 2017; Clarkson, 2022).”

- 15. Are the authors projecting demographic changes for census tracts that are expected to see pipeline proposals in the future? If not, please justify.**

While we understand the potential benefits of projecting demographic changes for census tracts that are expected to see pipeline proposals in the future, we are not projecting demographic changes. As we discussed in Comment #5, the reason why we have decided to not do this is because there is a possibility that pipeline policy itself might change demographic makeup in ways we wouldn't normally project from past demographic trends. We have indicated this as a limitation of our study in our revised document in Lines 338-350, which are quoted below. Here, we further give reason for our choice of using a 2030 projection of pipeline routes as opposed to a later timeframe, in order to likely limit the number of demographic changes over time while not accounting for this change in our analysis.

“Even with the assumption that these possible future pipeline routes are constructed, by the time future pipelines are constructed, the demographic makeup of the census tracts surrounding the pipeline may be significantly different from the demographic makeup between 2017-2021, which we used for our analysis. We do not project future the demographic makeup of census tracts surrounding the future pipeline routes because of concern that these projections may not be accurate: the future pipeline policy itself might change demographic makeup in ways we wouldn’t normally project from past trends. Therefore, a limitation of our analysis is that we assume that the demographic makeup of our studied areas will not significantly change from the 2017-2021 average to 2030. We attempt to mitigate the error produced by this limitation by assessing the 2030 projected pipeline routes, as opposed to a later dated projection, such as 2050 or 2100; 2030 projections are relatively closer to 2017-2021, therefore the demographic makeup of relevant areas in our study are likely to be more similar to the 2017-2021 average.”

16. As I noted above, more attention to comparing risks and accident rates to other, better-known infrastructure, i.e. electric transmission, would help contextualize findings.

Thank you for your comment. We have addressed this issue in our revised manuscript and in Comment #7, where we more clearly compared the accident rates of CO₂ pipelines to natural gas pipelines.

17. The authors’ citation 27, used to justify their urbanity metric, doesn’t appear to me to be an authoritative source on how to define urban versus rural communities. Better explanation is needed

We have used this urbanity metric based on the metric determined and utilized by Strube et al. (2021). However, as a more authoritative source, we have included a citation from the United States Department of Agriculture (USDA, 2024).

References

The references in **bold** are those that are not included in the manuscript.

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Carbon dioxide pipelines are disproportionately located in marginalized communities in the United States

Julia Davis, Nafiseh Salehi, Liqing Li, Majid Shafiee-Jood

Response Document

Ref.: COMMSENV-24-2893A

Dear Dr Shafiee-Jood,

Your manuscript titled "Pipelines of Inequity? Environmental Justice and CO2 Pipeline Infrastructure Amid Climate Policies" has now been seen by our reviewers, whose comments appear below. In light of their advice, we are delighted to say that we are happy, in principle, to publish a suitably revised version in Communications Earth & Environment.

We therefore invite you to edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

Dear Dr. Jennings and Dr. Grecequet,

We sincerely appreciate your handling of our manuscript and the guidance you provided throughout the peer review process. We are very pleased with the final version of our paper and feel that the review process has greatly enhanced its quality. We are excited about the opportunity to have our paper published in your journal.

In the revised version, we have edited our manuscript to comply with your format requirements.

EDITORIAL REQUESTS:

Please review our specific editorial comments and requests regarding your manuscript in the attached "Editorial Requests Table".

Please take care to match our formatting and policy requirements. We will check revised manuscript and return manuscripts that do not comply. Such requests will lead to delays.

Please outline your response to each request in the right hand column. Please upload the completed table with your manuscript files as a Related Manuscript file.

We have carefully reviewed and responded to each request in the Editorial Requests Table and revised our paper following the instructions provided.

Along with the Editorial Requests Table, we have uploaded a clean version of our revised manuscript, a version of our revised manuscript with all changes tracked, the editorial policy checklist document, the reporting summary document, and a PDF version of our supplementary information.

We hope that the changes we have made successfully meet the requirements of the journal.