**Broad idea:**

Places with high # of employment/establishment in sectors with high carbon emission will bear high costs of transitioning to net zero carbon emissions.

Places with high weather and climate disaster risk scores will bear greater economic costs from transitioning to net zero carbon emissions.

Most research (justifiably) focuses on the costs of climate change and climate risk exposure, but there is a misalignment between who will bear the benefits of reducing carbon emissions and who will bear the costs.

**Data:**

TBD: if we want to study on state/county/city/firm level?

1. Measure of climate change risk exposure

Data: Risk scores by county; Disaster cost by state

Disaster types include drought, flooding, freeze, severe storm, tropical cyclone, wildfire, winter storm

[Disaster and Risk Mapping | Billion-Dollar Weather and Climate Disasters | National Centers for Environmental Information (NCEI) (noaa.gov)](https://www.ncdc.noaa.gov/billions/mapping)

1. Measures of carbon emission by countysector

Data: 2020 Greenhouse gas emissions from large facilities by countysector

Sectors include powerplant, petroleum and natural gas systems, refineries, chemicals, other, minerals, waste, metals, pulp and paper.

[EPA Facility Level GHG Emissions Data](https://ghgdata.epa.gov/ghgp/main.do#/listSector/?q=Find%20a%20Facility%20or%20Location&st=GA&bs=&et=&fid=&sf=11001100&lowE=-20000&highE=23000000&g1=1&g2=1&g3=1&g4=1&g5=1&g6=0&g7=1&g8=1&g9=1&g10=1&g11=1&g12=1&s1=1&s2=1&s3=1&s4=1&s5=1&s6=1&s7=1&s8=1&s9=1&s10=1&s201=1&s202=1&s203=1&s204=1&s301=1&s302=1&s303=1&s304=1&s305=1&s306=1&s307=1&s401=1&s402=1&s403=1&s404=1&s405=1&s601=1&s602=1&s701=1&s702=1&s703=1&s704=1&s705=1&s706=1&s707=1&s708=1&s709=1&s710=1&s711=1&s801=1&s802=1&s803=1&s804=1&s805=1&s806=1&s807=1&s808=1&s809=1&s810=1&s901=1&s902=1&s903=1&s904=1&s905=1&s906=1&s907=1&s908=1&s909=1&s910=1&s911=1&si=&ss=&so=0&ds=E&yr=2020&tr=current&cyr=2020&ol=0&sl=0&rs=ALL)

1. Measure of employment by countysector

Data: number of employment or establishments by countysector

Note: We may need to reconcile the definitions of sectors to merge #2 and #3 datasets.

1. Measure of municipal bonds price
2. Issuance cost (Painter, 2020)

Total annualized issuance cost=annualized gross spread + bond yield

1. Spread (Goldsmith-Pinkham et al. 2021)

Benchmark for spread: Municipal Market Advisors AAA-rated curve

**Methods:**

1. What is the correlation with climate change risk exposure (negatively correlated?)?

We expect to be negative.

1. Is this risk priced into municipal bonds in these areas?

If priced in, we expect to be significantly positive.

1. Can this help explain voting patterns?

Not sure about county-level data of political party affiliation

But Yale Climate Opinion data shows county-level belief of climate change (Howe et al. 2015)

[Yale Climate Opinion Maps 2020 - Yale Program on Climate Change Communication](https://climatecommunication.yale.edu/visualizations-data/ycom-us/)

We expect to be negative.

1. Do we see slower mitigation at the firm-level when the local economy is more dependent on the industry?

Not sure about firm level. The paper about firm-level climate change exposure doesn’t have measure on the state/county/city level in the USA. But on the county level, we can use the textual analysis method developed by Shirley Lu and Anya Nakhmurina to analyze county-level documents to measure climate change adaption.

1. Related questions: what occupations are most exposed to climate change mitigation?

Not sure. Do you mean occupations within a industry? Maybe we can use EMSI data. But I think maybe we can run analysis in the previous sections and then decide if we want to go further with the occupation-level data.

**Reference:**

1. Marcus Painter, An inconvenient cost: The effects of climate change on municipal bonds, Journal of Financial Economics, Volume 135, Issue 2, 2020, Pages 468-482, ISSN 0304-405X, https://doi.org/10.1016/j.jfineco.2019.06.006.

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1. Goldsmith-Pinkham, Paul S. and Gustafson, Matthew and Lewis, Ryan and Schwert, Michael, Sea Level Rise Exposure and Municipal Bond Yields (October 6, 2021). Jacobs Levy Equity Management Center for Quantitative Financial Research Paper, Available at SSRN: https://ssrn.com/abstract=3478364 or <http://dx.doi.org/10.2139/ssrn.3478364>
2. Howe, P., Mildenberger, M., Marlon, J. et al. Geographic variation in opinions on climate change at state and local scales in the USA. Nature Clim Change 5, 596–603 (2015). https://doi.org/10.1038/nclimate2583