COMMENTS

TOWARD TRADABLE BUILDING PERFORMANCE STANDARDS

by Danielle Spiegel-Feld and Katrina M. Wyman

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The European Union, China, California, and a number of U.S. states in the Northeast are currently using emissions trading as part of their efforts to reduce greenhouse gas (GHG) emissions.[1] However, the popularity of emissions trading as a policy tool co-exists with a well-established, and increasingly politically powerful, set of critiques of it in the United States. These critiques come from environmental justice advocates as well as some academics and other observers.[2]

For example, in 2021, President Joe Biden decided not to appoint prominent California environmental regulator Mary Nichols as administrator of the U.S. Environmental Protection Agency (EPA) after a long list of environmental justice-oriented organizations criticized her for being insensitive to environmental justice concerns[3]; Nichols' support for California's GHG emissions trading program was given as a key example of her disregard for environmental justice communities (EJCs).[4] Extending long-standing critiques of trading, academics also have recently questioned the efficacy of existing emissions trading programs in reducing GHG emissions.[5] They have argued that the politics of these programs are bound to weaken them,[6] and that emissions trading is a complex neoliberal idea ill-suited to the ambitious goal of societal decarbonization.[7]

Against this backdrop, this Comment ventures to propose an innovative application for trading: the development of a municipal trading program to help reduce GHG emissions from buildings, which account for the lion's share of many cities' GHG emissions.[8] We call the proposed policy mechanism a "tradable building performance

Authors' Note: Danielle Spiegel-Feld was the lead author of a 2021 report for New York City that examined whether the city should develop a carbon trading program pursuant to its landmark building performance regulation, Local Law 97 of 2019. See Danielle Spiegel-Feld et al., Carbon Trading for New York City's Building Sector: Report of the Local Law 97 Carbon Trading Study Group to the New York City Mayor's Office of Climate and Sustainability (2021). *Katrina Wyman was also an author of the report. The views expressed in this Comment draw from lessons learned throughout the study of Local Law 97. Numerous contributors to the report, including Mary Jiang, Gilbert Metcalf, Jonathan Meyers, Sara Savarani, Jason Schwartz, Kathleen Spees, Kasparas Spokas, Burcin Ünel, and Mark Willis, as well as conversations with outside stakeholders, greatly influenced the authors' thinking about the potential to develop a tradable building performance standard.*

1. *See* World Bank, State and Trends of Carbon Pricing 2021, at 22 (2021).
2. *See*, *e.g.*, William Boyd, *The Poverty of Theory: Public Problems, Instrument Choice, and the Climate Emergency*, 46 Colum. J. Env't L. 399 (2021).
3. *See* Anna M. Phillips, *Environmental Justice Groups Block Mary Nichols' Path to EPA*, L.A. Times (Dec. 17, 2020), https://www.latimes.com/environment/story/2020-12-17/environmental-justice-groups-block-mary-nichols-path-to-epa; *see also* Letter from Drew Hudson, Founder, 198 methods et al., to Biden-Harris Transition Team (Dec. 2, 2020), https://1bps6437gg8c169i0y1drtgz-wpengine.netdna-ssl.com/wp-content/uploads/2020/12/2020-12-2-Nichols-letter.pdf.
4. *See* Phillips, *supra* note 3; Letter from Drew Hudson et al., *supra* note 3 ("Ms. Nichols and the [California Air Resources Board], in initially designing the carbon trading system, were fully aware of the disproportionate impacts that cap and trade would have on the health of low-income communities of color. Yet, they championed this strategy that perpetrated environmental racism.") (emphasis omitted). Note that some recent academic studies of the California emissions trading program have failed to find evidence to support the claim that the program has increased the pollution burden on low-income communities of color. *See infra* notes 41-45 and accompanying text. However, some other scholars have produced contrary findings. *See* Kristoffer Tigue, *Why Do Environmental Justice Advocates Oppose Carbon Markets? Look at California, They Say*, Inside Climate News (Feb. 25, 2022).
5. *See* Jessica F. Green, *Does Carbon Pricing Reduce Emissions? A Review of Ex-Post Analyses*, 16 Env't Rsch. Letters 043004, at 5-11 (2021).
6. *See* Danny Cullenward & David G. Victor, Making Climate Policy Work 7 (2021).
7. *See* Boyd, *supra* note 2, at 448-49, 469-70, 486-87.
8. *See*, *e.g.*, Press Release, Office of the Mayor of Chicago, Mayor Lightfoot Announces a Building Decarbonization Working Group (June 2, 2021), https://www.chicago.gov/city/en/depts/mayor/press_room/press_releases/2021/june/DecarbonizationWorkingGroup.html (70% in Chicago); City of Boston, *Building Emissions Reduction and Disclosure*, https://www.boston.gov/departments/environment/building-emissions-reduction-and-disclosure (last updated Feb. 25, 2022) (70% in Boston); New York City Council, *Climate Mobilization Act*, https://council.nyc.gov/data/green/ (last visited Mar. 6, 2022) (71% in New York); Washington, D.C., Department of Energy & Environment, *Greenhouse Gas Inventories*, https://doee.dc.gov/service/greenhouse-gas-inventories (last visited Mar. 6, 2022) (71% in Washington, D.C.).

standard" (tradable BPS).[9] The proposal is doubly novel: no U.S. city has established a trading program to reduce GHG emissions or any other form of air pollution.[10] Instead, the trading programs that exist in the United States have been developed at the state, regional, and federal levels.[11] Also, no existing trading program in the United States regulates the emissions of buildings, such as office buildings or multifamily apartment buildings. Instead, U.S. emissions trading programs tend to apply to power plants and other large industrial facilities.[12]

In addition to making the case for municipal trading programs for buildings, the Comment lays out two forms of tradable BPSs that cities could implement. In setting out these two paradigmatic forms, we draw on our experience leading a large-scale study (the Carbon Trading Study) into the potential to develop a carbon trading program for New York City's buildings pursuant to the city's landmark building emissions law, Local Law 97 of 2019 (LL97).[13] The study team was cognizant of the concerns about emissions trading, and sought to address them by centering environmental justice in the design of trading program proposals. The trading programs that we designed for New York City sought not only to ensure that trading would not harm EJCs, but that these communities would experience more investment and less local air pollution than they would if trading were not allowed.

The Comment proceeds in four parts. Part I explains why cities and states are seeking to regulate building GHG emissions, and the limitations of the existing forms of building emission regulation. Part II lays out why cities should consider developing trading programs for the building sector. It also discusses several of the main concerns with local governments using trading to reduce building emissions, and explains how these concerns could be addressed.

Part III then offers two approaches to a municipal trading program for buildings. We describe the two programs that were developed for New York City and what the costs and benefits of the two programs were predicted to be for different stakeholder groups within the city, including EJCs. Part IV concludes.

By way of background, we generally refer to the potential for building owners to engage in GHG emissions trading, because the study that we led focused on developing a GHG emissions trading program for buildings that could be added to New York City's GHG emissions-based BPS. However, other BPSs regulate energy efficiency, rather than GHG emissions, and a trading program could also be designed to trade energy efficiency. Indeed, there are examples of regulated markets where energy efficiency currently is traded.[14]

I. Background on Existing BPSs and Their Limitations

A. *Why Cities and States Are Establishing BPSs*

Energy use in buildings accounts for nearly 30% of total GHG emissions across the globe.[15] In dense cities, this figure can be much higher. Building emissions account for a particularly large share of emissions in dense areas in cold climates where many building owners rely on on-site combustion of fossil fuels for heating.[16] In New York City, for example, buildings account for more than two-thirds of annual GHG emissions.[17] In Chicago, the figure is approximately 70%.[18] Seventy-five percent of Boston's GHG emissions come from buildings.[19] Building emissions come from

9. *See also* New York State Climate Action Council, New York State Climate Action Council Draft Scoping Plan 254 (2021) (referring to three approaches for clean energy supply standards, including a "tradeable performance standard").
10. Note that Washington, D.C., has developed a type of trading program for stormwater credits, but this is distinct from tradable credits for emissions. Washington, D.C., Department of Energy & Environment, *Stormwater Retention Credit Trading Program*, https://doee.dc.gov/src (last visited Mar. 6, 2022).
11. *See*, *e.g.*, Cal. Code Regs. tit. 17, §95800 et seq. (2019) (state regulations establishing the California cap-and-trade program); Regional Greenhouse Gas Initiative (RGGI), Memorandum of Understanding (2005) (memorandum of understanding establishing the RGGI program among northeastern states); RGGI, *Model Rule and MOU Versions*, https://www.rggi.org/program-overview-and-design/design-archive/mou-model-rule (last visited Mar. 6, 2022); Benjamin Leard & Virginia McConnell, Resources for the Future, New Markets for Credit Trading Under US Automobile Greenhouse Gas and Fuel Economy Standards (2017), https://media.rff.org/documents/RFF-Rpt-AutoCreditTradingREV.pdf.
12. Tokyo is the only city we know that has a well-established GHG trading program that covers buildings. Several cities in China piloted emissions trading programs in the lead-up to the launch of a national GHG trading program, and some of these pilots appear to have allowed buildings to trade, though it is unclear how much trading occurred involving buildings. *See* Xiangnan Song et al., *Will China's Building Sector Participate in Emissions Trading System? Insights From Modelling an Owner's Optimal Carbon Reduction Strategies*, 118 Energy Pol'y 232, 233 (2018). In the United States, Resources for the Future has also raised the possibility of a market-based BPS. *See generally* Véronique Bugnion & Karen Palmer, Resources for the Future, Building Performance Standards: Lessons From Carbon Policy (2020); Kathryne Cleary & Karen Palmer, *Federal Climate Policy 106: The Buildings Sector*, Res. for Future (Apr. 6, 2021), https://www.rff.org/publications/explainers/federal-climate-policy-106-the-buildings-sector/.
13. The study was conducted by researchers at New York University, the Brattle Group, and HR&A Advisors. Staff at the New York City Mayor's Office of Climate and Sustainability set the policy objectives for the study and provided feedback throughout the process.
14. *See generally* Katrina M. Wyman & Adalene Minelli, *Propertizing Environmental Attributes*, 39 Yale J. Regul. ____ (forthcoming 2022) (referring to the sale of energy efficiency in electricity markets in the United States and energy savings certificates in France and Italy).
15. *See* United Nations Environment Programme, 2020 Global Status Report for Buildings and Construction: Towards a Zero-Emissions, Efficient, and Resilient Buildings and Construction Sector—Executive Summary 4 (2020) (noting that "CO_2 [carbon dioxide] emissions from the operation of buildings have increased to . . . 28% of total global energy-related CO_2 emissions," and to 38% if building construction emissions are included).
16. Note that there are important regional variations in the on-site combustion of fossil fuels. *See*, *e.g.*, Rocky Mountain Institute, The Impact of Fossil Fuels in Buildings 56 (2019).
17. *See* Danielle Spiegel-Feld et al., Carbon Trading for New York City's Building Sector: Report of the Local Law 97 Carbon Trading Study Group to the New York City Mayor's Office of Climate and Sustainability 22 n.29 (2021) [hereinafter CTS Report] (citing Ross MacWhinney & Omri Klagsbald, New York City Mayor's Office of Sustainability, Inventory of New York City Greenhouse Gas Emissions in 2016 (2017)).
18. Press Release, Office of the Mayor of Chicago, *supra* note 8.
19. Bos., Mass., Ordinance Amending City of Boston Code, Ordinances ch. VII, §§7-2.1 and 7-2.2, Building Energy Reporting and Disclosure (BERDO) (Oct. 5, 2021).

two main sources: the electricity that building owners buy from electric utilities (grid-supplied electricity), and fossil fuels that buildings burn on-site for uses such as heating and cooking.

In the past few years, a small but growing number of city and state governments have started regulating building emissions as part of their efforts to decarbonize. Some governments have banned gas lines from being connected to new buildings, or a subset of new buildings.[20] However, prohibiting fossil fuel use on-site in new construction does nothing to reduce fossil fuel use in existing buildings, many of which will stand for decades more. Across the United States, only about 2% of the building stock turns over each year, and most of the buildings that will exist in 2050 already exist today.[21]

Given the importance of decarbonizing the existing building stock alongside new construction, the most important form of building emission regulation is cities' and states' nascent efforts to impose BPSs that regulate the emissions of new and existing buildings alike.[22] As an indication of the importance of BPSs, EPA is actively promoting BPSs,[23] and President Biden has called for the federal government to establish a BPS for federally owned and occupied buildings.[24]

B. The Limitations of Existing BPSs

BPSs generally regulate either energy efficiency or buildings' GHG emissions.[25] The main difference between these two approaches is that energy-efficiency regulations seek to reduce the amount of energy that buildings consume, irrespective of the source of that energy, whereas GHG emissions standards only seek to reduce the amount of carbon-based energy that buildings use. Regardless of which approach is used, building owners are typically required to certify their compliance at regular increments on a building-by-building basis.[26]

It is self-evident how a GHG emissions standard could lead buildings to reduce their GHG emissions. If the standard is sufficiently stringent, it could motivate buildings to reduce their use of electricity (to reduce their emissions from electricity credited to the building); switch to clean distributed sources of electricity, such as solar photovoltaic (PV); and reduce the combustion of fossil fuels on-site for heating and cooking. Energy-efficiency standards could reduce building GHG emissions as well by incentivizing buildings to reduce their use of electricity and other forms of energy; as long as the energy sources on which buildings rely are generated using fossil fuels, reducing energy use will reduce GHG emissions.

Reducing energy use could also have the added benefit of lowering the cost of the ambitious task that some governments have established of switching buildings away from fossil fuels to electricity for all their energy needs, while simultaneously decarbonizing the sources of electricity.[27] Electrifying buildings—which many see as key to ultimately decarbonizing them—will increase demand for electricity[28]; improving energy efficiency could offset some of that increased demand, and therefore reduce the extent to which new renewable and zero-emitting generators need to be built to electrify buildings alongside motor vehicles.

For present purposes, the key point to underscore is that BPSs set performance standards for individual buildings, and typically envision that owners and operators of individual buildings will take actions to improve the performance of their buildings. To be sure, BPSs typically provide building owners with some flexibility in achieving the standards (see Table 1). For example, New York City's BPS, LL97, which caps the GHG emissions of large buildings, allows buildings that would otherwise exceed their caps to comply by reducing their electricity use on-site through retrofits,[29] electrifying the buildings (an emissions reduction strategy if grid-supplied electricity is less GHG-intensive than on-site combustion), and switching to clean distributed energy sources such as solar PV.[30] It also allows buildings to comply by purchasing renewable energy credits (RECs) for electricity supplied to the New York City area, and purchasing offsets.[31] Some buildings can also have the standards that apply to them relaxed under certain conditions.[32]

However, BPSs generally do not allow building owners to comply by paying other building owners to reduce their emissions by more than they are required to do under the BPS. In

20. *See* Anne Barnard, *N.Y.C.'s Gas Ban Takes Fight Against Climate Change to the Kitchen*, N.Y. Times (Dec. 15, 2021), https://www.nytimes.com/2021/12/15/nyregion/nyc-gas-stove-heat-ban.html; Emilie Raguso, *Berkeley First City in California to Ban Natural Gas in New Buildings*, Berkeleyside (July 17, 2019), https://www.berkeleyside.org/2019/07/17/natural-gas-pipes-now-banned-in-new-berkeley-buildings-with-some-exceptions. Note that these gas bans may be particularly impactful in states where today buildings are particularly reliant on natural gas for heating. *See* Rocky Mountain Institute, *supra* note 16, at 49.
21. *See* Andrew Pressman, Professional Practice 101: A Compendium of Effective Business Strategies in Architecture 70 (3d ed. 2021) ("In most established US cities, 80 to 90% of the buildings that will be consuming energy in 2050 already exist. US cities typically only see 1 to 2% turnover (renovation or replacement) of building stock each year.").
22. *See* Institute for Market Transformation, Building Performance Standards: A Powerful New Tool in the Fight Against Climate Change (2020), https://www.imt.org/wp-content/uploads/2019/10/IMT-Building-Performance-Standard-Basics-2-PG.pdf.
23. *See* U.S. EPA, Building Performance Standards: Overview for State and Local Decision Makers (2021) (EPA-430-F-21-002), https://www.epa.gov/sites/default/files/2021-02/documents/benchmarking_building_performance_standards_section2.pdf. The federal government also has launched the National Building Performance Standards Coalition to spur the adoption of BPSs at the local and state levels. *See* National BPS Coalition, *About the National BPS Coalition*, https://nationalbpscoalition.org/#about (last visited Mar. 6, 2022).
24. *See* Press Release, The White House, Fact Sheet: President Biden Signs Executive Order Catalyzing America's Clean Energy Economy Through Federal Sustainability (Dec. 8, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/08/fact-sheet-president-biden-signs-executive-order-catalyzing-americas-clean-energy-economy-through-federal-sustainability/.
25. *See* U.S. EPA, *supra* note 23, at 4.
26. *See*, *e.g.*, N.Y.C. Admin. Code §28-320.3.7 (2022); Bos., Mass., Ordinance Amending City of Boston Code, Ordinances ch. VII, §§7-2.1 and 7-2.2, BERDO §7-2.2(h) (Oct. 5, 2021); D.C. Code §8-1772.21 (2022).
27. *See* Eric Daniel Fournier et al., *Implications of the Timing of Residential Natural Gas Use for Appliance Electrification Efforts*, 15 Env't Rsch. Letters 124008 (2020).
28. *See* Danielle Spiegel-Feld & Katrina Wyman, *Building Better Building Performance Standards*, 52 ELR 10268 (Apr. 2022) (comparing the benefits of regulating the GHG emissions and energy efficiency of buildings). There are also many other important policy choices that need to be made in developing a BPS. *See*, *e.g.*, U.S. EPA, *supra* note 23.
29. *See* N.Y.C. Admin. Code §24-803 (2022).
30. *See id.* §28-320.3.6.
31. *See id.*
32. *See*, *e.g.*, *id.* §28-320.3.10.

Table 1. Flexibility Mechanisms in Various American Jurisdictions' BPSs

Flexibility Mechanisms	City and State Regulations
Mechanisms that reduce or delay a building's obligations	
Individualized compliance time lines	Boston Municipal Code §7-2.2(k) St. Louis City Ordinance 71132, §4(A)(4), (D)(2)(a) Washington Revised Code §19.27A.210(2)(d)(i)
Relaxed performance standard based on showing of hardship	Boston Municipal Code §7-2.2(l) New York City Administrative Code §§28-320.7, 28-320.8 St. Louis City Ordinance 71132, §4(A)(4), (D)(2)(a) Washington, D.C. Code §8-1772.21(e)(1)
Credit for installation of distributed generation on-site	New York City Administrative Code §28-320.3.6
Mechanisms that provide flexibility to comply by taking action at other covered buildings	
Owners of multiple buildings can demonstrate compliance on a portfolio basis	Boston Municipal Code §7-2.2(c) Washington, D.C. Code §8-1772.21(b)(2)
Mechanisms that give owners credit for actions that may not reduce covered buildings' energy use or emissions	
Owners pay penalty into government fund for excess energy use or emissions*	Boston Municipal Code §7-2.2(m) New York City Administrative Code §28-320.6 St. Louis City Ordinance 71132, §4(D)(2)(b) Washington, D.C. Code §34-1434(c)
Owners purchase GHG offsets	New York City Administrative Code §28-320.3.6.2
Owners purchase RECs	New York City Administrative Code §28-320.3.6.1 Boston Municipal Code §7-2.2(m) Washington, D.C. Code §§34-1432(d)-(e), 34-1433

* The fund may be the government's general fund, or a dedicated fund for collecting payments associated with the BPS.

other words, BPSs generally do not allow building owners to comply with the standards by trading responsibility for achieving the standards among buildings.[33]

We say that existing BPSs do not *generally* allow building owners to comply with their limits by trading responsibilities among regulated buildings advisedly, because there are some limited exceptions. Washington, D.C.'s BPS allows universities and hospitals to comply on a portfolio basis; assigning a university or hospital a single standard that covers all of its buildings means that the entity can comply by improving energy efficiency at the buildings where improvements can be made most cheaply.[34] Boston's BPS also allows any owner of a portfolio of buildings to comply on a portfolio basis under certain circumstances.[35] These mechanisms suggest that the drafters of the Boston and Washington, D.C., BPSs recognized some of the benefits of allowing building owners to reassign responsibility for meeting targets based on buildings' relative costs of compliance. But these provisions only allow such reassignment in limited circumstances, and therefore would not fully harness the potential benefits of a more comprehensive trading program.

II. Why Consider Trading and the Concerns With Trading

A. *Arguments for Trading*

Emissions trading is a means of reducing pollution at lower cost than a performance standard that requires all sources to reduce pollution at their locations. To understand how trading could lower the cost of reducing pollution from buildings, consider a city in which there is a BPS that covers only two buildings: Building A and Building B. Suppose Building A currently emits 12 tons of GHGs per year, its emissions are capped at 10 tons, and it could reduce its emissions to eight tons annually at a cost of $1 per ton reduced. Building B currently emits 14 tons, its emissions are capped at 10 tons, and it would cost $4 per ton to reduce its emissions from 14 to 10 tons.

Since there is no ability for A to sell excess emissions reductions, it will reduce its emissions from 12 to 10 at a cost of $2. B, which cannot pay A to help B comply, will pay $16 to reduce its emissions. Combined, A and B will reduce their emissions by six tons at a cost of $18. If trading were allowed, A might have reduced its emissions from 12 to eight tons, generated two credits for its two tons of extra emissions reductions, and sold the credits to B, which then would have had to reduce only two tons on-site to comply with its limit. In the trading scenario, A

33. There is one notable exception to this general rule: as discussed in the next paragraph above, some BPSs, including that recently adopted by Boston, allow owners of a portfolio of buildings to comply on a portfolio-wide basis such that owners can use overperformance in one of their buildings to offset another of their building's underperformance. *See* Table 1.
34. *See* D.C. Code §8-1772.21 (2022).
35. Portfolio owners must obtain approval to comply on a portfolio basis, and they may be required to submit "a portfolio emissions reduction plan that prioritizes emissions reductions in Buildings located in or near Environmental Justice Populations," and comply with "further conditions." Bos., Mass., Ordinance Amending City of Boston Code, Ordinances ch. VII, §§7-2.1 and 7-2.2, BERDO §7-2.2(c) (Oct. 5, 2021).

and B combined would still reduce six tons of GHGs, but at a total cost of $12 ($4 by A and $8 by B).

The inability to sell and buy excess emissions reductions thus increases the overall cost of achieving the BPS. This example illustrates the traditional economic argument that allowing regulated entities to reallocate responsibility for reducing pollution among themselves provides a lower cost way of reducing pollution than a performance standard that every regulated source must meet on its own. Notably, allowing trading will confer greater cost savings in situations in which the underlying regulation imposes relatively stringent emissions reduction targets; if the underlying standard is not very stringent, the opportunities for cost savings will be small because the law will not impose substantial costs on industry in any event.

Trading also provides an avenue for temporal flexibility, which may be particularly useful in the real estate sector. Making some types of energy-efficiency improvements can substantially disrupt tenants' use of their space, and landlords may be hesitant (or unable) to pursue these upgrades while their spaces are occupied.[36] Trading would give landlords flexibility to decide when to make improvements, timing major projects to coincide with the end of their tenants' leases. Note that this temporal flexibility could even be useful in jurisdictions that aim to impose a net-zero carbon mandate; in this case, buildings that reduce their emissions early can bank and then sell credits to other buildings that prefer to delay renovating to eliminate GHG emissions until the end of tenant leases. In fact, EPA permitted this type of banking and trading during the phase-down of lead from gasoline.[37]

Importantly, an emissions trading program can be designed to require that all the required GHG emissions reductions occur in buildings in the city and thus generate investment, employment, and co-pollutant reductions in the city. This is worth bearing in mind, because some of the flexibility mechanisms in existing BPSs would seem to allow building owners to comply without doing anything that will improve buildings in the city. For example, allowing building owners to comply by purchasing offsets, as New York City's LL97 permits, could allow owners to meet BPSs by buying credits for emissions reduction projects, such as maintaining forests, outside the United States whose GHG reductions are highly uncertain.[38] Also, allowing owners to comply with a BPS by buying RECs, which Boston, New York, and Washington, D.C., permit, seems likely to provide building owners with a cheaper way of complying with BPSs that will have no direct effect on buildings' emissions. In theory, building owners' purchases of RECs to comply with BPSs might finance the construction of renewable energy facilities that might not otherwise have been built. There is some anecdotal evidence that this has occurred in New York City.[39] However, we are not familiar with any rigorous analyses suggesting that allowing building owners to comply with BPSs using RECs will lead to the construction of renewable generation that would not otherwise occur.[40]

B. *Criticisms of Trading*

Notwithstanding the arguments for allowing regulated sources to reallocate responsibility for achieving environmental standards among the sources, there are well-established criticisms of the use of trading. We highlight the three main concerns that we heard during the study of whether New York City should establish a trading program for buildings:

1. Trading would be detrimental to EJCs.
2. Trading is too complex for cities and building owners to implement.
3. There are legal restrictions on the form of trading program that cities could adopt.

As we describe, we believe that there are strategies that could be employed to address each of these concerns, at least in certain cities. Alternatively, where cities lack the technical or legal capacity to implement a trading program, state governments may be able to introduce tradable BPSs.

36. *See* Caroline Fluhrer et al., Achieving Radically Energy Efficient Retrofits: The Empire State Building Example 3 (2010); *see also* Evonne Miller & Laurie Buys, *Retrofitting Commercial Office Buildings for Sustainability: Tenants' Perspectives*, 26 J. Prop. Inv. & Fin. 552, 558 (2008) (reporting that, when interviewed, tenants emphasized the importance of conducting retrofits in a manner that had "minimal impact on existing tenants").

37. *See* Richard G. Newell & Kristian Rogers, *The Market-Based Lead Phasedown*, *in* Moving to Markets in Environmental Regulation 173, 176 (Jody Freeman & Charles D. Kolstad eds., Oxford Univ. Press 2007) ("To ease the transition for refineries, the 1982 regulations also permitted both trading and banking of lead permits through a system of 'inter-refinery averaging.'"). Heather Payne has also proposed incorporating a trading component into plans to eventually phase out natural gas from new homes. *See* Heather Payne, *The Natural Gas Paradox: Shutting Down a System Designed to Last Forever*, 80 Md. L. Rev. 693, 736-37 (2021).

38. *See* N.Y.C. Admin. Code §28-320.3.6 (2022). Buildings in Boston also can comply with their caps by making an "alternative compliance payment"—which is a minimum of $234 per excess ton of GHG emission—into an "Equitable Emissions Investment Fund." Bos., Mass., Ordinance Amending City of Boston Code, Ordinances ch. VII, §§7-2.1 and 7-2.2, BERDO §7-2.2(m), (g) (Oct. 5, 2021). The fund can be allocated to improving affordable housing, but it also can be used for many other purposes, including "any further environmental initiatives." *Id.* §7-2.2(g). Thus, there is no guarantee that the fund will be used to reduce emissions or otherwise improve buildings in the city.

39. *See* James Barron, *Ending a Tale of Two Power Grids*, N.Y. Times (Nov. 30, 2021), https://www.nytimes.com/2021/11/30/nyregion/clean-energy-nyc.html (noting that a major real estate developer in New York City, Related, was helping to develop a new transmission line that would bring more renewable energy into New York City and that that renewable energy would help Related to meet its regulatory obligations under LL97).

40. As mentioned in the Comment's introduction, while we focus on the benefits of allowing buildings to trade responsibility for reducing GHG emissions, trading also could be used to lower the cost of implementing an energy efficiency-based BPS. Buildings would trade units of energy efficiency, rather than emissions.

1. Environmental Justice

The ability to transfer responsibility for reducing emissions to others has long caused environmental justice groups to worry that emissions trading would lead to a concentration of pollution in EJCs.[41] As economist Ryan Walch has observed, "the core distributional concerns of . . . EJ [environmental justice] groups could be valid if firms with relatively high marginal abatement costs are more likely to be located in disadvantaged communities."[42] In this scenario, polluters in EJCs will want to buy extra emissions reductions from polluters outside EJCs to reduce their compliance costs. But such purchases will mean that fewer emissions reductions occur on-site in EJCs, and thus pollution may be higher in EJCs than it would be if trading were not allowed.[43]

The empirical literature on existing emissions trading programs has generally failed to substantiate the concern that trading will exacerbate the disparate pollution burden imposed on historically marginalized communities. The Carbon Trading Study found that "[t]here are at least nine empirical studies analyzing whether trading programs have increased the relative difference between the pollution burden in disadvantaged communities and other communities," and "only one of the nine studies found a general shift in pollution towards disadvantaged communities."[44] Moreover, a more recent study of the program in which a shift toward disadvantaged communities was observed (California's cap-and-trade program) found the opposite result; the more recent study found that the trading program had narrowed the gap between pollution levels in disadvantaged areas and other areas.[45]

It is important to note that the trading programs the above studies examined meaningfully differ from the tradable BPS that we have in mind. Each of the studied existing programs regulates a relatively limited number of large industrial polluters. By contrast, a tradable BPS could regulate a much larger number of sources—by way of example, New York City's LL97 established performance standards for more than 11,000 properties[46]—and each of these individual properties is a much smaller source of emissions than is typically regulated under existing emissions trading programs. Moreover, a substantial share of building emissions comes from consuming electricity that is produced in power plants that may be located far away from the regulated property. As such, it is not always clear how emissions reductions attributable to a particular property will impact local pollution levels.

For all these reasons, it is difficult to apply the findings regarding the distributional impacts of existing emissions trading programs to the building sector. To understand whether adding trading to BPSs might shift pollution toward historically disadvantaged communities, policymakers would need to conduct a particularized analysis of the local context.[47]

If policymakers were concerned that trading might lead to an increasing concentration of pollution in disadvantaged communities, there are several guardrails that could be built into the program to prevent such an occurrence. For example, buildings in EJCs could be permitted to sell, but not buy, emissions credits. This would provide a revenue stream to buildings in EJCs that reduce their emissions without creating the potential for local emissions to increase. However, if buildings in EJCs cannot purchase credits, their compliance costs might increase relative to what they would be in an unrestricted market.[48]

As another example, if a portion of the emissions credits that regulated entities need were to be auctioned off, as is the case in many existing emissions trading programs, the revenue from that auction could be used to subsidize energy upgrades to buildings in EJCs.[49] The effect of such a subsidy is to make it relatively less expensive for buildings in EJCs to reduce their energy use, thus turning would-be buyers of credits into sellers. Note that if this approach were taken, trading might be used to induce additional pollution reductions in EJCs that might not occur if a uniform performance standard were adopted.

There is another benefit to this approach as well: it could redistribute the cost of lowering pollution from EJCs toward wealthier areas and/or better capitalized segments of the building stock. Whereas many existing trading programs regulate a fairly homogenous group of large corporate entities such as power plants, BPSs can cover a tremendous diversity of sources with very different ownership structures. Looking back at New York City's LL97, the law regulates commercial office buildings, hospitals, rental apartment buildings, cooperatively owned apartment buildings, and more.[50] These buildings often have different energy use profiles and different financial abilities to absorb the upfront costs associated with upgrading their

41. *See* Boyd, *supra* note 2, at 403-04; *see also* CTS Report, *supra* note 17, app. A.
42. Ryan Walch, The Effect of California's Carbon Cap and Trade Program on Co-Pollutants and Environmental Justice: Evidence From the Electricity Sector (Nov. 1, 2018) (unpublished manuscript).
43. Alternatively, it is also possible that "the flexibility inherent in market mechanisms may allow plant managers to make pollution control decisions on the basis of informal political or discriminatory, rather than purely economic, motives." Erin T. Mansur & Glenn Sheriff, *Do Pollution Markets Harm Low Income and Minority Communities? Ranking Emissions Distributions Generated by California's Reclaim Program* 2 (Nat'l Bureau of Econ. Rsch., Working Paper No. 25,666, 2019).
44. CTS Report, *supra* note 17, at 40.
45. *See* Danae Hernandez-Cortes & Kyle C. Meng, *Do Environmental Markets Cause Environmental Injustice? Evidence From California's Carbon Market* 30 (Nat'l Bureau of Econ. Rsch., Working Paper No. 27,205, 2020). Since the Carbon Trading Study was completed, there appears to have been additional empirical work on the impact of California's cap-and-trade program on EJCs. Tigue, *supra* note 4.
46. CTS Report, *supra* note 17, at 28.
47. As discussed further below, the study of implementing a building emissions trading program for New York City modelled the impacts of potential trading market designs for EJCs in the city.
48. CTS Report, *supra* note 17, at 84.
49. We discuss this option, as well as other strategies for targeting emissions reductions in EJCs, further in Part III.
50. *See* N.Y.C. Admin. Code §28-320.1 (2022). Boston's local law covers "City Building, Non-Residential Building, or Residential Building." Bos., Mass., Ordinance Amending City of Boston Code, Ordinances ch. VII, §§7-2.1 and 7-2.2, BERDO §7.2-2(b) (Oct. 5, 2021). Washington, D.C.'s, law covers all privately owned buildings of a certain square footage and ones that are D.C.-owned. *See* D.C. Code §8-1772.21 (2022).

properties to lower their emissions. Moreover, increasing housing costs may have qualitatively different economic or political implications than increases in commercial rents.

Given these disparities, policymakers might be concerned about how the cost of complying with a BPS is distributed among building owners and seek to ensure that the residential sector and/or EJCs do not shoulder the bulk of the burden. By investing auction proceeds in particular types of buildings or geographies, policymakers can use trading programs to help achieve their desired cost distribution.

2. Administrative Complexity for Cities

While emissions trading was often framed by its early proponents as an alternative to government regulation, it is in fact a form of such regulation, albeit one that relies on economic incentives. Pointing to the regulatory framework required to establish and operate a trading program, some critics of emissions trading argue that it is overly complex to implement.[51] In New York City, we have heard a version of this concern, with people suggesting that the city government might not have the administrative capacity to implement a trading program. Some also expressed a concern that it would be too difficult for building owners to participate in a trading program.

These concerns are certainly not unreasonable. Cities' lack of technical and bureaucratic resources has hindered past municipal environmental policy efforts.[52] Moreover, the incredible diversity of sources that could be regulated under a tradable BPS—in theory, such laws could regulate a cast of characters as diverse as the Empire State Building and a relatively small apartment building—means that entities with far fewer managerial and technical resources could participate in the programs.

We do not believe that either of these concerns is insurmountable. To begin with, the degree to which a trading program will add complexity—both for the regulator and the regulated entities—depends on the design of the trading program. Looking to our own study of LL97, one of the programs that we designed for New York City would be much less complicated administratively for both the city and regulated entities. The key difference between the two programs from the standpoint of administrative complexity is that one of them requires the city to develop a city-run (or, at least, city-authorized) auction to distribute a portion of the credits that buildings would need to cover their emissions.

Under the other program that we designed, no credits are auctioned off; instead, buildings generate credits for sale by reducing their emissions by more than they are legally required to do; these buildings would then sell the credits to others either bilaterally or on an exchange. Under this approach, the city does not need to administer an auction, and any building owner who believes participating in a trading program would be overly complicated can simply choose not to participate. Those buildings that are disinclined to participate in a trading program due to its complexity—say, the owners of relatively small multifamily buildings—could choose to avail themselves of any of the other compliance pathways that the BPS makes available to them, including retrofitting their own property or using any of the specified flexibility mechanisms that the law may provide for, such as purchasing RECs.

We recognize that even without an auction, trading introduces certain administrative complexities for the city that it would be spared if it opted for a uniform performance approach. For instance, once a market for credits is introduced, the government will need to take measures to prevent fraud and market manipulation. But these tasks may be less burdensome than policymakers might imagine. As an example, the Regional Greenhouse Gas Initiative (RGGI), which runs a trading program for emissions from power plants in 11 states in the northeastern United States, has employed between six and eight staff members each year since it began operations.[53] RGGI contracts with a private-sector consultant to administer its auctions and has paid between $317,000 and $420,000 per year for this service.[54] California also relies on private-sector consulting firms to conduct many of the administrative functions involved with running the California cap-and-trade program, including running quarterly auctions for allowances.[55]

Finally, to the extent that a tradable BPS would introduce additional administrative burdens above and beyond uniform BPSs, it is not necessarily the case that a city is less prepared to grapple with such complexities than a state. As a case in point, New York City has more than 10 times the population of the state of Vermont, which has participated in RGGI's trading program since 2005,[56] and Washington State, which is also less populous than New York City, legislated a carbon trading program in 2021.[57] New York City's annual budget is also larger than all but two states in the United States.[58]

51. *See*, *e.g.*, Boyd, *supra* note 2, at 420.
52. *See* Katrina Wyman & Danielle Spiegel-Feld, *Urban Environmental Renaissance*, 108 Cal. L. Rev. 305, 316 (2020).
53. *See* Alex Meeks et al., Carbon Trading for New York City's Building Sector: Implementation Plan 239 (2021).
54. *See id.* at 259.
55. *See id.* at 166.
56. *See* RGGI, *Program Design Archive: A Brief History of RGGI*, https://www.rggi.org/program-overview-and-design/design-archive (last visited Mar. 6, 2022) (stating that Vermont and six other states signed a memorandum of understanding to implement RGGI in 2005); New York City Department of City Planning, *Population*, https://www1.nyc.gov/site/planning/planning-level/nyc-population/nyc-population.page (last visited Mar. 6, 2022) (estimating New York City's population as of 2020 at more than 8.8 million); U.S. Census Bureau, *QuickFacts: Vermont*, https://www.census.gov/quickfacts/VT (last visited Mar. 6, 2022) (estimating Vermont's population as of 2021 at more than 600,000).
57. *See* News Release, State of Washington Department of Ecology, State Begins Work to Implement Climate Commitment Act (Aug. 6, 2021), https://ecology.wa.gov/About-us/Who-we-are/News/2021/Aug-6-State-begins-work-to-implement-Climate-Commi; U.S. Census Bureau, *QuickFacts: Washington*, https://www.census.gov/quickfacts/WA (last visited Mar. 6, 2022).
58. *See* Jeff Coltin, *What to Know About NYC's $92.2 Billion Budget*, City & St. N.Y. (Feb. 7, 2019), https://www.cityandstateny.com/politics/2019/02/what-to-know-about-nycs-922-billion-budget/177704/.

Obviously, New York is unique among North American cities, and we do not pretend that all (or even many other) cities are similarly resourced. We merely wish to suggest that the level of government (local versus state) is not necessarily dispositive, and some cities may be able to take on the required work. If they cannot, then states that are establishing BPSs might consider allowing covered buildings to reallocate responsibility for achieving their performance targets among themselves.

3. Legal Constraints

A third concern about developing a trading program at the municipal level is that cities operate in a more constrained legal space than higher levels of government, which may impact their ability to develop effective trading programs. The biggest legal constraint that is relevant here is that cities typically cannot impose new taxes without state authorization.[59]

The reason that the limits on taxation matter in this context is that cities that choose to auction off emissions credits could be accused of imposing a tax on the regulated entities. Industry groups in California that opposed the state's cap-and-trade program raised this argument in their attempt to have the state's courts invalidate the program.[60] The highest court to hear the case ruled that the auction did not amount to an unauthorized tax[61]; however, one of the three judges forcefully dissented from the opinion.[62] Moreover, the definition of "tax" is a matter of state law, so the California decision is not binding on courts in other states.

To avoid legal risk, cities may want to either avoid auctioning off allowances or seek prior authorization from their state legislature before doing so. Which of these options is preferable may depend on local political considerations, including the level of coordination between the city and state governments. In some states, such as California, state, as well as local, governments face restrictions in establishing new taxes,[63] so state governments also might need to be mindful of any such restrictions in establishing tradable BPSs with auctioned credits at the state level.

In summary, incorporating trading into a BPS could provide a number of advantages, including lowering costs and providing additional tools for targeting investment in EJCs. While there are certain complications associated with introducing trading at the municipal level, we believe that these complications can be mitigated, particularly in large, well-resourced cities such as New York.

III. Tailoring Trading to the Local Context

As Part II suggests, emissions trading programs take many different forms, and a tradable BPS could also be structured in a number of different ways. Among other decisions, policymakers need to decide how to initially allocate credits to regulated entities, whether there should be a minimum price set for the sale of credits, whether to take any action to target investment or pollution reductions toward particular geographies, including EJCs, and whether entities can bank unused credits for use in a later compliance period.

As noted in the introduction, in 2020-2021, we led a large team of researchers in a study for the New York City Mayor's Office of Climate and Sustainability[64] on whether, and how, a trading program might be added to LL97, a BPS that caps the GHG emissions of large buildings in the city starting in 2024.[65] LL97 itself required the city government to undertake the study.[66] The study sought to design a trading program that would reduce more GHG emissions than current LL97, lower the cost for building owners to comply with LL97, and center environmental justice, among other goals.[67] Throughout the analysis, we assumed that certain features of LL97 were fixed, such as the levels of the declining caps on building GHG emissions that the law established.[68]

In general terms, there were two environmental justice goals for the study: first, designing a trading program that would not increase emissions of local pollutants—sulfur oxide, nitrogen oxide, and fine particulate matter ($PM_{2.5}$)—in EJCs in any year compared to LL97 without trading.[69] In addition, the study aimed to increase investment in EJCs compared to what would occur under LL97 without trading.[70] To enable it to realize these goals, the study team mapped EJCs in the city,[71] developed a series of metrics for analyzing the impacts of different trading proposals on EJCs (and non-EJCs and the city as a whole),[72] used these metrics to track impacts on EJCs of different options,[73] and modelled the impacts of various options for improving outcomes in EJCs under trading.[74] Environmental justice groups were members of the two stakeholder committees that provided input into the study.[75]

After a lengthy iterative process, the study team identified two model trading program designs that we believe would effectively advance New York City's goals.[76] The two

59. *See* Erin Adele Scharff, *Green Fees: The Challenge of Pricing Externalities Under State Law*, 97 Neb. L. Rev. 168, 180-81 (2018). Cities generally have more leeway to impose fees and other types of non-tax charges, but the jurisprudence on how to distinguish tax from non-tax charges is murky. *See id.* at 185.
60. *See* California Chamber of Com. v. State Air Res. Bd., 216 Cal. Rptr. 3d 694, 700, 47 ELR 20053 (Ct. App. 2017).
61. *See id.* at 728.
62. *See id.* at 732-44 (Hull, J., dissenting).
63. Scharff, *supra* note 59, at 175, 210.
64. The office has since been renamed the Mayor's Office of Climate and Environmental Justice.
65. *See* N.Y.C., N.Y., Local Law No. 97 §5 (2019) (codified at N.Y.C. Admin. Code §28-320.11); CTS Report, *supra* note 17.
66. CTS Report, *supra* note 17, at 31.
67. *Id.* at 46.
68. *Id.* at 67-70.
69. *Id.* at 46.
70. *Id.*
71. *Id.* at 31-33.
72. *Id.* at 46-47.
73. *Id.* at 140-51 (Appendix C: Detailed Results of Initial Model Runs); *id.* at 152-65 (Appendix D: Detailed Evaluation Tables of the Two Illustrative Trading Proposals).
74. *Id.* at 82-83.
75. *Id.* at 168-69 (Appendix F: Stakeholder Group Participants).
76. *Id.* at 88-93.

proposals represent two different approaches to designing trading programs, differentiated based on how the emissions credits that buildings would buy and sell are initially allocated.[77] Option #1 relies on an auction to allocate some credits, while Option #2 relies on buildings generating credits. The two proposals include specific environmental justice-related features. Modelling for the study indicated that both proposals would achieve the objectives of increasing investment in EJCs, and not increasing the amount of local pollution in EJCs, compared with current LL97.[78]

Below, we briefly describe the two options and highlight key impacts, including for EJCs.[79] We offer these options as a stimulus to further thinking. Any trading program would have to be tailored to the local context and prevailing policy preferences of the decisionmakers.

A. Option #1: Partial Auction

Option #1 is arguably the more ambitious of the two proposals, and includes an auction. The city would allocate credits to building owners. Building owners outside of EJCs would only receive emissions credits equal to 70% of a building's LL97 emissions cap.[80] The city would sell the remaining credits at auction at a minimum price of $50 per credit and use a portion of the proceeds from the auction to subsidize retrofits of buildings in EJCs.[81] Building owners in EJCs, by contrast, would receive credits equal to 100% of their LL97 emissions cap.[82]

This proposal takes advantage of the potential mentioned above to use an auction to raise funds that can be redistributed to subsidize abatement in specific areas (under this proposal, EJCs). While this version of trading with an auction contemplates auctioning only a share of credits (partly to minimize the deviation from current LL97), a city might choose to sell more credits through an auction, and potentially raise a larger fund for subsidizing energy-efficiency improvements in buildings or other goals.

Option #1 also would allow certain categories of affordable housing buildings that do not have caps under LL97 to opt into a trading program and sell credits. Since these buildings are disproportionately in EJCs, this "opt-in" provision would benefit buildings in EJCs.[83] Option #1 also eliminates the potential for buildings to comply by buying offsets, which would presumably increase abatement within the city's borders.[84]

B. Option #2: No Auction

Under Option #2, there is no auction. Instead, building owners themselves generate credits that they can sell by reducing their emissions by the lesser of their 2018 emissions, which was the year before LL97 was passed, and their LL97 cap.[85] To drive additional investment toward EJCs, and ensure that these areas see more reductions in local air pollution than would occur under LL97 each year, this proposal also recommends that the city accelerate its phaseout of a particularly dirty form of heating oil known as No. 4 fuel oil.[86] As under Option #1, affordable housing buildings also would be able to opt into selling credits, and the ability to use offsets to comply would be eliminated.[87]

C. Impacts

The study's modelling indicated that both proposals would generate numerous benefits for New York City.[88] They both reduce more emissions of GHGs and local pollutants from buildings in New York City than LL97 without trading.[89] They both modestly reduce owners' costs.[90] As mentioned above, both proposals would also benefit EJCs. They both reduce more local air pollution, and generate more investment, in EJCs than LL97 without trading.[91] Both proposals also save more lives in EJCs than current LL97 as a result of the additional reductions in $PM_{2.5}$.[92]

Still, there are also some significant differences between the proposals. Of principal import, Option #1 is more redistributive, both in terms of investment and pollution. By allocating a larger share of free credits to buildings in EJCs than non-EJCs, and subsidizing the cost of retrofits in EJCs, this option shifts investment toward EJCs and shifts pollution toward non-EJCs.[93] Option #1 is also more complicated for the city to administer and potentially imposes more complications on regulated entities as well.[94]

Under Option #2, the city does not establish an auction and therefore does not need to obtain state legislative authorization to avoid the legal risk that auctioning credits would be challenged in court as a tax.[95] Also, under Option #2, building owners that do not want to have anything to do with trading can entirely avoid generating or buying credits, and comply in other ways.[96]

77. *Id.* at 88, 90.
78. *Id.* at 99.
79. A more detailed description of the proposals is available at CTS Report, *supra* note 17, at 88-93. This part of the Comment draws extensively on the findings of the Carbon Trading Study.
80. *Id.* at 91.
81. *Id.* at 92-93.
82. *Id.* at 91.
83. *Id.* at 92.
84. *Id.* at 93.
85. Buildings should only be allowed to generate credits if they reduce their emissions below their LL97 caps *and* their 2018 emissions, because otherwise buildings that already emitted less than their LL97 caps prior to the law's passage would get a windfall.
86. CTS Report, *supra* note 17, at 92.
87. *Id.* at 92-93.
88. *Id.* at 94-103 (describing the results of the modelling of the impacts of the two proposals).
89. *Id.* at 98.
90. *Id.* at 100-01.
91. *Id.* at 99.
92. *Id.* at 97 (Table 17. Avoided deaths by EJC status between 2024 and 2050, relative to base-case LL97 without trading).
93. *Id.* at 99-100.
94. *Id.* at 102.
95. *Id.*
96. *Id.*

In short, while the study's modelling projected both trading proposals to be beneficial, neither option is strictly superior to the other. Ultimately, the choice of how to structure a trading program depends on the local context and specific policy preferences of the local officials.

IV. Conclusion

Looking back at some of the decades-old academic literature advocating the use of emissions trading, it is hard not to feel that it portrays trading as a panacea that will be simple to implement, and significantly reduce the need for government regulation of pollution reduction.[97] As experience with emissions trading has accumulated, it has become clear that emissions trading is a mechanism for implementing regulation, not an alternative to it, and that poorly designed emissions trading programs can underperform just as other poorly designed regulatory approaches can fail. Moreover, emissions trading, like other forms of environmental regulation, could exacerbate environmental injustice.[98]

Rather than thinking of trading as a panacea—or an ineffective tool that will inevitably harm vulnerable populations—we think of it more modestly as a potentially valuable tool that could provide regulated sources, such as buildings, with a degree of flexibility as governments work to decarbonize society. If designed to do so, trading could also advance other goals, such as affirmatively advancing environmental justice. The merits of trading need to be considered on a case-by-case basis and in comparison with the other approaches to providing flexibility, such as RECs and offsets in the case of BPSs. As cities—and other levels of government—increasingly regulate building GHG emissions or energy efficiency, policymakers should consider the advantages and disadvantages in their local context of enabling regulated entities to reallocate responsibility for complying with these standards.

97. *See*, *e.g.*, Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 Colum. J. Env't L. 171 (1988).

98. *See* CTS Report, *supra* note 17, app. A.