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Climate policy, environmental justice, and local air pollution

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Introduction

Left unmitigated, climate change will have increasingly large negative impacts throughout the U.S. economy. Accordingly, climate change has become a defining economic issue. It is also, fundamentally, a social justice issue. A changing climate will disproportionately impact low-income communities and communities of color (USGCRP, 2018). Investments in climate change mitigation and adaptation could reduce – or increase – social and environmental inequalities in the United States, depending on how climate policies are designed and implemented.

Given these high stakes, the environmental justice movement has become an influential voice in the climate policy discourse. Through the lens of distributive justice, the movement has elevated concerns about disproportionate impacts of climate change, the distribution of climate policy benefits, and the incidence of climate change mitigation and adaptation costs. Through the lens of participatory justice, more substantive engagement of marginalized communities in the policy process is seen by many as an essential step towards achieving more equitable outcomes.

This paper explores linkages between U.S. climate policy, environmental justice (EJ), and local air pollution. Policy proposals recently introduced by Democrats place EJ concerns at the heart of the climate policy agenda.[1] To gain insight into how this policy imperative could be implemented, we draw lessons from recent legislative and regulatory experiences in California. In 2006, California began a path-breaking experiment to incorporate EJ concerns into an ambitious climate change mitigation agenda. We review this experience to date, noting some early pitfalls and subsequent course corrections. We base this analysis on our own research and policy engagement. We do not represent or claim to speak for the EJ community.

The environmental justice movement in the United States dates back to the late 1970s when community activism and scholarship drew attention to the disproportionate siting of hazardous waste facilities in low-income minority communities.[2] Subsequent research has documented striking inequities in the cumulative exposure of low income and racial minority communities to many forms of pollution, in addition to other social stressors.[3] Over the past 50 years, remarkable improvements in environmental quality have been achieved under the Clean Air Act (Currie and Walker 2019, Aldy et al. 2020). However, some low-income communities still bear a disproportionate burden of persistent environmental harms from air pollution.

There is an important connection between local air pollution exposure, environmental justice, and policies that aim to mitigate climate change. Greenhouse gas emissions (GHGs)

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1. Biden-Sanders Unity Task Force Recommendations released 7/8/2020.

2. Whereas the protests in Warren County, South Carolina are often cited as the birthplace of the EJ movement, EJ concerns had emerged as a galvanizing issue well before. See, for example, Taylor (1997).

3. These findings have been synthesized by Bullard (1994), Cole and Foster (2001), Bowen (2002), Mohai, Pellow, and Roberts (2009), London et al (2008), and Timmins et al (2019).

are often co-emitted with other pollutants that impact local air quality. If efforts to reduce GHGs also reduce these harmful co-pollutants, climate policies can indirectly cause local air quality improvements. These "co-benefits" can be substantial (see e.g., Aldy et al. 2020). For example, under the Obama Administration's Clean Power Plan to limit GHGs from power plants, it was projected that 60 percent of the benefits would come from reductions in precursors to local and regional air pollution that were not directly targeted by the regulation.

Addressing local air pollution problems can have an important role to play in building political support for domestic action on climate change.[4] In this paper, we look to a jurisdiction that has been working to combine stringent climate goals with unprecedented emphasis on social justice and local air quality. Starting with the Global Warming Solutions Act of 2006, California has positioned itself on the leading edge of policy innovation in this space.

We review the California experience to date, paying particular attention to lessons that could be instructive for other jurisdictions. Under the Global Warming Solutions Act, or AB 32, tensions quickly surfaced as government agencies endeavored to address climate change and local air pollution — two fundamentally different problems — under the same regulatory framework. Disagreements about the appropriate scope of policy emphasis were one source of conflict. A related controversy stemmed from disagreements over the role of market-based greenhouse gas (GHG) regulations. Whereas economists and many policy makers generally favor market-based mechanisms for GHG reductions (e.g., cap-and-trade or a carbon tax), EJ advocates have vehemently opposed California's GHG cap-and-trade program on the grounds that it fails to guarantee local air quality improvements. A third source of tension was process related; although the 2006 legislation included several provisions that were intended to give "fenceline" communities a seat at the table, these efforts initially fell short.

Negotiating these challenges led to important policy refinements, many of which have been codified in new legislation. Assembly Bill 617 (AB 617) was designed to directly address ongoing issues of local air pollution in disadvantaged communities, recognizing that the existing provisions under AB 32 and the Clean Air Act were insufficient. AB 617 is not a climate change policy, but it is an important companion bill that was designed in direct response to frustrations with the initial climate policy framework. It is groundbreaking in at least two ways: First, it attempts to overcome significant limitations of the Clean Air Act in both identifying and addressing local pollution "hotspots".[5] Second, AB 617 uniquely

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4. In July 2019, a coalition of EJ and state, local and national environmental groups announced creation of a "National Platform" to confront racial, economic, and EJ. Among the objectives of the coalition are to enact solutions to address the "legacy of pollution" and environmental harms in overburdened communities (Source: https://www.americanprogress.org/press/release/2019/07/18/472265/environmental-justice-national-environmental-groups-advance-historic-joint-climate-platform/, Accessed on July 24, 2020).

5. The existing EPA air pollution monitoring network is extremely sparse and incapable of measuring air quality at neighborhood levels. Hsiang, Oliva, and Walker (2019) point out that out of 3144 counties, only 1289 have monitors for any "criteria" air pollutant (i.e. pollutants regulated under the Clean Air Act) at any point between

empowers communities in the regulatory process by having them work directly with regulators to create legally binding roadmaps for addressing local environmental issues. In doing so, AB 617 also provides communities with significantly expanded air pollution monitoring networks to better identify and address local air quality issues.

California's joint implementation of an ambitious climate change policy agenda together with a targeted effort to mitigate inequities in both pollution exposure and policy participation could serve as a model for other jurisdictions.[6] Although it is too early to tell whether AB 617 will succeed in eliminating persistent pollution exposure and process inequities, we see some reasons for optimism. The approach is laying foundations for local air quality improvements in neighborhoods that existing regulations have failed to protect.

In what follows, we first consider why disparities in pollution exposure have persisted under seemingly comprehensive federal and state air pollution regulations. Specifically, Section 2 discusses the primary reasons why the Clean Air Act has failed to address many areas of persistent environmental inequality. Section 3 introduces California's earlier efforts to address climate change, and local air quality problems, within the same policy framework. Sections 4 and 5 introduce AB 617 and take stock of implementation progress to date. Section 6 suggests lessons for other jurisdictions. Section 7 concludes.

Disproportionate pollution burden and regulatory failure

An enormous body of evidence documents that low-income and/or minority communities are disproportionately exposed to various sources of air and water pollution such as refineries, congested highways, and/or hazardous waste or superfund sites.[7] While proximity to these emissions sources is certainly correlated with exposures, it has been difficult to comprehensively measure disparities in pollution exposure given the sparseness of the air pollution monitoring network in the United States. For example, fewer than 20 percent of U.S. counties contain a regulatory-grade device capable of monitoring small particulates . . .

1990-2015. Carlson (2018) provides a useful overview of how the Clean Air Act is poorly suited for addressing local, "hotspot" air pollution problems.

6. Recently, other states have started down a similar path. For example, in late 2019, New York legislature adopted a bill that makes many important changes to the state's climate protection law. NY State Climate Leadership and Community Protection Act (S.6599/A.8429) includes provisions that are remarkably similar to California's AB 617. https://legislation.nysenate.gov/pdf/bills/2019/S6599. The bill is described as having the most aggressive climate target in the US (Roberts, 2019). Presidential candidate Joseph Biden has proposed a climate change plan that integrates several key features of the California model. Elements of the Biden Plan include: tools to identify communities most threatened by local air pollution and climate change; new air quality monitoring for "fenceline" communities; a public health corps to help communities access and act on local air pollution information (Source: https://joebiden.com/environmental-justice/, accessed on July 24, 2020).

7. See Banzhaf, Ma, and Timmins (2019a, 2019b) for recent reviews of the economics literature on environmental inequality. Brulle and Pellow (2006) provide a useful overview from the public health community.

(Fowlie, Rubin, and Walker, 2019). Hence, while we know that there are racial differences in the proximity to toxic facilities, hazardous waste sites, and road networks, discerning what these differences imply for measured exposures is difficult.

Fortunately, recent advances in low-cost monitoring technology and remote sensing now allow a more complete understanding of the spatial variation in air pollution exposure. For example, satellite imagery, can provide highly granular measurements of certain pollutants for the entire United States on a daily basis (see e.g., Di et al. 2016, Von Donkelaar et al. 2015). Similarly, low cost monitors allow individuals and community groups to measure air quality in their neighborhoods (Caubel, 2019). These technologies are transforming our understanding of disparities in pollution exposure and how these disparities have evolved over time. For example, Currie, Voorheis, and Walker (2020) use granular, satellite-derived measures of PM2.5 to show how the black-white racial gap in PM2.5 exposure has narrowed considerably over the past 20 years.

These technological advances have exposed some important limitations of the Clean Air Act (CAA) (Carlson 2018). By many measures, the CAA and its implementing regulations have been incredibly successful in improving air quality. For example, average concentrations of air pollutants such as particulate matter and ozone have fallen by, in many cases, 85 to 90 percent since 1980 (Currie and Walker 2019). Air toxics emissions have also dropped significantly.[8] This success notwithstanding, local air quality problems can endure under seemingly comprehensive regulations owing to shortcomings in the three most important components of the CAA.

First, the CAA and its subsequent amendments (CAAA) include a system of health-based national ambient air quality standards (NAAQS). Compliance with these standards is assessed using a network of monitoring stations that measure average air pollution concentrations at "representative" locations. One shortcoming of this approach is that the network of ambient air quality monitors is sparse. Historically, it has been far too expensive to maintain a dense network of air quality monitors.[9] The problem is that regionally representative monitor measurement can mask enormous differences in air quality across neighborhoods within the region.[10] Thus, there are communities in areas that the Environmental Protection Agency (EPA) deems in "attainment" (a.k.a. compliance) that regularly experience pollution levels above the regulatory standard (Fowlie, Rubin, and Walker, 2019).

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8. By 2014 Benzene emissions were down 66 percent, mercury down 60 percent, and lead down 84 percent (compared to 1990). Source: https://www.epa.gov/urban-air-toxics/fact-sheet-second-integrated-urban-air-toxics-report-congress (accessed on July 15, 2020).

9. EPA's monitoring regulations appear in 40 C.F.R. §52 app. D (2016).

10. As one point of reference, we used Census block measurements of PM2.5 from Di et al (2016) to calculate the difference between the cleanest and dirtiest Census block within every county in the US in 2015. The average within-county difference in PM2.5 between the cleanest and dirtiest Census block in a county was 7 $\mu g/m^3$. The largest within-county difference in neighborhoods was 22 $\mu g/m^3$. The CAA NAAQS for PM2.5 is an annual mean, averaged over 3 years, of 12.0 $\mu g/m^3$.

Another shortcoming of the NAAQS program lies in the EPA's limited ability to force compliance with air quality standards. The most effective means of bringing an area into compliance involves imposing various sanctions on states, but this option is rarely invoked. Rather, progress is usually achieved through more subtle forms of cajoling, financial incentives, tighter permitting and technical assistance. This process is slow, such that it can take decades to bring polluted areas into attainment.

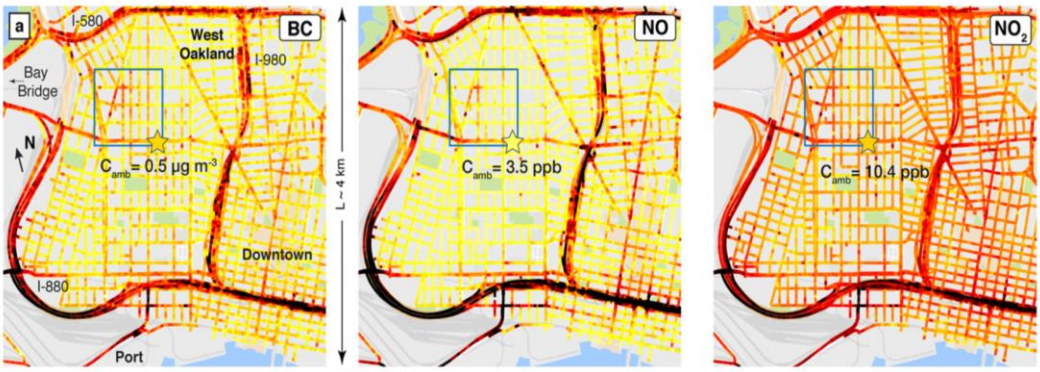
A second pillar of the CAA is a suite of standards and permitting requirements used to restrict emissions from stationary sources, such as power plants and industrial facilities. These rules supplement NAAQS by requiring permit applicants to monitor and model air quality around their proposed sites and employ emission controls for criteria pollutants. Major sources must also limit emissions of hazardous air pollutants with up-to-date emission control equipment. One reason why these source-specific regulations can fail to adequately protect local communities is that the permitting process is mainly prospective, relying on engineering estimates or emissions factors to permit the majority of stationary source emissions. With the important exception of power plants, EPA has limited regulatory capacity to continuously monitor emissions or air quality impacts from a facility once it has been permitted. Accordingly, evidence suggests that large industrial sources, like oil refineries, have actual emissions that can be orders of magnitude higher than limits prescribed in the air quality permit (Cuclis 2012, Hoyt and Raun 2015). By using only engineering-based emissions factors, regulators may be unable to assess the complaints of residents who can smell the chemicals and regularly experience respiratory problems. Once permitted, regulators and community members have limited ability to enforce limits on new stationary ambient exposure, and emissions monitoring requirements at many facilities are limited.

A third category of CAAA regulations targets mobile sources. Heavy-duty trucks, freight operations, and passenger cars are leading causes of hotspot pollution. The CAA authorizes the EPA to set emission standards for new mobile sources and requires inspection and maintenance (I&M) of some types of existing vehicles in NAAQS nonattainment areas. To promote uniformity, however, the law generally bars states and local agencies from setting mobile source emissions standards, with one big exception; California can set vehicle emission standards that are stricter than EPA's if EPA grants a "waiver," after which other states can follow California's lead. This jurisdictional structure implies that regional and local agencies, who are arguably in the best position to address local air pollution problems, have limited authority over mobile source emissions. States can regulate the operation of vehicles, for example, through limits on access to ports by older model trucks, limits on idling of truck engines, prohibitions on heavy duty vehicles in certain neighborhoods and I&M requirements for vehicles (beyond those required for nonattainment areas). While these federal and state measures do reduce mobile source emissions, they can't be targeted to mobile source hotspots (with the exception of road and port access rules). Moreover, it takes time for the vehicle fleet turn-over. Thus, federal and state vehicle emission standards targeting new vehicles work slowly to reduce emissions.

California, despite its long history of adopting mobile source emission standards stronger than federal rules, is home to some of the most polluted communities in the country (Amer-

ican Lung Association, 2020). Communities near ports, rail yards, warehouses, and freeways experience a higher concentration of air pollution than other areas due to emissions from cars, trucks, locomotives, and ships (CARB 2018). Figure 1 helps to illustrate how pollution measurements taken at one location misrepresent exposure levels only a few miles away. These figures are generated from thousands of monitor measurements in West Oakland collected using instruments mounted on Google Streetview cars (Apte et. al 2017). The figures show how neighborhoods located near highways experience much higher pollution levels of Black Carbon, NO, and NO_2 than other neighborhoods. Many of these same communities also experience pollution impacts from other sources such as ports, oil refineries, and metal recycling facilities.

Figure 1: Pollution hotspots in Oakland, CA as identified by Google Streetview Air Quality Monitoring Project



Source: Apte et. al 2017

Note: Within West Oakland, some areas had 5-8 times higher pollution levels than others within a 4km radius. Many parts of the neighborhood had higher air pollution levels, as indicated by dark red and black, than those measured by the central regulatory monitor. The leftmost figure shows measurement of black carbon (BC), the middle figure shows measurements of NO, and the rightmost figure shows measurements of NO2.

Hyper-local air quality problems, such as those experienced in parts of West Oakland, have galvanized EJ groups in California to demand progress. By the time California began to develop its comprehensive climate policy framework, the EJ movement was firmly established and in position to influence legislative and regulatory processes.

While there is a long history of public involvement in environmental regulation in the United States, community engagement (such as public comment periods on pending regulations or environmental impact assessments) often comes late in the process. This has made it hard for community involvement to substantively change the outcome (Chess and Purcell 1999). Thus, along with concerns about local pollution exposure, calls for increased representation and participation were an important consideration in the design stages of California's landmark climate change policy framework.

A California climate policy experiment

California is on the front lines of climate change. Increasingly intense forest fires, coastal flooding and erosion, prolonged droughts, and higher temperatures have galvanized efforts to pursue aggressive GHG emissions reductions. In 2006, California passed the Global Warming Solutions Act (AB 32), which at the time was the most significant climate change legislation in the country. Under the auspices of AB 32, California has implemented a suite of policies to reduce in-state GHG emissions and develop low carbon solutions that can be deployed in other states and nations.

From the outset, AB 32 sought to also improve local air quality problems, in addition to climate change mitigation. Along these lines, AB 32 included several provisions to address distributive and procedural dimensions of EJ concerns. Kaswan (2019) argues that this emphasis allowed California to "overcome the fears and resistance that more narrowly conceived climate policies often spark."

To address disproportionate exposure to local air pollution in some communities, AB 32 legislation directed the California Air Resources Board (CARB) to "maximize additional environmental and economic co-benefits for California and complement the state's efforts to improve air quality." Acknowledging concerns about market-based GHG regulations, CARB was required to "consider the potential for direct, indirect, and cumulative emissions impacts from these mechanisms, including localized impacts in communities that are already impacted by air pollution."

AB 32 also mandated a suite of procedural changes that were designed to give community advocates a seat at the table. Researchers, activists, and policy makers have argued for policies that formalize mechanisms of community input, create greater legitimacy for community demands, educate citizens about their rights, and support local monitoring efforts (O'Rourke 2004). Under AB32, an EJ advisory committee (EJAC) was chartered. Policy planning workshops in communities with minority and low-income populations were required. CARB added two voting members with experience on EJ issues and a new executive position to coordinate with EJ communities.

Overall, the language of AB 32 was unprecedented in its emphasis on EJ concerns and objectives. However, the practical implementation of this landmark legislation encountered some formidable challenges. In a candid assessment of the first implementation phase (i.e. 2006-2012), London et al. (2013) describe a "seemingly intractable conflict" between state agencies and the EJ communities. In our view, three fundamental sources of tension merit careful consideration by other jurisdictions pursuing similar policy directions.

One source of conflict is the GHG cap-and-trade program. Economists and many policy makers see carbon pricing as an essential mechanism to incentivize economy-wide investments in the most cost-effective emissions abatement opportunities while also raising revenues to fund other policy objectives. In contrast, the EJ community has strongly opposed the GHG cap-and-trade program. Much of this opposition is rooted in a distrust of market-based policy solutions and concerns about the flexibility that firms have when complying with these regulations. Whereas economists view this flexibility as critical to ensuring cost-

effective emissions reductions, EJ groups see reduced opportunity for community input and agency.

Community advocates have also been concerned that emissions permit trading would allow for continued (or increased) exposure of disadvantaged communities to co-emitted local pollution.[11] To date, the weight of the evidence suggests that emissions trading programs in California have delivered equal or greater air quality benefits to disadvantaged communities (see, for example, Fowlie et al. 2012; Grainger and Ruangmas, 2017; Mansur and Sheriff, 2019). However, the extent to which the GHG emissions trading has impacted local air quality in different neighborhoods has been hard to disentangle because the introduction of the cap-and-trade program coincided with several other economic and policy changes.[12]

A second, related source of tension concerns the appropriate scope of AB 32 and the range of pollution issues it should address. Although the language of AB 32 promised to address both local pollution problems and climate change mitigation, this broad scope was difficult to negotiate in practice. For example, EJ advocates wanted to see restrictions on GHG permit trading that prioritized ancillary health benefits and co-pollutant emissions reductions in specific locations.[13] Because targeting GHG reductions at specific sources could significantly increase the cost of achieving the state's ambitious GHG reduction targets, these suggestions did not find broad support. Economists and other stakeholders argued that trying to use climate policy to address two fundamentally different problems – local and global pollution – would undermine progress on both fronts (see, for example, Borenstein, 2017; Fowlie, 2017). These arguments are correct in theory. But after decades of disproportionate harm, fenceline communities were understandably frustrated by the suggestion that it would be "more administratively efficient" to rely on the existing regulatory framework under the CAA as a means of addressing local pollution problems (Schatzki and Stavins, 2018), especially in light of the CAA failures highlighted above.

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11. See, e.g., EJ Advisory Committee, Recommendations and Comments of the EJ Advisory Committee on the Implementation of the Global Warming Solutions Act of 2006 (AB 32) on the Draft Scoping Plan (2008), https://www.arb.ca.gov/cc/ejac/ejac_comments_final.pdf.

12. Cushing et al. (2018) compare facility-level emissions during the first three years of the GHG cap-and-trade program against emissions in the years immediately preceding. These authors find that emissions were *less* likely to decrease at facilities located in close proximity to disadvantaged communities. This differential trend is difficult to interpret because of many confounding factors that impacted facilities differently over this time period (such as recession impacts). A more recent study revisits this question using a longer time series and a more sophisticated model of how local air pollution disperses over space (Hernandez-Cortes and Meng, 2020). On the basis of estimated *average* impacts of the program on facility-level emissions, these authors conclude that California's GHG trading program has *reduced* inequities in local air pollution exposure. However, because this study focuses on average exposure, it does not fully address EJ concerns about inequities in the distribution of pollution across neighborhoods.

13. See, for example, proposed amendments to Assembly Bill No. 378 (AB 378) would have imposed individual facility GHG emissions caps and empowered the California Air Resources Board (ARB) to establish "no-trade zones."

A third, and related, point of conflict has stemmed from the nature of the interactions between CARB and the EJ community. Throughout the AB 32implementation process, EJAC members expressed frustration that CARB was failing to comply with procedural requirements, and that their input was not being taken seriously. In 2009, seven of the eleven members of the EJAC joined a lawsuit against CARB alleging that the implementation of AB 32 was misaligned with the legislative intent to protect EJ communities.[14]

When it came time to launch the second, more ambitious phase of GHG emissions reductions in 2017, these points of conflict had not been resolved. EJ groups fiercely opposed renewing the GHG cap-and-trade program. Proponents argued that carbon pricing was essential to both GHG abatement cost minimization and revenue generation. Ultimately, a critical compromise was reached.[15] The GHG cap-and-trade program was extended. However, rather than relying on climate change policies to deliver local air quality improvements, the state promised to tackle local air pollution concerns more directly through California's Assembly Bill 617.

An important course correction

AB 617 responds directly to two enduring frustrations. First, local air pollution problems were not being adequately addressed. Second, despite the emphasis that AB 32 placed on community engagement and procedural justice, local community groups continued to feel that their input was not being valued or integrated into policy design or implementation. AB 617 provides unprecedented levels of support for public engagement in the development of comprehensive, community-level emission reduction plans.[16] AB 617 also includes new regulatory authority and funding to expand local air pollution monitoring systems to better diagnose and monitor local pollution hotspot problems in communities.

A selected set of California communities with high cumulative exposure burdens from toxic air contaminants and criteria air pollutants were identified as possible candidates for the program. From this list, CARB selected 10 communities to participate in the first round of AB 617.[17] These ten communities were placed into one of three regulatory tracks: enhanced community air monitoring, community emissions reduction plan, or both. [18]

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14. London et al. (2013) provides an excellent discussion of this lawsuit, (AIR vs. CARB, Case No. 09-509562), and subsequent court action.

15. A number of EJ groups were not supportive of this compromise, including Communities for a Better Environment.

16. The implementation process has been guided by a Community Air Protection Blueprint developed by CARB. Blueprint documents are available at: https://ww2.arb.ca.gov/capp-blueprint

17. CARB selected three additional communities to participate in AB 617 in the second year of the program.

18. There was a mixed process of proposing communities for selection: in some places, such as Imperial, Oakland and the SJV, the community organizations played a very strong role in proposing the 617 sites

Figure 2: Communities participating in California's AB 617 community emissions reduction and air monitoring plan

Source: https://ww2.arb.ca.gov/news/carb-adds-more-california-neighborhoods-disadvantaged-communities-statewide-community-air (Accessed: July 24, 2020).

Once communities were selected, local air districts helped create multi-stakeholder community steering committees (CSC). These CSCs include a wide range of community stakeholders, including residents, local businesses, and labor groups. The committee is first tasked with identifying community issues and concerns, determining the final geographic boundary of the community being served, and facilitating community outreach and engagement. The local air district works with the steering committee to establish a charter to clearly set out the committee process and structure. This charter sets out a roadmap for developing and implementing a community emissions reduction plan.[19]

In "monitoring communities," CSCs were tasked with developing a community air monitoring plan (CAMP). These plans determined the location and types of air quality monitoring to be used. Once established, the local monitors help to characterize local air quality

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while in others such as Richmond and Sacramento the district played the primary role. This was largely a function of the range of existing community organization capacity in these places.

19. AB 617 allocated funds to help local organizations engage closely in the steering committee and emissions reduction plan process. CARB and state legislators hoped to build organizational capacity to become active partners to identify, evaluate, and ultimately reduce exposure to harmful air emissions. To date, CARB has disbursed $10 million in the Community Air Grants Program (Air Grants), although some have suggested that additional funds are needed to compensate for the significant time burdens associated with steering committee membership (London 2020).

conditions and identify the sources contributing to local air quality problems. The expectation, for the three communities that only received enhanced community air monitoring, is that the monitor data will help provide important information for future emissions reduction strategies, including community emissions reduction plans. Community-based monitoring and planning not only compensate for gaps in the national network of air pollution monitors, but also reinforce local community engagement in the regulatory process.

Community Emissions Reduction Plans (CERP) establish priorities, identify specific strategies for emissions reductions, and define schedules for implementation. The goal is to identify a strategy to address air pollution from stationary, mobile, and area-wide sources that contribute to the cumulative emissions and exposure burden in these communities. CERPs must include new actions (e.g., regulations, enforcement, incentives, enforceable agreements) that go beyond existing regulatory efforts to further reduce air pollution disparities. CARB provides specific guidance on the types of actions and the process for identifying and evaluating local pollution reduction strategies to be included as part of each community emissions reduction program.[20] While the individual strategies will vary by community, the statewide criteria establish a minimum baseline for the types of strategies to be considered and discussed with the community steering committees.[21]

Considerable discretion is left to community steering committees as to how deep to cut emissions affecting a community. This discretion is important to allow communities the autonomy to chart their own course. But it has also contributed to tensions between communities and air districts (London et al. 2020). The law states only that the measures should be cost-effective, address both mobile and stationary sources, and result in emission reductions in the community. All emissions reduction plans must ultimately be approved by CARB. Compliance with the community emissions reduction program is enforceable by the air district and CARB. The language suggests that the emission reduction plan should reflect the relative contribution of sources to elevated exposure to air pollution in impacted communities. As of June 2020, CARB has approved all seven of the initial community emissions reduction plans.

As may be intuited from the discussion above, AB 617 has a unique governance structure, split between CARB, communities, and local air districts. CARB provides oversight and grants to community groups to participate in the process; communities provide direction and partner with air districts on monitoring and emissions reduction programs; local air districts partner with communities on community air monitoring and emissions reduction plans, provide incentive funding, and can require stronger pollution controls for sources.

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20. The bill contains some specific requirements for stationary sources in nonattainment areas, which require air districts to adopt an expedited schedule for the implementation of best available retrofit control technology (BARCT) and requires CARB to establish a statewide clearinghouse that identifies BARCT for sources of criteria air pollutants and toxics.

21. These include: adoption of more stringent emissions limits and improved control techniques, permitting requirements for new sources, enhanced enforcement to deal with local compliance issues, and coordination with local land use and transportation agencies

Early experience with AB 617

The AB 617 is very early in its implementation phase. Hence, it remains to be seen whether the program will succeed in reducing the pollution exposure burdens in affected communities. That being said, there are some early lessons that are instructive for other states and/or federal policy going forward. This section draws insights from early experience with the community engagement and local air monitoring and abatement planning embodied in AB 617. These observations are based on our experience in abatement plan development,[22] surveys of community participants in West Oakland,[23] and participant surveys in other AB 617 communities (carried out by a team led by Jonathan London of UC Davis).[24]

Timelines: After years of neglect, communities burdened by disproportionate levels of air pollution are anxious to see real and lasting improvements. This sense of urgency is reflected in the aggressive timetable established in AB 617. In hindsight, however, the two-year deadline for plan development proved too aggressive. Effective community engagement is not always in the skill set of air pollution control agency staff, who need time to engage additional expertise or learn new proficiencies. It also takes time to develop trust and effective information exchange in matters of technical complexity and requiring institutional change.[25]

The aggressive timeline constrained the quality of community involvement and limited the range of source abatement strategies that could be considered. For example, the West Oakland plan identifies many measures to reduce emissions from port activities and sets a long-term goal to electrify trucking and freight handling equipment. But the plan lacks detail on those measures and often does not identify a process or timeline by which they would be planned, funded and implemented.

Governance and engagement: The process of supporting and building community engagement has varied substantively across the 10 communities. Regional air districts took different approaches to governance, community outreach, business involvement, exposure assessment and analysis. Communities arrived with different priorities and different levels of experience. Some communities had well-established community groups that could quickly step into a leadership role. For example, in West Oakland, a local EJ group, West Oakland Environmental Indicators Project (WOIEP), co-led the process with the Bay Area

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22. *Owning Our Air: The West Oakland Community Action Plan,* https://www.baaqmd.gov/community-health/community-health-protection-program/west-oakland-community-action-plan

23. Survey was carried out by Lily McIver, UC Berkeley graduate student researcher at Goldman School. This research was supported by a grant from the Bay Area Air Quality Management District (BAAQMD).

24. A recent paper by Jonathan London of UC Davis, evaluates the AB 617 community engagement processes. London et al. (2020). The paper contains detailed recommendations to improve the AB 617 process in California. Those details are beyond the scope of this paper. Although London believes the first efforts to implement AB 617 process were generally successful, he identifies several improvements to enhance the value of the policy.

25. Recent surveys of AB 617 participants show a significant degree of conflict between the AB 617 community steering groups and the Air Districts (London et al. 2020).

Air Quality Management District, under advice of a community-based steering group with limited business community membership. In other communities, such as South Sacramento, there were no EJ organizations with substantial experience in air quality issues to engage, and the process was primarily driven by the local air district.

Drawing from the limited experience to date, the communities that adopted a co-lead model appear to have had more success in building trust and fostering community leadership compared with the communities that proceeded under a district-led process. This is particularly true in communities where community steering committees could leverage a pre-existing community group that had already gained the respect and recognition of the local community. Co-led planning also appears to have had more success in pushing for cooperation across historically siloed agencies (e.g. air districts, city government, port authorities, health departments, and planning agencies).

The community-based process set in motion by AB 617 brought representatives from multiple governmental agencies into the same room. Despite having overlapping jurisdiction, some of these agencies had not interacted with the community, or each other, on local air pollution issues. Prior to the AB 617 planning process, interactions between the community and local, regional and state air quality agencies was episodic, often involving a shifting set of agency personnel, from multiple jurisdictional entities (state, city, port, health and transportation agencies). Addressing local air quality problems requires a more sustained commitment and collaboration between disparate agencies. This is an important benefit of an AB 617 process which forces greater interagency cooperation and reduces frustration and transaction costs for community groups and residents.[26]

While it is difficult to generalize across the range of community experiences, it seems clear that a legislative mandate to directly engage community members in the planning process is helping to mitigate some of the barriers that have historically stood in the way of community involvement. This process has elevated the influence of local community groups and improved access to agency staff and decision making. In some regions, community groups that had routinely been ignored or dismissed by agency staff note that their phone calls were being returned and meetings scheduled. In other settings, where community groups already had relatively good access to air quality agencies and local government, the mandate of AB 617 has increased their ability to assert political pressure on state and local agencies to make local air quality a priority.

Community monitoring: AB 617 has provided critical support for community-based air quality monitoring. People need information in order to understand local problems, take action in the near term, and advocate for permanent solutions in the long term. Expanded monitoring at the neighborhood level also builds trust in the policy process and helps focus pollution control agency attention on problem areas and sources.

The design and implementation of local monitoring plans varied substantially across communities. In some cases, the Air Districts developed modeling procedures to attribute local

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26. Clarification of interagency responsibility would be especially important in a federal version of AB 617 where effectiveness of an EPA led hotspot abatement plan could be either enhanced or undermined by planning or funding decisions of federal transportation, infrastructure, energy or economic development agencies. See discussion below on federal policy implications.

exposure to particular sources of pollution. This helped prioritize pollution abatement planning and complementary exposure reduction strategies for heavily affected locations (e.g. indoor air filtration for senior centers, low income housing, and schools located in high impact sub-neighborhoods). This was, however, a very resource intensive effort that could strain the capacity of air quality agencies with smaller staffs and budgets. In other cases, attribution can be adequately inferred from emission inventories without the need for expensive and time-consuming source attribution modeling.

One criticism of the AB 617 process to date is that there has been a lack of clarity regarding how monitoring information should guide pollution abatement action. Although local air quality monitoring has been an important component, is it not sufficient to simply provide and support expanded monitoring in a community with significant pollution exposure burdens. There must also be a clear mechanism through which monitoring, and data collection can inform and advance emission abatement planning and implementation. And, the aggressive time frame for program implementation has meant that, in some cases, the monitoring data was not available in time to inform the design of emissions reduction plans. AB 617 could be improved by better coordination of deadlines for monitoring results and abatement plans; monitoring data could be combined with health risk assessment tools to help community groups and agencies identify the highest abatement priorities.

Emissions reductions: The Community Emissions Reduction Plans (CERPs) developed under the AB 617 process constitute a powerful step toward reduced exposure to local air pollution. There are reasons to think that this initiative could be more successful than past efforts to address local air quality problems. Unlike past efforts in which community participation was gathered in the form of comments on agency proposals, the AB 617 process has engaged community members from the beginning. Emissions reduction plans are not recommendations or wish lists from communities – they are co-created strategies in a CARB-approved plan. Local community groups have now established relationships, through repeated interactions, with the agency actors who can move these plans forward. Moreover, monitoring information about local exposures is now in the hands of local stakeholders.

However, unless the community remains actively engaged in the process with substantive decision-making authority, implementation by state, region and local government could stall, particularly on difficult issues that require interagency cooperation (e.g. land use, transportation planning, infrastructure investment). The ability to sustain community engagement through the implementation phase is a key factor that will determine whether AB 617 will succeed in delivering substantive and durable improvements in local air quality.

Funding: Participation in steering committees and emissions reduction planning requires significant investments of time by community members. Funding for community engagement during implementation of AB 617 has often been uncertain and subject to annual budgetary commitments. Going forward, active engagement in the implementation process may be difficult to sustain without a more stable form of financial support for community groups, air districts and CARB. In addition, CARB will require funds to oversee and imple-

ment community plans. Notably, much of the funding for AB 617 comes from auction revenues in the cap-and-trade program. Further appropriations from the State may be necessary, especially in these critical implementation stages.

Insights for federal and state policymakers

Concerns about air pollution hotspots and the marginalization of disadvantaged communities in throughout the policy process are not unique to California. These EJ concerns span all 50 states. In this respect, the California experience could guide policy innovation in other states and/or at the federal level.

In the context of federal policy, we believe there are several potential avenues to address systemic pollution exposure burdens in marginalized communities: amendments to the CAA; new legislation outside the CAA; EPA rulemaking; or programmatic actions supported by congressional appropriations. Although we focus primarily on the federal policy arena, much of the discussion is applicable to state legislation and agency actions on EJ.

For decades, political divisions have made a comprehensive revision of the CAA unthinkable. While Congress has passed narrowly tailored CAA amendments to create new control mechanisms (e.g. agricultural fuels) and made an unsuccessful run at a separate climate law in 2010, the 1990 CAAA remains intact and has proven resilient to the political tides. This is not to say that a reopening of the Clean Air Act is impossible. Undoubtedly, there are improvements that could be made to the 30-50-year-old statute. However, the job would be difficult, and absent a fundamentally different political alignment, opening the door to CAA amendments could weaken the CAA's health and environmental protections.

Rather than try to work within the existing CAA framework, mounting public support for climate action could open the door for federal climate legislation separate from the CAA. Given the tensions that can arise when policymakers attempt to tackle local air pollution and climate change with the same policy instrument, a new federal policy platform would ideally bundle climate change regulations with complementary – but distinct – EJ provisions.

An economy-wide carbon price has an important role to play in a federal climate change policy platform. Although a carbon pricing regime is not well-suited for hot-spot remediation, it can provide a valuable means of raising the revenues required to support a national hot-spot remediation mandate and supporting appropriations. The EPA could act in a supervisory role to guide and approve local air pollution reduction plans by states, akin to the way it approves state implementation plans under the existing NAAQS. This program could operate the way AB 617 places the Air Resources Board in an oversight and approval role (relative to regional air districts) in California.

If Congress remains too divided to act on climate, could EPA mount a coordinated response to climate change local air pollution hotspots under the current CAA authority? The EPA has broad authority under the 1990 Clean Air Act Amendments to address EJ concerns within many of the standard setting, grant making, permitting and monitoring components

of the Act.[27] One can imagine a set of ambitious power sector,[28] transportation and fuel technology performance standards, adopted under existing CAA authority, that would over time largely eliminate exposure to diesel particulate, refinery, and ozone precursor emissions. EPA could explore whether CAA rulemaking initiatives could include goals or standards designed to eliminate racial disparities in air pollution exposure, using authority under Title 6 of the federal Civil Rights Act.[29] EPA could also tighten ambient air quality (NAAQS) and toxics (MACT) standards and revive the urban air toxics (GACT) program.[30] But this is not an easy road. The process to set and revise ambient air quality standards and technology standards is notoriously time consuming and may not be effective to address local air pollution hotspots involving cumulative impacts from multiple source categories and pollutant types (Carlson 2018).

To deliver more immediate results, the EPA could complement the initiatives described above with a more targeted program fashioned along the lines of AB 617. The EPA could use its broad grant making and monitoring authority powers under the existing CAA to support enhanced local air quality monitoring, community engagement, and citizen-monitoring-science. The agency has managed EJ programs for many years.[31] EPA could expand that effort and accelerate the process of certifying low cost monitors[32] to enable denser

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27. Environmental Law Institute, Research Report, *Opportunities for Advancing EJ: An Analysis of U.S. EPA Statutory Authorities*, November 2001, https://www.eli.org/research-report/opportunities-advancing-environmental-justice-analysis-us-epa-statutory-authorities.

28. See, UC Berkeley Goldman School of Public Policy *2035 Report,* https://www.2035report.com/downloads/

29. See, US Commission on Civil Rights, *EJ: Examining the Environmental Protection Agency's Compliance and Enforcement of Title VI and Executive Order 12,898,* https://www.usccr.gov/pubs/2016/Statutory_Enforcement_Report2016.pdf

30. See, Second Integrated Urban Air Toxics Report to Congress, 2014. https://www.epa.gov/urban-air-toxics/fact-sheet-second-integrated-urban-air-toxics-report-congress ("...additional work remains to improve our understanding of air toxics and to effectively reduce remaining risks, particularly in overburdened communities…)

31. See, https://earthjustice.org/news/press/2016/epa-commits-to-strengthen-enforcement-for-communities-hit-hardest-by-environmental-injustice.

> …(EPA) released the first governmental report comprehensively examining EJ, entitled "Equity: Reducing Risk for All Communities." Shortly thereafter the EPA established what ultimately became known as the Office of EJ, and in 1993 it created the National EJ Advisory Committee to provide independent advice and recommendations to the Administrator on EJ matters. Then in 1994, President Clinton issued an Executive Order on EJ (EO 12898), mandating that all federal agencies incorporate EJ into their missions (see Box 1).

UCLA Luskin School of Public Affairs, *Pathways to EJ: Advancing a Framework for Evaluation, page 3,* 2012, *https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Pathways_to_Environmental_Justice.pdf*

32. Technology for neighborhood scale monitoring is rapidly emerging for many common air pollution types, including black carbon and diesel particulates. Monitoring for air toxics, however, will likely remain expensive,

monitor networks in communities. That data could trigger regulatory action (nonattainment designations,[33] targeted enforcement,[34] upgraded air toxics standards,[35] stationary source permit revisions,[36] Urban Air Toxics standards for "area" sources,[37] and incentives for adoption of zero-emission heavy duty trucking[38]) to provide near term relief to communities experiencing high air pollution exposure. It may be that EPA would need to modify its existing monitoring rules and procedures to accomplish such results. The design of EPA monitoring protocols is fully within its delegated power from Congress and a refresh of its air quality monitoring system may well be needed to reflect both the increased recognition of local air quality problems and the availability of new lower cost monitoring technologies. Federal funding could also be bought into play as an incentive for state or local government action to initiate AB 617-like processes.

In sum, there is no reason why a new federal administration could not, one way or another, begin to address persistent inequity of air pollution exposure in low income neighborhoods and communities of color in the United States. A clearly articulated EJ mandate, supporting institutional structures, and increased funding from Congress would help a great deal. However, we believe the EPA can move forward on its own if Congress does not act.

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and the agency will need to use increasingly sophisticated screening techniques to prioritize the deployment of gas chromatographs and similar broad-spectrum monitoring equipment.

33. Monitoring could be used to identify new nonattainment areas or to reclassify air quality regions in a way that requires revisions of a state implementation plan for criteria pollutants, including fine particulate pollution.

34. Researchers and regulators in California are developing new methods by which to identify and inspect trucks whose emission systems are failing. Monitoring could also identify need for enforcement of stationary source controls.

35. Under section 112, EPA sets technology standards specific to certain types of emissions sources, to regulate emission of air toxics from stationary sources. (Maximum Achievable Control Technology, MACT). To supplement these technology standards EPA must set risk-based standards for emission source categories where air toxics monitoring data shows risk of life time cancer risk of one-in-10,000 (*i.e.,* 100 in 1,000,000) or greater and can set "residual risk" standards where risk is up one-in-a-million after considering costs, technical feasibility and other factors. Additional monitoring for air toxics exposure could identify a need for tighter or additional MACT or residual risk standards.

36. Permits under the Clean Air Act and state clean air laws are periodically reviewed and renewed on a regular schedule. Monitoring that identified unhealthy local hotspots could trigger permit revisions for stationary sources and require new emission reductions. CAA § 502(b)(5)(D) specifically requires states implementing Title V to have the authority to terminate, modify, revoke or reissue permits "for cause." 42 U.S.C.A. § 7661a(b)(5)(D). States can establish additional permitting requirements not inconsistent with the Federal CAA permitting chapter. While the permitting provisions of the federal CAA primarily focus on implementing the relevant technology-based controls, state permitting authorities retain the right to impose more stringent requirements based upon localized pollution. 42 USC §7416.

37. EPA's Urban Air Toxics strategy and Area Source Standards program could be revived to address urban hotpots in disadvantaged communities.

38. Monitoring for air pollution hot spots could help target EPA and state funding for voluntary programs to reduce emissions from trucking and freight equipment and stationary source diesel generators through grant and incentive programs.

Conclusion

At this very moment, thousands of communities throughout the United States are being exposed to unhealthy levels of air pollution. The regulatory framework designed to safeguard our air quality is failing to adequately address local air pollution problems. This is the unfinished business of the Clean Air Act. At the same time, climate change is predicted to have disproportionate impacts on low-income, marginalized communities. Public support for state and federal action on both fronts – EJ and climate change – is building.

A community-driven process to address air pollution hotspots in historically disadvantaged communities is likely to be a political prerequisite for any serious federal or state climate policy initiative. This paper draws lessons from recent legislative and regulatory experiences in California in the interest of informing policy efforts elsewhere.

One lesson we take away is that local air pollution and global climate change are fundamentally different problems. Attempting to address both problems with the same policy instrument can lead to conflict and controversy. A related lesson is that deep tensions surrounding the role of carbon pricing can be impossible to resolve if these market-based policies are construed as a mechanism to address local air pollution problems. We continue to see an important role for carbon pricing when it comes to climate change mitigation. In contrast to technology mandates, a carbon price generates revenue that can be used to pursue other objectives (including local air quality improvements); carbon pricing also incentivizes cost-effective abatement across every sector of the economy. These benefits notwithstanding, an efficient carbon pricing regime is not designed to eliminate local pollution hotspots. A portfolio of complementary policies is needed to ensure that both local and global pollution problems are mitigated in a coordinated, efficient, and equitable way.

California's policy experiment-in-progress has focused attention on gaps in pollution controls and safeguards that affect local communities and weaken the overall effectiveness of state climate and clean air plans. These gaps are not unique to California. We expect that efforts in other jurisdictions to complement climate policy with community-driven approaches to local air pollution mitigation would uncover similar complementarities.

AB 617 is also demonstrating proof of an essential procedural concept: Community-Driven Regulation. AB 617 is not replacing or even circumventing traditional command-and-control regulation, but rather represents a supplementary, community-based "demand-and-control" approach. In principle, community pressures can help build the capacity of state agencies to eliminate racial/ethnic/class disparities in environmental exposures, bolster agency demands for greater resources, improve community influence over decisions affecting air quality, increase the likelihood that existing command-and-control regulation is implemented, and advance other mechanisms of environmental regulation.

Although it is too early to tell whether the AB 617 policy experiment will succeed in delivering substantial and durable improvements in local pollution hotspots, the process so far has forced deliberation on EJ issues, bringing local pollution problems into the light of public debate. It is advancing a form of accountability politics, asking important questions

about how public agencies are succeeding and where they are falling short. Finally, California is demonstrating a model of coordinated and complementary efforts to mitigate local and global air pollution issues. These issues are not unique to California, and we believe that the political economy of climate change policy demands a parallel effort to address the historic disparities in local environmental exposure that marginalized communities live with on a daily basis. With sufficient investment and political commitment, many of the lessons from the California climate and EJ experience could translate to jurisdictions elsewhere.

References

American Lung Association (2020), "State of the Air", Chicago, IL.

Apte, J. S., Messier, K. P., Gani, S., Brauer, M., Kirchstetter, T. W., Lunden, M. M., ... & Hamburg, S. P. (2017). High-resolution air pollution mapping with Google street view cars: exploiting big data. Environmental science & technology, 51(12), 6999-7008.

Aldy, J. E., Auffhammer, M., Cropper, M. L., Fraas, A. G., & Morgenstern, R. (2020). Looking Back at Fifty Years of the Clean Air Act (No. w26687). National Bureau of Economic Research.

Aldy, J., Kotchen, M., Evans, M., Fowlie, M., Levinson, A., & Palmer, K. (2020). Deep flaws in a mercury regulatory analysis. Science, 368(6488), 247-248.

Balazs, C. L., & Morello-Frosch, R. (2013). The three Rs: How community-based participatory research strengthens the rigor, relevance, and reach of science. Environmental Justice, 6(1), 9-16.

Banzhaf, S., Ma, L., & Timmins, C. (2019a). EJ: The economics of race, place, and pollution. Journal of Economic Perspectives, 33(1), 185-208.

Banzhaf, H. S., Ma, L., & Timmins, C. (2019b). Environmental justice: Establishing causal relationships. Annual Review of Resource Economics, 11, 377-398.

Borenstein, Severin (2017). "Fight Both Local and Global Pollution, But Separately", Energy Institute Blog, UC Berkeley, January 17, 2017.

Bowen, W. (2002). An analytical review of EJ research: what do we really know?. Environmental management, 29(1), 3-15.

Brulle, R. J., & Pellow, D. N. (2006). Environmental justice: human health and environmental inequalities. Annu. Rev. Public Health, 27, 103-124.

Bullard, R. (2000). EJ in the 21st century. People of color environmental groups. Directory, 1-21.

California Air Resources Board (2016), Air Quality Progress in California Communities, July 23, 2016, (https://www.arb.ca.gov/board/books/2016/062316/16-6-2pres.pdf, accessed on June 28, 2020).

California Air Resources Board (2018). Final Community Air Protection Blueprint for Selecting Communities, Preparing Community Emissions Reduction Programs, Identifying Statewide Strategies, and Conducting Community Air Monitoring (https://ww2.arb.ca.gov/capp-blueprint, accessed on June 28, 2020).

Carlson, A. E. (2018). The clean air act's blind spot: Microclimates and hotspot pollution. UCLA L. Rev., 65, 1036.

Caubel, JJ; Cados, TE; Prevle, CV; Kirchstetter, TW (2019) Distributed Network of 100 Black Carbon Sensors for 100 Days of Air Quality Monitoring in West Oakland, California, Environ. Sci. Technol., doi:10.1021/acs.est.9b00282.

Clark, L. P., Millet, D. B., & Marshall, J. D. (2017). Changes in transportation-related air pollution exposures by race-ethnicity and socioeconomic status: Outdoor nitrogen dioxide in the United States in 2000 and 2010. Environmental health perspectives, 125(9), 097012.

Chess, C., & Purcell, K. (1999). Public participation and the environment: Do we know what works?. Environmental science & technology, 33(16), 2685-2692.

Cole, L. W., & Foster, S. R. (2001). From the ground up: Environmental racism and the rise of the EJ movement (Vol. 34). NYU Press.

Cuclis, Alex (2012). "Why Emission Factors Don't Work at Refineries and What to do about it" EPA: Emissions Inventory Conference, web: https://www3.epa.gov/ttn/chief/conference/ei20/session7/acuclis.pdf (accessed on June 28, 2020).

Currie, J., Voorheis, J., & Walker, R. (2020). What caused racial disparities in particulate exposure to fall? New evidence from the Clean Air Act and satellite-based measures of air quality (No. w26659). National Bureau of Economic Research.

Currie, J., & Walker, R. (2019). What Do Economists Have to Say about the Clean Air Act 50 Years after the Establishment of the Environmental Protection Agency?. Journal of Economic Perspectives, 33(4), 3-26.

Cushing, L., Blaustein-Rejto, D., Wander, M., Pastor, M., Sadd, J., Zhu, A., & Morello-Frosch, R. (2018). Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011–2015). PLoS medicine, 15(7), e1002604.

Di, Q., Kloog, I., Koutrakis, P., Lyapustin, A., Wang, Y., & Schwartz, J. (2016). Assessing PM2. 5 exposures with high spatiotemporal resolution across the continental United States. Environmental science & technology, 50(9), 4712-4721.

Fowlie, M., Holland, S., & Mansur, E. (2012). "Do Emissions Markets Deliver and to Whom? Evidence from Southern California's NOx Trading Program." American Economic Review 102(2): 965-93.

Fowlie, M., Rubin, E., & Walker, R. (2019, May). Bringing satellite-based air quality estimates down to earth. In AEA Papers and Proceedings (Vol. 109, pp. 283-88).

Fowlie, Meredith (2017). "Is Cap and Trade Failing Low Income and Minority Communities?", Energy Institute Blog, UC Berkeley, October 10, 2016.

Grainger, C., & Ruangmas, T. (2017). "Who Wins from Emissions Trading? Evidence from California." Environmental and Resource Economics.

Helm, N., et. Al (2017). Advancing EJ, A New Regulatory Framework to bat4 Community-Level Air Pollution Hotspots and Improve Health Outcomes, Center for Enviromenal Public Policy, Goldman School of public Policy University of California, https://gspp.berkeley.edu/assets/uploads/page/CEPP_Report_09.7.17.pdf

Hernandez-Cortes, D., & Meng, K. C. (2020). Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market (No. w27205). National Bureau of Economic Research.

Hoyt, D., & Raun, L. H. (2015). Measured and estimated benzene and volatile organic carbon (VOC) emissions at a major US refinery/chemical plant: Comparison and prioritization. Journal of the Air & Waste Management Association, 65(8), 1020-1031.

Hsiang, S., Oliva, P., & Walker, R. (2019). The distribution of environmental damages. Review of Environmental Economics and Policy, 13(1), 83-103.

Karapin, R. (2018), Not Waiting for Washington: Climate Policy Adoption in California and New York. Political Science Quarterly, 133: 317-353. doi:10.1002/polq.12774

London, J., Karner, A., Sze, J., Rowan, D., Gambirazzio, G., & Niemeier, D. (2013). Racing climate change: Collaboration and conflict in California's global climate change policy arena. Global Environmental Change, 23(4), 791-799.

London, J., Nguyen, P., Dawson M., and Manrique, K. (2020). "Community Engagement in AB 617: An Evaluation of Challenges, Successes, Lessons Learned and Recommendations for the Future" UC Davis. Report Commissioned by the California Air Resources Board.

London, J, Sze, J.,"EJ at the crossroads." Sociology Compass 2.4 (2008): 1331-1354.

Mansur, E. and Sheriff, G. (2019). "Do Pollution Markets Harm Low Income and Minority Communities? Ranking Emissions Distributions Generated by California's RECLAIM Program", NBER Working Paper 25666.

McAdam, Doug, McCarthy, John, and Mayer Zald. 1996. Comparative Perspectives on Social Movements. New York: Cambridge University Press.

Mohai, P., Pellow, D., & Roberts, J. T. (2009). EJ. Annual review of environment and resources, 34, 405-430.

O'Rourke, D. (2004). Community-driven regulation: Balancing development and the environment in Vietnam. MIT Press.

Ottinger, G. (2010). Buckets of resistance: Standards and the effectiveness of citizen science. Science, Technology, & Human Values, 35(2), 244-270.

Overdevest, C., & Mayer, B. (2008). Harnessing the power of information for the next generation of environmental law: I. Collection and construction of information: Harnessing the power of information through community monitoring: Insights from social science. Texas Law Review, 86, 1493-1837.

Putnam, R. D. (2000). Bowling alone: The collapse and revival of American community. Simon and schuster.

Roberts, David (2019). "New York just passed the most ambitious climate target in the country." Vox Media. https://www.vox.com/energy-and-environment/2019/6/20/18691058/new-york-green-new-deal-climate-change-cuomo (accessed on July 24, 2020).

Schatzki T, Stavins RN. Addressing EJ concerns in the design of California's climate policy. Analysis Group; 2009 Oct [cited 2018 Jun 13]. 33 p. .

USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp.

Taylor DE (1997) American environmentalism: the role of race, class and gender in shaping activism 1820–1995. Race, Gend Class 1997, 5:16.

Van Donkelaar, A., Martin, R. V., Brauer, M., & Boys, B. L. (2015). Use of satellite observations for long-term exposure assessment of global concentrations of fine particulate matter. Environmental health perspectives, 123(2), 135-143.

Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. Theory and society, 27(2), 151-208.\

Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. The world bank research observer, 15(2), 225-249.

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