CLIMATE XCHANGE

CARBON PRICING IN A JUST TRANSITION

A POLICY FRAMEWORK AND CASE STUDY OF CALIFORNIA CAP-AND-TRADE

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CLIMATE XCHANGE

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Climate XChange was founded in 2013 with a mission to develop and promote effective and viable policy solutions to reduce carbon emissions. We built and promoted winning climate policies in our home state of Massachusetts and have since brought our expertise, resources and guidance to state-level carbon pricing campaigns around the country. At a time when climate action has been heavily politicized and the federal government is not taking action, it has been left up to state governments to lead the way.

Climate XChange provides research, education, and advocacy tools to promote carbon pricing and bold leadership on climate change. We achieve this through multiple means, such as authoring economic research, providing technical assistance to policymakers crafting state policy, running the Climate Action Business Association, convening the State Carbon Pricing Network, and running a national newsletter. We believe that effective change on carbon pricing can be achieved at the nexus of cutting-edge research, compelling media, and strategic advocacy.

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EXECUTIVE SUMMARY

Carbon pricing is a promising policy option to help facilitate the transition to a green sustainable economy. Putting a price on greenhouse gas (GHG) emissions allows us to accurately reflect the true cost of pollution, leading the market — meaning the countless choices made every day by people and businesses — to favor cleaner ways of living and doing business.

It also has the potential to provide substantial and crucial revenue to fund the diverse solutions needed for a rapid transition. Increasing existing carbon prices and expanding to new jurisdictions can rapidly unlock trillions of dollars of private and public capital to mobilize a sustainable transition across the globe.

Meanwhile, the concept of a just transition has emerged from environmental justice (EJ) and labor-roots — the change away from an extractive economy to a regenerative economy must also address deep issues of social and environmental injustice associated with the current polluter-industrial structure of the economy.

If carbon pricing is to be a central component of climate policy moving forward, it must not only reduce GHG emissions, but also embrace deep overlapping connections with linked social and environmental justice issues. This report offers a carbon pricing policy framework that contextualizes the potential role it can play in a larger green just transition.

We use California's cap-and-trade program as a case study for this framework. Due to the state's ambitious climate policies, large administrative capacity, and robust environmental justice community, the experience in California serves as a key learning resource for other states to extract best practices and ongoing challenges in building a just policy framework.

We highlight some key design choices for future systems to include:

INVEST IN COMMUNITY-DRIVEN, TRANSFORMATIVE PROJECTS
Investing carbon pricing revenue into community-driven, transformative projects can provide some of the most durable and effective benefits to the communities that need it most, empowering them to facilitate a just transition in the local context.

RETURN REVENUE TO ENSURE ECONOMIC PROTECTION
Providing a full scope of economic opportunity entails returning a portion of revenue directly to ratepayers, which guarantees short-term protection from increased energy costs due to carbon pricing.

STRONGER CARBON PRICES AS A PRIORITY DESIGN CHOICE
We identify higher carbon prices as a critical design choice for a just transition for three key reasons — to reduce emissions to the degree needed; to generate sufficient funds for investment; and to produce positive health outcomes.

COMPLEMENTARY POLICIES
Even with higher carbon prices, revenue return mechanisms, and inclusive investment processes, carbon pricing alone will not provide a full scope of economic opportunity and environmental justice. Future states should therefore think strategically about the intersection of carbon pricing and complementary policies, rather than design carbon pricing as a standalone policy measure.

ESTABLISHING A JUST CARBON PRICING FRAMEWORK

COMPONENTS OF CARBON PRICING

We can break carbon pricing down into its central design components, each of which has strengths and limitations in providing various aspects of a just transition. These components are:

1| THE CARBON PRICE SIGNAL, which increases the relative cost of GHG-intensive activities, incentivizing individuals and businesses to switch to cleaner alternatives.

2| INVESTMENT OF THE REVENUE, typically into projects that further reduce GHG emissions and/or address other vital state/community needs.

3| REVENUE RETURN MECHANISMS, such as a household rebate or reduction in other taxes, that offsets the burden that carbon pricing can impose on vulnerable households and businesses.

4 | COMPLEMENTARY POLICIES, which can fulfill goals that carbon pricing fails to address. Key to this framework is that carbon pricing is contextualized as part of a larger, cohesive policy roadmap.

ECONOMIC OPPORTUNITY AND ENVIRONMENTAL JUSTICE

Next, we consider two broad categories of benefits that each component of carbon pricing can provide towards a just transition — economic opportunity and environmental justice.

Carbon pricing can deliver *economic opportunity* by providing:

COMMUNITY-LEVEL INVESTMENT to create concentrated, durable benefits such as job creation, mobility, and increased access to public and private resources.

SHORT-TERM PROTECTIONS TO VULNERABLE HOUSEHOLDS AND SMALL BUSINESSES, such that the policy creates a net reduction in the cost of living and/or doing business in these communities.

TRANSITIONAL ASSISTANCE FOR FOSSIL FUEL DEPENDENT WORKERS AND COMMUNITIES, such that new sources of revenue are created for families and local governments currently depending on pollution-intensive industries.

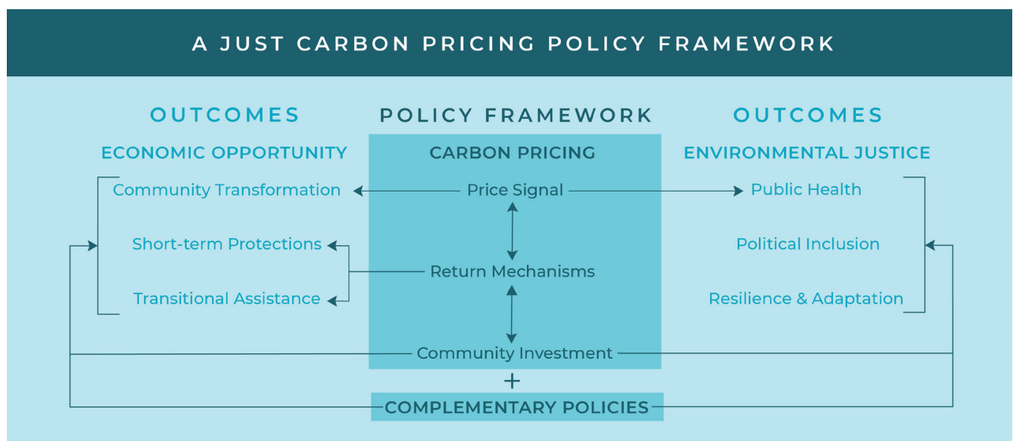
Carbon pricing can deliver *environmental justice* by providing:

POLITICAL INCLUSION AND COMMUNITY-OWNED RESOURCES that empower local organizations and governments to facilitate the green just transition in their local context.

POSITIVE PUBLIC HEALTH OUTCOMES, particularly reductions in local air pollutants that disproportionately harm low-income communities, communities of color, and non-English speaking communities.

RESILIENCE AND ADAPTATION TO CLIMATE CHANGE, as these communities are also more susceptible to the impacts of the climate crisis on everyday life.

FIGURE ES-1 A Just Carbon Pricing Policy Framework



These non-exhaustive definitions must be decided in each state to capture the unique challenges of the local context.

PRIORITY POPULATIONS

Mirroring California's terminology, this report focuses on priority populations, which broadly constitute the worst victims of social and environmental injustice. Each state needs to have its own transparent and inclusive process to define priority populations in a comprehensive manner. California considers two subsets of priority populations:

DISADVANTAGED COMMUNITIES are defined at the census tract level using open data on 22 different measures of pollution exposure, environmental effects, health sensitivities, and socioeconomic factors.

LOW-INCOME POPULATIONS are defined either at the census tract or household level, as those below 80% of the state median household income, although a household can alternatively qualify under area-adjusted income limits.

Whether or not California's current policies are sufficient to achieve a just transition to a green economy remains to be seen in the coming years. Disadvantaged communities are still subject to greater levels of local pollutants in the air they breathe, both from vehicles and facilities.[1,2] Massive challenges remain in solving the transportation, housing, and public health crises across the state. Yet, the evolution of California's climate policy over the past decade presents a vital case study opportunity to accelerate climate policy development in future states.

With the policy design choices, desired outcomes, and priority populations all defined, we can subsequently apply this framework to California's cap-and-trade program to extract best practices and ongoing challenges in crafting market-based mechanisms within a just transition framework.

INVEST IN COMMUNITY-DRIVEN, TRANSFORMATIVE PROJECTS

Investing carbon pricing revenue into community-driven, transformative projects can provide some of the most durable and effective benefits to priority populations, but it requires data-driven, transparent, inclusive processes for deciding how the revenue is spent. We highlight the following actionable steps that states can take to effectively invest carbon pricing revenue to the benefit of priority populations:

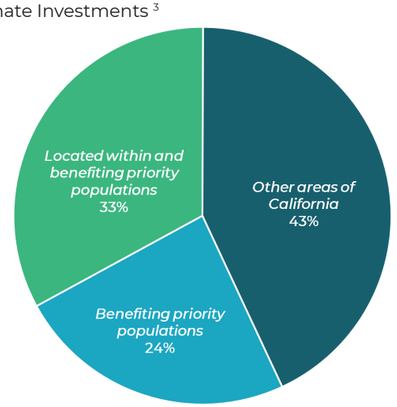
DEFINE PRIORITY POPULATIONS using data-driven, collaborative tools and an extensive public process to ensure these definitions are comprehensive, fair, and transparent.

LEGISLATIVELY MANDATE that a significant portion of investments from carbon pricing funds are located in, and provide real benefits to, priority populations.

DEVELOP OPEN METHODOLOGIES to quantify GHG reductions, local pollutant reductions, job creation, and other co-benefits in order to reveal and objectively evaluate which investments are most effective and impactful.

ESTABLISH COMMUNITY-ORIENTED GOVERNANCE STRUCTURES and transparent review processes to provide multiple pathways for community ownership, such as advisory committees, local air districts, and place-based initiatives. This includes a strong component of education, public engagement, and technical assistance to ensure fair access to all investment opportunities.

FIGURE ES-2 Cumulative Outcomes of California Climate Investments [3]



1 | Union of Concerned Scientists, 2019. "Inequitable Exposure to Air Pollution from Vehicles in California."

2 | Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, 2017. "Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report."

3 | California Air Resources Board, 2019. "Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds."

To date, California has raised nearly $12 billion for California Climate Investments (CCIs). Legislation introduced in 2012, and subsequently strengthened in 2016, requires a percentage of funds to benefit priority populations. These mandates have been repeatedly and vastly exceeded, suggesting that future systems can set more ambitious equity requirements both in their benefit criteria and their share of overall investment funds.

The benefits of deploying investments transparently and effectively far outweigh the administrative costs, with 3.5% of total investment funds being used for administration and support in California.[4]

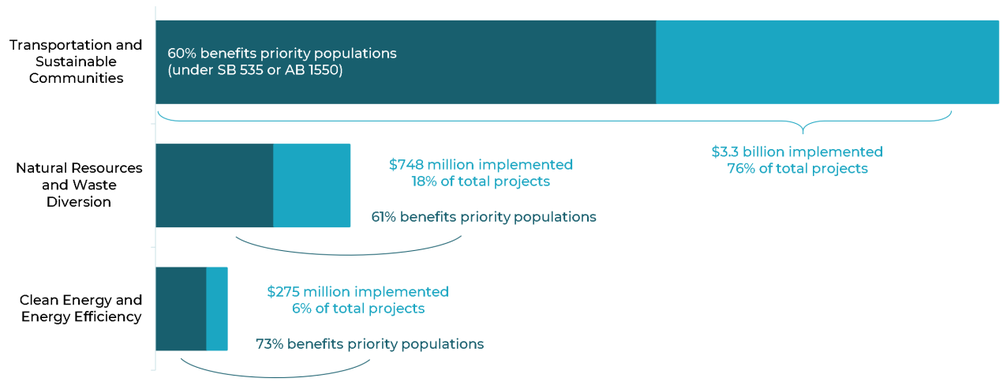
States following California's lead will have to consider the balance between long-term, large infrastructural transformations, and the need to empower localities to realize their own solutions. In California, 60% of auction revenue is continuously appropriated to large, state-planned initiatives such as rail projects and affordable housing. The remaining 40% is appropriated annually by the legislature to a wide variety of small and medium-scale projects.[5]

California has signaled a priority shift in the coming years towards community-level projects that provide economic, environmental, and public health benefits.[6] The Transformative Climate Communities Program is exemplary for achieving these goals by providing dense place-based funding to local actors seeking to realize their own vision for what their community could look like.

However, the program constitutes only 2% of California's overall appropriations to date.[7] These projects with extensive co-benefits need to be expanded to align the state with just transition principles.

> **The benefits of deploying investments transparently and effectively far outweigh the administrative costs, with 3.5% of total investment funds being used for administration and support in California.**

FIGURE ES-3 Implemented California Climate Investments



4 | California Air Resources Board, 2019. "Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds."

5 | Starting in FY 2020-2021, an additional 5% of auction revenue will be continuously appropriated to clean water initiatives which will increase the total ongoing appropriations to 65%.

6 | California Air Resources Board, 2019. "Cap-and-Trade Auction Proceeds Third Investment Plan: Fiscal Years 2019-20 through 2021-22."

7 | California Air Resources Board, August 2019. "August 2019 CCI Data Update."

STRONGER CARBON PRICES AS A PRIORITY DESIGN CHOICE

We identify higher carbon prices as the critical design choice in a just transition framework, for three key reasons:

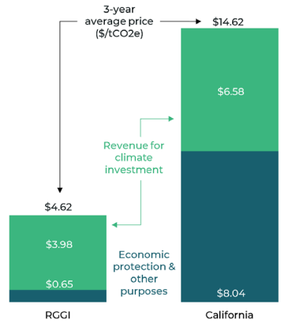
1| HIGHER CARBON PRICES ARE NEEDED TO ACCURATELY REFLECT THE SOCIAL COST OF POLLUTION AND SPUR REAL GHG REDUCTIONS

The social cost of carbon, which is an estimate of the long-term global damages caused by pollution, has been estimated to be as low as $52 per metric ton of carbon dioxide equivalent (tCO_2e),[8] and upwards of $417/$tCO_2e$.[9] Until these costs are reflected in the carbon price signal, our economy will continue to pollute without fully accounting for the external damages, leading to further global injustice and economic inefficiency.

The Stern-Stiglitz Commission on Carbon Pricing finds that, assuming complementary policies are in place, a carbon price of $40–$80/tCO_2e by 2020 will be needed across the globe to keep temperature rise below 2°C. In contrast, California's carbon price has grown from about $10 to $17.50/$tCO_2e$ since the launch of the program.

The degree to which higher carbon prices will be required in California remains to be seen, as the state relies extensively on additional regulations to achieve most of the emissions reductions needed.

FIGURE ES-5 Carbon Price and Investment Revenue in California and RGGI



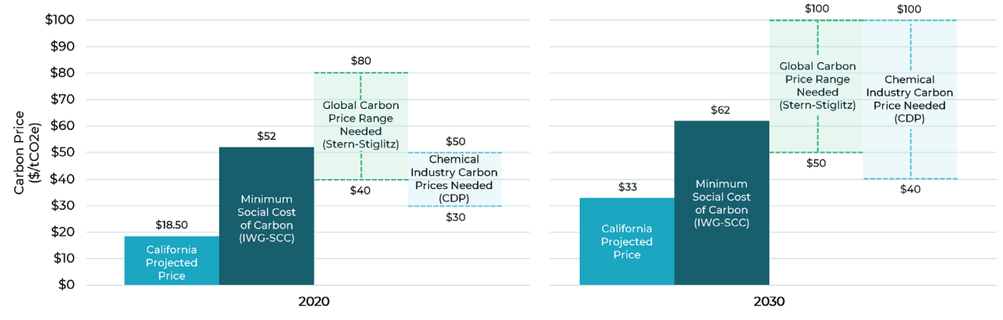
2| HIGHER CARBON PRICES ARE NEEDED TO RAISE REVENUE FOR A GREEN JUST TRANSITION

Higher carbon prices will be needed to fund the vast transformations required for a just transition to a green economy. Counterintuitively, returning a portion of revenue to households can actually raise more money for investment, if it in turn leads to higher carbon prices.

For instance, the Regional Greenhouse Gas Initiative (RGGI), a regional cap-and-trade program for electricity sector emissions in the Northeast and Mid-Atlantic, dedicates almost all auction proceeds to GHG reductions, but has maintained very low carbon prices.

On the other hand, due to higher carbon prices, California is raising significantly more revenue for climate investment per allowance sold, despite about half of the allowance budget being directed to other purposes.

FIGURE ES-4 Global Literature on Carbon Prices



8 | Interagency Working Group on Social Cost of Greenhouse Gases, 2016. "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis." Adjusted to 2019 dollars.

9 | Ricke et. al., 2018. "Country-level social cost of carbon." Nature Climate Change.

3| HIGHER CARBON PRICES INCREASE THE CHANCE OF PRODUCING POSITIVE HEALTH OUTCOMES

The carbon price signal itself is not typically designed to guarantee reductions at the local level, but if passing a carbon pricing policy preempts or strips away other regulations that address more locally targeted emissions reductions, then it needs to fill this role to the best of its ability.

Preliminary analysis of California suggests that local pollutant emissions from stationary sources are decreasing across the state, although further research is needed to examine mobile sources of local pollutants, as well as the public health outcomes occurring specifically in disadvantaged communities.

CHALLENGES WITH CAP-AND-TRADE AND CARBON PRICE SIGNALS

Cap-and-trade is not designed to prescribe a specific carbon price, and thus the degree to which the program reaches the price levels needed for a green just transition depends on the symphony of policy choices and external factors that influence the allowance market. We identify two key steps to maintaining effective price levels in future cap-and-trade programs:

1| AVOID PERMIT OVERSUPPLY. Cap-and-trade systems have historically provided far more allowances than required. The resulting oversupply keeps allowances cheap at auction and threatens the program's ability to reduce emissions in later years. Future systems need to set a stricter cap, and build in periodic cap adjustments, to ensure the program maintains an appropriate level of stringency.

This includes accounting for offsets in market design. In California, we calculate that 226 million excess allowances from 2013–2018 are currently held in private accounts, which is nearly equal to the 236 million tCO_2e that the program is expected to reduce between 2021 and 2030. If one allowance was removed from the market for every offset previously used for compliance, California's current oversupply problem would be nearly cut in half.

2| IMPLEMENT A HIGH PRICE FLOOR. Should future systems fail to properly balance the supply of allowances, sufficient carbon prices can still be achieved by setting a lower limit for what price an allowance can sell for at auction.

RETURN REVENUE TO ENSURE ECONOMIC PROTECTION

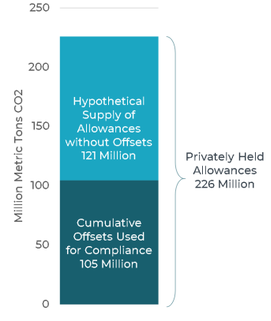
Providing a full scope of economic opportunity entails returning a portion of revenue directly to priority populations, which guarantees short-term protection from increased energy costs due to carbon pricing. The program can in fact be flipped to create progressive outcomes by leaving low-income households with a net financial gain from the program.

California's cap-and-trade program distributes a flat climate dividend on all utility bills, resulting in average net savings of $50 to $65 on annual utility costs for low-income households.[10] This provides a base level of guaranteed economic protection without even considering the benefits from investment. However, no such protections exist for transportation fuel costs.

Low-income households, by state standards, tend to constitute a small portion of overall emissions in the typical state.[11] As such, a fairly small portion of carbon pricing revenue can provide sufficient protections to low-income households.

In California's case, an even smaller portion of the total allowance budget could be used to provide the same scale of protection to low-income households if the climate dividend was weighed according to income rather than administered on a flat basis to all households.

FIGURE ES-6 Current Oversupply and Offset Usage in California, 2013-2018



10 | Juien Gattaciecca, Colleen Callahan, and J.R. DeShazo, UCLA Luskin Center for Innovation, 2016. "Protecting the Most Vulnerable: A Financial Analysis of Cap-and-Trade's Impact on Households in Disadvantaged Communities Across California."

11 | Marc Breslow, Climate XChange, 2019. "Impacts of Carbon Pollution Pricing on Massachusetts Households at Different Income Levels."

COMPLEMENTARY POLICIES

Even with higher carbon prices, revenue return mechanisms, and inclusive investment processes, carbon pricing alone will not provide a full scope of GHG reductions, economic opportunity, or environmental justice. Future states should therefore think strategically about the intersection of carbon pricing and complementary policies, rather than design carbon pricing as a standalone policy measure.

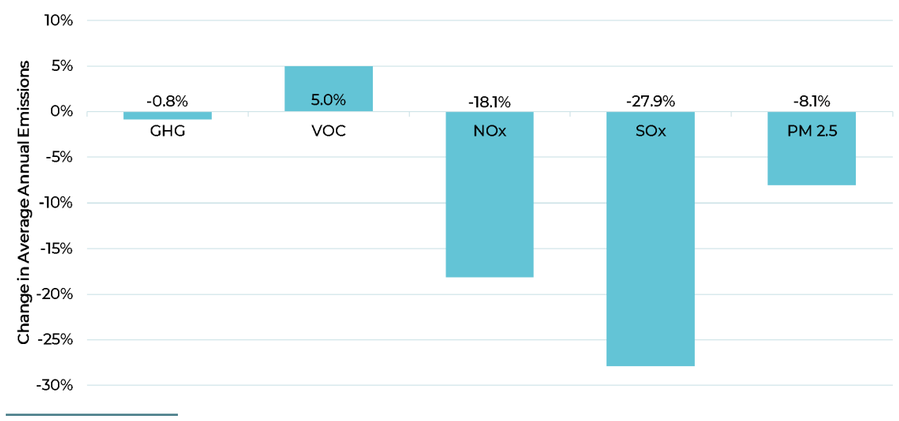
In California, the cap-and-trade program is expected to contribute 38% of the GHG reductions needed to achieve their 2030 target. The rest of the reductions come from "complementary policies," including those affecting short-lived pollutants, energy efficiency, and renewable energy.

Additional regulations will play a pivotal role in addressing local pollutants moving forward. AB 617 — which directs additional resources, monitoring, and actionable authority for CARB and local air districts to reduce local pollutant emissions from stationary sources — is the direct result of the political concern for tackling equitable air quality outcomes in disadvantaged communities.

The degree to which these policies will sufficiently address public health inequities is uncertain, but preliminary evidence suggests that some types of local pollution from stationary sources are decreasing across the state.

Photo: CXC Staff

FIGURE ES-7 Change in Average Emissions from Stationary Sources, 2010-2012 to 2015-2017 [12]



12 | Derived from California Mandatory Reporting Regulation Data, 2010-2017.

CONCLUSION

As the climate crisis continues to worsen, so does our need for bold and rapid policy solutions. Excitement around the Green New Deal demonstrates a political desire to consider not only how the climate crisis can be addressed, but also how the current polluter-industrial economy can be transformed to provide accessible transportation infrastructure, sustainable energy, good jobs, and clean air for everyone.

If carbon pricing is to play a central role in our solution to the climate crisis, it must tap into, and make progress on other key social and environmental justice issues of our time. It requires a comprehensive investment process; revenue return mechanisms to provide a fundamental level of economic protection; sufficiently high carbon prices to reflect the damages of pollution and raise the revenue needed for a green just transition; and a cohesive design strategy within a larger policy roadmap. Future states should consider this framework to maximize the economic opportunity and environmental justice that their program provides to the people that need it most.

INTRODUCTION

Mitigating the global climate crisis requires all major nations and economies to undertake deep, rapid, transformative action immediately. In order to keep global warming to 1.5°C, as opposed to 2°C, global greenhouse gas (GHG) emissions must fall by 45% from 2010 levels by 2030 and reach "net zero" by 2050.[13] The world stands to lose hundreds of millions of lives, hundreds of trillions of dollars, and millions of species due to climate collapse and ecological disruption that will last hundreds of years if we are unable to rapidly enact far-reaching and unprecedented changes in all aspects of society.[14]

No single solution will sufficiently tackle this problem. However, carbon pricing has emerged as one of the leading policy options to help transition to a green sustainable economy. Putting a price on greenhouse gas pollution allows us to accurately reflect the true cost of polluting products and activities leading the market — meaning the countless choices made every day by people and businesses – to favor cleaner ways of living and doing business.

This also has the potential to provide substantial and crucial revenue to fund the diverse solutions needed for a rapid transition. Existing carbon pricing systems already cover 14% of the global economy and are worth a collective $100 billion per year, despite prices remaining fairly low.[15] Increasing existing carbon price levels and expanding to new jurisdictions can rapidly unlock trillions of dollars of private and public capital to mobilize a sustainable transition across the globe.

However, our climate policies need to go beyond GHG reductions. The environmental justice (EJ) movement has grown in response to the historic and systematic environmental racism that has left communities of color and low-income communities disproportionately exposed to hazardous pollution and industrial practices. As climate change became the forefront issue of environmental policy, the concept of a just transition emerged from EJ roots, emphasizing that the change from an extractive economy to a regenerative one, must also address deep issues of social and environmental inequality associated with the current polluter-industrial structure of the economy.

In addition to GHGs, the US economy also produces local pollutants such as sulfur oxides (SO_x), nitrogen oxides (NO_x), and particulate matter (PM 2.5) that directly harm public health, causing respiratory and cardiovascular disease.[16] Global observational studies find that 3 million premature deaths are attributable to ambient air pollution, and 3.4 million additional premature deaths are due to household pollution each year.[17] These co-pollutants tend to come out of the same tailpipes and vents as carbon dioxide, and do so disproportionately in communities of color and low-income neighborhoods.[18,19]

13 | IPCC, 2018. "Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty."

14 | Ibid.

15 | World Bank Group, 2019. "State and Trends of Carbon Pricing 2019."

16 | Smith et. al., 2013. "Energy and Human Health." Annual Review of Public Health.

17 | World Health Organization, 2016. "Ambient air pollution: a global assessment of exposure and burden of disease."

> **Carbon pricing must not only tackle the climate crisis, but also embrace deep overlapping connections with key social and environmental justice issues of our time.**

At the same time, we suffer from a transportation crisis, housing crisis, and deep historical issues of social inequity, which require substantial resources and political will to address. Carbon pricing has the potential to raise substantial revenue, and is therefore vital to establish processes that give resource ownership and investment in communities at the frontlines of climate change, in order to achieve the physical and political transformations that they need.

Opportunity cost is used in economics to guide efficient use of time and resources, such that an action is not necessarily successful because it achieves a net profit, but rather it is only successful if it achieves greater results than what alternative actions would have accomplished.

The concept applies to environmental policy as well. If carbon pricing is to be a central component of climate policy moving forward, it must not only be designed to make real impacts on GHG emission reductions, but also embrace deep overlapping connections with social and environmental justice in order to maximize its contributed value over the opportunity cost of incremental, isolated approaches.

Incorporating key cross-sectional issues into carbon pricing design not only increases the effectiveness of the program, but also increases its chance of political success by appealing to a wider support base through inspiration and ambition, unifying multiple voices within a group of stakeholders that has historically been fractured.

In this report, we outline a potential policy framework for carbon pricing in a just transition, using California's cap-and-trade program as a case study. As the only economy-wide carbon pricing program in the United States, California presents a valuable opportunity to apply the just transition framework and extract best practices for other states to learn from.

The political capital required to launch the program in 2012, and consequently extend it through 2030, has created pressure for it to deliver not just on emissions reductions, but also provide real economic opportunity and advance environmental justice in the state. As a state with relatively high climate ambition, extensive administrative capacity, and a robust environmental justice community, California presents learning lessons and ongoing challenges in how to design carbon pricing in a way that is impactful, equitable, and delivers real results to disadvantaged communities.

Each state has unique conditions that require different policy solutions, and this report is not meant to prescribe a duplicative approach to California. Instead, we provide detailed information, with extensive input from California groups and experts, on key practices and pitfalls that other states can learn from to create carbon pricing policies that are more comprehensive, impactful, and equitable.

18 | Ihab Mikati, Adam Benson, Thomas Luben, Jason Sacks, Jennifer Richmond-Bryant, 2018. "Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status." American Public Health Association.

19 | Anjum Hajat, Charlene Hsia, Marie O'Neill, 2015. "Socioeconomic Disparities and Air Pollution Exposure: A Global Review."

KEY DEFINITIONS FOR A JUST CARBON PRICING FRAMEWORK

PRIORITY POPULATIONS

Fundamental to our analysis is defining the households and communities that states should prioritize in their environmental policy. Mirroring California's terminology, we use the term priority populations to describe the worst victims of environmental and economic injustice as it relates to issues such as air quality, public health, transportation and energy access, economic mobility, housing, and political inclusion. Each state needs to have their own substantive, transparent, and inclusive process to define priority populations in their local context. California defines priority populations as two different subsets:

DISADVANTAGED COMMUNITIES are defined by California's Environmental Protection Agency (CalEPA) using CalEnviroScreen, a tool that transparently evaluates each census tract according to 22 different measures of pollution exposure, environmental effects, health sensitivities, and socioeconomic factors. These factors are weighed and combined to create a comprehensive CalEnviroScreen score for every census tract in the state, the top 25% scoring communities are then classified as disadvantaged.[20]

LOW-INCOME POPULATIONS can be defined at the census tract or household level. Cost of living varies greatly by geography, meaning that one definition of low-income may be appropriate in one area but inappropriate in another. California's program defines low-income as any of the following:

> A *household* with income less than 80% of the statewide median.
>
> A *household* with income less than the localized income limits defined by the California Department of Housing and Community Development (CalHUD), typically 80% of the area-adjusted median income.
>
> A *census tract* with a median income at or below 80% of the statewide median income.

These definitions may need to look different in other states. Rather than prescribe a universal definition for priority populations, we recommend each state arrives at these definitions in an inclusive, transparent, and comprehensive manner.

ECONOMIC OPPORTUNITY AND ENVIRONMENTAL JUSTICE

This report seeks to evaluate how carbon pricing policies can provide economic opportunity and advance environmental justice goals in priority populations. These topics are deeply complex and include many aspects that go beyond the scope of this report. Hence, we constrain our concepts to the most prominent climate justice issues that carbon pricing can reasonably address. Like priority populations, a detailed definition of economic opportunity and environmental justice needs to be redefined in each state to capture the unique challenges within the local context.

ECONOMIC OPPORTUNITY focuses on the program's ability to provide a broad scope of economic benefits to priority populations, in line with the principles of a just transition. This can be broken down into three components:

1 | Community-Level Transformation
A carbon pricing program should not just protect vulnerable populations from increased costs of living, but also help facilitate the transition away from fossil fuels in such a way that tackles deeper causes of economic inequality and provides concentrated, durable benefits to priority populations such as job creation, mobility, and increased access to public and private resources.

2 | Protection of Households and Small Businesses
As carbon pricing can raise the cost of energy, some of the revenue must be used to counteract these costs for households and small businesses that are vulnerable to higher costs of living/doing business.

3 | Transitional Assistance for Fossil-Fuel Dependent Workers and Communities
A comprehensive policy helps state and local governments shift their tax dependency away from extractive industries, and provides working families in the fossil fuel industry new, good-paying alternative occupations. This aspect of economic opportunity is outside the scope of this study.

ENVIRONMENTAL JUSTICE is defined by the Environmental Protection Agency as "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."[21] In our carbon pricing policy framework, we break this definition down into three concepts:

1| Political Inclusion and Community Ownership
All aspects of the carbon pricing program must be designed with input and influence from priority populations and representative organizations. This includes sufficient stakeholder engagement, public comment, and educational tools for these groups to make fully-informed and collaborative program design choices, as well as appropriate governance structures and transparency to give communities ownership over their future.

2| Equitable Public Health Outcomes
To the degree that a carbon pricing program preempts other policies that tackle local pollutants in disadvantaged communities, it must be designed intentionally to produce equitable public health outcomes in overburdened communities. This can be achieved through a combination of investment projects and carbon price signals, but may also require additional regulations. Sufficient monitoring and data to track local health outcomes is imperative to ensure equity in public health outcomes.

3| Strengthen Resilience and Adaptation to Climate Change
Vulnerable communities and households are also more susceptible to localized climate change impacts. The carbon pricing program must deploy sufficient resources and technical assistance to prepare communities for these impacts.

20 | See "Defining and Mapping Priority Populations" for more information on the public process and methodology behind CalEnviroScreen.

BUILDING A POLICY FRAMEWORK

Using these definitions, we can build a policy framework for the role carbon pricing can play in a just transition to a green economy. Our policy framework breaks down carbon pricing into four subcomponents:

1| THE CARBON PRICE SIGNAL, which increases the relative cost of GHG-intensive activities, incentivizing people and businesses to switch to cleaner alternatives.

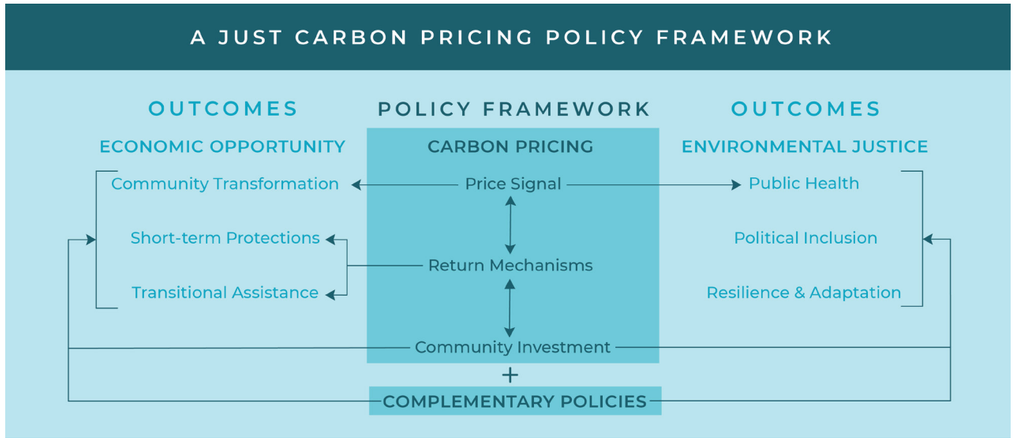
2| INVESTMENT OF THE REVENUE, typically into projects that further reduce GHG emissions and address other vital community needs.

3| REVENUE RETURN MECHANISMS, such as an annual household rebate or reduction in other taxes, meant to offset the economic burden that carbon pricing could impose on vulnerable households or businesses.

4| COMPLEMENTARY POLICIES, which can fulfill remaining goals that carbon pricing fails to address. Conversely, carbon pricing can be designed to fill gaps in existing policies. Key to this framework is that carbon pricing is contextualized as part of a larger, cohesive policy roadmap in any given state.

Each of these subcomponents has their own strengths and limitations in providing economic opportunity and environmental justice to priority populations. By analyzing them both in isolation and cohesively, we can illuminate key lessons in making effective decisions for carbon pricing design to achieve equitable and inclusive outcomes.

FIGURE 1 A Just Carbon Pricing Policy Framework



21 | Environmental Protection Agency, 2019.

CALIFORNIA AS A CASE STUDY

California presents a unique and valuable case study to apply our framework. The state's comprehensive approach to climate policy stands as the most ambitious state-level action on climate change in the United States. We chose California for a few reasons:

California's cap-and-trade program is the first and only economy-wide carbon price in the United States. States should examine what California has learned from running and adjusting a carbon pricing program for the majority of the last decade.

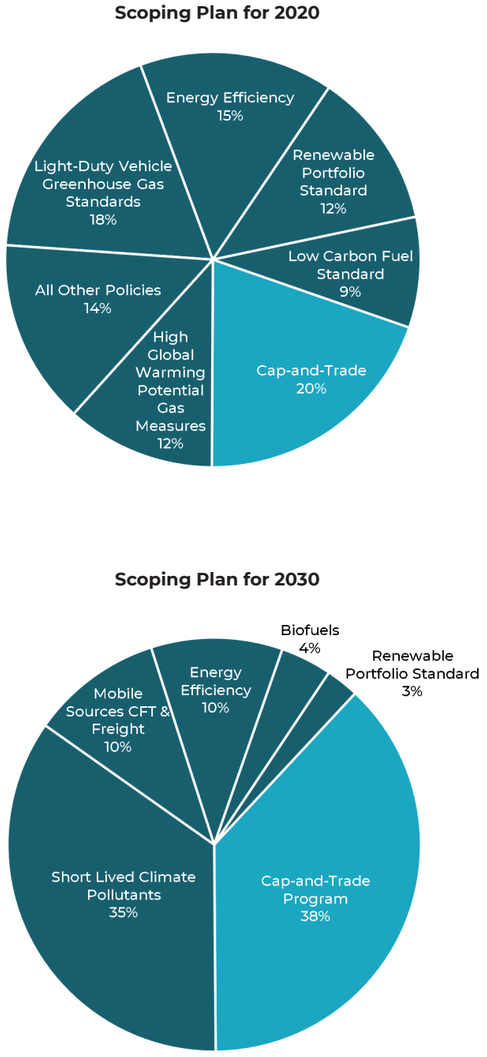
California also boasts the greatest administrative capacity for environmental programs of any US state, allowing them to pursue a greater range of policy design and implementation choices.

Hundreds of communities and environmental justice groups have engaged in California's legislative and implementation process with the interests of priority populations in mind. The compromises made between state government and these groups provide learning lessons for both policy makers and advocacy groups in states considering prospective carbon pricing.

The foundation of climate policy in California began in 2006 with the passing of AB 32, the California Global Warming Solutions Act. The bill sets an emissions target of returning to 1990 levels by 2020, and gives the California Air Resources Board (CARB) authority to develop a plan to reach that target, including a market-based mechanism.[22]

In 2012, California implemented a cap-and-trade system for greenhouse gas emissions. Under the program, power generators, fuel distributors, and other polluting facilities must submit a permit, otherwise known as an allowance, for each metric ton of carbon dioxide equivalent (tCO_2e) they emit. Companies are either freely distributed these allowances or must purchase them at government auctions. By reducing the allowances offered or distributed each year, otherwise known as the "cap", the government can guide emissions downward, while the market, in theory, sets the value of allowances in order to keep emissions on track.

FIGURE 2 California's Expected Policy Contributions for 2020 and 2030 Goals [23]



22 | AB 32, 2006. "California Global Warming Solutions Act of 2006."

23 | California Air Resources Board, 2008. "Climate Change Scoping Plan: A Framework for Change; California Air Resources Board, 2017. "California's 2017 Climate Change Scoping Plan."

Included within a larger suite of policies, cap-and-trade was designed as a "backstop" policy for achieving California's 2020 targets. Other policies, such as fuel efficiency, energy efficiency, and renewable portfolio standards, were expected to achieve the majority of emissions reductions, with cap-and-trade closing the final gap. Should emissions reductions happen faster than expected, then we would expect cap-and-trade to have little impact on reducing emissions. Should these other policies underperform or fail, leading to higher emissions than expected, the cap-and-trade program has the flexibility to pick up slack and keep the state on target for 2020.[24]

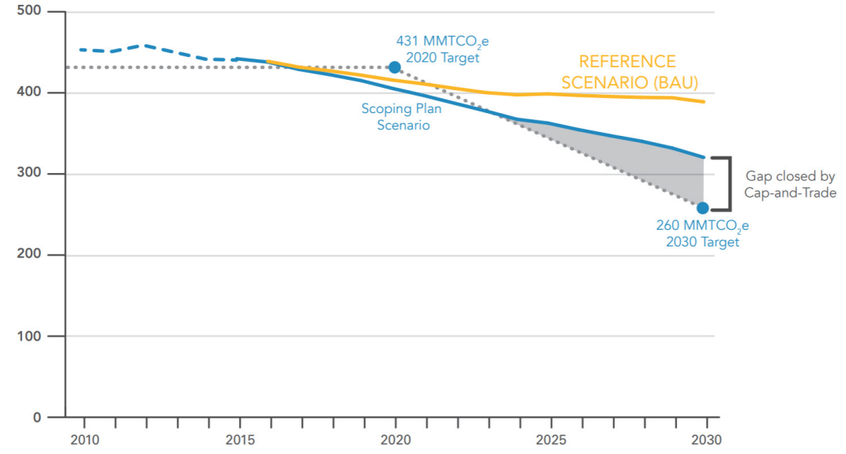
Thus far, the program has played a smaller role than initially planned. Due to the economic recession, complementary policies, and shifting contracts for imported electricity, emissions have decreased faster than expected, and as a result the cap-and-trade program has played a small role in the state achieving the 2020 emissions target by 2016.[25]

By 2017, California had extended the cap-and-trade program to 2030 and set an emissions reduction target of 40% below 1990 emissions. As reflected in their updated scoping plan, CARB expects the program to play a far more pivotal role in achieving this goal, producing more emissions reductions than any other policy measure.[26]

Due to the increased load put on cap-and-trade, and the more ambitious climate targets for 2030, there is an opportunity for carbon pricing to play a pivotal role in California in the next decade. The first few years of the program have served as an iterative process, with modifications made to the various design elements to improve its efficacy. Hundreds of community groups have engaged in ongoing discourse to tweak and improve investment priorities, data practices, carbon pricing mechanisms, and complementary policies to best address the climate crisis, economic opportunity, and environmental justice.

Future states and nations can learn from this experience to better serve the needs of their constituents and build comprehensive policies. However, these outcomes are not guaranteed unless carbon pricing is designed in the right way. While not a roadmap, California's progression into its current climate policy framework provides an opportunity for other states to expedite their own climate policy evolution.

FIGURE 3 California's Expected Policy Contributions for 2030 Goal[27]



24 | California Air Resources Board, 2011. "Final Supplement to the AB 32 Scoping Plan Functional Equivalent Document."

25 | Jonah Kurman-Faber, Marc Breslow, 2018. "Regional Cap-and-Trade: Lessons from the Regional Greenhouse Gas Initiative and Western Climate Initiative."

26 | California Air Resources Board, 2017. "California's 2017 Climate Change Scoping Plan."

27 | Ibid.

COMMUNITY-DRIVEN INVESTMENT

LEGISLATIVE GUIDANCE AND DEFINING PRIORITY POPULATIONS

BEST PRACTICES

Mandate a percentage of investments to benefit priority populations.

Define these populations through a public and transparent process with extensive data inputs on socioeconomic and environmental factors.

Use both statewide and localized definitions to robustly define low-income households and communities.

Create a balance of long-term, medium-term, and short-term funding structures to open up the investment process to a wider variety of projects.

LEGISLATIVE GUIDANCE

California's legislature has been considerably involved in guiding the investment process. SB 862 (2014) dedicates a continuous 60% of auction revenue to ongoing long-term projects:[28]

25% High-Speed Rail

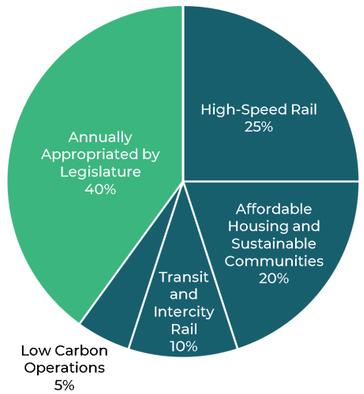
20% the Affordable Housing and Sustainable Communities Program

10% the Transit and Intercity Rail Capital Program

5% the Low Carbon Operations Program

The remaining 40% is appropriated annually by the Legislature, guided by three-year investment plans created by the Department of Finance, CARB, and other relevant state agencies. The plan establishes a general road map, identifying near-term and long-term GHG reduction goals, gaps in current strategies, and investment priorities to focus on. California's current investment plan prioritizes community-level projects and participation, greater funding certainty to allow long-term planning, and an increased emphasis on additional economic, environmental, and public health benefits.[29]

FIGURE 4 Funding Pathways for California Climate Investments[30]



28 | Prior to the 60/40 split, a small portion of proceeds is set aside for backfilling manufacturing sales tax exemptions and revenue from the State Fire Prevention Fund, as established in AB 398 (2017). Starting in FY 2020-21, an additional 5% of auction revenue will be continuously appropriated to clean water initiatives, as established in SB 200 (2019), which will increase the total ongoing appropriations to 65%.

29 | California Air Resources Board, 2019. "Cap-and-Trade Auction Proceeds Third Investment Plan: Fiscal Years 2019-20 through 2021-22."

30 | California Air Resources Board. "CCI Legislative Guidance." Accessed July 2019.

Across the entire investment portfolio, two bills have guided the program's investment equity requirements:

SB 535 (2012) requires the California Environmental Protection Agency (CalEPA) to identify "disadvantaged communities" for the purpose of California Climate Investments, and requires CARB to provide guidance on maximizing benefits to identified communities. At least 25% of all investment must provide benefit to these communities, and at least 10% of all investment must be directly located in these communities.

AB 1550 (2016) requires at least 25% of investments to be directly located in and benefiting disadvantaged communities. An additional 10% of investment must benefit low-income populations in the following ways:

5% of investment must be located within and benefiting individuals living in low-income communities (as defined by the Department of Housing and Community Development) or fund projects benefiting low-income households statewide (defined as 80% of the statewide median).

5% must benefit low-income communities or households within half a mile of a disadvantaged community.

MAPPING DISADVANTAGED COMMUNITIES

The CalEPA is charged with designating disadvantaged communities and uses their CalEnviroScreen software to do so. The software uses open calculations and GIS software to score each census tract according to 22 different measures of environmental and socioeconomic conditions.

Each of these data factors, which are measured at the census tract level, are selected and weighted by a complex algorithm, which is the product of a multi-year consultation with state agencies and the public to define disadvantaged communities as the top 25% scoring of 8,000 census tracts.

A small number of additional communities had insufficient data to receive a full score, but were designated as disadvantaged due to excessive pollution rates. Of note, California's research indicates that these factors tend to be correlated, although some low-income communities did not make the 25% threshold.

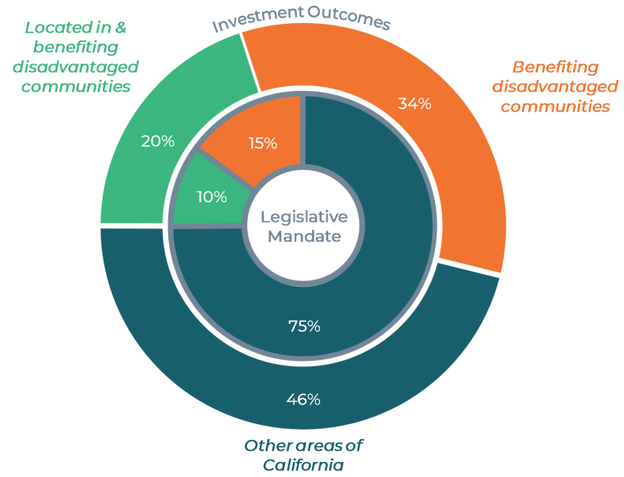
When the tool was established, CalEPA underwent extensive engagement with stakeholders over what the appropriate datasets were for defining these priority populations, as well as what the appropriate percentile for qualifying as "disadvantaged" should be. Since SB 535 mandated 25% of funds benefit priority populations, CalEPA determined it was appropriate to denote only the top 25% scoring communities.

FIGURE 5 CalEnviroScreen 3.0 Indicators and Component Scoring[31]

	Pollution Burden		Population Characteristics		
Exposures	Ozone Concentrations PM2.5 Concentrations Diesel PM Emissions Drinking Water Quality Pesticide Use Toxic Releases from Facilities Traffic Density	×	*Sensitive Populations*	Cardiovascular Disease Low Birth-Weight Births Asthma Emergency Department Visits	= CalEnviroScreen Score
Environmental Effects	Cleanup Sites Groundwater Threats Hazardous Waste Impaired Water Bodies Solid Waste Sites and Facilities		*Socioeconomic Factors*	Educational Attainment Linguistic Isolation Poverty Unemployment Housing Burdened Low Income Households	

31 | California Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, 2017. "CalEnviroScreen 3.0: Update to the California Communities Environmental Health Screening Tool."

California Climate Investments Prior to August 2017 (SB 535)



California Climate Investments Since August 2017 (AB 1550)

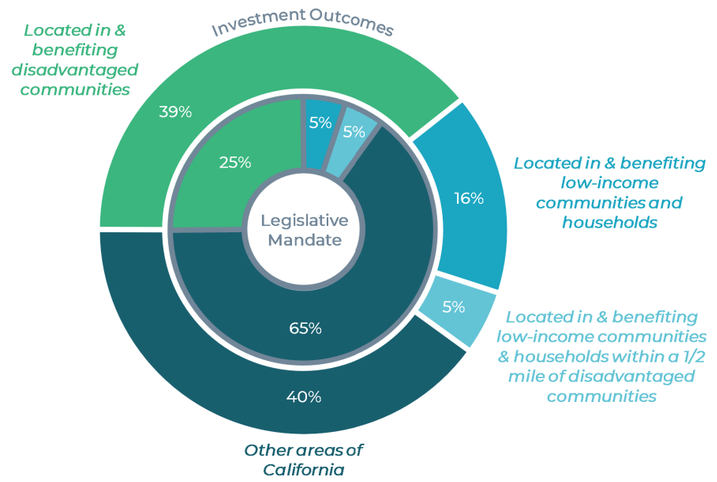


FIGURE 6 Mandated Equity Requirements vs Program Outcomes of California Climate Investments.

Note that the inner circles represent those percentages mandated by legislation, while the outer circles represent those percentages achieved in practice, according to California's own estimates.

In practice, California has repeatedly exceeded these requirements, suggesting that future states can set more ambitious equity requirements from the outset of the program.[32]

LESSONS FOR FUTURE STATES

With billions of dollars at stake, it is imperative for states to create data-driven, transparent, and iterative tools to evaluate the recipients and beneficiaries of investment projects. Additionally, these tools need to be calibrated over time as new data becomes available. States may want to consider weighing these various economic and environmental indicators to reflect the most dire needs of priority populations.

Policymakers and program administrators have to consider what datasets already exist, and which need to be created or obtained, to replicate this approach in their own state. Studies show that many of these factors are correlated,[33] meaning that states without access to the same datasets as California may be able to arrive at similar conclusions with alternative measurements.

As with all aspects of program design, political interest can influence data-driven tools. For example, different regions of the state may benefit from increasing the weight of particular indicators to better serve their region. These conflicting voices need to be hashed out through due diligence and public workshops in order to arrive at a final product that is fair for all regions of the state.

The various funding pathways for investment also need to be carefully balanced. Dedicating 60% of continuous auction revenue to large infrastructural projects was a choice made in California to serve the larger regional needs of the state through long-term projects. The 40% allocated yearly thus presents the only opportunity for medium and short-term projects to find funding. This annual funding cycle can be difficult for agencies and programs that have to build staff capacity to implement the projects funded, since there is no guarantee that the legislature will continue to fund a given project in future years, due to the myriad of political factors that inform legislative decisions.

Future states can learn from this experience and shift the legislative appropriations to a multi-year basis. If appropriations were made on a two or three-year cycle, agencies and program administrators would feel more secure hiring staff and investing in the resources needed to implement their projects appropriately. Additionally, multi-year funding would allow communities that secure funding to plan more durable, long-lasting changes in their community.

IDENTIFYING AND MEASURING BENEFITS FOR PRIORITY POPULATIONS

BEST PRACTICES

Codify a process for engaging, identifying, and addressing the needs of a community.

Develop methodologies to the extent feasible that measure the benefits of investment, particularly GHG reductions, public health outcomes, job creation, mobility, and energy and fuel cost savings.

Invest in administrative capacity. The overhead from administering these funds is miniscule compared to the benefits of maximizing investment impacts.

ESTABLISHING FUNDING GUIDELINES

With equity requirements and priority populations defined, a process needs to be established to maximize and ensure real benefits to these communities. CARB has developed extensive funding guidelines for agencies to implement cap-and-trade funds, with the following 3-step process as a foundation:

1| IDENTIFY THE PRIORITY POPULATION(S) based on census tract and/or the program's ability to benefit low-income households. This can be done using CARB's resource page on CalEnviroScreen and low-income calculators. For low-income households located outside these boundaries, the agency must identify an approach to confirm income eligibility.

2| ADDRESS A NEED. Agencies are required to demonstrate how their project meaningfully addresses an important community or household need in the identified priority population. This is done through direct engagement with local residents and groups through community meetings, workshops, consulting organizations, community surveys, and other outreach efforts. As an alternative, agencies can identify individual factors that most impact priority populations and/or refer to the following list of common needs and select a need that has documented broad support from residents and/or community groups.

32 | California Air Resources Board, 2019. "Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds."

33 | Anjum Hajat, Charlene Hsia, Marie O'Neill, 2015. "Socioeconomic Disparities and Air Pollution Exposure: A Global Review."

FIGURE 7 Potential Benefits of California Climate Investments[34]

Public Health
Reduce health harms due to air pollutants
Reduce health harms due to the built environment
Increase community safety
Reduce heat-related illnesses and increase thermal comfort
Increase access to parks, greenways, open space, and other community assets
Economic
Create quality jobs and increase family income
Increase job readiness and career opportunities
Revitalize local economies and support California-based small businesses
Reduce housing costs
Reduce transportation costs and improve access to public transportation
Reduce energy costs for residents
Improve transit service levels and reliability
Bring jobs and housing closer together
Preserve community stability and maintain housing affordability for low-income households
Provide educational and community capacity building opportunities through community engagement and leadership
Environmental
Reduce exposure to local environmental contaminants, such as toxic air contaminants, criteria air pollutants, and drinking water contaminants
Prioritize zero-emission vehicle projects for areas with high diesel air pollution, especially around schools or other sensitive populations
Reduce exposure to pesticides in communities near agricultural operations
Greening communities through restoring local ecosystems, improving landscape, and/or increasing public access for recreation

3| PROVIDE A BENEFIT. The agency must identify at least one direct, meaningful, and assured benefit that the project provides. The benefit must directly address the identified need. While many of these projects provide multiple benefits, the agency is only required to report one benefit criteria.

DATA PRACTICES AND QUANTIFYING BENEFITS

CARB has developed resources, methodologies, and literature reviews to maximize, verify, and quantify GHG reductions from investments. At the moment, CARB maintains over 35 separate methodologies for GHG reductions, catered to specific project types.

CARB currently has also completed methodologies for estimating 10 different types of co-benefits from potential projects:

Jobs

Air pollutant emissions

Travel cost savings

Vehicle miles traveled

Energy and fuel cost savings

Water savings

Soil health and conservation

Climate adaptation

Community engagement

Heart and lung health

These methodologies are fully documented and open for public comment. Over time, they are updated and adjusted as new data and research becomes available.[35] CARB has developed two additional literature reviews on anti-displacement and accelerated implementation of technology, however current research is insufficient to develop quantification tools for these co-benefits.

CARB's updated Funding Guidelines now require administering agencies to quantify and report potential future job benefits when projects are awarded funds. After they are implemented, large projects and projects that claim employment benefits for priority populations must report back on the quantity and quality of jobs benefits provided post-implementation.

34 | California Air Resources Board, 2018. "Funding Guidelines for Agencies that Administer California Climate Investments."

35 | California Air Resources Board. "CCI Quantification, Benefits, and Reporting Materials." Accessed July 2019.

Photo: CXC Staff

LESSONS FOR FUTURE STATES

Governments have to strike a balance between administrative burden and granularity of data practices. Currently in California, agencies are only required to identify one co-benefit for their investment project to comply with equity requirements. Identifying and quantifying all co-benefits from an investment project is a difficult requirement for state agencies, even with California's high administrative capacity.

Governments that lack resources should start with strong requirements for community outreach and stakeholder engagement to identify and address the needs of the community, but adding administrative capacity to improve data practices should be an early priority. As it took CARB several years to develop co-benefit calculation methodologies, billions of dollars were implemented without a comprehensive understanding of their co-benefits. To the extent that governments can develop these quantification tools ahead of time, the benefits of program investments can be more effectively measured, selected, and celebrated from day one.

While executing a thorough investment process is hard work, the added administrative costs are minis-cule in comparison to the scale of investment revenue and resulting benefits. California's 2019 Investment Report states that $162 million has been reported as cumulative program administration costs, which amounts to less than 3.5% of the $4.6 billion reported in budgetary expenditures on climate programs and 1.2% of the $14.2 billion in total project costs.[36]

Carbon pricing legislation should enable administrators to dedicate a portion of revenue to the administration of the program, including the added capacity required to create investment plans that are transparent, community-driven, and extensively quantified.

California stakeholders have also highlighted the effectiveness of the competitive grant process in leveraging additional federal, state, local, and private funding sources. Many investment programs extend their reach by requiring or encouraging applicants to secure additional funds from these sources. Cumulatively, $2.7 billion in implemented funds has leveraged an additional $10.8 billion from other sources of public and private capital, which amounts to $3.96 in leveraged capital for every $1 invested.[37]

36 | This includes $3.4 billion in cap-and-trade revenue and an additional $10.8 billion leveraged from other sources of public and private capital. Source: California Air Resources Board, 2019. "Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds."

37 | $10.8 billion is the minimum level of leveraged funds, as it excludes additional funds not reported by agencies as well as High-Speed Rail, which is expected to leverage over $60 billion over the project's lifetime.

Wind Turbine Panorama Outside Palm Springs California. Photo: Joe Wolf

GOVERNANCE, TRANSPARENCY, AND EDUCATION

BEST PRACTICES

Establish a comprehensive investment plan that goes beyond GHG reduction to increase the program's ability to benefit priority populations.

Build a combination of ground-up and representative governance structures to sufficiently establish community ownership over investments.

Provide technical assistance to ensure equitable access to competitive grant programs and place-based initiatives.

Maximize uptake of available programs by priority populations through streamlined and intuitive education campaigns.

While the above processes demonstrate the extensive efforts undertaken by agencies in California to engage priority populations and measure benefits to these communities, the decision process is nonetheless largely centralized. Whether or not a community has been extensively "engaged" does not determine whether they have ownership over outcomes in their community.

A majority of investment funds in California are dedicated to projects that simultaneously address larger state needs, while providing benefits to disadvantaged populations, such as new passenger rail lines. These projects, whether or not they actually produce positive outcomes for communities, lack a significant degree of community ownership. Future states can learn from this process by 1) establishing their funding guidelines and processes around a more holistic view on investment from the beginning; and 2) in the case of large state-wide projects, establish a governance structure with sufficient community representation.

In California, this process is improving, but still has room to grow. California's investment priorities, as demonstrated by legislative appropriations and CARB's three-year investment plans, are shifting away from a narrow view on GHG reductions to a more holistic view on economic and environmental co-benefits, particularly job creation. These shifting priorities are reflected in the investment process itself, including CARB's Funding Guideline requirements, co-benefit calculators, and other transparent data-driven tools to identify benefits beyond GHG reductions.

The first five years of California's investments were focused on shovel-ready projects, which tended to be concentrated in municipalities with city planners and considerable resources such as San Francisco and Los Angeles. Meanwhile, smaller communities with limited or zero staff capacity were left behind. In these cases, dedicated funding for administration, support, and technical assistance is vital to keep grant funds accessible to priority populations, community groups, and smaller municipalities.

Last year, California introduced the Regional Climate Collaboratives Program, which provides educational awareness to communities, organizations, and the larger public in order to maximize equitable access to cap-and-trade funds. A cumulative $6 million has also been appropriated to the California Strategic Growth Council for the California Climate Investments Technical Assistance Program.

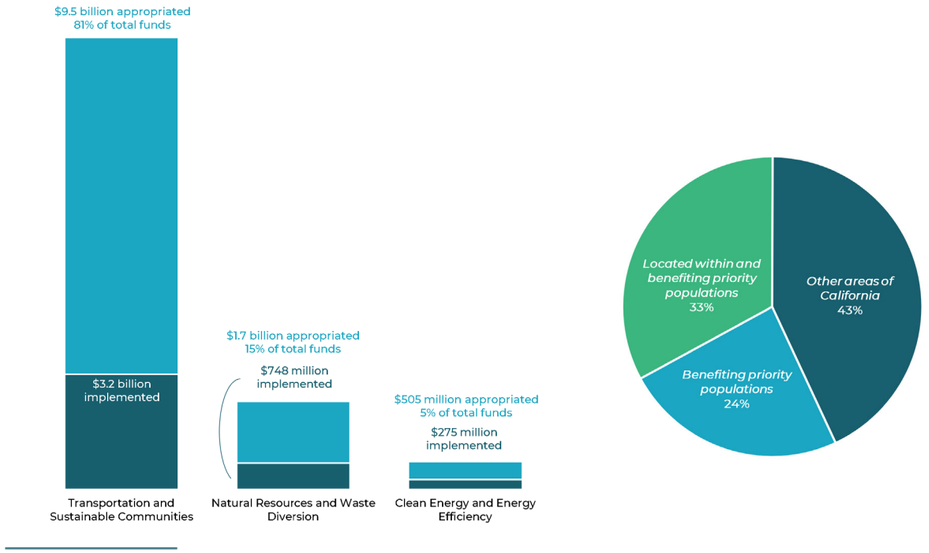
Such awareness needs to happen at the household level as well. A disadvantaged or low-income household in California may qualify for 10 to 15 programs at any given time. Many of these programs are administered by completely different agencies, making it difficult for individuals to keep track of what programs are available and what they qualify for. In response, the state is currently building a one-stop web portal to streamline the application process. Other states can learn from this experience and prepare a streamlined, multilingual application platform to incorporate investment programs into their existing offerings to households.

FUNDED PROGRAMS

An Annual Report of Investments is presented to the legislature each year, which extensively outlines funded projects to date. As the requirements to benefit low-income populations were recently implemented, it has not yet been integrated in detail into official investment reports. However, the report offers historical data on the cumulative benefits that have been realized by priority populations.

Investments fall into one of three main buckets: (1) *transportation and sustainable communities*, (2) *clean energy and energy efficiency*, *and* (3) *natural resources and waste diversion*. For a full list of appropriated funds, see Appendix A.

FIGURE 8 Implemented Funds and Cumulative Benefits of California Climate Investments for Priority Populations[38]



38 | California Air Resources Board, Feb 2019. "Greenhouse Gas Reduction Fund Appropriations by Fiscal Year."; "Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds"; "2019 Semi-Annual Update."

Los Angeles Financial District. Photo: Ken Lund

1 | TRANSPORTATION/SUSTAINABLE COMMUNITIES ($9.5 BILLION APPROPRIATED, 79% OF TOTAL FUNDS)

The majority of transportation/sustainable community funds are directed towards public transit infrastructure, clean vehicle programs, and affordable housing, most of which qualifies to a significant degree as benefiting disadvantaged communities. Some of these initiatives include town-level projects such as zero-emissions school buses and worker vanpools in disadvantaged communities, but a majority of funds are directed towards state-wide projects such as high-speed rail and other forms of public transit. About 12% of funds in this category are appropriated to community air protection, technical assistance, and community grant programs.

2| CLEAN ENERGY/ENERGY EFFICIENCY ($505 MILLION APPROPRIATED, 4% OF TOTAL FUNDS)

A good portion of this category is directed to various low-income weatherization programs (1.8% of overall appropriations), which provides energy efficiency and solar projects for low-income households. Together with water efficiency programs, the equity benefits are easily verifiable and measurable at the household level, making them effective investment pathways to offset some of the increased energy costs from the cap-and-trade program.[39]

3 | NATURAL RESOURCES AND WASTE DIVERSION ($1.7 BILLION APPROPRIATED, 15% OF TOTAL FUNDS)

Forest management is the largest portion of funding within this pathway, with additional funds directed to manure management, dairy digesters, and waste diversion. The remaining funds are dedicated to training and workforce development, restoration projects, urban greening, and climate adaptation.

A 2018 study finds that California Climate Investments are creating 8.8 jobs per $1 million invested, compared to 1.6 jobs created per $1 million invested into oil and gas industries.[40]

TRANSFORMATIVE CLIMATE COMMUNITIES

Emerging programs in California highlight a new level of community ownership over investment decisions. The Transformative Climate Communities (TCC) Program, for example, establishes a competitive grant fund for neighborhoods to realize the changes needed in their local community.

A wide variety of groups can apply for these funds, including community organizations, local government, faith-based organizations, tribal governments, and more. The majority of a project area must reside in the most disadvantaged communities in the state, defined as the top 5% of CalEnviroScreen census tract scores. The remainder of the project must occur within any priority population.

In the first two rounds of funding, $180 million has been awarded to local actors in Los Angeles, Fresno, Sacramento, and elsewhere to create their own transformations. For example, the Watts Rising project was awarded $33 million to create hundreds of new affordable homes, plant thousands of new trees, create new car-sharing services, introduce 10 new electric buses, perform energy efficiency upgrades and solar installations on hundreds of homes, create 50 new mini-farms, construct miles of bike paths, and redesign 30+ blocks of streetscape to accommodate pedestrians and urban trails, creating over 300 construction and permanent jobs and over 500 new training opportunities in the community.[41]

The TCC Program also offers technical assistance through the Strategic Growth Council, including a review of application responses, financial analysis and budget development, support for project integration, and assessment of project readiness. Additional assistance is available through select academic and private providers across California.

This dense, place-based approach to investment allows some of the most overburdened and underserved communities to realize radical transformations that fundamentally change their built environment, public health concerns, and provide pathways to success. Representing 2.1% of cumulative appropriations since program launch, the TCC Program should be drastically expanded in accordance with the state's shifting investment priorities towards community-level development and job co-benefits.

Future states should carefully examine the TCC program as a vital component of their own investment strategy in order to create the most profound and equitable impacts in the communities that need it most.

39 | Beginning in FY 2020-21, an additional 5% of continuous cap-and-trade revenue will be directed to clean water initiatives, further signaling the shift in California's investments beyond GHG reductions.

40 | J.R. DeShazo, Jason Karpman, Weilong Kong, Colleen Callahan, UCLA Luskin Center for Innovation, 2018. "Employment Benefits from California Climate Investments and Co-Investments."

41 | California Strategic Growth Council, 2018. "Watts Rising: Transformative Climate Communities."

STRONG CARBON PRICE SIGNALS

BEST PRACTICES

A sufficient carbon price signal is a crucial design choice for impactful and equitable carbon pricing, for three reasons:

To capture the social cost of pollution. Current global estimates of carbon's social cost are as low as $52/tCO$_2$e and upwards of $417/tCO$_2$e.

To create equitable health outcomes. Global studies suggest that a price of $40-$80/tCO$_2$e may be a good starting point to penetrate some industries responsible for inequitable public health outcomes.

To raise vital revenue for a just transition. Rapidly achieving a just transition requires trillions of dollars of public and private capital, which carbon pricing can help raise.

Cap-and-trade systems do not prescribe a carbon price, and therefore its technical design choices ultimately determine the program's effectiveness.

CALIFORNIA FINDINGS

As the state relies predominantly on other policies, California's carbon price has remained near the price floor, between $10 and $17.50/tCO$_2$e since program launch. This is relatively low compared to the social cost of carbon.

California has significantly overallocated allowances in their cap-and-trade program, which has suppressed carbon prices. Offsets may be responsible for nearly half of the privately banked supply through 2018.

However, preliminary research suggests that co-pollutants from stationary sources are decreasing in California. Further research is needed into the specific impact in disadvantaged communities and mobile sources of co-pollutants.

SOCIAL COSTS OF CARBON

Historically, where present, carbon prices have been fairly low. Among established cap-and-trade systems, current carbon prices range between approximately $5 and $25 per metric ton CO$_2$e.[42] California's allowances have sold at auction between $10 and $17.45 since program launch.[43]

By comparison, the social cost of carbon, meaning the cumulative damages associated with emitting one metric ton of CO$_2$e, is estimated at $52 by the US Interagency Working Group on Social Cost of Greenhouse Gases.[44] There is documented broad consensus that this estimate is low,[45] with recent studies estimating the global social cost as high as $417/tCO$_2$e.[46] When carbon prices are lower than this social cost, they fail to capture the full extent of the damage carbon pollution causes to communities across the globe.

These costs are even higher when accounting for co-pollutants that are harmful to public health. A 2015 study found that the most efficient carbon price among top polluting countries in order to capture public health co-benefits (disregarding the global climate benefits) would be $67.50 in 2019 dollars.[47] Several studies have also found that the economic benefits of reduced illness and death from air pollution often outweigh the costs of GHG reduction.[48,49]

Based on local impacts alone, current carbon prices are far too low to address the external damages of both greenhouse gases and co-pollutants. States should consider capturing these damages through higher carbon prices than currently implemented globally. Alternatively, an additional fee can be assessed on co-pollutant emissions to more efficiently target major sources of harm to public health.

USING THE CARBON PRICE SIGNAL FOR ENVIRONMENTAL JUSTICE

California's legal requirements dictate their program reflect the "cost of abatement," or the minimum price needed to achieve their emissions targets, more so than the social cost of carbon. As such, the program is designed to maintain the lowest carbon prices needed in order to keep the state on track for their 2020 and 2030 goals.

This creates challenges in using the carbon price to target specific health outcomes in disadvantaged communities. When a cap-and-trade program is designed to facilitate the cheapest, most efficient ways to reduce pollution, it likely will do so first in the electricity sector. This has occurred in California, where a majority of reductions in the state were due to increased hydroelectricity output, plummeting costs for wind and solar, and shifting contracts for imports.

Meanwhile, other sources of pollution that create co-pollutants in disadvantaged communities, such as manufacturing, refineries, and diesel engines, require higher price signals in order to facilitate change.

The degree to which this dynamic has taken place in California is unclear. A preliminary study found that in the first 3 years of the program, little had changed in terms of co-pollutant and GHG emissions from stationary sources in disadvantaged communities.[50] This study is currently being updated to include more recent years of data, as well as being applied to mobile sources of local pollutants such as diesel engines.

42 | World Bank Group, 2019. "State and Trends of Carbon Pricing 2019."

43 | California Air Resources Board, "Auction Notices and Reports." Accessed July 2019.

44 | Interagency Working Group on Social Cost of Greenhouse Gases, 2016. "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis." Adjusted to 2019 dollars.

45 | Peter Howard, Derek Sylvan, 2015. "The Economic Climate: Establishing Consensus on the Economics of Climate Change."

46 | Ricke et. al., 2018. "Country-level social cost of carbon." Nature Climate Change.

47 | Adjusted for inflation. Original findings calculated a price of $57.50/tCO2e for 2010. International Monetary Fund, 2015. "How Much Carbon Pricing is in Countries' Own Interests? The Critical Role of Co-Benefits."

48 | "Christina Zapata, Nicholas Muller, Michael Kleeman, 2012. "PM 2.5 co-benefits of climate change legislation part 1: California's AB 32."

49 | Jonathan Buonocore, Jonathan Levy, Renzo Guinto, Aaron Bernstein, 2018. "Climate, air quality, and health benefits of a carbon fee-and-rebate bill in Massachusetts, USA."

50 | Lara Cushing et. al., 2018. "Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011-2015."

Photo: Torbakhopper

Our preliminary analysis finds that through 2017, the state is starting to see reductions in pollutants from stationary sources, although further research is needed to apply this analysis to disadvantaged communities, mobile sources, and what degree cap-and-trade is responsible.

However, looking at this data at the aggregate level doesn't sufficiently characterize pollution dynamics at play. The majority of positive changes from stationary sources are coming from electricity generators and cogenerators, while most other types of facilities continue to increase both their GHG and local pollutant emissions.

FIGURE 9 3-Year Average Emissions from Stationary Sources, 2010-2012 to 2015-2017 [51]

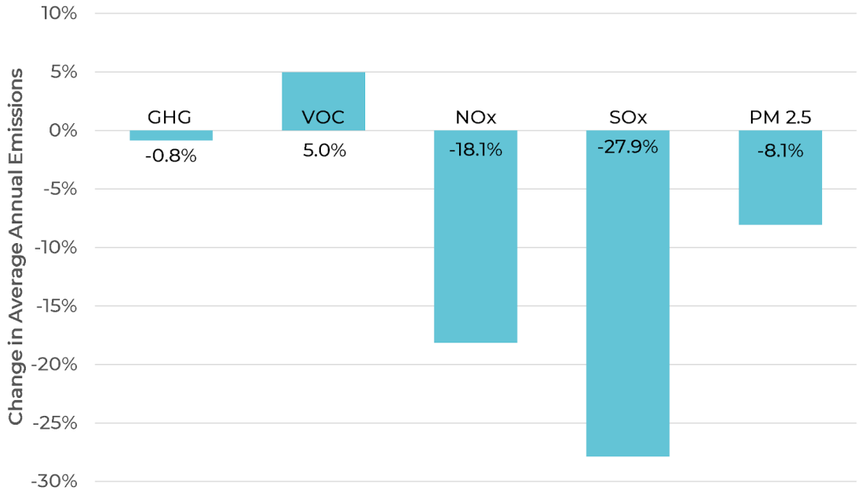
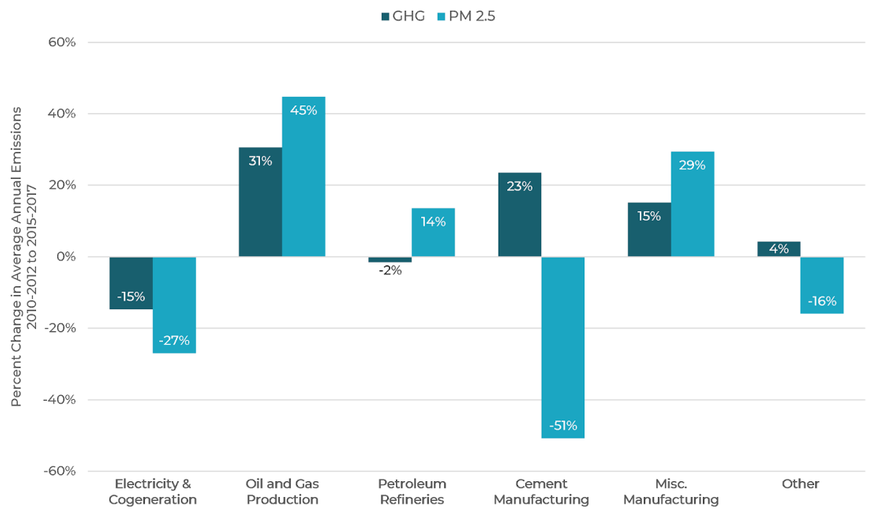


FIGURE 10 Change in 3-Year Average Emissions by Industry, 2010-2012 to 2015-2017 [52]



51 | California Mandatory Reporting Regulation Data, 2010-2017

52 | Ibid.

Each industry tells a different story. Electricity generation and cogeneration facilities experienced a 15% drop in GHG emissions and a 27% drop in PM 2.5 emissions. As they represent the largest share of facility emissions, these drops outpaced the collective changes of all other types of facilities.

Meanwhile oil and gas production and miscellaneous manufacturers continue to drastically increase both GHG and PM 2.5 emissions, suggesting current policies (including cap-and-trade) have been insufficient to significantly change behavior in these industries.

Cement manufacturing has experienced a massive drop in PM 2.5 emissions while GHG emissions have continued to increase. This suggests that GHG and PM 2.5 emissions may be decoupling in this sector, in which case GHG-oriented policies such as cap-and-trade may not be effective instruments to address co-pollutants from cement manufacturing.

We can infer from this analysis that the combination of cap-and-trade, other policies, and market forces are collectively creating positive changes in the GHG and PM 2.5 emissions of electricity generators and cogenerators, but have been insufficient to tackle petroleum refineries and other manufacturing.

It is key for policymakers to examine these dynamics on an industry basis while designing carbon pricing, in order to maximize the program's ability to create positive local health impacts.

MARGINAL COST OF ABATEMENT

A more detailed understanding of industrial behavior can empower policymakers to design carbon pricing to achieve targeted GHG and local health outcomes. Each type of facility, whether it be an electricity generator, petroleum refinery, or manufacturer, has different potential actions they can take to reduce their emissions, and each of these actions has a cost. These various options are collectively described as a facility's marginal abatement cost curve (MACC).

Figure 11 is a sample MACC chart of the various options a hypothetical facility could choose from to reduce its annual GHG emissions. Each of these options varies in cost, as expressed in dollars per tCO_2e avoided. For example, investing in option 1, which could be an energy efficiency upgrade, saves a facility more money over time than it costs to implement. As a result, the cost of abatement is negative (-$50/$tCO_2e$), meaning there is a financial incentive to undertake such measures with or without a carbon price.

However, more expensive options may require upfront capital that is not recuperated over time. For example, option 4 will save an average of 10,000 tCO_2e per year, but will cost about $50 per tCO_2e avoided. Thus, a carbon price above $50 will create the proper incentive to implement this option because doing so will save the company money over time in the form of avoided payments to the carbon pricing program.

FIGURE 11 Sample Marginal Abatement Cost Curve

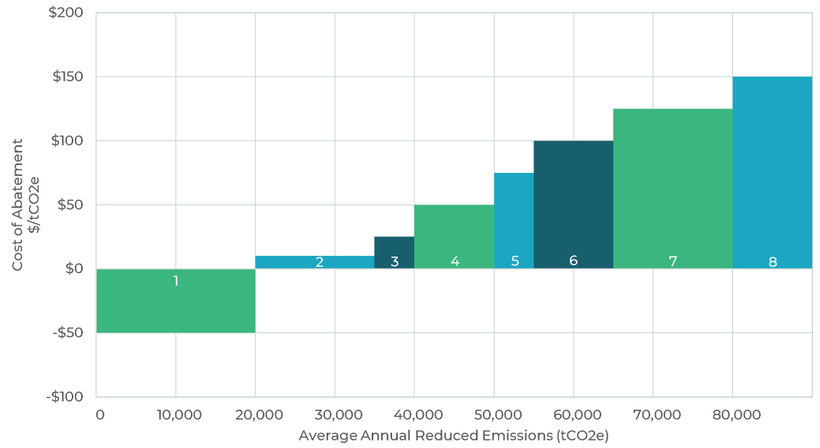
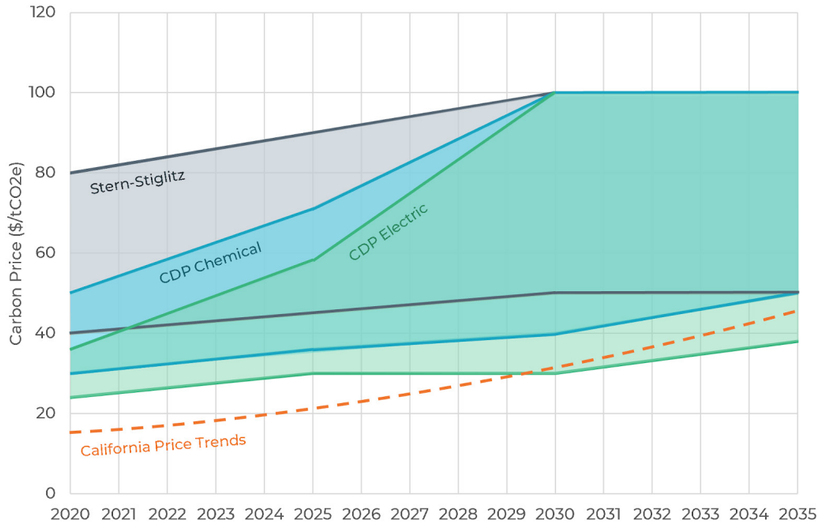


FIGURE 12 Global Studies on Carbon Prices Needed 2020-2035 [53]



A facility will pursue these projects in the order presented in the MACC curve as the carbon price rises to the appropriate level for each option.

The marginal cost of abatement curve (MACC) can vary widely by industry. Prescribing what exact price will bring about desired outcomes requires detailed research into the specific facilities within a given jurisdiction. However, current global research provides a rough context of what prices could start to make a difference.

The Stern-Stiglitz High-Level Commission on Carbon Prices finds that a carbon price of $40-$80 by 2020 and $50-$100 by 2030 is needed to achieve the goals of the Paris Agreement, assuming complementary policy is in place.[54] This would spur early industrial facilities to take action using best-available-technology (BAT), especially if the carbon price signal were to predictably increase over time.

A 2018 report by the Carbon Disclosure Project estimates that a price range of $24-$36/tCO_2e in the power sector and $30-$50/tCO_2e in the chemical industry in 2020 will put a majority of these respective industries on track to reduce emissions in the short and medium term.[55] These price corridors increase over time to incentivize new decarbonization solutions that may be higher up in a facility's MACC chart. However, these corridors do not cover all types of power and chemical facilities, and a portion of the chemical sector reports they would require a carbon price as high as $100 by 2020 and up to $400 by 2035.[56]

Future states should closely examine what carbon price they can politically achieve and what ramifications that price level will have for each major source of pollution in the state. By using this lens, policymakers and advocates can identify what areas the carbon price can effectively address, and what areas will require further action by investment and/or complementary policy.

For example, industries such as cement manufacturing lack the technological alternatives to significantly reduce GHG pollution, and as such would require carbon prices far higher than politically feasible.

53 | California price trends are calculated based on historical growth of the price floor, and is meant to represent the minimum expected price assuming current regulations continue through 2035.

54 | The World Bank, 2017. "Report of the High-Level Commission on Carbon Prices."

55 | CDP, 2018. "Carbon Pricing Corridors: The Market View 2018."

56 | Ibid.

ALLOWANCE OVERSUPPLY KEEPS CARBON PRICES LOW

Achieving higher carbon prices in cap-and-trade systems is slightly more complicated, as these systems do not explicitly prescribe a carbon price. However, effective price ranges can still be achieved through the technical design choices that influence the resulting stringency of the program.

First, price floors and ceilings can keep allowance prices within a desired range. The "price floor" set in cap-and-trade systems, or the minimum price at which allowances can be sold, is particularly crucial, as allowance prices tend to stay close to the price floor.

Setting the minimum and maximum allowance prices at an effectively high level is the most straightforward way to ensure an effective carbon price is achieved.

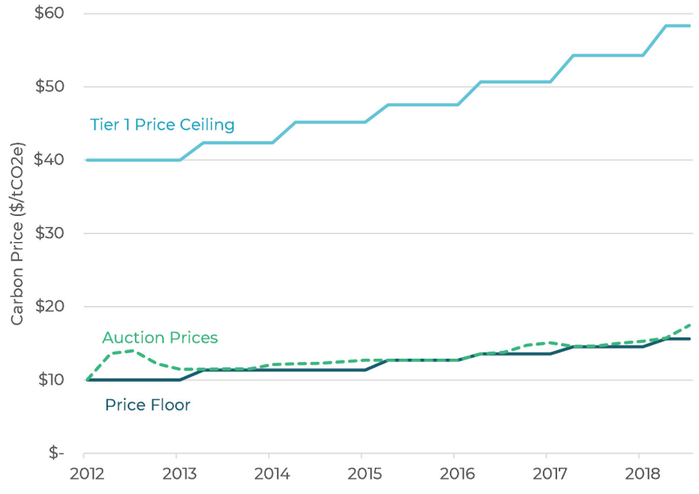
Second, the supply of allowances can be adjusted downward over time to facilitate higher allowance prices. Existing studies find that California is dealing with a large oversupply of allowances that has kept carbon prices low.[58,59,60] We estimate that after accounting for emissions in 2018, there are over 226 million excess allowances currently held in private accounts, which is nearly equivalent to the program's expected cumulative reductions of 236 million tCO_2e between 2021 and 2030.[61]

As long as an excessive number of allowances circulate the market, low carbon prices will persist. Other cap-and-trade systems, such as the Regional Greenhouse Gas Initiative, have enacted banking adjustments, where the future auction of allowances is decreased to account for the allowances that have accumulated in private accounts.

THE IMPACT OF OFFSETS

In California, a portion of emissions can be covered by offsets instead of allowances, such that companies can invest in projects that remove greenhouse gas emissions from other sectors of the economy, or other geographic locations. Most commonly in Cali-

FIGURE 13 Historical California Carbon Prices vs Price Collars[57]



57 | California Air Resources Board, "Auction Notices and Reports." Accessed July 2019.

58 | Near Zero, 2018. "Holding Limits Don't Constrain Banking in California's Cap-and-Trade Program."

59 | Chris Busch, 2017. "Recalibrating California's Cap-and-Trade Program to Account for Oversupply."

60 | Legislative Analyst Office, 2017. "Cap-and-Trade Extension: Issues for Legislative Oversight."

61 | See Appendix B for calculations

fornia, this has entailed financing forestry projects to sequester carbon dioxide.

These protocols allow industries to invest in emissions reductions that otherwise would not have occurred, adding to the geographic flexibility and efficiency of the program. Currently, California facilities can fulfill 8% of their emissions obligation with offsets instead of allowances, although that percentage will drop in the coming decade.[62]

It's important to acknowledge that in practice, facilities are not forgoing emissions reductions in favor of offsets. A 2018 study of California observes that while companies using offsets tended to be larger emitters overall, their changes in greenhouse gas and co-pollutant emissions are indistinguishable from those of companies not using offsets.[63] Because the price of allowances in many cases is too low to reduce emissions, these facilities are more likely to use offsets to replace a portion of allowances that they otherwise would have submitted.

However, there are other significant environmental justice challenges with offsets. In addition to current concerns about the legitimacy of these offset projects,[64] community groups lament that companies are sending payments to offset developers outside of their community (or even outside the state or country), rather than investing in solutions to the harm they cause locally.

Perhaps the most underestimated detriment of offsets in California is that they contribute to the allowance oversupply problem. For every offset used, an allowance is left in the market that otherwise would have been used for compliance. In this sense, offsets effectively increase the total allowance supply, leading to suppressed carbon prices.

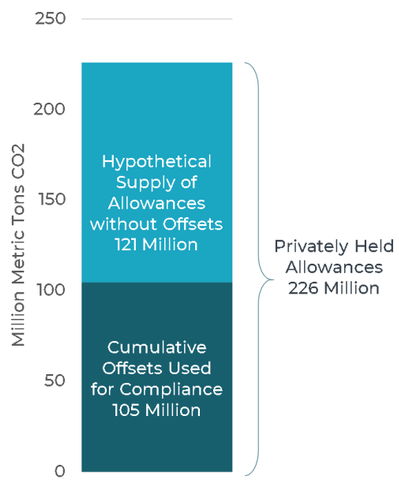
An estimated 226 million allowances were saved in private accounts as of the end of 2018. We find that if one allowance was removed from the market for every offset used for compliance, California's current oversupply problem would be nearly cut in half.[65]

Determining whether such a change would lead to notable increases in allowance prices is beyond the scope of this report. However, future systems can learn from California by:

- **CONSIDERING THE IMPLICATIONS** of offsets on the supply/demand dynamics of their program.
- **ESTABLISHING PERIODIC REVIEWS** or automatic adjustments to calibrate the program in future years if it becomes overallocated.
- **RESTRICTING OFFSET USE** by entities that emit local pollutants, or require offset projects to be based in the local community.

These measures all stand to keep the program impactful and help maintain carbon prices at meaningful levels, which will drastically increase the likelihood that the program will produce positive public health outcomes in priority neighborhoods.

FIGURE 14 Current Oversupply in California vs Cumulative Offsets Retired



62 | "Final Regulation Order, California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms."

63 | Lara Cushing et. al., 2018. "Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011-2015)."

64 | Barbara Haya, 2019. "Policy Brief: The California Air Resources Board's U.S. Forest offset protocol underestimates leakage."

65 | See Appendix B for calculations

Solar project at Fort Hunter Liggett. Photo: John Prettyman, U.S. Army

RETURNING REVENUE TO CONSUMERS AND EMPLOYERS

BEST PRACTICES

Setting aside a portion of revenue to protect consumers and employers enables policymakers to increase carbon prices to necessary levels without risking harm to priority populations.

Because low-income households constitute a small portion of overall emissions, a relatively small portion of overall carbon pricing revenue can effectively cover these households.

CALIFORNIA FINDINGS

California directs about 35% of total allowance value to electric and gas utilities, which are required to use that revenue to benefit ratepayers.

This revenue is mostly directed back to households and businesses on their utility bills, with low-income households on average receiving a net benefit. No such protections exist for transportation costs.

Due to its higher carbon price, California is raising significantly more revenue per covered tCO_2e than the Regional Greenhouse Gas Initiative, despite directing half of allowances to protect households and businesses.

One of the challenges of achieving higher carbon prices is the political fear of imposing economic harm on constituents. Building guaranteed economic protections into the program can therefore be key to the viability of a bill passing, or reaching a higher level of carbon price ambition.

This can be done in a variety of ways. In California, just over one-third of allowances are "consigned", meaning they are sold at auction by the government and the revenue is passed on to electric and natural gas utilities. By law, this revenue must be used to benefit ratepayers.

Utilities have used the revenue from consignment to benefit consumers and businesses in a variety of ways, such as:

RESIDENTIAL CLIMATE CREDIT: Beginning in 2014, residential customers of investor-owned utilities (IOUs) have received a twice-annual credit on their electricity bills. Per a ruling by the California Public Utilities Commission, all auction proceeds not used for other purposes listed below are divided equally amongst all residential customers of the utility.

COMPLIANCE OR PURCHASE OF ALLOWANCES: Privately owned utilities (POUs) and electric cooperatives (COOPs), which are locally governed and regulated, can opt their consigned allowances out of the auction and use them directly for compliance instead. This is another form of cost protection for ratepayers.

CLEAN ENERGY AND EFFICIENCY PROGRAMS: Under existing law, up to 15% of auction proceeds for IOUs can be dedicated to clean energy or energy efficiency. In 2017, IOUs dedicated 2% of consignment funds to the multifamily affordable housing solar roofs program, while POUs and COOPs spent 15% of consignment funds on renewable energy and energy efficiency.

SMALL BUSINESS RETURN: The Small Business California Climate Credit is designed to help small businesses gradually adapt to the carbon cost under the program. Beginning in 2014, eligible businesses were provided a credit on their electricity bill to offset 100% of cap-and-trade's impact on electricity costs. This percentage declines by 10% per year after 2015.

EITE RETURN: A portion of revenue is directed to energy-intensive trade-exposed (EITE) industries, consisting primarily of manufacturers and petroleum refiners. As these facilities are susceptible to global competition for their products and are sensitive to changes in energy costs, the state sought to provide some degree of protection.

RESIDENTIAL VOLUMETRIC RETURN: During 2014 and 2015, some utilities used a portion of proceeds to reduce residential electricity rates, rather than provide a flat climate dividend. The magnitude of the residential rate offset was designed to exactly match the cost of the cap-and-trade program. As this effectively eliminates the incentive to reduce electricity consumption, the approach was mostly discontinued at the end of 2015.

ADMINISTRATION AND OUTREACH: In 2014 and 2015, a portion of consignment funds were used to conduct a broad public outreach and education campaign to raise awareness for the actions ratepayers can take to reduce energy consumption. In 2016, utilities spent a small portion of funding on low-cost outreach efforts such as bill inserts and email notifications to raise awareness of the California Climate Credit. Cumulatively, administration and outreach has constituted 0.5% of total consignment funds.

IMPACT OF CONSIGNMENT ON CONSUMERS

Revenue return is a design choice meant to mitigate the immediate and measurable impacts of the

FIGURE 15 California Distribution of Allowances, 2015-2018[66]

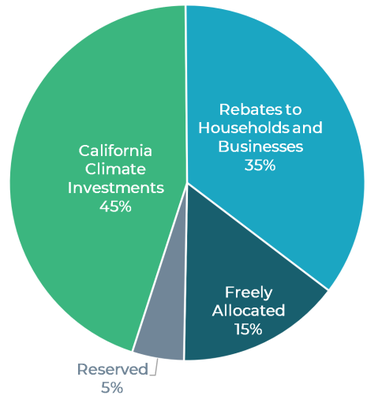
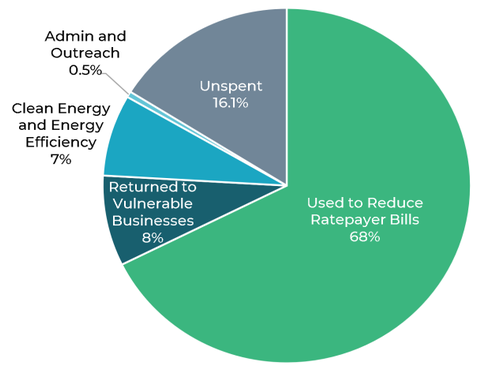


FIGURE 16 Total Use of $1.3 Billion in Cap-and-Trade Funds by Electric Utilities, 2017[67]



Note that the above data is only for electric utilities. One-third of consigned allowance value is given to natural gas suppliers, who began deploying their funds in 2018[68] The first summary report of natural gas supplier (NGS) revenue use will be published by 2020.

66 | Jonah Kurman-Faber, Marc Breslow, 2018. "Regional Cap and Trade: Lessons from the Regional Greenhouse Gas Initiative and Western Climate Initiative."

67 | California Air Resources Board, 2019. "Cap-and-Trade Program: Summary of 2013-2017 Electrical Distribution Utility Allocated Allowance Value Usage."

68 | Natural gas utilities are required to reimburse households their increased energy costs due to cap-and-trade from 2015 and 2017. Once that value has been repaid, the majority of revenue will be directed back to households as a flat climate dividend, similar to electric utilities.


Photo: CXC Staff

program on energy costs. Low-income households spend a higher percentage of their income on energy expenses, making them particularly sensitive to increased energy prices. However, these households still consume less energy per capita than moderate and high-income households, and subsequently tend to constitute a small portion of the economy's total emissions.[69]

According to a study by the Luskin Center of Innovation, the typical low-income electricity and natural gas customer will receive a cumulative climate dividend between 2016 and 2020 that is $245 to $329 higher than the costs of the cap-and-trade program on utility bills. Since the size of the climate dividend increases as the price of allowances increase, low-income customers are guaranteed protection from adverse utility costs.[70]

The consignment approach highlights an effective practice in economic equity for future systems to learn from. Low-income households can be protected from the cost impacts of the program with a relatively small portion of total program funds. Note that in California, consignment revenue is distributed to all income levels as a flat rebate, rather than concentrated in the households that need it most, yet still provides average net-positive benefits to the majority of low-income households.

69 | Justin Caron, Thibault Fally, 2018. "Per Capita Income, Consumption Patterns, and CO2 Emissions."

70 | Juien Gattaciecca, Colleen Callahan, and J.R. DeShazo, UCLA Luskin Center for Innovation, 2016. "Protecting the Most Vulnerable: A Financial Analysis of Cap-and-Trade's Impact on Households in Disadvantaged Communities Across California."

Despite not having any revenue return mechanisms in place for gasoline, the benefits of complementary policies are expected to outweigh the cost impacts of cap-and-trade. The study finds that low-income gasoline customers could receive a net benefit of $350 to $700 through 2020 from motor vehicle fuel efficiency standards, state policies, climate investments, and other factors that are reducing motor vehicle reliance and increasing fuel efficiency over time.[71]

California's decision not to provide rebates to gasoline consumers was due to several factors, including legal and administrative limitations. These limitations may manifest in future programs, highlighting the need for versatile, creative, and well-informed solutions to protect vulnerable consumers. California's existing policy suite is sufficient to mitigate impacts from increased gasoline prices due to carbon pricing, however if the price were to increase in later years, these protections may no longer be sufficient.[72]

Existing research can predict the short-term distributional impacts of carbon pricing on households. Future programs should intentionally and strategically use revenue return mechanisms to provide short-term protection to priority constituents and encourage more ambitious carbon pricing design. These protections should also carefully consider the other components of carbon pricing design – the carbon price, investment strategy, and complementary policies – in order to provide a cohesive scope of economic opportunity in the short, medium, and long-term.

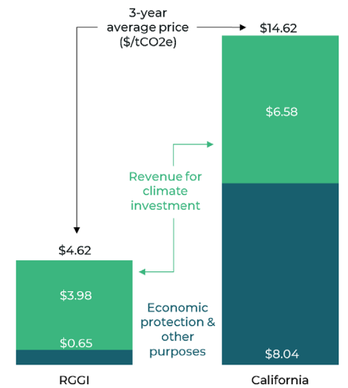
RETURNING REVENUE TO JUSTIFY HIGHER CARBON PRICES

A common misconception is that revenue return mechanisms and investment are mutually exclusive. However, these two measures can strengthen each other. If returning a portion of revenue enables policymakers to achieve higher carbon prices, then it can lead to greater revenue for investment.

For example, the Regional Greenhouse Gas Initiative (RGGI), a regional cap-and-trade program for electricity sector emissions in the Northeast and Mid-Atlantic, dedicates almost all auction proceeds to climate investments such as energy efficiency and renewable projects. However, they have maintained very low allowance prices, with a three-year average of $4.62/tCO$_2$e.

Conversely, California dedicates approximately half of their annual allowance budget to climate investments, but has achieved far higher carbon prices with a three-year average of $14.62/tCO$_2$e. As a result, California is raising significantly more revenue for climate investment, despite a majority of allowances being directed to economic protections or other purposes.

FIGURE 17 Carbon Prices and Use of Revenue in California and RGGI[73]



71 | These net benefits vary widely by household, and are not sufficient to protect low-income households from the costs of cap-and-trade if the price significantly increases in coming years.

72 | Juien Gattaciecca, Colleen Callahan, and J.R. DeShazo, UCLA Luskin Center for Innovation, 2016. "Protecting the Most Vulnerable: A Financial Analysis of Cap-and-Trade's Impact on Households in Disadvantaged Communities Across California."

73 | See Appendix B for Calculations

COMPLEMENTARY POLICY

BEST PRACTICES

Carbon pricing alone is not sufficient to achieve a just transition to a green economy. It is most effective as part of a cohesive, science-driven suite of policies to achieve GHG targets and create targeted public health outcomes.

To the degree that a carbon pricing program is designed to share the burden of GHG reductions with other policies, then it should be intentionally designed to share the load of addressing environmental justice goals as well.

CALIFORNIA FINDINGS

Additional policies in the transportation sector are vital to counteract the cap-and-trade program's impact on transportation costs for low-income households.

California is currently implementing a program to reduce local pollutants in disadvantaged communities, but its effectiveness is yet to be seen.

Even with higher carbon prices, revenue return mechanisms, and inclusive investment processes, carbon pricing alone will not provide all of the GHG reductions needed for a given state, nor a full scope of economic opportunity and environmental justice. Political obstacles in a given state may prohibit some or all of carbon pricing's design subcomponents from being effectively carried out. For carbon pricing alone to sufficiently reduce GHGs, the carbon price signal would have to be far higher than politically feasible.

It therefore becomes vital to contextualize carbon pricing into the policy landscape of a given state and use cutting-edge research to determine what contributions each policy will make to climate change and environmental justice goals.

In California, the additional policies in place play a vital role in filling voids left by cap-and-trade. For example, while the cap-and-trade program has sufficient dividends to protect low-income households from increased utility bills, no such protections exist for transportation costs. Even so, low-income households are still expected to experience net savings on their transportation costs through 2020 due to complementary policies that reduce vehicle reliance and increase fuel efficiency.[74]

Alongside passing AB 398 in 2017, which extended California's cap-and-trade program through 2030, the state passed AB 617 to further address local air pollutants. Specifically, the bill requires new air pollution monitoring technology at a community level, establishes emissions abatement programs, updates air quality standards, and improves the level of enforcement and community engagement in the process.[75]

AB 617 was passed as a result of coordinated and concerted efforts from environmental justice groups who realized that cap-and-trade, as currently designed in the state, would not guarantee the local environmental goals they were fighting to achieve. The true impact and success of this policy remains to be seen as it is implemented in the coming years. To the extent feasible, states should avoid preempting these other vital policies in their carbon pricing policy language.

Complementary policies also serve to distribute the load of addressing the climate crisis, such that no one policy is responsible for bearing more weight than politically feasible. Each of these policies, to the extent that they reduce emissions covered by the cap-and-trade program, further suppress carbon prices by decreasing the demand for allowances.

As long as such policies are cohesively planned to achieve GHG reduction goals, then such an approach is acceptable. However, this has important implications for the carbon pricing program's ability to achieve additional goals of a just transition. In California, as cap-and-trade was intended to be a backstop policy through 2020, it was not designed to sufficiently tackle inequitable local air pollution nor achieve a carbon price signal that captures the true social cost of carbon.

Rather than approach carbon pricing policy design in a vacuum, policymakers and advocates need to examine the role carbon pricing can strategically play within a larger suite of policies to provide a comprehensive scope of economic opportunity and environmental justice to priority populations.

74 | Juien Gattaciecca, Colleen Callahan, and J.R. DeShazo, UCLA Luskin Center for Innovation, 2016. "Protecting the Most Vulnerable: A Financial Analysis of Cap-and-Trade's Impact on Households in Disadvantaged Communities Across California."

75 | California Air Resources Board, "Community Air Protection Program." Accessed July 2019.

Photo: CXC Staff

Photo: CXC Staff

CHALLENGES FOR FUTURE RESEARCH

Further research is required to address questions beyond the scope of this report. The degree to which the benefits from these projects are real and legitimate requires a closer look into the case-by-case results of each project. For example, public transit projects have historically assumed that all residents within a half mile of a transportation project are considered beneficiaries.[76]

Rather than prescribing the specific investments other states need, this report focuses on highlighting the proper steps to best identify the unique needs and solutions for each community in a transparent and fair way. It is thus up to each state to apply these findings in order to reveal what projects are most appropriate to fund.

Meanwhile, a more comprehensive study of California's program impact on transportation is yet to be completed. Current studies are underway to investigate changes in local pollutants from mobile sources in priority communities, as well as the potential gentrification of neighborhoods due to climate investments and development practices. As a majority of California investments are directed to transportation projects, these studies should be a priority moving forward.

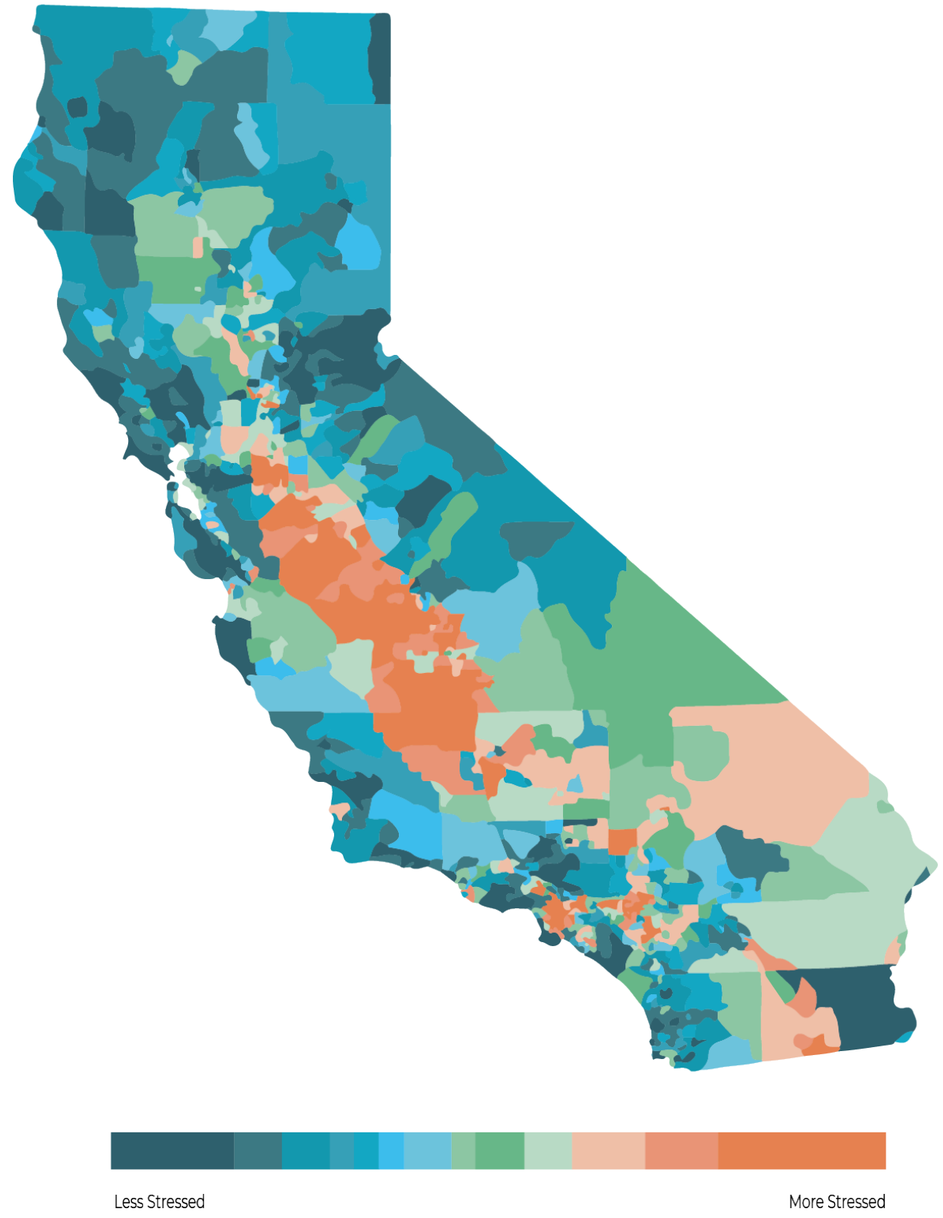
We identify that mobile and stationary sources of co-pollutants interface with carbon pricing very differently. As our analysis on California demonstrates, stationary sources such as manufacturing facilities can be resistance to carbon prices due to the lack of technological alternatives. Investments into these facilities may spur some change, but deep decarbonization will come from a combination of far higher price signals, complementary policy, and research into technological alternatives.

Mobile sources present a different dynamic, as there is no MACC curve for large infrastructural transportation emissions. Local pollutants from diesel engines are ultimately a product of the built environment, such as traffic congestion, bus depots, and parking lots. We have highlighted investments that have far more potential to address co-pollutants from these sources, as opposed to stationary ones, if directed to projects that provide safe, reliable, clean transportation. This dynamic needs to be further investigated in California and elsewhere.

We also identify other key aspects of economic opportunity and environmental justice that go beyond the scope of this report. Specifically, that carbon pricing programs need to provide transitional assistance to families that are wage-dependent, as well as communities that are tax-dependent on fossil fuel industries. Other aspects of environmental justice, such as climate resilience and adaptation, water access, and waste disposal warrant separate investigations outside of our emissions-centric framework, although following the investment principles outlined in this report should capture these concepts as well.

76 | Erick Guerra, Robert Cervero, Daniel Tischler, 2011. "The Half-Mile Circle: Does It Best Represent Transit Station Catchments?"

FIGURE 18 Communities most affected by pollution and socio-economic challenges, by census tract.



77 | CalEnviroScreen 3.0 database

APPENDIX A: CALIFORNIA'S FUNDED PROGRAMS

Cumulative Appropriations for California Climate Investments

Administering Agency	Program	Appropriations[1,2] ($M)		
		Cumulative Appropriations, Prior to FY 2019–20 Appropriations	FY 2019–20 Appropriations	Cumulative Total
CALIFORNIA AIR RESOURCES BOARD	Community Air Protection	$556	$291	$847
	Funding Agricultural Replacement Measures for Emission Reductions	$197	$65	$262
	Low Carbon Transportation	$1,722	$492	$2,214
Caltrans	Active Transportation	$10	–	$10
	Low Carbon Transit Operations	$459	–[2]	$459
CALIFORNIA High-Speed Rail Authority	High-Speed Rail Project[3]	$2,523	–[2]	$2,523
CalSTA CALIFORNIA STATE TRANSPORTATION AGENCY	Transit and Intercity Rail Capital	$1,030	–[2]	$1,030
CALIFORNIA STRATEGIC GROWTH COUNCIL	Affordable Housing and Sustainable Communities	$1,877	–[2]	$1,877
	Sustainable Agricultural Lands Conservation			
	Climate Change Research	$29	$5	$34
	Technical Assistance	$2	$2	$6
	Transformative Climate Communities	$150	$60	$250
CALIFORNIA AIR RESOURCES BOARD	Fluorinated Gases Emission Reduction Incentives	–	$1	$1
	Woodsmoke Reduction	$5	–	$8
CSD	Low-Income Weatherization	$192	$10	$212
cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE	Alternative Renewable Fuels	$3	–	$3
	State Water Efficiency and Enhancement	$65	–	$65
	State Water Project Turbines	$20	–	$20
	Water-Energy Grant	$50	–	$50
STATE OF CALIFORNIA ENERGY COMMISSION	Food Production Investment	$124	–	$124
	Low-Carbon Fuel Production	$13	–	$13
	Renewable Energy for Agriculture	$10	–	$10
CALIFORNIA AIR RESOURCES BOARD	Prescribed Fire Smoke Monitoring	$6	$2	$8
CALIFORNIA COASTAL COMMISSION	Coastal Resilience Planning	$3	$2	$5
CCC	Training and Workforce Development	$24	$14	$38
CALIFORNIA	Wetlands and Watershed Restoration	$46	$0	$47
CAL FIRE	Healthy Soils	$13	$28	$41
	Fire Prevention	$107	$84	$191
	Prescribed Fire	$25	$35	$60
	Sustainable Forests	$457	$170	$627
	Wildland Urban Interface	–	$10	$10
CalRecycle	Waste Diversion	$136	$25	$161
Cal OES GOVERNOR'S OFFICE OF EMERGENCY SERVICES	Wildfire Response and Readiness	$50	$1	$51
CALIFORNIA natural resources AGENCY	Regional Forest and Fire Capacity	$20	–	$20
	Urban Greening	$126	$30	$156
Coastal Conservancy	Climate Ready	$7	–	$7
WCB Wildlife Conservation Board	Climate Adaptation and Conservation Easements	$20	–	$20
bcdc	Coastal Resilience Planning	$1	$2	$3
CalEPA California Environmental Protection Agency	Transition to a Carbon-Neutral Economy	–	$3	$3
Water Boards	Safe Drinking Water	–	$100	$100
CALIFORNIA Workforce Development Board	Low Carbon Economy Workforce	–	$35	$35
	Total	**$10,337**	**$1,500**	**$11,894**

1 Appropriations listed are estimates based on published budgets, legislation, quarterly Cap-and-Trade auction results, and reversions to available funds. Administering agencies may transfer appropriations to other State agencies for implementing programs.

2 FY 2018-19 auctions have not yet occurred. Each quarterly auctions will increase Fiscal Year 2019-20 appropriations for programs with continuous appropriations.

3 SB 862 states that $400 million shall be available to the California High-Speed Rail Authority beginning in FY 2015-16 as repayment of a loan from the GGRF to the General Fund. This money shall be repaid as necessary, based on the financial needs of the High-Speed Rail Project. $100 million of loan amount is included in the reported $2.5 billion cumulative appropriations.

78 | California Climate Investments, Aug. 2019. "2019 Semi-Annual Data Update."

Summary of California Climate Investments and Outcomes through May 2019

Administering Agency	Subprogram	Implemented	Implemented Projects				
			GHG Reduction (1,000 $MTCO_2e$)	Cost per GHG ($/$MTCO_2e$)	Number of Projects	Funds Benefiting Priority Populations	
						($M)	%
California Air Resources Board	Community Air Grants	$9.2	[2]	N/A	26	$8.9	97%
	Community Air Protection Funds	$156.1	70	$2,215	1,173	$136.8	88%
	Funding Agricultural Replacement Measures for Emission Reductions	$41.4	31	$1,354	1,176	$26.5	64%
	Advanced Technology Freight Demonstration Projects	$79.2	16	$4,939	11	$79.2	100%
	Agricultural Worker Vanpools	$6.0	5	$1,307	1	$6.0	100%
	Clean Mobility Options for Disadvantaged Communities	$9.6	3	$2,952	7	$9.6	100%
	Clean Mobility in Schools Project	TBD					
	Clean Off-Road Equipment	TBD					
	Clean Truck & Bus Voucher Program	$276.9	1,063	$260	4,305	$193.3	70%
	Clean Vehicle Rebate Project	$578.5	5,721	$101	247,317	$178.2	31%
	Clean Cars For All (Enhanced Fleet Modernization Program/Plus-Up)	$29.5	24	$1,214	4,634	$23.3	79%
	Financing Assistance for Lower-Income Consumers	$3.3	4	$875	619	$2.9	90%
	Rural School Bus Pilot Projects	$15.2	13	$1,198	46	$8.9	59%
	Zero- and Near Zero-Emission Freight Facilities	$148.7	50	$2,997	10	$148.7	100%
	Zero-Emission Truck and Bus Pilot Projects	$82.8	107	$778	9	$64.5	78%
California Department of Transportation	Active Transportation	$10.0	<1	$163,934	3	$10.0	100%
	Low Carbon Transit Operations	$248.3	3,198	$78	433	$237.0	95%
California High-Speed Rail Authority	High-Speed Rail	$624.7	[3]	–[4]	1	$0.0	0%
California State Transportation Agency	Transit and Intercity Rail Capital	$338.9	2,340	$145	21	$327.9	97%
Strategic Growth Council	Affordable Housing and Sustainable Communities	$433.8	1,173	$370	52	$353.6	82%
	Sustainable Agricultural Lands Conservation	$22.4	TBD		25	$4.3	19%
	Climate Research	$18.1	[2]	N/A	12	$0.0	0%
	Technical Assistance	$4.3	[2]	N/A	19	$3.0	69%
	Transformative Climate Communities	$111.7	80	$1,401	3	$111.7	100%
California Air Resources Board	Fluorinated Gases Emission Reduction Incentives	NEW PROGRAM FOR FY 2019-20					
	Woodsmoke Reduction	$3.3	60	$56	1,124	$2.8	83%
California Energy Commission	Food Production Investment	$21.2	533	$40	10	$21.2	100%
	Low-Carbon Fuel Production	TBD					
	Renewable Energy for Agriculture	TBD					
California Department of Community Services and Development	Community Solar	$4.4	18	$242	2	$4.4	100%
	Farmworker Housing Single-Family Energy Efficiency and Solar PV	$0.2	TBD	TBD	1	$0.2	100%
	Multi-Family Energy Efficiency and Renewables	$23.5	111	$212	5,918	$23.5	100%
	Single-Family Energy Efficiency and Solar Photovoltaics	$57.1	204	$280	15,958	$57.0	100%
	Single-Family Solar Photovoltaics	$47.6	[137]	$348	1,800	$47.6	100%

79 | California Climate Investments, Aug. 2019. "2019 Semi-Annual Data Update."

Administering Agency	Subprogram	Implemented	Implemented Projects				
			GHG Reduction (1,000 $MTCO_2e$)	Cost per GHG ($/$MTCO_2e$)	Number of Projects	Funds Benefiting Priority Populations	
						($M)	%
California Department of Food and Agriculture	Alternative Renewable Fuels	$3.0	–[2]	N/A	1	$0.0	0%
	State Water Efficiency and Enhancement	$61.3	744	$82	599	$22.7	37%
California Department of Water Resources	State Water Project Turbines	$20.0	37	$542	2	$0.0	0%
	Water-Energy Grant	$33.0	347	$95	89,697	$21.6	65%
California Air Resources Board	Prescribed Fire Smoke Monitoring	$2.3	[2]	N/A	31	$0.0	0%
California Coastal Commission	Coastal Resilience Planning	$0.8	[2]	N/A	5	$0.3	37%
California Conservation Corps	Training and Workforce Development	$10.7	9	$1,259	133	$7.1	66%
California Department of Fish and Wildlife	Wetlands & Watershed Restoration	$25.5	796	$32	15	$16.0	63%
California Department of Food and Agriculture	Alternative Manure Management	$30.5	641	$48	56	$0.0	0%
	Dairy Digester Research and Development	$114.5	12,808	$9	65	$73.1	64%
	Healthy Soils	$5.6	46	$121	103	$0.0	0%
California Department of Forestry and Fire Protection	Fire Prevention	$75.5	–[2]	N/A	39	$52.4	69%
	Prescribed Fire	TBD	TBD	TBD	TBD	TBD	TBD
	Fire Prevention Grants	$79.4	–[2]	N/A	142	$28.0	35%
	Forest Health	$136.2	5,200	$26	66	$52.2	38%
	Urban and Community Forestry	$52.8	373	$142	89	$51.8	98%
	Wildland Urban Interface	NEW PROGRAM FOR FY 2019-20					
California Department of Resources Recycling and Recovery	Food Waste Prevention and Rescue Grants	$20.7	436	$47	67	$19.9	96%
	Organics and Recycling Manufacturing Loans	$5.7	685	$8	4	$0.8	15%
	Organics Grants	$56.7	1,285	$44	23	$47.2	83%
	Recycled Fiber, Plastic, and Glass Grants	$25.7	671	$38	11	$14.7	57%
California Governor's Office of Emergency Services	Fire Engines and Equipment	TBD					
	Wildfire Response and Readiness	$3.4	–[2]	N/A	60	$0.0	0%
California Natural Resources Agency	Regional Forest and Fire Capacity	TBD					
	Urban Greening	$98.0	36	$2,737	62	$91.5	93%
California State Coastal Conservancy	Climate Ready	$3.8	1	$3,287	12	$3.1	81%
California Wildlife Conservation Board	Climate Adaptation and Conservation Easements	$0.1	–[2]	N/A	1	$0.0	0%
San Francisco Bay Conservation and Development Commission	Climate Resilience Planning	TBD	–[2]	N/A	TBD	TBD	TBD
California Environmental Protection Agency	Transition to a Carbon-Neutral Economy	NEW PROGRAM FOR FY 2019-20					
California State Water Resources Control Board	Safe Drinking Water	NEW PROGRAM FOR FY 2019-20					
California Workforce Development Board	Low Carbon Economy Workforce	NEW PROGRAM FOR FY 2019-20					
	Total	**$4,271.1**	**39,075**	**–**	**375,999**	**$2,593.4**	**61%**

80 | California Climate Investments, Aug. 2019. "2019 Semi-Annual Data Update."

APPENDIX B: METHODOLOGIES

1| ALLOWANCE OVERSUPPLY AND OFFSETS IN CALIFORNIA

This calculation actually entails privately held allowances in both California and Quebec, as part of the linked Western Climate Initiative's carbon market. We derived the total excess allowances in this system in the following steps:

1| Summed up the total allowances currently held in private accounts, according to the latest CITSS report. To avoid complications, we only consider allowances of vintage 2013-2018. This total comes to 582,486,966 allowances.

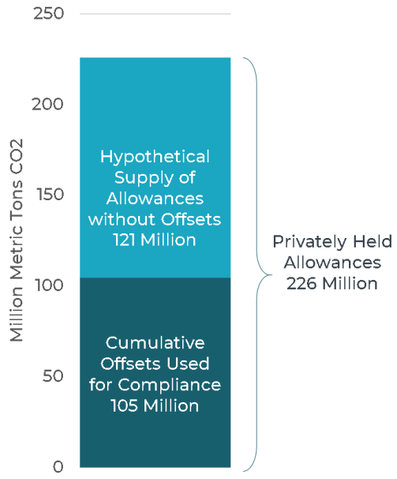
2| Calculated a simplified prediction of what the total compliance obligation will be in 2018. This is treating the WCI system as if 2018 obligations are due immediately, in order to simplify what excess allowances currently look like. Using historical emissions data, we project a compliance obligation for 2018 of 379,225,507 tCO_2e.

3| Using historical compliance data, we find that approximately 6% of compliance obligation is met with offsets. We apply that %age to our projected compliance obligation for 2018 to find that 22,753,530 offsets will be retired to fulfill 2018 obligations.

4| Assuming those offsets will replace allowances retired for 2018, we subtract it from our total compliance obligation from step 2 to calculate the number of allowances required to fulfill 2018 compliance. We then subtract that number from the total 2013-2018 privately held allowances to calculate our private bank through 2018, which comes out to 226,014,989 allowances.

With the private bank through 2018 calculated, we can go through previous compliance data to calculate the cumulative use of offsets. 81,877,932 offsets were retired between 2013 and 2017. Adding our projected offset retirements for 2018 brings us to a total of 104,631,462 offsets retired 2013-2018. As a thought exercise, if an allowance was removed from auction for every offset retired, then the current oversupply would be nearly cut in half:

226 million excess allowances – 105 million offsets = 121 million theoretical excess allowances



2| COMPARISON OF RGGI AND CALIFORNIA CARBON PRICE REVENUE

This calculation uses historical price averages and uses of revenue to compare what level of investment revenue is raised for every tCO_2e that is covered in the program.

First, the last three years of auction data (12 quarterly auctions each) were pulled from both California and RGGI's public records in order to calculate the average price per allowance sold at auction. RGGI's allowances had to be converted from short tons to metric tons in order to make both systems directly comparable. This resulted in a $14.62/$tCO_2e$ price in California and $4.62/$tCO_2e$ in RGGI.

Next, the distribution of allowances was used to infer what share of the total allowance budget is directed to what purpose. Not all of California's allowances are auctioned – however, we factor free allowances into our ultimate calculation in order to represent the average use of revenue across all covered GHGs.

According to California's public reports, we find that 45% of the allowance budget between 2015 and 2018 has been auctioned with proceeds directed to the Greenhouse Gas Reduction Fund (GGRF). The other 55% is consigned to utilities, freely allocated to industries, or put in a reserve for future use. In RGGI, 100% of the allowance budget is auctioned, but 86% of this revenue is invested, with 14% dedicated to direct bill assistance and program administration.

Combining this percentages with our average carbon prices, we find that California is raising $6.58 for climate investments, and $8.04 for other purposes, from each covered tCO2e. Meanwhile, RGGI is raising $3.98 for climate investments, and $0.65 for other purposes, from each covered tCO2e.

Of note, these numbers may look different for 2019, as the distribution of allowances and prices change annually. However, this is represents a 3-year average on how allowance value has historically been used.