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Introduction

Dallas Burtraw and Ann Carlson

The close of the decade provides an important milestone for California's climate policy. Emissions reduction goals for 2020 set out initially in AB 32 in 2006 required the state's Air Resources Board (ARB or CARB) to reduce statewide greenhouse gas emissions to 1990 levels or below by 2020. The state achieved that emissions target four years ahead of schedule. Sources covered by the cap-and-trade program contributed to that outcome, improving the cost effectiveness of the overall policy. Until the fallout from the pandemic, the state's economy has thrived at the same time emissions cuts have occurred. From 2010 to 2018, the California economy grew by 33 percent, outpacing most other states in the nation.

In 2016 the California Legislature and Governor Edmund G. Brown, Jr. passed and signed into law SB 32, which extended the state's climate policy goals through 2030. SB 32 increases the stringency of state programs and directs CARB to ensure that the state reduce its greenhouse gas emissions to at least 40 percent below the 2020 statutory limit by the end of the decade.

One substantial challenge to achieving this goal is that the portion of statewide emissions outside the cap-and-trade program, such as emissions from dairies, landfills, refrigerants, and process emissions from industry, has gained importance relative to sources covered by cap and trade, which generally include the emissions associated with combustion of fossil fuels. The state's first Scoping Plan in 2008 identified about 86 percent of the state's greenhouse gas emissions that would be covered by cap and trade. In 2015 when the cap-and-trade program expanded to include liquid fuels, according to information in the Mandatory Reporting of Greenhouse Gas Emissions, the cap-and-trade program covered only 77 percent of statewide greenhouse gas emissions. By 2018 the share had fallen to 75 percent. Most emissions reductions from sectors covered by the cap-and-trade program are attributable to regulations, but the contribution from cap and trade is expected to increase over time. The anticipated emissions reductions attributable to the cap-and-trade program has risen from 20 percent in the 2008 Scoping Plan in 2020, to 38 percent cumulatively over the next decade through 2030 in the (third) Scoping Plan in 2017. The growing role of cap and trade in achieving emissions reductions is expected to further improve cost effectiveness, and it also elevates the importance of the program design.

In this report, we address challenges and opportunities facing the state as it now implements programs to meet the 2030 goal. We identify changes the state might make to the operation of the cap-and-trade program as well as considerations the state should take into account to reduce transportation emissions in light of effects on driving and vehicle purchases from the pandemic.

First, the number of new emissions allowances that are issued every year under the cap-and-trade program is often described as the "cap" and this number declines every year. However, the potential reintroduction of a large surplus of unused ("banked")

allowances currently held in private and public accounts would enable emissions in future years to exceed the annual cap. These banked allowances are likely to lessen the contribution of sources covered by cap and trade to the state's overall emissions target and place even greater requirements on uncapped sources and sectors, where emissions reductions have already been hard to attain. In the chapter on Allowance Supply, we discuss a potential remedy to this problem through an adjustment to the annual cap, an approach that has been implemented in other programs.

Second, the design of the cap-and-trade program provides additional ways to help address the challenge of achieving increasingly stringent emission goals. At current anticipated allowance prices, the annual asset value of emissions allowances created under the program exceeds five billion dollars. The distribution of this value into the economy provides a mechanism to protect jobs in California industry, help ratepayers, and make contributions to the Greenhouse Gas Reduction Fund (GGRF). The GGRF provides significant revenue to projects that accelerate emissions reductions investments to protect overburdened communities from the costs of reducing emissions and from the impacts of a changing climate. As the chapter on Free Allocation highlights, however, a decision to fund any one of these priorities necessarily means less funding for another one. We describe additional criteria the state could utilize to decide free allocation as well as to prioritize investments from the GGRF, including the preservation and creation of good careers in the emerging green economy.

In the third chapter, on Auctions Allocation, we describe the priority given to ratepayer protection over contributions to the Greenhouse Gas Reduction Fund in the design of the auction. We then address two issues with (free) allowance allocation: how and whether the state should respond to volatility in state revenues, both in the overall budget and in the Greenhouse Gas Reduction Fund, by reprioritizing certain funding; and how allowance allocations might be affected by any changes in allowance supply.

An important component of the state's climate policy portfolio involves many policies that directly regulate sectors of the economy. Emissions reductions from these policies reduce the demand for allowances and are influential in keeping prices in the allowance market relatively modest, but the effect of some of these policies is to achieve emissions reductions at relatively high costs. In the fourth chapter, on Cost Containment, we encourage the Air Resources Board to evaluate the portfolio to improve its cost effectiveness and the overall affordability of the state's climate policy portfolio. And in the fifth chapter, Scoping Plan, we call for a more explicit conceptual and practical balance between the emissions cap and other policies. In the Plan and in the design of the state's climate programs, the Board is required to balance several criteria including cost effectiveness, technological feasibility, and minimizing leakage in the service of achieving the state's emissions target. Evaluating the impacts of any one program and how multiple programs interact within the policy portfolio has proven difficult, even for the Legislative Analyst's Office. Nonetheless, the Scoping Plan provides an opportunity to construct and articulate a more transparent understanding of the role that the cap-and-trade program provides in ensuring the overall emissions outcome.

Among sources covered by cap and trade, electricity sector emissions have fallen substantially and are expected to continue do so in compliance with SB100, which establishes a pathway for decarbonizing the sector. In the final chapter, we discuss the fact that emissions reductions from the transportation sector have not kept pace. While the COVID-19 pandemic has shaken up the transportation sector in important ways, leading for the first time in years to declines in vehicle miles traveled, it has also decimated the public transportation sector and led to huge declines in vehicle purchases. The Transportation chapter addresses the challenges and opportunities the pandemic has created and makes suggestions for responding to them.

The end of 2020 marks not only the attainment of the original goals of AB32 and the end of a compliance period for the cap-and-trade program, but also the beginning of a process to develop a new five-year Scoping Plan to meet increasingly stringent goals. Since the last Scoping Plan, the science of climate change has become increasingly clear and widely understood, as made evident for example by the 2018 report of the Intergovernmental Panel on Climate Change. The EU has recently increased the stringency of its targets for 2030, Canada has proposed a federal carbon price backstop of $170 (Canadian) per ton by 2030 and a Clean Energy Standard that aligns with California's Low Carbon Fuel Standard, and other jurisdictions have importantly strengthened the stringency and breadth of their climate policies. Further, changes in the economy, including the impact of the pandemic on energy demand and lifestyle patterns, have changed the pattern of emissions. Finally, the state has a number of years of experience with its climate policies under its belt. This experience, and changes in science, technology, the policies in other jurisdictions, and in the economy invite a fresh examination of state climate policy.

We are now embarking on a new decade. Cap and trade has functioned to help achieve emissions targets, and now important challenges and opportunities will shape its role in the future. This report begins to address the program going forward. The 2020 milestone and the Scoping Plan process provide an opportunity to strengthen an already successful program to enable it to meet the challenges of the next decade. We believe that to do so will require reforms that will strengthen the cap-and-trade program. In this report we identify several places for the Air Resources Board to look as it begins that process.

Allowance Supply

Dallas Burtraw and Danny Cullenward

Outcomes in the allowance market are one reflection of California's multifaceted efforts to address climate change. The cap-and-trade program covers about 75 percent (320 million metric tons CO_2e, or $MMtCO_2e$) of total greenhouse gas emissions in the state (425 $MMtCO_2e$). Generally, covered emissions are associated with combustion of fossil fuels. The balance between the supply of emissions allowances (and other compliance instruments, including offsets) and demand for allowances from sources covered by the program drives allowance market prices.

The demand for allowances has been and remains challenging to predict. Several uncertain factors affect allowance demand including overall economic activity, investments in energy efficiency, companion regulatory programs that reduce emissions (such as SB 100 and vehicle emissions standards), the opportunity to bank allowances for future use, and uncertainty about future regulations (including the possibility of linking the program with carbon markets in other jurisdictions). Importantly, in 2020 the global pandemic has affected energy use and emissions. The long-term implications are not yet clear. Some of these new patterns might be transient, while others could prove persistent.

The cap-and-trade program already includes design features that anticipate some of this uncertainty. For example, the program reduces allowance supply if the market price falls to the price floor and increases supply if the price rises to levels that trigger the availability of various allowance reserves. In between the price floor and price containment points, however, the allowance supply does not adjust to changes in demand. Over this range of prices, emissions reductions stimulated by local jurisdictions and businesses and companion regulatory programs do not lead to a reduction in allowance supply. Prices have been at the low end of this range, in part due to the state achieving its 2020 emissions goals several years early as well as the influence of the pandemic. Low emissions have enabled the accumulation of a large bank of emissions allowances that has kept market prices at or near the price floor. Some of this bank is already held in private accounts; other supplies are held in public accounts that could re-enter the market if prices rise. Both types of banked allowances add to the issuance and auction of new allowances from each annual program "cap," making greater emissions possible in the future despite declining program caps.

In its 2018 and 2019 reports, this Committee discussed methods to assess the supply of allowances in circulation (including banked allowances) and framed questions about how the program's cumulative emissions cap could contribute to California's long-run emissions reduction goals. In the near future the Board will have significant new information that will help address some of these questions. Notably, the cap-and-trade program's third compliance period ends in December 2020 and will lead to a compliance event in November 2021, at which point the Air Resources Board will be able to comprehensively account for market-wide allowance holdings on an empirical basis.

As part of the Scoping Plan process that will begin in early 2021, the Air Resources Board also has an opportunity to align the future issuance of new allowances with the allowance supplies already available in private and public banks. Alignment matters because allowances currently in private and public accounts enable emissions in excess of the annual issuance of new allowances. The Board should consider future allowance supplies with the expectation that privately held allowances will re-enter the market and publicly held allowances will do so if prices reach levels that access the allowance reserves. To achieve ambitious emissions reduction goals, the annual issuance of new allowances could be adjusted to better align the total supply of emissions allowances in circulation (including banked allowances) with the state's goals.

In its 2019 report, this Committee described approaches to potential changes in allowance supply that might be used to strengthen the emissions market, which would improve the cost effectiveness of overall climate policy. One approach to strengthening the market, for example, would be to reduce the cumulative emissions cap by reducing the issuance of new allowances. Another approach would be to raise the price floor to a level that might reduce the sale of new allowances. The Board could also increase the price-responsiveness of allowance supply by adding one or more price steps above the price floor: this would create a price staircase, with varying quantities of allowances sold at different prices in the auction.

Recommendations:

The Scoping Plan process offers an opportunity to position the cap-and-trade program to make an increasing contribution to achieving the state's emissions reduction goals. An adjustment to allowance supply is likely to be necessary for the cap-and-trade program to play that role. If the Board chooses to make a change to allowance supplies, several issues should be considered explicitly:

- Reductions in allowance supplies would be expected to increase the market price, which would also be expected to increase, on average, the auction revenues available to the Greenhouse Gas Reduction Fund. The increased availability and stability of GGRF revenues would contribute to achieving program goals.

- An increase in the allowance price would create one-time benefits for parties that currently hold and bank emissions allowances. Many of these allowances were initially distributed for free. The distributional effects of these profits can and should be anticipated.

- Any decision to reduce allowance supplies or increase market prices would invite further consideration of how free allocation is implemented (see chapter on Free Allocation). If the Board decides to reduce allowance supply, should free

allocation be affected similarly? If so, should all types of free allocation be affected proportionally, or should reductions be based on another principle?

- The carbon market interacts with many companion policies (see chapter on the Scoping Plan). The upcoming Scoping Plan process provides an opportunity to examine the role of companion policies and how they interact with cap and trade, and to signal more clearly the Board's expectations about emissions reductions achieved by the cap-and-trade program.

Free Allocation

Jennifer Kropke and Dallas Burtraw

1. Explanation of Allowance Distribution

Emissions allowances enter the cap-and-trade market through two general mechanisms. About half are sold at auction with proceeds deposited in the Greenhouse Gas Reduction Fund (GGRF) and used for investments and program expenditures to address various legislative priorities, and about half are allocated for free to utilities and industry to address the effects on ratepayers, workers, and firms in those sectors.

This chapter addresses the objectives of free allocation, the possibility for reforms that might better address those objectives, and the opportunity cost of free allocation in view of legislative priorities given to the GGRF. First, we summarize the objectives of the different approaches to distributing allowances. Second, we address free allocation to utilities. Third, we address free allocation to industry.

2. Objectives for the Initial Distribution of Emissions Allowances

Auction proceeds deposited to the GGRF are the source of funding for programs addressing legislative priorities including emissions reductions, research, mitigation of impacts on underserved and overburdened communities, adaptation, and other purposes. Funding for these legislative priorities is affected by the dedication of allowance value to free allocation to utilities and industry.[1]

At the outset of the cap-and-trade program, an objective of free allocation to electricity and natural gas utilities has been to rebalance the cost of greenhouse gas emission mitigation across sectors. Utilities had already implemented energy efficiency and renewable energy programs for decades. These programs tended to increase the price of utility service even if, by reducing consumption, they reduced costs. Free allocation to utilities helps mitigate further price increases that might occur from cap and trade.

Free allocation to industry is intended to protect workers and firms in sectors that might be subject to unfair competition from unregulated entities outside the state. There would be no virtue in the state imposing requirements on compliance entities in the state if it resulted in the movement of economic activity with associated emissions to other jurisdictions. In many cases, California industry is relatively efficient, and leakage of economic activity to jurisdictions with relatively lax environmental standards could lead to an increase in emissions overall.

These motivations for different ways to initially distribute allowances come into conflict because they compete for the allocation of scarce allowance value. Free allocation to utilities or industry represents a decline in revenue to the GGRF, and vice versa.

[1] Funding for these programs also has been affected by the variability of proceeds from the allowance auction. Another chapter of this report examines the auction design and how it might be modified to provide greater stability in auction proceeds coming to the GGRF.

However, we note that these alternatives for the initial distribution of allowances also share some common objectives.

3. Allocation of Free Allowances to Utilities

Electric and natural gas utilities receive a significant number of allowances (as well as the monetary value attached therein), and face similar requirements, so they will be collectively analyzed here. Investor-Owned Utilities ("IOUs") for electrical distribution receive a conditional allocation of allowances that cannot be used for compliance until they have been consigned to the allowance auction, with revenues from the auction returned to the IOUs (see Chapter on Auction Allocation). The Air Resources Board requires the auction proceeds from the consigned allowances to be used for the benefit of IOU rate payers, consistent with AB 32. Publicly Owned Utilities ("POUs") also receive free allocation and they are not required to consign their allowances to the auction before they can be used for compliance, although a portion of the allowances allocated to these utilities also are sold through consignment. POUs are not regulated directly by the Public Utility Commission and are assumed to direct the allowance value they receive to the benefit of their customers. IOUs for natural gas distribution have historically used about two-thirds of their allocation to reduce their compliance costs and directed about one-third to ratepayers. POUs for natural gas distribution use their allowance value primarily for compliance.

Aside from the allowances used directly for compliance by natural gas utilities, the IOUs have used allowance value to support various programs with the most important share directed to the Climate Credit, which is given to residential customers on an equal per customer account basis within various climate zones in the state. Twice every year, electricity and natural gas IOU customers, whether a customer of the IOU or a customer of a community choice aggregator, receive an on-bill credit known as the "California Climate Credit."

<u>Ratepayer Monetary Benefit:</u>

The focus of this discussion is whether the on-bill credit is the best way to benefit ratepayers in light of the economic changes associated with climate. The economic impact that a credit on a residential ratepayer's bill will have on one's household finances will vary greatly depending on the socio-economic status of the household. For Disadvantaged Community (DAC) members, utility bills (electric and gas) can represent a large portion of one's monthly expenses. In these communities, the California Climate Credit can represent a relatively large contribution to balancing the household's financial resources. In contrast, the utility bills and Credit are likely to represent a smaller portion of the monthly expenses of higher-income earners.

This difference between impacts across households highlights considerations that should be addressed as part of the Scoping Plan process in 2021. Giving the Credit to high-earning Californians does not address affordability concerns that most heavily impact lower income households. In view of objectives to address affordability and to mitigate financial impacts on overburdened communities (IEMAC 2019), the assignment

of the Credit to households implies diverts that same allowance value away from targeted efforts.

In contrast, a justification for equal per-household Credits stems from viewing the Credit value as compensation (Burtraw and Sekar 2014). A uniform Credit signals that all households are treated equally, which could help build support for climate action generally (Barnes 2014). However, as the Credit has been implemented, most ratepayers do not receive clear communication that the Credit is to provide compensation for their efforts to help the state achieve its climate and energy goals.

It would be disadvantageous to the state's climate policy goals to differentiate Credit payments based on an individual household's energy consumption or utility bill because this would effectively undermine the economic incentive of the carbon price to promote energy savings. Further, utilities do not have financial information about households that would enable differential Credit payments based on income. In other programs, utility customers have been able to self-declare their income levels to qualify for bill relief. Alternatively, the utilities could refine the differentiation of payments based on a customer's community of residence to anticipate impacts on households in overburdened (DAC) communities.

The Climate Credit is just one option for how allowance value could be used to benefit ratepayers. There may be other opportunities for how to benefit ratepayers by looking to the opportunity to benefit communities generally.

Climate Benefit:
The modest on-bill Credit of for example, $35-$85 twice per year, benefits households directly and tangibly. However, aggregating the value of the Credits to collectively advance the climate and air quality interests of the state also may deliver substantial benefits. In aggregate, the Credit payments represent nearly a billion dollars of value. Starting in 2020 the natural gas Credit rebates will be reduced so that a portion of proceeds can be used for decarbonizing buildings. Even greater value rests with electric utility Credit rebates. Many individuals, businesses (large and small), municipalities and ports are interested in advancing California Climate goals but lack the financial resources to do so. Investments in projects to reduce emissions and enhance efficiency and operation of these facilities would help achieve the states climate goals and may invoke further interest of labor and business in supporting California Climate goals.

Workforce Development Benefit:
As part of helping households and communities adapt to and engage in the ongoing energy transformation, there is an urgent need to reconsider how we think about our workforce in the coming years (Zabin et al. 2020) Transitioning our energy sources and methods of transportation could have the unintended effect of displacing good, high-paying jobs that provide family-sustaining wages, health care and retirement benefits. However, those same transitions could provide opportunities to create good high-earning careers that pay similar wages and have comparable benefits and offer greater job security for the future.

Several climate-related objectives could be served by directing more cap-and-trade allowance-to funding projects including promotion of responsible contractor policies, Project Labor Agreements, joint labor-management apprentices, as well as targeted hiring practices to involve previously incarcerated hires, veteran hires, and DAC hires, to name a few. Including skilled and trained workforce development language to provide the good, apprenticeship-based career pathways that prior fossil fuel-related jobs have provided to Californians is imperative. The foregoing applies to workforce development in the skilled construction trades; however, responsible contractor policy should apply to all employers working on projects that might be funded with California Climate Credit allowance value or funded through the GGRF. Only projects with good labor practices should be permitted to receive allowance value to ensure we are working on creating good careers for all Californians.

For example, both The Port of Long Beach and the Interstate 710 Freeway are in Southern California Edison territory. Collectively the Port, Los Angeles Metropolitan Transit Agency, Cal-Transportation Agency and leadership in the Gateway Cities Council of Governments, as well as residents have come to an uncomfortable conclusion- many of the electrification goals, while important, lack the requisite funding. Converting the medium and heavy-duty trucking fleets to zero-emission models, including installation of the charging infrastructure and potential upgrades necessary also requires additional funding. These projects, with clear workforce development language as discussed above, may be possible through collective utilization of the California Climate Credit.

These considerations point to the potential reconsideration of the California Climate Credit that is provided to individual ratepayers. There may be advantages to collectively use the Credit value, or a portion of the Credit value that currently accrues to high income households, for grants to fund more clean energy, clean transportation, and other, pre-defined air quality improvement projects. All such projects should create opportunities for apprenticeship-based career pathways for highly skilled workers via the strategies discussed above. This approach might be blended with the continued provision of California Climate Credits for DAC residents and ratepayers enrolled in the California Alternative Rates for Energy program.

4. Free Allocation to Industry

Free allocation to industry is intended to prevent the leakage of economic activity and emissions to other jurisdictions. To provide an incentive to maintain economic activity in the state, allowances are awarded for free to specific industries in proportion to their recent level of economic activity in the state, with this formula updated and allocation adjusted regularly. This output-adjusted allocation provides a production incentive because allowances are earned with every unit of product. The free allowances reduce the variable cost of operations to keep California industry competitive with industry in other jurisdictions, while also providing an incentive to reduce the emissions intensity of activity because the award of allowances is not tied to facility-specific emissions.

As part of the Scoping Plan process that will initiate in 2021, the Board can examine how these industries have been affected by the program or if they have grown or shrunk over the last decade. This would be a good time for an empirical assessment of the need for free allocation. Is this allocation of allowance value helping to enable innovation? Does it protect jobs and communities?

The industry group that receives the greatest allocation of allowances are refineries. This allocation is intended to keep refinement of product in the state, which incidentally has relatively efficient facilities compared to out-of-state facilities. Employment at and around the refineries offers relatively high-paying jobs. Unionized jobs pay family-sustaining wages and provide a middle-class career pathway for important societal segments: those that lack the financial resources to pay college tuition, those individuals who are mechanically inclined and prefer to not work at the traditional "office and desk setting", and/or those choosing a career path that begins other than attending a traditional college. Working opportunities at many refineries provides careers that include health care and retirement benefits, the loss of which could be catastrophic to those workers, as well as the local communities in which they live and reside, where they patronize businesses, day care facilities and otherwise locally reinvest their incomes.

The 2010 report of the Economic and Allowance Allocation Committee (EEAC 2010) provided a justification for free allocation to refineries based on the threat to in-state activity resulting from the cost differential between imports and fuels produced in California. The report argued that the regulatory cost associated with the trading program that would be sufficient to overcome the increased cost of transportation and blending to meet California specifications would begin when allowance prices reached around $50 per ton ($60 in 2020 dollars). With allowance prices around $17 currently, the threat of leakage of refining activity may not be present. In view of many competing justifications for the distribution and use of allowance value, the Scoping Plan process provides an opportunity to reexamine tradeoffs and priorities for the free allocation of allowances especially in light of expected future allowance prices.

Recommendations:

The Air Resources Board should take advantage of the Scoping Plan process to evaluate the outcome from free allocation in consideration of broad program goals and alternative assignment of allowance value. Among these goals it would be important for the Board to highlight the following:

- Universal eligibility across customer accounts may build support for the program among ratepayers, but delivery of the Climate Credit should be accompanied by stronger communication about its origin and the purpose of climate programs.

- Universal eligibility should be evaluated in face of other opportunities. Allowance value that accrues to high income households might be directed to other households who face the greatest affordability challenges associated with the

costs of climate policy and the impacts of climate change. An alternative might be to aggregate allowance value and direct it toward investments to expand electrification of the economy and accelerate decarbonization of the electricity grid.

- Refineries receive the largest share of free allocation among industry. The rationale for this free allocation should be evaluated considering past and future expected trends in allowance prices.

- Workforce development including the preservation and/or creation of good-paying careers and utilization of the demand-side policy tools discussed previously should be a condition of free allocation to utilities and industry and as well as serve as an important criterion in choosing investments from the Greenhouse Gas Reduction Fund (Zabin, et al, 2020).

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Auction Allocation

Ann Carlson and Meredith Fowlie

As described in the chapter on Allowance Allocation, under California's cap and trade program, allowances are allocated to regulated entities in one of three ways:

1. Emissions intensive and trade exposed (EITE) entities are allocated permits for free on the basis of past output. This allocation, an implicit production subsidy, is designed to mitigate the risk of emissions 'leakage';

2. Investor-Owned Utilities (IOUs) also receive free allowances. Utilities are required to sell these allowances at auction and proceeds must be used to benefit ratepayers. Electricity Publicly Owned Utilities (POUs) also receive free allowances, but they are not required to consign allowances to the auction. Electricity distribution companies receive approximately 45% of the freely allocated allowances in total. Natural gas utilities receive another 20% of the freely allocated allowances and they are required to consign allowances to the auction by an increasing percentage each year, reaching 100 percent by 2030.

3. GHG permits that are not allocated to EITE entities or IOUs are sold at auction. Revenue from the sale of these permits is deposited in the Greenhouse Gas Reduction Fund (GGRF) and allocated to various state programs.

In the event that the supply of permits sold at auction exceeds demand, permits allocated to utilities are sold first. Any unsold utility allowances are automatically reoffered at the next quarterly auction. Unsold state allowances are put in a holding account and reoffered after two consecutive auctions clear the floor price. If permits are unsold after a period of 24 months, these allowances are transferred to the price containment reserve.

In 2016/2017, approximately 38 million allowances went unsold. Looking ahead, given the substantial bank of unused allowances, it seems possible that excess supply conditions could occur again in future auctions, particularly during periods of economic downturn. In an over-supply situation, the price stability afforded by a binding price floor comes at a cost of increased auction revenue volatility. This raises two related issues. The first concerns the choice of which programs to protect when revenues fall short. The second relates to the larger discussion of allowance supply adjustments.

Revenue Volatility

The global pandemic has produced significant turmoil in state budgets across the country, and California has not been spared (although state revenues have proven to be far more resilient to the stay-at-home orders than initially predicted). The economic downturn has significantly affected GHG auction revenues as the economic recession has led to reduced GHG emissions and therefore reduced demand for GHG permits.

The first auction during the pandemic in May of 2020, for example, failed to sell out, though the August and November auctions rebounded.

Because utility permits are auctioned first, those programs funded by their sale are relatively less exposed to auction revenue volatility compared with programs funded through GGRF revenue. The primary IOU-funded program is the California Climate Credit, which provides a rebate on utility bills to California electricity ratepayers. As the Allowance Allocation chapter discusses, the state may wish to reconsider whether all ratepayers should receive a rebate regardless of income. A related question pertains to whether ratepayer climate credits (and other programs supported by IOU revenues) should be prioritized over other programs funded under the GGRF when GGRF funds decline because allowance supply exceeds demand.

When auction revenues fall short of expectations, planned GGRF expenditures must be scaled back. As the Legislative Analyst has described, approximately 65 percent of GGRF auction revenues are used to fund continuous appropriations such as highspeed rail, affordable housing, and safe drinking water programs. The remaining revenue is allocated to discretionary programs. In the event of a revenue shortfall, the programs funded through continuous appropriations and discretionary funding will be cut; the continuous appropriations programs are cut automatically. Discretionary programs include AB 617, low carbon transportation funding, including for low-income communities, healthy forests, and others.[2]

It is unclear whether the Legislature would cut program funding in the way that it currently occurs. Given limited GGRF funds and prevailing uncertainty about future revenues, the Legislature should consider re-evaluating the current protocols for allocating scarce revenues and clarifying spending priorities.

Allowance Supply

In the event that the Air Resources Board adopts a mechanism to restrict allowance supply (see Allowance Supply Chapter for additional detail), ARB will need to consider how to implement the restriction across the three categories of allowance allocation (auctioned allowances, IOU and POU allowances, and output-based allocations to industry). One obvious approach would be to implement an across the board, proportionate reduction. But a proportionate reduction may not be the best method to achieve the state's objectives. If the state wants to maintain or increase support for GGRF-funded programs, for example, it may wish to reduce the quantity of permits allocated to EITE entities and IOUs by a greater amount than those sold at auction.

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[2] *See* Legislative Analyst's Office, Addressing Revenue Uncertainty in the 2020-21 Cap-and-Trade Expenditure Plan, (June 4, 2020), https://lao.ca.gov/Publications/Report/4250. We relied heavily on this publication in preparing our subcommittee report.

Conversely, if the state wants to protect residential ratepayers for GHG-related costs via the climate credit program, it may wish to impose disproportionately fewer restrictions on IOU allowance supply. Our point is not to make a substantive recommendation about how to distribute restrictions in allowance supply across the three categories but instead to recommend that CARB evaluate the efficiency and equity implications of alternative approaches to reducing permit supply.

Our three recommendations, in sum, are:

1) That CARB evaluate whether consigned allowances should continue to be prioritized at auction given the effects on programmatic funding in the event that there is low demand in the GHG allowance auction;

2) That the Legislature prioritize programs funded through GGRF revenue to ensure that, in the event of revenue shortfalls, the highest priority programs are affected the least; and

3) That CARB, if it adopts a mechanism to adjust allowance supply, consider how to implement reductions in allowances across the three categories of allowance supply to regulated entities in accordance with state priorities.

Cost Containment, Retrospective Analysis, and Policy Feedback Loops

Meredith Fowlie and Danny Cullenward

In the midst of a global pandemic and economic recession, cost containment and affordability concerns will loom large in any discussion of future climate policy. It will be important to design cost effective programs that can mitigate—rather than exacerbate—social, economic, and environmental inequality. To meet these objectives, policy makers will need to anticipate what programs will cost and who will end up paying.

Projecting how climate change programs and policies will impact households and firms can be challenging. But this exercise gets easier, in principle, as California accumulates policy implementation experience. In the interest of learning from this experience, there are already some requirements in place to formalize retrospective analysis of existing climate policies in California. One example is AB 398 which requires the Legislative Analyst's Office (LAO) to report annually on the economic impacts and benefits of California's greenhouse gas emissions targets.[3] Other mandates apply to specific programs, such as a requirement that utilities document the costs of complying with the Renewable Portfolio Standard.[4]

These reporting obligations and retrospective analyses can provide valuable insights. For example, the accumulating evidence on California's renewable energy policies underscores the importance of considering not only the costs of these programs, but also how these costs are distributed across households and firms. In this short chapter, we illustrate and compare the cost incidence of two programs that have accelerated investment in renewable electricity generation: the Renewable Portfolio Standard (RPS) and Net Energy Metering (NEM).[5]

These RPS and the NEM program have supported different kinds of investment in renewable energy technologies. Under the RPS, utility-scale solar and wind generation capacity had reached almost 12,000 MW and 6,000 MW, respectively, by 2018 (CEC, 2019). The NEM program supports investments in behind-the-meter distributed solar PV. By 2018, 6,854 MW of distributed solar had been installed under the NEM program, 4,356 MW of which is residential (California Distributed Energy Statistics, 2020).

These programs differ not only in terms of what technologies are supported, but also how costs are incurred and allocated across California households. Under the RPS, load serving entities in California must demonstrate that they are procuring the mandated share of electricity supply from qualifying renewable energy resources. To the extent that qualifying renewable resources are more expensive than the generation they would have otherwise procured, the RPS mandate increases supply costs. With falling renewable energy technology costs, this above-market premium has been

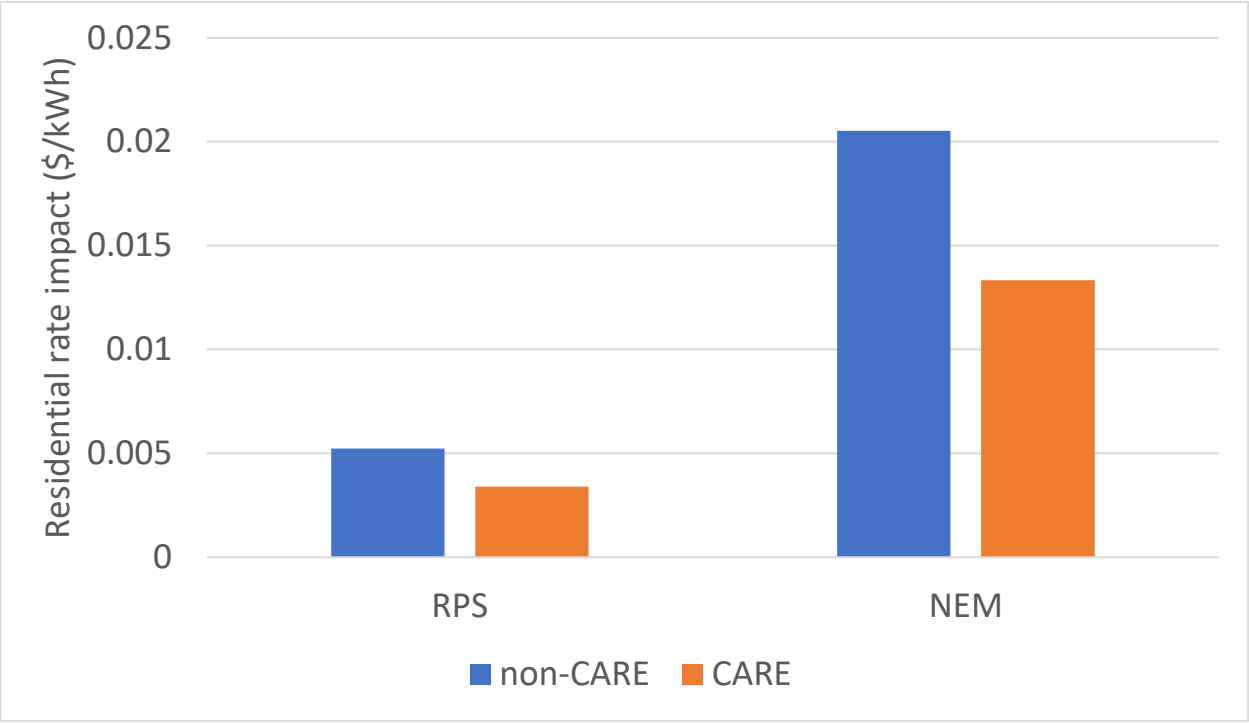
[3] Health & Safety Code § 38592.6.
[4] Public Utilities Code § 913.3.
[5] Numerical calculations in this chapter are based on ongoing research on California electricity rate design by Severin Borenstein, Meredith Fowlie, and Jim Sallee. Marshall Blundell provided excellent research assistance.

declining steadily over time. According to the 2020 Padilla Report, the difference in RPS versus non-RPS procurement costs reported by the large investor-owned utilities had dropped to 0.28 ¢/kWh. This compliance cost is passed through to utility customers in the form of higher electricity rates (CPUC, 2020).

Under net energy metering, customers with rooftop PV systems are credited at the retail electricity rate for every kWh of solar electricity they generate. However, a substantial share of the retail rates paid by California IOU customers support fixed costs such as transmission and distribution infrastructure costs, wildfire mitigation costs, energy efficiency program costs, and other public purpose initiatives. As a result, crediting NEM customers at the retail rate significantly exceeds the social value of each kWh of solar electricity generated, even after accounting for benefits from reduced local air pollution and greenhouse gas emissions. In other words, net metering confers a generous subsidy to PV adopters by shifting an increasing share of fixed costs onto the bills of non-adopters.

The figure below summarizes the approximate impacts of these two programs on the retail electricity prices paid by customers of California's largest utility, PG&E. More precisely, we estimate the impact of these two programs on the average residential electricity price (measured in $/kWh). We look at how cost impacts affect customers enrolled in the California Alternate Rates for Energy (CARE) program, which provides discounted retail rates to low-income customers, as well as non-CARE customers. Details are summarized in the appendix.

Figure 1: PG&E residential rate impacts ($/kWh) in 2019 for non-CARE and CARE customers



The figure shows how RPS and NEM policies, which are both designed to accelerate investments in renewable energy, have very different impacts in terms of cost incidence. Although renewable energy investments mandated under the RPS are much larger than those subsidized under the NEM program, NEM has had a much larger impact on residential retail rates.

To put these rate impacts in perspective, we can estimate the associated impacts on annual electricity expenditures among households that have not adopted solar PV. The PG&E CARE report estimates that average monthly electricity consumption among non-CARE and CARE households was 467 kWh and 495 kWh, respectively (PG&E, 2019: page 125). These consumption numbers suggest that, on average, non-CARE customers are paying about $115 per year to support the NEM program and low-income CARE customers are paying about $80 per year. Because NEM-induced cost shifting will increase as more customers invest in solar PV, the equity implications of shifting an increasing cost burden onto non-adopters are concerning.

These summary calculations are meant to be approximate and illustrative. They consider only monetized costs and benefits, leaving out other important issues such as land use requirements and learning-by-doing effects. We are also mindful that decisions about the design of NEM policies is chiefly the responsibility of the Public Utilities Commission, rather than the Air Resources Board. Nevertheless, these calculations underscore the importance of considering both costs *and cost incidence* in the design and implementation of climate change policies.

When ex post assessments reveal that a policy is not working as intended, it will be important to translate these insights into policy course corrections. There are some processes in place to facilitate this policy feedback loop. For example, the CPUC has recently initiated a proceeding to revisit rate design in the NEM program.[6] Going forward, it will be important to critically evaluate the impacts of all major climate change policies and programs, and to ensure that lessons learned directly inform the design and implementation of our future programs and policies.

Recommendations:

- We strongly endorse the LAO recommendation to direct agencies to conduct more rigorous retrospective evaluations of all major climate change programs and policies. Whenever possible, programs should be designed and implemented in ways that can support robust evaluation (LAO, 2020).

- We urge the Board to consider not only the costs and emissions implications of existing and proposed policies, but also who pays these costs. Equity and affordability concerns should guide policy instrument choice in future scoping plans.

[6] California Public Utilities Commission, Order Instituting Rulemaking to Revisit Net Energy Metering Tariffs Pursuant to Decision D.16-01-044, and to Address Other Issues Related to Net Energy Metering (August 27, 2020); see Rulemaking 20-08-020.

- We encourage the Board to formalize a process through which insights from retrospective analysis can more directly inform prospective policy design/scoping. Successes—and failures—hold lessons for not only California, but also other jurisdictions considering similar policy paths.

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Scoping Plan

Meredith Fowlie and Danny Cullenward

State law requires the Air Resources Board to update its official strategy for achieving California's climate targets at least once every five years.[7] California has considered the role of the cap-and-trade program in three such Scoping Plans to date (ARB, 2008; ARB, 2013; ARB, 2017; Mastrandrea et al., 2020) and is preparing to commence a regulatory process in early 2021 to develop a fourth effort. This chapter reviews important analytical issues the Board will need to address in its upcoming Scoping Plan process concerning the relationship between the greenhouse gas (GHG) cap-and-trade program and California's broader climate policy portfolio.

The Board has a statutory obligation to establish sufficiently stringent emissions regulations so as to provide confidence that the state will meet its annual GHG emissions targets in milestone years. In each of the three previous Scoping Plans, the Board has relied on the cap-and-trade program as a backstop guarantee that the state will meet these annual targets. However, to function in this role, the cap-and-trade program must be designed so that the limited supply of compliance instruments will deliver targeted GHG emissions outcomes, such as the statutory statewide limits on annual emissions in 2020 and 2030 — no matter the performance or stringency of other climate policy measures in the Scoping Plan.

The most important GHG, carbon dioxide, is known as a "stock" pollutant because its climate impacts are a function of cumulative emissions over time. In theory, there are significant efficiency gains from designing GHG cap-and-trade programs to meet a *cumulative* emissions target. Under a cumulative target, allocating permits in advance of need (and allowing banking over time) can increase economic efficiency by improving price stability, facilitating intertemporal arbitrage, and enabling cost-effective abatement investment trajectories. In contrast, California's statewide policy targets, such as the limits set by AB 32 and SB 32 for 2020 and 2030, respectively, are denominated in terms of *annual* emissions. A cap-and-trade program that features allowance banking rules (as California's does) can deliver on a cumulative emissions target, but doesn't provide the backstop guarantee on annual emissions targets that many policymakers assume. Furthermore, compliance with statewide policy targets is measured on the basis of statewide emissions, about 75% of which are covered by the cap-and-trade program.

As a result of these two issues — the difference between cumulative and annual emissions, as well as the difference between covered and statewide emissions — the cap-and-trade program's cumulative emissions budgets do not guarantee that the state achieves a specific annual emissions limit. Translating a cumulative emissions budget into annual statewide emissions outcomes requires detailed assumptions about uncertain variables such as macroeconomic growth, technological change, non-covered emissions outside the cap-and-trade program, and allowance banking within the cap-

[7] Cal. Health & Safety Code § 38561(h).

and-trade program. If expectations about any of these variables turn out to be incorrect, changes to future cap-and-trade emissions budgets could be needed to re-calibrate the system and maintain a backstop approach.

Cap-and-trade programs can also be designed with "hybrid" features, such as administratively determined minimum floor and maximum ceiling prices. These features are particularly important because uncertainty in business-as-usual emissions and in emission reductions from other climate policies increase the likelihood that hybrid program features will constrain market prices (Borenstein et al., 2019). This finding highlights the importance of setting hybrid program features through careful analysis that is linked to specific policy goals.

Although the California cap-and-trade program was initially designed without a price ceiling to ensure the state would meet milestone annual emissions targets, the 2017 cap-and-trade extension bill, AB 398, required the Board to add one. A 2018 rulemaking process implementing that bill retained the program's minimum floor prices, which were developed in 2010 before California adopted its 2030 climate target.[8] It also added new intermediate price containment points,[9] implemented the new price ceiling,[10] and emphasized a "steadily increasing carbon price signal" in support of needed emission reductions (ARB 2018; Cullenward, 2018). Although there is nothing wrong with this description — indeed, we should expect to see steadily increasing carbon prices when annual emissions limits are tightening — the Board did not specify what price levels would likely be needed to support the SB 32 target. Meanwhile, the large quantity of banked allowances raises concerns that the cap-and-trade program will not be up to the task of constraining 2030 emissions below the SB 32 target (Cullenward et al., 2019; Inman et al., 2020).

Economists agree that carbon pricing programs can contribute to the cost-effective realization of climate policy goals, whether structured in terms of explicit prices, quantity targets, or a hybrid policy that combines both features (Goulder and Schein, 2013). Nevertheless, it is important to align California's cap-and-trade program design with its evolving role in the state's comprehensive climate policy portfolio.

The Air Resources Board has an opportunity in the upcoming Scoping Plan process to align the analytical framework it uses to design the cap-and-trade program and the role the Board expects the program to play in supporting its statutory obligation to limit annual emissions in 2030. We believe that additional clarity about the intended function of the cap-and-trade program would be beneficial in the upcoming Scoping Plan process and could be used to help guide any consideration of potential cap-and-trade program reforms.

[8] Cal. Code Regs., title 19, § 94911(c); see also ARB (2010: II-37).
[9] Cal. Health & Safety Code § 38562(c)(2)(B); Cal. Code Regs., title 19, § 95913(h).
[10] Cal. Health & Safety Code § 38562(c)(2)(A); Cal. Code Regs., title 19, § 95915.

Recommendations:

We urge the Board to focus on analytical consistency between the upcoming Scoping Plan, which charts a course towards an annual GHG target, and the cap-and-trade program, which is designed to meet a cumulative GHG target. To achieve consistency, the Board should elucidate the desired role of the cap-and-trade program in California's overall climate strategy and review the current market design in light of that preferred direction. Given the "hybrid" design of the current cap-and-trade program, the Board could consider identifying a range of carbon prices that are consistent with the portfolio of strategies adopted in its final Scoping Plan and align the cap-and-trade program design with its desired carbon price trajectories. Alternatively, if the Board prefers to design the program as a backstop guarantee on the state's 2030 climate target, then it should focus on a comprehensive analysis of market oversupply conditions and design cap-and-trade program reforms to fully address those concerns.

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Transportation

Ann Carlson and Jennifer Kropke

Transportation sector emissions remain the largest source of GHGs in California and nationally. About 40 percent of the state's GHGs come from transportation sources, and passenger vehicles are the largest category of emissions within the transportation sector, comprising 28 percent of the state's emissions. Since 2013, the trajectory of GHG emissions from transportation has gone in the wrong direction, increasing every year rather than decreasing. Most of the increases are from light duty vehicles and much of the increase is from more driving, reflected in year over year increases in vehicle miles travelled (VMTs).

2020 will be different. Like every other sector of the economy, the pandemic and its economic outfall have affected the transportation sector in a number of ways and are very likely to result in a decline in GHGs for the first time in eight years. The pandemic and economic effects include the following:

> Estimates are that auto sales in California will decline more than 22 percent in 2020 -- they declined almost 27 percent in the first half of the year and almost 50 percent in the second quarter;
>
> Electric vehicles have to date increased their market share slightly, rising from 4.9 percent to 5.8 percent year over year. Tesla has completely dominated the California market, making up 89 percent of total EV sales for the year;
>
> Californians have continued to purchase light trucks rather than passenger cars at huge rates: 62 percent of new sales in 2020 so far fall into the light truck category and light truck sales have declined less than new car sales;
>
> Stay at home orders have resulted in huge declines in vehicle miles travelled, though the decreases were most dramatic during the early months of the pandemic. Nationally, fourth quarter VMT totals for 2020 are predicted to be only moderately lower than the 4th quarter of 2019. Nevertheless, the declines are noteworthy: in California's major counties, VMTs declined between 65 and 90 percent in April, though by mid-June they had rebounded to 30-75 percent below normal.
>
> The pandemic has also resulted in huge declines in public transit usage, with national declines almost 70 percent lower in November, 2020, than in November, 2019.
>
> Gasoline prices in California were 15 percent lower in September, 2020 than in September, 2019.

In addition to the pandemic and its effect on transportation in the state, the Presidential election will also obviously have a large effect on some of the state's transportation

policies. Most directly, the incoming Biden Administration will almost certainly strengthen the state's ability to reduce GHGs and conventional pollutants from new vehicles, including both light and heavy duty vehicles. The Trump Administration has revoked California's Clean Air Act waiver for its GHG and Zero-Emission Vehicle programs, a decision the Biden Administration is likely to reverse. And the state will very likely receive a waiver for its Advanced Clean Trucks rule, which for the first time will impose on truck manufacturers a zero emission vehicle sales requirement.

In last year's IEMAC report on transportation emissions, we focused primarily on recommendations to evaluate how to accelerate the retirement of the internal combustion engine light duty fleet. We remain concerned that internal combustion engines will remain too dominant in California for too many years to allow the state to achieve its GHG goals, though changes in the auto market, including Ford's commitment to an all-electric fleet, GM's announcement of significant new investments in EVs, and the announcement of new policies like the Governor's 2035 target for prohibiting the sale of new vehicles with internal combustion engines are all positive developments. Indeed, it is possible that if EV prices remain high relative to traditional cars, the incentive to hold onto old cars may increase. We applaud new efforts by the state's public utilities and CARB to provide additional EV incentives funded with LCFS auction revenue but continue to believe that a focus on accelerating the turnover of the auto fleet is crucial to meeting long term GHG goals.

This pandemic has continued conversations regarding the evolution of transportation from traditional fossil fuel-based sources to newer technologies, such as battery-electric, and hydrogen fuel cell-electric vehicles; and the job creation implications that new technologies have. AB 841 (Ting) created an important workforce development standard to ensure that California-funded Electric Vehicle Service Equipment (EVSE) or EV "Chargers" as they are also commonly called, are installed utilizing a skilled and trained workforce via Electric Vehicle Infrastructure Training Program. This is an important step to ensuring California creates high-road jobs in our common transportation evolution, but by no means the only step California can take. There are other demand-side policy levers that have proven successful and warrant consideration to ensure all have access to high road jobs, such as wage and benefit standards, responsible employer standards and community benefit agreements.

We agree that with Tim Rainey and Kate Gordon when they write in the Foreword to the Zabin (2020) report:

> "….labor should be considered an investment rather than a cost – and investments in growing, diversifying, and upskilling California's workforce can positively affect returns on climate mitigation efforts. In other words, well trained workers are key to delivering emissions reductions and moving California closer to its climate targets."

We also have concerns that, as the economy returns to normal and as the pandemic comes to an end, GHG transportation emissions will return to their pre-pandemic levels

and even increase. It is difficult to know, however, what long-term effects the pandemic will have. Some could be positive and others negative. We think it important that the state not simply observe the state's rebound, but instead recommend that California consider responding to at least four potential effects of the pandemic if the responses would produce cost-effective emissions reductions:

The state should determine:

Whether California can sustain decreases in VMTs by, for example, incentivizing employers to continue to allow employees to work from home at least part of the time;

What can be done to return public transportation ridership to at least pre-pandemic levels and ultimately to well above those levels – one possibility is to use GGRF proceeds to make public transit free, at least for a limited period of time as the pandemic eases;

Given that auto sales are down dramatically this year, can the state take advantage of an expected increase in 2021 sales to increase the number of zero emission vehicles purchased. Options include subsidizing or even making free electricity used to charge EVs at home through GGRF expenditures; expanding the joint CARB-public utility rebate program; and increasing the amount of money available to retire used cars if replaced with clean vehicles.

What additional policy levers, such as those described previously, can best be implemented in California to create "high-road careers" (including family-sustaining wages, health care, retirement and strong worker classification and protections) in the coming transportation-electrification era we are heading toward.

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Appendix

These summary calculations are approximate, illustrative, and based on work-in-progress by Severin Borenstein, Meredith Fowlie, and Jim Sallee.

Estimated impacts of the RPS on PG&E retail rates:

- The 2020 Padilla Report summarizes RPS and non-RPS procurement expenditures in terms of $/kWh. For PG&E these are $0.123 and $0.104/kWh, respectively, for a difference of $0.019/kWh.

- The Padilla Report also reports RPS revenue requirements by utility. PG&E reports $2.52 billion in revenue required to support RPS energy procurements in 2019. Dividing this revenue requirement by the average procurement cost ($0.123/kWh) yields an estimate of the quantity of RPS electricity generated (20.5 TWh), based on the assumption that actual procurement costs match projected revenue requirements for these purchases.

- We estimate RPS compliance costs as the product of the cost premium ($0.019/kWh) and RPS-eligible renewable energy generation (20.5 TWh), for a total of $389 million.

- We assume that the share of the costs recovered from residential customers is proportional to the residential share of utility sales (34%), for a total of $132 million.

- Dividing this estimated cost impact across residential sales in 2018 implies an average retail price increase of $0.0047/kWh.

- To compute CARE and non-CARE rates we assume a CARE subsidy of 35%. We assume that 28% of residential sales are to CARE customers. Using these assumptions, we calculate an impact of $0.005 to non-CARE customers and $0.003 to CARE customers.

Estimated impacts of NEM on PG&E retail rates:

- We use public data on NEM 2019 residential PV systems in PG&E territory provided by the LBNL Tracking the Sun Report (https://emp.lbl.gov/tracking-the-sun).

- We use PV Watts to estimate the annual solar PV generation from these residential systems (approximately 4.51 TWh).

- To compute residential kWh demand without NEM, we add this PV generation to residential sales (28 TWh), for a counterfactual residential demand of 32.5 TWh.

- To compute the residential revenue requirement without NEM, we increase the 2019 residential revenue requirement by the product of NEM PV generation and the E3 estimate of avoided cost ($0.09/kWh). We estimate this counterfactual residential revenue requirement to be $6.7 billion.

- To estimate the counterfactual average residential rate, divide the counterfactual residential revenue requirement by the counterfactual residential demand.

- To compute CARE and non-CARE rates we assume a CARE subsidy of 35%. We assume that 28% of residential sales are to CARE customers. We also conservatively assume that both CARE and non-CARE ratepayers are equally likely to have residential PV systems subject to NEM tariffs.

- We calculate a counterfactual non-CARE rate of $0.227/kWh, which is $0.021/kWh lower than the actual non-CARE rate of $0.248/kWh. We calculate a counterfactual CARE rate of $0.148/kWh, which is $0.013/kWh lower than the actual CARE rate of $0.161 /kWh. We report the difference between actual and counterfactual rates as the rate impact of the NEM policy.