State of California
AIR RESOURCES BOARD

STANDARDIZED REGULATORY IMPACT ASSESSMENT

PROPOSED AMENDMENTS TO THE CALIFORNIA CAP ON GREENHOUSE GAS EMISSIONS AND MARKET-BASED COMPLIANCE MECHANISMS REGULATION

DATE:

June 2018

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Air Resources Board
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A. SUMMARY

The Cap-and-Trade Program (Program) is a key element of California's greenhouse gas (GHG) reduction strategy. It establishes a declining limit on 80 percent of statewide GHG emissions and creates a powerful economic incentive for major investment in cleaner, more advanced technologies. The Program also gives businesses the flexibility to choose the lowest-cost approach to reducing GHG emissions.

This analysis provides an economic assessment of proposed amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation (Cap-and-Trade Regulation or Regulation) for Board consideration for adoption in December 2018. The preliminary proposal (Amended Regulation) includes modifications to the Program in several areas that would take effect within the Program's third compliance period (2018-2020) as well as the post-2020 period of the Program to conform with requirements of recently enacted Assembly Bill (AB) 398 (Chapter 135, Statutes of 2017). AB 398 clarified the role of the Cap-and-Trade Program to help realize California's GHG emissions reduction target of at least 40 percent below 1990 levels by 2030, as mandated in Senate Bill (SB) 32 (Chapter 249, Statutes of 2016). This analysis represents a snapshot of the Amended Regulation based on the best information available to the California Air Resources Board (CARB or Board) at the time of the SRIA submittal, including current linkages California has in regulation with the Canadian provinces of Québec and Ontario. In developing the SRIA, it is important to understand that CARB continues to consider stakeholder feedback on the topics presented in this analysis and had to make certain assumptions in order to compile the analysis. Given recent announcements in Ontario, additional information and action may be required by CARB, and all of the assumptions in this SRIA may not represent the final proposal for Board consideration.

Upon approval by the Board and subsequent certification by California's Secretary of State, the Amended Regulation is expected to be effective in early 2019 with full implementation upon the effective date.

1. Background

The Cap-and-Trade Program establishes a declining cap on approximately 80 percent of total statewide GHG emissions and creates a strong economic incentive for investments in cleaner, more efficient technologies. CARB issues allowances equal to the total amount of permissible emissions over a given compliance period. One allowance equals one metric ton of carbon dioxide equivalent ($MTCO_2e$) (using the 100-year global warming potential). Each compliance period represents either a 2-year or 3-year block in the Program, 2013-2014, 2015-2017, 2018-2020, 2021-2023, 2024-2026, 2027-2029, and 2030 and beyond. Having multiyear compliance periods allows for smoothing of annual emissions variations that may be due to drought or unique production conditions. As the cap declines over time, fewer allowances are issued. A steady decline in allowance supply over time ensures a steadily increasing carbon price signal to prompt emissions reductions to achieve the statewide target.

The Program is designed to achieve the most cost-effective statewide GHG emissions reductions. There are no individual or facility-specific emissions reduction requirements; rather, each covered entity must report and verify their GHG emissions annually and acquire and surrender compliance instruments in an amount equal to its total covered GHG emissions during each compliance period. Covered entities can also meet a portion of their compliance obligation by surrendering offset credits, which are compliance instruments that are derived from rigorously verified emissions reductions from projects outside the scope of the Program. By virtue of current linkages with the Québec and Ontario cap-and-trade systems, California entities can use Québec and Ontario-issued allowances and offsets, as all compliance instruments issued by all three jurisdictions are fully fungible. As indicated above, recent announcements in Ontario regarding its cap-and-trade program may necessitate further action by CARB.

The Program gives covered entities the flexibility to develop their most cost-effective compliance strategy. Covered entities may find methods to reduce emissions at their own facilities, trade allowances and offsets with other firms, and/or purchase allowances at auction. Through these mechanisms, the Program is designed to leverage the power of the market to find the most cost-effective methods to reach California's environmental goals. The ability to auction and trade allowances establishes a price signal needed to drive long-term investment in cleaner fuels, new technology, and more efficient use of energy. It also provides flexibility for regulated entities to seek out and implement the lowest-cost options to reduce emissions.

Since its initial adoption in October 2011, the Regulation has been amended six times to streamline Program requirements, include jurisdictional linkages, and incorporate new mandates.

In 2012, CARB proposed two sets of amendments to the Regulation. The first set of amendments, related to program implementation, was approved by the Board in June 2012 and took effect in September 2012. The second set of amendments, related to jurisdictional linkage with Québec, was approved by the Board in April 2013. These amendments took effect in October 2013 and specified a January 1, 2014 start date for the linked California and Québec Cap-and-Trade Programs.

In 2013, CARB proposed amendments to extend the 100 percent assistance factor (given to energy intensive and trade exposed industries to minimize leakage) for the second compliance period for industrial sectors as staff initiated additional studies at the Board's direction to better understand the potential for leakage, refine the required data collected from registered participants to support market oversight, and add an additional cost containment measure. These amendments also included a new compliance offset protocol, Mine Methane Capture, and updates to offset implementation and usage. The Board approved these amendments in April 2014 and they took effect on July 1, 2014.

In 2014, CARB proposed amendments that clarified the quantification of production data, updated the compliance offset protocols, and modified requirements related to compliance, corporate association disclosures, and offset transfer price reporting. The Board approved these amendments in September 2014 and they took effect on January 1, 2015.

In 2016, CARB proposed another set of amendments to extend the major provisions of the Program beyond 2020, broaden carbon market through linkage with Ontario, clarify compliance obligations for certain sectors, and enhance staff's ability to implement and oversee the Program. These amendments were approved on July 27, 2017 and went into effect on October 1, 2017.

In January 2018, CARB proposed a narrow set of amendments to the Regulation to ensure that the responsibility to meet compliance obligations is transferred to new owners along with assets during an ownership change process. The amendments also clarified the regulatory procedure for establishing the Auction Reserve Price by ensuring consistency with the procedure for establishing the Auction Reserve Price in the Ontario and Québec regulations, and ensure that California can certify joint auctions regardless of which jurisdiction's Auction Reserve Price is used for a joint auction. The Board approved these amendments on March 22, 2018, and they went into effect on May 30, 2018.

2. Proposed Regulatory Amendments

a. Overview

The Amended Regulation analyzed in this SRIA builds upon the Regulation that is currently in force, including all previous amendments approved by the Board. The public process for the Amended Regulation began with a kickoff workshop on October 12, 2017, with four additional publicly noticed workshops through June 2018. In addition, CARB staff held numerous informal meetings with stakeholders to discuss specific topics related to the proposed amendments. These forums provided CARB staff and stakeholders opportunities to present and discuss initial regulatory language, concepts, and potential alternatives. The workshops and meetings allowed CARB staff to consider stakeholder feedback and to incorporate it into the Amended Regulation, as appropriate. CARB staff will continue to consider stakeholder feedback throughout the regulatory adoption process, including up to the adoption of the final regulation. Thus, this analysis represents a snapshot of the Amended Regulation, and the costs and compliance requirements represent the best information available to CARB at the time of the SRIA submittal.

The Amended Regulation analyzed in this SRIA may differ from the proposed regulation presented to the Board in October 2018, which will be informed by continued interactions with stakeholders, the public, external researchers, other regulatory agencies, as well as by direction the Board may provide to CARB staff at Board hearings. The Initial Statement of Reasons (ISOR) will include an economic analysis of the final proposed Amended Regulation that will be presented to the Board and may rely on additional information and analysis techniques. Over the course of the next few months, as the Amended Regulation is finalized, additional supporting documents for the economic analyses may also be added to the rulemaking record.

b. Proposed Changes

The Amended Regulation will propose changes to industrial allocation, including the number of free allowances provided in the third compliance period and beyond. AB 32 requires CARB to minimize leakage, which is defined as "a reduction in GHG emissions within the State that is offset by an increase in GHG emissions outside the state" (Section 38505(J)). Leakage occurs when industry or production moves out of state in response to increased costs due to the California price on carbon. As a result, there would appear to be a reduction in GHG emissions for AB 32 statewide accounting purposes, but the atmosphere would not experience a net reduction in GHG emissions.

Per AB 398, the assistance factors for all industrial entities receiving allocation for purposes of minimizing leakage will be set at 100 percent beginning in 2021. As the cap declines each year, so does allowance allocation. The Amended Regulation includes provisions that reflect this legislative direction.

Further, in 2017, Board Resolution 17-21 directed staff to "propose subsequent regulatory amendments to provide a quantity of allocation, for the purposes of minimizing emissions leakage, to industrial entities for 2018 through 2020 by using the same assistance factors in place for 2013 through 2017." The assistance factors for 2013 through 2017 are set at 100 percent. It is important to note, a 100 percent assistance factor does not mean an industrial entity receives, from the State, all of the allowances it needs for compliance. And, the amount of freely allocated allowances continues to decrease each year by about 4 percent after 2020. If these amendments are ultimately adopted, they would smooth out the assistance factors between the second compliance period and post-2020 by setting them to 100 percent for 2018 through 2020. These amendments would be consistent with past Board action wherein the Board undertook a conservative approach to leakage assessment in modifying the initially proposed assistance factors for the second compliance period (2015-2018) to reflect a 100 percent assistance factor for the entire second compliance period.[1]

Other provisions in the Amended Regulation related to allocation include extending legacy contract assistance for entities with non-industrial counterparties, providing

[1] https://www.arb.ca.gov/regact/2013/capandtrade13/capandtrade13.htm

transition assistance to waste-to-energy entities as they are no longer exempted from the Program beginning with the third compliance period, and alternative cap adjustment factors for limited situations where a sector is highly emissions intensive and highly trade exposed.

AB 398 also calls for changes to the design of the cost-containment mechanisms in the Program. Amendments are being considered to add a price ceiling that, if breached, would allow regulated entities to comply with the Program at a cost-per-metric ton basis. In establishing the price ceiling, AB 398 requires CARB to consider the following: avoiding adverse impacts on households, businesses, and the economy; the 2020 tier prices in the Reserve; the social cost of carbon; the Auction Reserve Price; the potential for environmental and economic leakage; and the cost per metric ton of GHG emissions to achieve the statewide GHG emission reduction targets. The current Allowance Price Containment Reserve (Reserve) is also proposed to be restructured to go from a single tier to two tiers (called price containment points in AB 398) where regulated entities could purchase from a pool of allowances set aside from within the cap at higher prices, but below the price of the price ceiling.

The Amended Regulation also includes provisions to reduce the offset usage limit from the current 8 percent limit during the first three compliance periods (2013 through 2020) to 4 percent of compliance obligations based on emissions from 2021 to 2025, and then to increase the usage limit to 6 percent of compliance obligations based on emissions from 2026 to 2030. Additionally, in a public workshop, staff indicated the potential to remove approximately 23 million additional allowances from 2021 through 2030 budgets to compensate for the increase in the offset usage limit in 2026. Staff is also still taking comment on that option. The Amended Regulation also includes a proposal to differentiate offsets that provide “direct environmental benefits to the state” as defined in AB 398.

Provisions are also being considered to provide further clarity on use of allowance value for consigned allowances by natural gas suppliers and electricity distribution utilities.

c. Price Range Assessed for the Amended Regulation

The Cap-and-Trade Program sets an economy-wide GHG emissions cap and gives firms the flexibility to choose the lowest-cost approach to reduce emissions. The direct cost of any single specific GHG reduction activity under the Cap-and-Trade Program is subject to a large degree of uncertainty. However, as Cap-and-Trade allows covered entities to pursue the reduction options that emerge as the most efficient, overall abatement costs can be bounded by the allowance price. Covered entities will pursue reduction actions with costs less than or equal to the allowance price. An upper bound on the compliance costs under the Cap-and-Trade Program can therefore be estimated by multiplying the range of potential allowance prices by the anticipated GHG reductions needed (in conjunction with the reductions achieved through the prescriptive measures) to achieve the SB 32 target.

A large number of factors influence the allowance price including the ease of transition of firms to low-carbon production methods, consumer price response, the pace of technological progress, and impacts of fuel prices. Other policy factors that also impact the allowance price include the use of auction proceeds from the sale of State-owned allowances to reduce GHG emissions and linkage with other jurisdictions.

This analysis includes a range of allowance prices bounded by the projected Cap-and-Trade auction reserve price which represents the minimum sales price for allowances sold at auction and the price ceiling, which would allow regulated entities to comply with the Program at a cost-per-metric ton basis and is the highest allowable price under the Program. This modeling approach is consistent with the economic analysis for the 2017 Climate Change Scoping Plan Update (2017 Scoping Plan),[2] the 2016 Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms[3] as well as the 2010 Cap-and-Trade Regulation in which CARB determined the GHG reductions required by the Program would likely be achieved at an allowance price ranging from \$15 $MTCO_2e$ to \$30 $MTCO_2e$ in 2020.[4]

The auction reserve price grows at a real rate of 5 percent per year through 2030. Since CARB staff continues to consider stakeholder feedback and additional analysis in the development of the Amended Regulation, for purposes of this SRIA, CARB staff is analyzing a range of price containment points and price ceilings, to assess the potential economic impact of the Amended Regulation.

In developing the range of prices for the Amended Regulation analysis, it is important to consider the relationship between allowance prices and abatement. Setting low price containment points and price ceiling may dampen the long-term price signal needed for businesses to make capital investments in on-site transformational technology and could lead to lower GHG emissions reductions than required to achieve the SB 32 target. Conversely, price points that are significantly higher than the marginal abatement cost needed to achieve reductions under the Program could result in emissions leakage and greater consumer impacts. This SRIA includes two schedules of price containment points (also called Point 1 and Point 2) and price ceilings that represent comments received during the early regulatory process for the Amended Regulation. Table 1 and Table 2 present the different price value scenarios.

In the current Regulation, the Reserve is structured with three tiers that were separated by \$5 in 2013, escalating in real terms by 5 percent annually. Because of this real escalation, they are separated in 2018 by approximately \$6.80 in 2018 dollars. Under the current Regulation, these three tiers will collapse into a single tier in 2021. CARB agrees with stakeholders that having more separation between the two price

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[2] https://www.arb.ca.gov/cc/scopingplan/2030sp_appe_econ_final.pdf

[3] https://www.arb.ca.gov/regact/2016/capandtrade16/isor.pdf Page 313.

[4] See https://www.arb.ca.gov/regact/2010/capandtrade10/capisor.pdf page Viii-8 for additional information.

containment points in the post-2020 period, per AB 398, will allow more time for the market to respond to the need for GHG reductions, potentially avoiding immediate need to access allowances in the second price containment point and the price ceiling.

The first scenario, shown in Table 1, represents an upper-range of prices based on stakeholder comments during early workshops for the Amended Regulation. In this scenario, the price containment points and price ceiling have price values set closer together in 2021. Then, the values diverge over time. The price containment points maintain equal distance from point 1 to point 2, and point 2 to the ceiling throughout the 2020s to recognize stakeholders' preference for separation between the each of the containment points and ceiling.

The price ceiling value in 2021 is set to recognize the cost-per-metric ton for GHG reductions through the deployment of carbon capture and sequestration (CCS). Setting the price ceiling at this price value will enable CCS projects to be considered and deployed. Once deployed, these projects can capture and sequester millions of metric tons of GHG emissions. To meet the objective of maintaining equal distance, deployment of CCS, and incorporating stakeholder's upper range of a 2030 price ceiling, the price containment points and price ceiling in this upper range scenario must escalate at different annual rates: the first price containment point (Point 1) escalates at 7 percent, the second price containment point (Point 2) escalates at 9 percent, and the price ceiling escalates at 10.4 percent real.

Table 1. Amended Regulation Upper 2030 Range Price Points ($2018)

Year	Auction Reserve Price	Point 1	Point 2	Price Ceiling
2021	$16.77	$50.00	$57.00	$65.00
2022	$17.60	$53.51	$62.20	$71.75
2023	$18.46	$57.26	$67.88	$79.21
2024	$19.36	$61.27	$74.08	$87.44
2025	$20.31	$65.57	$80.84	$96.52
2026	$21.31	$70.17	$88.22	$106.55
2027	$22.35	$75.09	$96.28	$117.62
2028	$23.45	$80.35	$105.07	$129.85
2029	$24.60	$85.99	$114.66	$143.34
2030	$25.80	$92.02	$125.12	$158.23

Table 2 starts from the same 2021 values, and maintains equal distance from point 1 to point 2, and point 2 to the ceiling from 2021 through 2030. The 2030 price ceiling reflects a lower-range based in part on comments from CARB workshops. However, in order to avoid having the cost containment prices interfere with incentives for onsite reductions in the $60 range such as CCS, CARB has included an escalation of the price containment points and price ceiling such that they diverge from the auction reserve price over time. To meet the objectives of equal distance, deployment of CCS and onsite reductions, and a lower 2030 ceiling price, the price containment points and price ceiling in this lower range scenario must escalate at different annual rates: Point 1 escalates at 1.2 percent, Point 2 escalates at 2.4 percent, and the price ceiling escalates at 3.1 percent real.

Table 2. Amended Regulation Lower 2030 Range Price Points ($2018)

Year	Auction Reserve Price	Point 1	Point 2	Price Ceiling
2021	$16.77	$50.00	$57.00	$65.00
2022	$17.60	$50.60	$58.37	$67.01
2023	$18.46	$51.20	$59.76	$69.07
2024	$19.36	$51.81	$61.20	$71.20
2025	$20.31	$52.43	$62.66	$73.40
2026	$21.31	$53.05	$64.16	$75.67
2027	$22.35	$53.68	$65.70	$78.00
2028	$23.45	$54.32	$67.27	$80.41
2029	$24.60	$54.97	$68.88	$82.89
2030	$25.80	$55.62	$70.53	$85.44

For the remainder of this SRIA, these two scenarios are referred to as the Upper 2030 Range and Lower 2030 Range Scenarios.

3. Statement of the Need of the Proposed Regulation – Climate Impacts

Climate scientists agree that global warming and other shifts in the climate system observed over the past century are caused by human activities. These recorded changes are occurring at an unprecedented rate (Cook 2016). According to new research, unabated GHG emissions could cause sea levels to rise up to ten feet by the end of this century—an outcome that could devastate coastal communities in California and around the world (California Ocean Protection Council 2017).

California is already feeling the effects of climate change, and projections show that these effects will continue and worsen over the coming centuries. The impacts of climate change on California have been documented by the Office of Environmental Health Hazard Assessment (OEHHA) in the Indicators of Climate Change Report (OEHHA 2018), which details the following changes that are occurring already:

- A recorded increase in annual average temperatures, as well as increases in daily minimum and maximum temperatures.
- An increase in the occurrence of extreme events, including wildfire and heat waves.
- A reduction in spring runoff volumes, as a result of declining snowpack.
- A decrease in winter chill hours, necessary for the production of high-value fruit and nut crops.
- Changes in the timing and location of species sightings, including migration upslope of flora and fauna.

In addition to these trends, the State's current conditions point to a changing climate. California's recent historic drought incited land subsidence, pest invasions that killed over 100 million trees, and water shortages throughout the State. Recent scientific studies show that such extreme drought conditions are more likely to occur under a changing climate (Diffenbaugh et al. 2015; Cayan et al. 2010). The total statewide economic cost of the 2013–2014 drought was estimated at $2.2 billion, with a total loss of 17,100 jobs (Howitt et al. 2014). In the Central Valley, the drought cost California agriculture about $2.7 billion and more than 20,000 jobs in 2015, which highlights the critical need for developing drought resilience (Williams et al. 2015). Drought affects other sectors as well. An analysis of the amount of water consumed in meeting California's energy needs between 1990 and 2012 shows that while California's energy policies have supported climate mitigation efforts, the performance of these policies have increased vulnerability to climate impacts, especially greater hydrologic uncertainty (Fulton and Cooley 2015).

Several publications carefully examined the potential role of climate change in the recent California drought. One study examined both precipitation and runoff in the Sacramento and San Joaquin River basins and found that 10 of the past 14 years between 2000 and 2014 have been below normal, and recent years have been the driest and hottest in the full instrumental record from 1895 through November 2014 (Mann and Gleick 2015). In another study, the authors show that the increasing co-occurrence of dry years with warm years raises the risk of drought, highlighting the critical role of elevated temperatures in altering water availability and increasing overall drought intensity and impact (Diffenbaugh et al. 2015). Generally, there is growing risk of unprecedented drought in the western United States driven primarily by rising temperatures, regardless of whether or not there is a clear precipitation trend (Cook et al. 2015). Even more recently, California experienced the deadliest wildfires in its history. Climate change is making events like these more frequent, more catastrophic, and costlier.

A warming climate also causes sea level to rise; first, by warming the oceans which causes the water to expand, and second, by melting land ice which transfers water to the ocean. Even if storms do not become more intense or frequent, sea level rise itself will magnify the adverse impact of any storm surge and high waves on the California coast. Some observational studies report that the largest waves are already getting higher and winds are getting stronger (National Research Council of the National Academy of Sciences 2012). Further, as temperatures warm and atmospheric carbon dioxide concentrations increase, more carbon dioxide dissolves in the ocean, making it more acidic. More acidic ocean water affects a wide variety of marine species, including species that people rely on for food. Recent projections indicate that if no significant GHG mitigation efforts are taken, the San Francisco Bay Area may experience sea level rise between 1.6 and 3.4 feet, and in an extreme scenario involving the rapid loss of the Antarctic ice sheet, sea levels along California's coastline could rise up to 10 feet by 2100 (California Ocean Protection Council 2017). This change is likely to have substantial ecological and economic consequences in California and worldwide (Chan et al. 2016).

While more intense dry periods are anticipated under warmer conditions, extremes on the wet end of the spectrum are also expected to increase due to more frequent warm, wet atmospheric river events and a higher proportion of precipitation falling as rain instead of snow. In recent years, atmospheric rivers have also been recognized as the cause of the large majority of major floods in rivers all along the U.S. West Coast and as the source of 30–50 percent of all precipitation in the same region (Dettinger 2013). These extreme precipitation events, together with the rising snowline, often cause devastating floods in major river basins (e.g., California's Russian River). It was estimated that the top 50 observed floods in the U.S. Pacific Northwest were due to atmospheric rivers (Warner et al. 2012). Looking ahead, the frequency and severity of atmospheric rivers on the U.S. West Coast will increase due to higher atmospheric water vapor content that occurs with rising temperature, leading to more frequent flooding (Hagos et al. 2016; Payne and Magnusdottir 2015).

Climate change can drive extreme weather events such as coastal storm surges, drought, wildfires, floods, and heat waves, and disrupt environmental systems including our forests and oceans. As GHG emissions continue to accumulate and climate disruption grows, such destructive events will become more frequent. Several recent studies project increased precipitation within hurricanes over ocean regions (Easterling et al. 2016; National Academy of Sciences 2016). The primary physical mechanism for this increase is higher water vapor in the warmer atmosphere, which enhances moisture convergence in a storm for a given circulation strength. Since hurricanes are responsible for many of the most extreme precipitation events, such events are likely to become more extreme. Anthropogenic warming by the end of the 21st century will likely cause tropical cyclones globally to become more intense on average. This change implies an even larger percentage increase in the destructive potential per storm, assuming no changes in storm size (Sobel et al. 2016; Kossin et al. 2016). Thus, the historical record, which once set expectations for the range of weather and other natural events, is becoming an increasingly unreliable predictor of the climate conditions we will face in the future. Consequently, the best available science must drive effective climate policy.

It is imperative that California continue to work to reduce GHG emissions in order to decrease the probability of these impacts. In 2005, Governor Schwarzenegger issued Executive Order S-3-05 (EO S-3-05), which set, among other things, targets of reducing statewide GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. In 2006, California enacted AB 32 to address this public problem by requiring cost-effective reductions in GHG emissions and by codifying the 2020 target. AB 32 directed CARB to continue its leadership role on climate change and to develop a scoping plan identifying integrated and cost-effective regional, national, and international GHG reduction programs. In 2015, Governor Brown issued Executive Order B-30-15 (EO B-30-15), which set a goal of reducing statewide GHG emissions to 40 percent below 1990 levels by 2030. In 2016, the Legislature passed, and Governor Brown signed, SB 32, which codified the 40 percent reduction goal from 1990 levels by 2030.

In July 2017, Governor Brown signed a legislative package clarifying the role of the Cap-and-Trade Program in achieving the 2030 GHG reduction target (AB 398; Chapter 135, Statutes of 2017) and establishing a new program to improve air quality in local communities (AB 617; Chapter 136, Statutes of 2017). The legislation helps ensure California continues to meet its ambitious climate change goals while addressing air pollution in communities with the dirtiest air. AB 398 also provided direction on the 2017 Scoping Plan and required its adoption by January 1, 2018. The rulemaking process for the Amended Regulation will implement the requirements of AB 398 pertaining to the Cap-and-Trade Program. With respect to AB 617, CARB has begun work to implement a new community-focused air quality program including monitoring and emission reduction plans.

On December 14, 2017, the Board unanimously approved the 2017 Scoping Plan (CARB 2017a), which sets out specific measures to accomplish California's plan to reduce climate-changing gases an additional 40 percent below 1990 levels by 2030 pursuant to SB 32.

a. California Climate Change Scoping Plan

Pursuant to AB 32, the first Climate Change Scoping Plan (Initial Scoping Plan (CARB 2008) was adopted in 2008 and laid out a comprehensive program to reduce California's GHG emissions to 1990 levels by 2020, to reduce the State's dependence on fossil fuels, to stimulate investment in clean and efficient technologies, and to improve air quality and public health. The Initial Scoping Plan presented the first economy-wide approach to reducing emissions and highlighted the value of combining both carbon pricing with other complementary programs to meet California's 2020

GHG emissions target while ensuring progress in all sectors. The coordinated set of policies in the Initial Scoping Plan employed strategies tailored to specific needs, including market-based compliance mechanisms, performance standards, technology requirements, and voluntary reductions. The Initial Scoping Plan also described a conceptual design for a cap-and-trade program that included eventual linkage to other cap-and-trade programs to form a larger regional trading program. As implemented, the Cap-and-Trade Program is designed to work in concert with other measures, such as standards for cleaner vehicles, low-carbon fuels, renewable electricity, and energy efficiency. The Program also complements and supports California's existing efforts to reduce criteria and toxic air pollutants. AB 32 also requires the Scoping Plan to be updated at least once every five years.

The First Update to the Scoping Plan (First Update), approved in 2014, presented an update on the program and its progress toward meeting the 2020 limit (CARB 2014). It also developed the first vision for long-term progress beyond 2020. In doing so, the First Update laid the groundwork for the goals set forth in Executive Orders S-3-05[5] and B-16-2012.[6] It also identified the need for a 2030 mid-term target to establish a continuum of actions to maintain and continue reductions, rather than only focusing on targets for 2020 or 2050.

On December 14, 2017, the Board unanimously approved the 2017 Scoping Plan. Over 20 state agencies collaborated to produce the Plan, informed by 15 state agency-sponsored workshops and more than 500 public comments. The broad range of state agencies involved reflects the complex nature of addressing climate change, and the need to work across institutional boundaries and traditional economic sectors to effectively reduce GHG emissions. The 2017 Scoping Plan incorporates, coordinates, and leverages many existing and ongoing efforts and identifies new policies and actions to accomplish the State's climate goals.

Guided by legislative direction, the actions identified in the 2017 Scoping Plan (CARB 2017a) reduce overall GHG emissions in California and deliver policy signals that will continue to drive investment and certainty in a low carbon economy. The 2017 Scoping Plan builds upon the successful framework established by the Initial Scoping Plan and First Update, while identifying new, technologically feasible, and cost-effective strategies to ensure that California meets its GHG reduction targets in a way that promotes and rewards innovation, continues to foster economic growth, and delivers improvements to the environment and public health, including in disadvantaged communities. The plan includes policies to require direct GHG reductions at some of the State's largest stationary sources and mobile sources. These policies include the use of lower GHG fuels, efficiency regulations, and the Cap-and-Trade Program, which constrains and reduces emissions at covered sources.

[5] http://www.climatechange.ca.gov/state/executive_orders.html
[6] https://www.gov.ca.gov/news.php?id=17472

4. Major Regulation Determination

The Amended Regulation was determined to be a major regulation as modeling results for the anticipated provisions related to the post-2020 Program show a greater than $50 million economic impact over a 12-month period after full implementation. Proposed changes to the Amended Regulation for the third compliance period are anticipated to have a small economic impact. Therefore, the focus of this analysis is on the provisions of the Amended Regulation related to the post-2020 Cap-and-Trade Program.

As CARB staff will continue to take public comments on the Amended Regulation, including engagement at public workshops and Board meetings, and are considering further changes to the Amended Regulation based on stakeholder input, additional changes to the current Amended Regulation related to harmonization of the Program with AB 398 will continue to be considered. The economic impact of the final rule (including any modifications to the current Amended Regulation that occur during the regulatory process) will be fully analyzed in the Economic and Fiscal Impact Statement (STD. 399) submitted to the Department of Finance and Office of Administrative Law with the final regulatory package.

5. Baseline Information

To estimate the economic impacts of the Amended Regulation, a baseline or business-as-usual (BAU) characterization of California GHG emissions was developed. The BAU outlines the estimated emissions reductions that the Amended Regulation may need to deliver for California to achieve the SB 32 target based on estimates of California GHG emissions through 2030 and on assumptions about post-2020 California climate policy. In this analysis, the economic baseline used in analyzing the impact of the Amended Regulation and two alternatives is adjusted to reflect the Department of Finance Conforming Forecast, dated November 2017.

The Initial Scoping Plan outlined a strategy to achieve the 1990 GHG emissions level by 2020 through a portfolio of GHG reduction actions, including direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, and market-based mechanisms. This approach is consistent with recommendations made by the Market Advisory Committee, which advocated for the use of multiple policy levers to address market failures related to climate change and air quality. In the 2017 Scoping Plan, California augmented and extended the statewide portfolio of market and direct regulatory measures to achieve at least a 40 percent reduction below 1990 GHG emissions by 2030. California's current climate policy includes the Renewables Portfolio Standard, the Low Carbon Fuel Standard, aggressive energy efficiency programs, the Short-Lived Climate Pollutant Strategy, the Cap-and-Trade Program, and other GHG reduction strategies.

To meet the 2030 emissions target, GHG emissions allowed under the post-2020 Cap- and-Trade Program, plus emissions from sources not covered by the Program, must not exceed the statewide target, 260 $MMTCO_2e$ in 2030. To the extent some climate policies reduce emissions in sources covered by the Program, the Program has to deliver fewer reductions on its own. The policies that cover the same sources of emissions in the Program are referred to as complementary policies. These mostly include policies to reduce GHG emissions from transportation and energy sectors. For example, tailpipe GHG standards for new vehicles and the Low Carbon Fuel Standard result in reduced GHG emissions in the transportation sector, reducing the emissions reductions that will be required to be achieved by the Program. Determining the share of post-2020 emissions reductions that must be achieved by the Cap-and-Trade Program, therefore, requires generating forecasts of California GHG emissions that include potential reductions from anticipated post-2020 complementary policies.

There are a variety of models that can be used to model GHG emissions. For the 2017 Scoping Plan, the State used the California PATHWAYS model.[7] California PATHWAYS is a long-horizon energy model that can be used to assess the cost and greenhouse gas emissions impacts of a system's energy demand and supply choices. The PATHWAYS model is an economy-wide "bottom-up" technology-rich model that includes representations of the buildings, industry, transportation, and electricity sectors, including hourly electricity supply and demand. PATHWAYS explicitly models stocks and replacement of buildings, vehicles and appliances over the 35-year timeframe from 2015 through 2050. Demand for energy is driven by external data on population, building square footage, and other energy demand forecasts. Energy and infrastructure costs are tracked, and greenhouse gas emissions are calculated based on energy demand and energy supply choices.

PATHWAYS calculates GHG emissions from California energy use and from non-energy activities (such as agriculture and the use of refrigerants) and incorporates relationships among energy supply and demand across sectors. For example, the electrification of transportation will increase the demand for electricity, which will interact with electric sector policies, such as the Renewables Portfolio Standard. The increased use of electricity for transportation also interacts with the Low Carbon Fuel Standard. PATHWAYS estimates the costs and savings for the combined set of measures included in the 2017 Scoping Plan. PATHWAYS, however, does not reflect any change in transportation infrastructure and land use demand associated with additional ZEVs on the road.

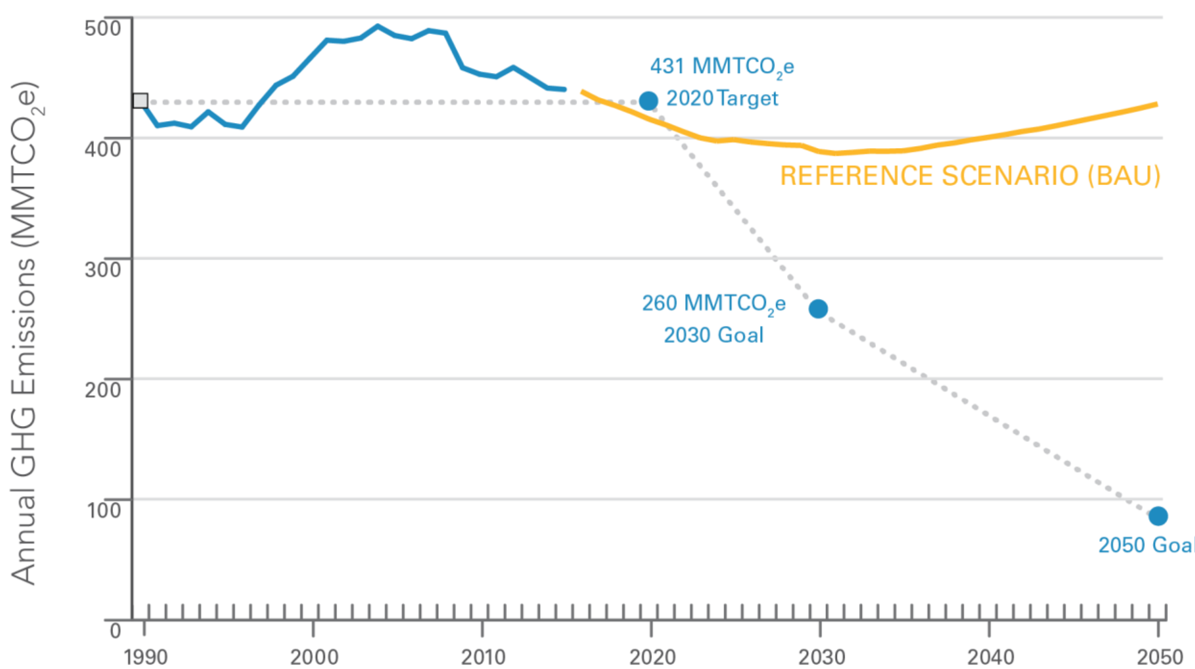
The PATHWAYS modeling in the 2017 Scoping Plan shows the significant action that the State must take to reach its long-term GHG reduction goals. It is also important to note that the modeling assumptions used in the 2017 Scoping Plan may differ from other models used by other State agencies in evaluating different climate and air quality policies.

[7] AB 32 Scoping Plan Public Workshops PATHWAYS modeling information and available at: see descriptions and links on PATHWAYS model).
https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

The development of the 2017 Scoping Plan began by first modeling a Reference or Business as Usual Scenario that represents California emissions through 2030 with existing policies and programs, but without any further action to reduce GHGs beyond 2020 (Reference Scenario or BAU). Since the 2017 Scoping Plan represents the most current assessment of the overall measures to achieve California's 2030 GHG reduction target, this SRIA utilizes the modeling framework and Reference Scenario utilized in the 2017 Scoping Plan, which was adopted by the Board in December 2017.

Figure 1 provides the modeling results for the Reference Scenario from the 2017 Scoping Plan. The graph shows the State is expected to reduce emissions below the 2020 statewide GHG target by 2020, but that additional efforts will be needed to maintain and continue GHG reductions to meet the mid-term (2030) and long-term (2050) targets. While Figure 1 depicts a linear, straight-line path to the 2030 target, it should be noted that in any year, GHG emissions may be higher or lower than the straight line. This may be due to periods of economic recession or increased economic activity, annual variations in hydropower, and many other factors that introduce uncertainty into the projection of GHG emissions in the State. CARB's annual GHG reporting and GHG inventory will continue to provide public data on progress towards achieving the 2030 target. More details about the modeling for the Reference Scenario can be found in Appendix D to the 2017 Scoping Plan (CARB 2017b).

Figure 1. 2017 Scoping Plan Reference Scenario



The State strategy for meeting the 2030 GHG target is also called the Scoping Plan Scenario. This suite of measures includes the ongoing and statutorily required programs that will achieve GHG reductions towards the 2030 target as well as a continuation of the Cap-and-Trade Program. The Scoping Plan Scenario is summarized in Table 3. While most of the measures in Table 3 are existing programs or required by statute, they are not included in the Reference Scenario as their passage and implementation is related to meeting SB 32 or other long-term climate and air quality objective.

Table 3. Scoping Plan Scenario

Policy	Primary Objective	Highlights	Implementation Time Frame
SB 350[8]	Reduce GHG emissions in the electricity sector through the implementation of the 50 percent RPS, doubling of energy savings, and other actions as appropriate to achieve GHG emissions reductions planning targets in the Integrated Resource Plan (IRP) process.	• Load-serving entities file plans to achieve GHG emissions reductions planning targets while ensuring reliability and meeting the State's other policy goals cost-effectively. • 50 percent RPS. • Doubling of energy efficiency savings in natural gas and electricity end uses statewide.	2030
Low Carbon Fuel Standard (LCFS)	Transition to cleaner/less-polluting fuels that have a lower carbon footprint.	• At least 18 percent reduction in carbon intensity, as included in the Mobile Source Strategy.	2030
Mobile Source Strategy (Cleaner Technology and	Reduce GHGs and other pollutants from the transportation	• 1.5 million zero emission vehicles (ZEV), including plug-in hybrid electric, battery-electric, and hydrogen fuel cell vehicles by 2025 and 4.2 million ZEVs by 2030.	Various

[8] SB 350 Clean Energy and Pollution Reduction Act of 2015 (De León, Chapter 547, Statutes of 2015). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350. This policy also includes increased demand response and PV.

Policy	Primary Objective	Highlights	Implementation Time Frame
Fuels [CTF] Scenario)[9]	sector through transition to zero-emission and low-emission vehicles, cleaner transit systems and reduction of vehicle miles traveled.	• Continue ramp up of GHG stringency for all light-duty vehicles beyond 2025. • Reductions in GHGs from medium-duty and heavy-duty vehicles via the Phase 2 Medium and Heavy-Duty GHG Standards. • Innovative Clean Transit: Transition to a suite of innovative clean transit options. Assumed 20 percent of new urban buses purchased beginning in 2018 will be zero emission buses with the penetration of zero-emission technology ramped up to 100 percent of new bus sales in 2030. Also, new natural gas buses, starting in 2018, and diesel buses, starting in 2020, meet the optional heavy-duty low-NOx standard. • Last Mile Delivery: New regulation that would result in the use of low NOx or cleaner engines and the deployment of increasing numbers of zero-emission trucks primarily for class 3-7 last mile delivery trucks in California. This measure assumes ZEVs comprise 2.5 percent of new Class 3–7 truck sales in local fleets starting in 2020, increasing to 10 percent in 2025. • Reduction in vehicle miles traveled (VMT), to be achieved in part by continued implementation of SB 375 and regional Sustainable Community Strategies;	

[9] CARB. 2016. Mobile Source Strategy. https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf

Policy	Primary Objective	Highlights	Implementation Time Frame
		forthcoming statewide implementation of SB 743; and potential additional VMT reduction strategies not specified in the Mobile Source Strategy, but included in the document "Potential VMT Reduction Strategies for Discussion" in Appendix C.[10]	
SB 1383	Approve and Implement Short-Lived Climate Pollutant strategy[11] to reduce highly potent GHGs	• 40 percent reduction in methane and hydrofluorocarbon (HFC) emissions below 2013 levels by 2030. • 50 percent reduction in anthropogenic black carbon emissions below 2013 levels by 2030.	2030
California Sustainable Freight Action Plan[12]	Improve freight efficiency, transition to zero emission technologies, and increase competitiveness of California's freight system.	• Improve freight system efficiency by 25 percent by 2030. • Deploy over 100,000 freight vehicles and equipment capable of zero emission operation and maximize both zero and near-zero emission freight vehicles and equipment powered by renewable energy by 2030.	2030
Post-2020 Cap-and-Trade Program	Reduce GHGs across largest GHG emissions sources	• Continue the existing Cap-and-Trade Program with declining caps to ensure the State's 2030 target is achieved.	

[10] CARB. 2016. Potential State-Level Strategies to Advance Sustainable, Equitable Communities and Reduce Vehicle Miles of Travel (VMT)--for Discussion. www.arb.ca.gov/cc/scopingplan/meetings/091316/Potential%20VMT%20Measures%20For%20Discussion_9.13.16.pdf

[11] CARB. Reducing Short-Lived Climate Pollutants in California. www.arb.ca.gov/cc/shortlived/shortlived.htm

[12] California Department of Transportation. California Sustainable Freight Action Plan website. http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/main.html

Table 4 summarizes the results of the modeling for the 2017 Scoping Plan Reference Scenario. Per SB 32, which requires a 40 percent reduction below 1990 GHG emissions, the 2030 limit is 260 $MMTCO_2e$. At approximately 389 $MMTCO_2e$ in 2030, the Reference Scenario is expected to exceed the 2030 limit by about 129 $MMTCO_2e$.

Table 4 also compares the Reference Scenario 2030 emissions estimate of 389 $MMTCO_2e$ to the 2030 target of 260 $MMTCO_2e$ and the level of 2030 emissions with the non Cap-and-Trade Program policies, estimated to be 320 $MMTCO_2e$ in 2030. In the context of a linear path to achieve the 2030 target, there is also a need to achieve cumulative estimated emissions reductions of 621 $MMTCO_2e$ from 2021 to 2030 to reach the 2030 limit. While there is no explicit statutory limit on cumulative emissions, the 2017 Scoping Plan analysis considers and presents some results in cumulative form.

It should be recognized that policies and measures may perform differently over time. For example, in early years, a policy or measure may be slowly deployed, but over time that policy may have a large emissions reduction impact. Looking at the annual performance in 2021 versus 2030 could mask the importance of the measure in achieving reductions over time. Further, once GHGs are emitted into the atmosphere, they can have long lifetimes that contribute to global warming for decades. Policies that reduce both cumulative GHG emissions and achieve the single-year 2030 target provide the most effective path to reducing climate change impacts. A cumulative construct provides a more complete way to evaluate the effectiveness of any measure over time, instead of just considering a snapshot for a single year.

Table 4. 2030 Modeling GHG Results for the Reference Scenario and Non Cap-and-Trade Policies

Modeling Scenario	2030 GHG Emissions ($MMTCO_2e$)	Cumulative GHG Reductions 2021–2030 ($MMTCO_2e$)	Cumulative Gap to 2030 Target ($MMTCO_2e$)
Reference Scenario (Business-as-Usual)	389	n/a	621
Non-Cap-and-Trade Program Measures	320	385	236

As noted above, the non Cap-and-Trade Program policies are not expected to achieve the 2030 target, requiring the Cap-and-Trade Program to achieve emissions reductions of 60 $MMTCO_2e$ in 2030 and cumulative emissions reductions of about 236 $MMTCO_2e$ from 2021 through 2030. If the estimated GHG reductions from the non-Cap-and-Trade Program policies are not realized due to delays in implementation or technology deployment, the post-2020 Cap-and-Trade Program would need to deliver the additional GHG reductions in the sectors it covers to ensure the 2030 target is achieved.

Since the Scoping Plan adoption in December 2017, the State has begun the process to enhance or design some of the policies included in the 2017 Scoping Plan. For example, CARB is in the process of updating the Low Carbon Fuel Standard Regulation to increase the carbon intensity reduction to 20 percent by 2030, which is beyond the 18 percent carbon intensity reduction in 2030 identified in the 2017 Scoping Plan.[13] Since the 2017 Scoping Plan, CARB has also proposed to allow the electricity sector to achieve GHG reductions beyond the 50 percent RPS (required by Senate Bill 350 (SB 350)) through the SB 350 Integrated Response Plan range.[14] This electricity sector range recognizes that some utilities may be able to exceed the 50 percent RPS and the sector could deliver more GHG reductions between 2021 and 2030 than estimated in the 2017 Scoping Plan modeling. While these two examples show enhancements to policies beyond those modeled in the 2017 Scoping Plan, there may be implementation, technological, or other delays in designing and implementing other policies, which would mean some policies may deliver fewer GHG reductions than modeled in the 2017 Scoping Plan process.

During the development of the 2017 Scoping Plan, an uncertainty analysis was performed to examine the range of outcomes that could occur under the Scoping Plan policies and measures. Uncertainty in the following factors was characterized and evaluated:

- Economic growth through 2030;
- Emission intensity of the California economy;
- Cumulative emissions reductions (2021 to 2030) achieved by the non-Cap-and-Trade Program measures; and
- Cumulative emissions reductions (2021 to 2030) that can be motivated by emission prices under the Cap-and-Trade Program.

The 2017 Scoping Plan analysis estimates that the non-Cap-and-Trade Program measures will achieve cumulative emissions reductions of 385 $MMTCO_2e$, while the Cap-and-Trade Program will achieve 236 $MMTCO_2e$, resulting in total cumulative emissions reductions of 621 $MMTCO_2e$ from 2021 through 2030. The results of the Uncertainty Analysis are summarized as follows:

- The cumulative emissions reductions required to achieve the 2030 emission limit has the potential to be higher or lower than the Scoping Plan estimate. The uncertainty analysis simulates an average required emissions reductions of about 660 $MMTCO_2e$ with a range of $\pm$130 $MMTCO_2e$.[15] Notably, the estimate of the average required emissions reductions is 40 $MMTCO_2e$ greater than the estimate in the Scoping Plan analysis.

- Non-Cap-and-Trade Program measures have the potential to underperform relative to expectations. Based on CARB staff assessments of the potential risk

[13] https://www.arb.ca.gov/regact/2018/lcfs18/lcfs18.htm
[14] https://www.arb.ca.gov/cc/sb350/draftstaffreport_sb350_irp.pdf
[15] The ranges presented are the 5th and 95th percentile observations in the Uncertainty Analysis. See Appendix E of the 2017 Climate Change Scoping Plan for details. Available here: https://www.arb.ca.gov/cc/scopingplan/2030sp_appe_econ_final.pdf

of underperformance of each measure, the average emissions reductions simulated to be achieved was 335 $MMTCO_2e$, or about 13 percent below the Scoping Plan estimate. The range for the performance of the measures was about $\pm$50 $MMTCO_2e$.

- The Cap-and-Trade Program is designed to fill the gap in the required emissions reductions over and above what is achieved by the other 2017 Scoping Plan measures. Because the total required emissions reductions are uncertain, and the emissions reductions achieved by non-Cap-and-Trade Program measures are uncertain, the required emissions reductions from the Cap-and-Trade Program are also uncertain. The uncertainty analysis simulated the average cumulative emissions reductions achieved by the Cap-and-Trade Program at about 305 $MMTCO_2e$, or about 30 percent higher than the 2017 Scoping Plan estimate. The range was simulated to be about $\pm$120 $MMTCO_2e$.

Given uncertainty in future emissions and reductions, the Cap-and-Trade Program may need to deliver more, or fewer, GHG reductions than anticipated in the 2017 Scoping Plan depending on how many reductions the other policies ultimately deliver through 2030 and the emissions intensity of the California economy.

In constructing the baseline conditions for this analysis, the 2017 Scoping Plan provides context for the role of the Cap-and-Trade Program in achieving the 2030 target. In addition, the baseline conditions must include the Cap-and-Trade Program that is currently in force and that would exist in the absence of the Amended Regulation through 2030.

Table 5 above outlines the baseline scenario for this analysis and includes a description of the rationale for each baseline feature. The list of features in Table 5 does not represent all design elements of the Program. This list only includes the design features that are subject to change in this rulemaking, and it is these features that have been input as the baseline scenario into the modeling described later in the macroeconomic impacts described in Section E.

Table 5. Cap-and-Trade Program Baseline Scenario

Program Feature	Baseline Description	Rationale
Allowance Price Containment Reserve (APCR or Reserve) Structure	Single Tier	Existing Regulation[16]
Reserve Price	$75.58 (2021) to $84.86 (2030) ($2018)(extrapolation)	Existing Regulation
Allowances from post-2020 Reserve and any unsold auction allowances	Placed into single tier	Existing Regulation
Offset usage limit	8 percent	Existing Regulation
Industrial Allocation Assistance Factors	2018-2020: 50%, 75%, 100% 2021-2030: CARB will assess the Proposed Amendments for post-2020 against the current CP3 baseline of 50%, 75%, and 100%"	AB 32, AB 398 both speak to the need to minimize leakage. Free allocation of allowances is the primary mechanism in the Cap-and-Trade Program to respond to this mandate. AB 398 sets the post-2020 assistance factors to 100 percent. It is reasonable to set the post-2020 assistance factors for the baseline scenario to at least those in the third compliance period as CARB would continue to be required to minimize leakage under AB 32. The existing 50%, 75%, and 100% baseline further reflects that in the previous regulatory revisions approved by the Board in 2017, staff was continuing to consider whether to maintain these three assistance factor levels based on leakage studies and Board direction in the 2018-2030 timeframe, or to modify them based on additional leakage assessments.[17]
Energy Imbalance Market (EIM) Outstanding Emissions and unfulfilled compliance obligations from bankruptcies	Retirement for EIM if unsold allowances still available.	Existing Regulation

Use of State-Controlled Proceeds	100% to Greenhouse Gas Reduction Fund (GGRF)	Approximately $2.5 billion allocated to projects through GGRF with the remainder returned to directly to consumers.
Reductions from Non-Cap-and-Trade Program Measures	As specified in Initial Scoping Plan	Discussed above.

For comparison purposes with the range of price points assessed for the Amended Regulation, Table 6 contains the auction reserve price and single-tier Reserve price from the current Regulation which is used in the baseline scenario through 2030.

Table 6. Baseline Prices ($2018)

Year	Auction Reserve Price	Single Reserve Tier
2021	$16.82	$75.58
2022	$17.66	$76.42
2023	$18.54	$77.31
2024	$19.47	$78.23
2025	$20.45	$79.21
2026	$21.47	$80.23
2027	$22.54	$81.30
2028	$23.67	$82.43
2029	$24.85	$83.61
2030	$26.09	$84.86

6. Public Outreach and Input

CARB has requested input from stakeholders and the public regarding the Amended Regulation. In 2017 and 2018, CARB conducted four public workshops, which were webcast and made available by teleconference, on the Amended Regulation. Information regarding these workshops and any associated materials are posted on the CARB website and distributed through several public listservs that include over 1,000 recipients.[18] In addition, CARB staff held numerous informal meetings with stakeholders. The workshops and meetings allowed CARB staff to consider stakeholder feedback and to incorporate it into the Amended Regulation, as appropriate. CARB staff will continue to consider stakeholder feedback throughout the regulatory adoption process, including up to the adoption of the final regulation.

[16] Existing Regulation refers to what is currently in force pursuant to Board adoption of amendments to the Cap-and-Trade Regulation in 2017. https://www.arb.ca.gov/cc/capandtrade/capandtrade/unofficial_ct_100217.pdf
[17] https://www.arb.ca.gov/regact/2016/capandtrade16/capandtrade16.htm
[18] https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm

The public workshops at which CARB solicited comments and feedback from affected stakeholders regarding the amendments include:

- Oct. 12, 2017: A “Kickoff workshop on Next Steps for the Post-2020 Cap-and-Trade Regulation” introduced possible revisions to the Regulation in response to AB 398 and Board Resolution 17-21, as well as other possible changes. Representatives of Québec and Ontario also presented updates and took questions on their respective programs.

- March 2, 2018: A “Workshop to Discuss Possible Revisions to the Cap-and-Trade Regulation” presented potential revisions to the Regulation in more detail. In advance of this workshop, staff provided a Preliminary Discussion Draft of possible changes to regulatory text and a Price Containment Concept Paper that presented and discussed options for establishing the price ceiling and post-2020 Reserve tiers. In addition, a representative from the California Independent System Operator (CAISO) presented a draft proposal for calculating GHG emissions from the EIM.

- April 26, 2018: A “Workshop to Discuss Possible Revisions to the Cap-and-Trade Regulation” presented further information on potential amendment concepts. Prior to this workshop, staff released two documents to facilitate public discussion: Supporting Material for Assessment of Post-2020 Caps, which assessed post-2020 caps per AB 398, and Summary of Stakeholder Workshop Comments, which summarized stakeholder feedback on material presented in conjunction with the March 2 workshop.

- June 21, 2018: A “Workshop to Discuss Possible Revisions to the Cap-and-Trade Regulation” presented further information on potential amendment concepts. Prior to the workshop, staff released a second-round version of the Preliminary Discussion Draft of possible changes to regulatory text. In addition, a representative from CAISO presented an update on its draft proposal for calculating GHG emissions from the EIM.

In addition to continued efforts to solicit feedback from stakeholders about alternatives to the Amended Regulation, specific solicitations to help inform the SRIA were made through an initial concept paper on “Price Containment Points, Price Ceiling, and Allowance Pools” (CARB 2018) released prior to the March 2, 2018 workshop and during the workshops for stakeholders to provide regulatory alternatives that have been incorporated into this SRIA analysis.

B. BENEFITS

The Cap-and-Trade Program and the proposed Amended Regulation have been designed to support growth in activities that result in lower GHG emissions. As the benefits related to emissions reductions and return of allowance value are not different than modeled in the baseline scenario under the current Regulation, there are not any anticipated incremental benefits as a result of the Amended Regulation. CARB expects indirect benefits could accrue as a result of the overall Program (including the current Regulation and Amended Regulation). First, benefits such as reduced GHG emissions and reduced operating costs could result from investments in energy efficiency and energy conservation funded through the use of proceeds from the sale of State-owned allowances through the Greenhouse Gas Reduction Fund (GGRF). Second, these reduced GHG emissions could result in benefits from avoided environmental damages. Third, there could be potential avoided health impacts related to a reduction in co-pollutants.

If the allowance price rises above the Reserve price in current Regulation for the post-2020 period, there may be an incentive for entities to make emissions reductions sooner under the Amended Regulation. The potential benefit of expedited reductions can be valued using the Social Cost of Carbon (SCC). The SCC provides a dollar valuation of the damages caused by one metric ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.[19] As described by the Interagency Working Group (IWG) which developed a methodology for estimating the SCC, these damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as the services that natural ecosystems provide to society. Many of these damages from carbon emissions today will affect economic outcomes throughout the next several centuries.[20]

As outlined in Table 7, the SCC is year specific and increases over time. The damages of carbon emissions in 2030 are higher than in 2025, therefore expediting reductions would result in a reduction in the environmental damages associated with carbon emissions. As the potential for expedited reductions resulting from the Amended Regulation is highly uncertain, CARB did not estimate the quantity of potential reduction. However, Table 7 can provide an estimate of the total potential avoided costs from the Amended Regulation.

[19] See page 39 of the 2017 Scoping Plan for more information on California's use of the SCC: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

[20] From The National Academies, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, 2017, available at: http://www.nap.edu/24651

Table 7. Social Cost of Carbon 2020 – 2030 Per Metric Ton

Year	5 Percent Discount Rate	3 Percent Discount Rate	2.5 Percent Discount Rate
	($2018)		
2020	$14.47	$50.65	$74.76
2025	$16.88	$55.47	$82.00
2030	$19.29	$60.29	$88.03

1. Benefits to Individuals

There are no direct incremental benefits to individuals from the Amended Regulation, relative to the existing Program. However, individuals benefit from the return of value through the sale of State-owned allowances. If the return of allowance value under the Amended Regulation is different from the return of value under the current Regulation, individuals in California may see any indirect benefit. California Climate Investment programs that currently benefit individuals include electric vehicle incentives, more efficient water pumps, utility climate credits, and other expenditures. Individuals also may experience lower household expenditures relative to the existing Program, which may be driven by greater energy efficiency, clean technology innovations, and additional economic benefits from any direct return of allowance value under the Amended Regulation.

Additional benefits to individuals may include the following:

- To the extent actions may be taken earlier in response to the price points included in the Amended Regulation, there may be benefits to individuals related to criteria and toxic emission reduction co-benefits.[21]

- As well-designed Program that continues to reduce GHG emissions while growing the economy will attract new linkage partners or support other jurisdictions introducing carbon pricing modeled after the Program. Increased and broader action on climate change mitigation will help avoid the most harmful impacts of climate change and reduce the intensity and durations of drought, heat waves, wild fires, and other extreme weather-related events that lead to personal financial losses and loss of life.

- Specifically, low income households are more vulnerable to the impacts posed by climate change and usually have fewer resources to adapt or respond to those impacts. The Cap-and-Trade Program provides monies through the return of allowance value from the sale of state-owned allowances to help residents in the State's most vulnerable communities, ensuring that all California residents can have access to clean technology, energy efficiency tools, and participate in the

[21] CARB. 2017. Response to Comments on the Draft Environmental Analysis for the Cap-and-Trade Regulatory Amendments and California's Compliance Plan for the Federal Clean Power Plan, p. 2-22, https://www.arb.ca.gov/regact/2016/capandtrade16/finalrtc.pdf.

cleaner economy. Further, SB 535 and AB 1550 direct State and local agencies to make significant investments using GGRF monies to assist California's most vulnerable communities. To date, 50 percent of the $1.2 billion dollars spent on California Climate Investments projects provided benefits to disadvantage communities; and 34 percent of this funding was used on projects located directly in disadvantaged communities[22]

- In addition, although difficult to assess, if the Proposed Amendments result in additional offset projects that result in direct environmental benefits to the state, these projects may result in additional benefits to individuals. For example, if the if criteria related to direct environmental benefits incentivizes additional forestry projects, individuals may gain from the water quality, ecological, and recreational amenities produced by the forest.

2. Benefits to Typical Businesses

Typical businesses may benefit from the financial incentive to develop lower-carbon technologies and manufacturing processes that could provide substantial expenditure reductions in the operations of many covered facilities. The addition of the price ceiling per AB 398 provides some planning certainty regarding the upper bound on a cost for a metric ton of carbon in the Program, which may benefit businesses as they plan their long-term investment strategies.

Covered industrial businesses may receive additional freely allocated allowances in the third compliance period under the Amended Regulation as compared with the current Regulation, reducing their direct cost of compliance and cost pass through. If these businesses reduce emissions and sell excess allowances they may recover some costs related to investments in emission reductions.

3. Benefits to Small Businesses

There are likely no small businesses directly regulated by the Cap-and-Trade Program. However, small businesses could experience indirect economic benefits as a result of cost-savings attributed to the operation of energy efficient technologies and utility climate credits for small businesses. The Amended Regulation may also benefit small businesses that produce or sell low-carbon technologies.

C. DIRECT COSTS

1. Direct Cost Inputs

a. Change in relative offset prices

[22] https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

AB 398 imposes two requirements that could have the effect of reducing the percentage of offsets each California covered entity may surrender for compliance post-2020, as well as reducing the supply of offsets that qualify for the full surrender percentage. Given market dynamics, the cost impact of the potential offset usage limit is difficult to quantify. Any potential change in offset usage limit could impact the supply of offsets as well as the demand, relative to other compliance instruments.

i. Change in Quantitative Offset Usage Limit

AB 398 requires that CARB implement an offsets usage limit of 4 percent of compliance obligations based on emissions from 2021 to 2025, and then increase the usage limit to 6 percent of compliance obligations based on emissions from 2026 to 2030. CARB does not anticipate any economic impact from the change in the quantitative offset usage limit if the number of offsets issued in the future by all jurisdictions continues to be less than the combined offset usage limits for the three linked jurisdictions.

ii. Half of Offsets Used for Compliance Must Demonstrate a Direct Environmental Benefit to California

AB 398 specifies that at least half of offsets surrendered to meet a compliance obligation for emissions years 2021-2030 must provide a DEB in California. AB 398 defines “direct environmental benefits in the state” as “the reduction or avoidance of emissions of any air pollutant in the state or the reduction or avoidance of any pollutant that could have an adverse impact on waters of the state.” This requirement speaks to air pollutant reductions or the avoidance of any pollutant beyond GHG benefits for which an offset credit would be provided.

CARB has not finalized a proposal to define what constitutes a DEB. For this SRIA, we assume there will be some proportion of offsets issued, depending on the finalized DEB criteria, that do not provide a DEB.

Application of the DEB criteria may change the way in which covered entities use offsets. Once CARB defines the DEB criteria, there will be an incentive for those holding or already contracted to purchase offsets that may not meet the DEB definition to use them for second and third compliance period surrender, before the restriction comes into effect. Prices of offsets that provide DEB (or even for those that are expected to provide DEB) would likely rise in relation to offsets that do not provide DEB, but this price differential on offsets is not expected to have an overall macroeconomic impact on the California economy.

The DEB requirement will apply to offsets surrendered to cover emissions from 2021 onwards. Therefore, this provision will not restrict the number of offsets that may be used to cover obligations from 2018 through 2020. There are currently a total of approximately 62.6 million offsets held in entity accounts. Under the existing 8 percent offset usage limit, California covered entities could use approximately 30 million offsets per year for the second and third compliance periods. An increased use of offsets during 2018 through 2020 may provide some reduced cost of compliance during that period as offsets are still lower cost compliance options than purchasing and retiring allowances.

iii. Combined Effects of the Two Offset Restrictions

The DEB and quantitative usage restrictions could create a pool of offsets that can be used by California covered entities through 2020, but only used in limited quantities after that, which could affect their current market value. If the DEB and quantitative usage restrictions limit the number of offsets California covered entities may use for compliance, entities would have to either invest in more onsite reductions earlier than planned or, more likely, purchase more allowances. This could increase allowance prices as well as the proceeds from the auction of state owned allowances. As the impact depends on future emissions, potential opportunities for abatement, and market conditions that are uncertain, the overall impact of the two offset restrictions is not known with certainty.

CARB is continuing to work on a proposed definition of DEB and does not have a forecast of future offset production. CARB makes two assumptions to estimate the potential cost impact of this provision. First, CARB assumes entities would use offsets up to each year's limit. Second, CARB evaluates the cost of compliance instruments at the Auction Reserve Price. As the above assessment makes clear, CARB cannot determine how many additional allowances entities will have to use for compliance to replace offsets they can no longer used based on the two restrictions described above. Staff calculates the cost of a hypothetical one percent increase in the use of allowances to replace offsets. This approach allows for the scaling up of cost estimates if estimates of offsets that do not meet the DEB criteria become available in the future. CARB estimates the incremental cost of an additional allowance surrendered using historical differences between average allowance and offset prices.

b. Potential change in allowance prices due to offset rules

Based on the observed offset usage from entities in the Program, CARB anticipates that restricting the use of offsets will have minimal economic impact on businesses, and even then, only if covered entities in linked jurisdictions do not use offsets up to their current 8 percent usage limits for 2018-2020 emissions. If that happens, and California entities use offsets up to the California limits, then CARB assumes California covered entities will have to purchase a greater number of allowances to cover their compliance obligation. Since prices for offsets are currently about 15 percent less expensive than allowances, as indicated by the Summary Table of Market Transfers Completed in 2016,[23] covered entities will be paying a higher amount to cover their compliance obligation. This could potentially result in increased investments in onsite reductions, however given the uncertainty in entity response, this potential impact is not quantified.

CARB estimates the increased cost of the change in offset rules at $32 million per year

[23] https://www.arb.ca.gov/cc/capandtrade/2016transferssummary%20final.xlsx

from 2021 through 2025 (when the AB 398 offset usage limit is 4 percent) and about $16 million per year from 2026 through 2030 (when the AB 398 offset usage limit is 6 percent) when evaluated at the Auction Reserve Price. Table 8 presents the estimated incremental cost to entities in California from the change in offset rules for the years 2021 and 2026 when the offset limit is the most limited, though impacts will exist for all years. The values in the table represent the average expenditure on allowances or offsets over the 2021-2025 and 2026-2030 periods.

If the usage limits and DEB requirement reduce the pool of offsets available to California covered entities, the additional purchase of allowances to replace the offsets could increase the price of allowances. While the potential price impact is highly uncertain, if the price of allowances were to increase by 1 percent, then covered entities would spend an estimated additional $85 million per year from 2021 through 2025 and about $65 million per year from 2026 through 2030.

Table 8. Potential Impacts from Offset Use Limit Change Evaluated at the Auction Reserve Price (Million $2018)

	2021-2025 Average Expenditure	**2026-2030 Average Expenditure**
Current Baseline Use Limit	**8%**	**8%**
Allowances Cost	$5,007.3	$4,931.8
Offset Cost	$370.6	$365.0
Total Cost	$5,377.8	$5,296.8
Proposed Amendment Use Limit	**4%**	**6%**
Allowances Cost	$5,194.4	$5,039.0
Offset Cost	$211.3	$273.7
Total Cost	$5,405.7	$5,312.8
Absolute Change	**$27.9**	**$16.0**
Percent Change	**0.5%**	**0.3%**

Finally, since AB 398 requires that at least half of the offsets that may be surrendered for compliance periods covering emissions years 2021-2030 must originate from projects that provide DEB in state, there is the potential that not enough offsets will be available since not enough will meet the DEB criteria. The effect of this supply restriction would be that an even greater amount of entities' obligations would need to be made up of allowances, which would further increase the overall cost of compliance as described above.

To date, only larger covered entities having been utilizing offsets, while medium to smaller covered entities have not. It the offset usage pattern were to persist and not enough offsets are available for the larger covered entities, these entities would acquire more allowances increasing their compliance costs. An increased demand for allowances could also potentially raise compliance costs for medium and smaller covered entities.

c. Replacement of Future Vintage Borrowing Provisions with the Price Ceiling

If demand for allowances should exceed the number of allowances available for sale to covered entities at Reserve sales, the existing Regulation makes available an additional 10 percent of each future vintage allowances (see Section 95870(i)(1).) If this mechanism is needed, the Regulation requires the sale of allowances first from the latest vintage year of allowances. For example, if this mechanism were needed today, CARB would take 10 percent of the allowances from the year 2030. The 10 percent would be calculated against the number of allowances left in 2030 after any are removed for the existing Reserve. Any use of this mechanism to retire future vintage allowances for current compliance surrender obligations would reduce the number of allowances available to the market in the future as these allowances are from under the cap.

AB 398 requires CARB to modify the Regulation to create a price ceiling at which covered entities may purchase allowances or, if such allowances are exhausted, pay for metric tons to meet their compliance obligations. AB 398 requires that CARB use proceeds from purchases at the price ceiling to obtain sufficient real reductions to meet all demand at the price ceiling. In addition, in accordance with AB 398, some of the allowances remaining in the existing Reserve will be available for sale at the price ceiling. This amount will include at least 40,611,000 pre-2021 allowances from the existing Reserve and any allowances that remain unsold from auctions for a period of 24 months.

Given the legislative direction on the price ceiling, as part of the Amended Regulation, CARB is proposing to remove the existing regulatory provision that funds the Reserve with allowances borrowed from future allowance budgets. The new price ceiling mechanism makes the borrowing provision unnecessary. The price ceiling mechanism will eliminate the potential reduction in future allowance auction budgets. This means that unlike under the existing Regulation’s Reserve borrowing mechanism, accessing the price ceiling mechanism will not increase the likelihood that the borrowing mechanism will be accessed in the future. However, it is possible that market participants may anticipate that the annual decline in the emissions cap means that once the price ceiling mechanism is accessed, prices will remain at that level.

Importantly, adding a price ceiling does not increase the chance of higher prices relative to the existing Regulation. The existing regulation has a single Reserve tier with slightly above 214 million allowances at a price of $84.86 in 2030 (in 2018 dollars). Under the current Regulation, this single tier would be comprised of 121.8 million pre-2021 APCR allowances, 52.4 million post-2020 Reserve allowances, and at least 40 million allowances that have remained unsold at auction for over 24 months (pursuant to the current Regulation). There exist several design features in the current Regulation that will mitigate against price volatility and price spikes that could lead to prices higher than those in the current Reserve. These features include the ability for covered entities to reduce emissions early and 'bank' those allowances for future use. This can significantly lower the cost of meeting emissions reductions goals by providing temporal flexibility and encouraging early action. Banking allows entities to plan and appropriately manage their costs for the Cap-and-Trade Program through limited hedging up to the holding limits. The continued use of limited banking, carefully designed price containment tiers as required by AB 398, allocation to minimize leakage, a steadily escalating Auction Reserve Price, and robust offset supply should provide for a smooth carbon price trajectory through 2030.

Further, the price ceiling would only be accessed if there was a significant year-over-year demand for compliance instruments due to GHG emissions increases. Due to existing holding limits in the Program, it would be very difficult to force prices to the level of a price ceiling unless high emissions persisted and the price ceiling were set low. Recent 2017 Scoping Plan modeling shows that aggregate emissions in the covered sectors of the Program are anticipated to decline through 2030 in response to the non Cap-and-Trade Program policies. Therefore, CARB does not expect persistently high GHG emissions. And, in fact, recent economic and GHG inventory data shows the California economy is becoming more efficient over time.[24]

The price ceiling represents the upper bound of compliance on a cost-per-metric ton basis, but only if needed, which provides benefits to the Program. As presented in a paper by the Emissions Market Advisory Committee,[25] a price ceiling can serve as a deterrent to detrimental trading behavior that attempts to manipulate the market. The price ceiling could also serve as a safety valve in the Program against high prices so that ad hoc emergency measures based on political considerations would be less likely to occur, which would add significant uncertainty and potential disruptions to the market. Therefore, the price ceiling can increase regulatory and cost certainty and provide a long-term market signal for continued investment in emissions reductions.

However, as the primary goal of the Program is to reduce GHGs to help the State achieve its 2030 GHG target, the price ceiling must allow for discovery and action on the lowest cost opportunities to reduce GHG emissions across the economy. This means the price ceiling must be set to encourage actions to reduce emissions and not merely paying a cost-per-metric ton for compliance with no incentives or time to actually reduce emissions from covered sectors.

[24] https://www.arb.ca.gov/cc/inventory/data/data.htm
[25] https://www.arb.ca.gov/cc/capandtrade/emissionsmarketassessment/priceceiling.pdf

d. Effect of the Price Ceiling on the Value of Future Auction Proceeds.

Provisions under the Amended Regulation are anticipated to have no effect on future auction proceeds. If the price ceiling were accessed, the monies generated would be used by CARB to find GHG reductions on a tonne-per-tonne basis and not deposited into the GGRF. There are not anticipated to be any decrease in the future supply of allowances at auction, therefore there is not expected to be any incremental impact on the auction proceeds as a result of the Amended Regulation.

e. Baseline Distribution of Allowances Remaining from Existing Reserve

Under the current Regulation baseline scenario, the Reserve consists of three tiers until 2021, when the three tiers will collapse into a single tier. The three tiers were initially created with an equal number of allowances in each tier. The current Regulation also requires that allowances remaining unsold at auction after 24 months be diverted to the Reserve. Depending on future auction results, CARB currently expects at least 40 million unsold allowances to be placed in the Reserve. In addition, the current Regulation sets aside 52.4 million allowances from within the 2021-2030 caps to be placed into the collapsed single tier Reserve.

AB 398 requires CARB to implement several changes to the distribution of Reserve allowances compared with the existing Reserve. First, two-thirds of the allowances in the Reserve as of December 31, 2017 are to be removed from potential sale until 2021, when they will be divided evenly between the two new Reserve tiers, or price containment points under AB 398. Second, AB 398 requires that allowances remaining unsold after 24 months are transferred to the Reserve. This is similar to the existing requirement, except that the existing requirement requires the allowances to be placed in the top Reserve tier. Third, the allowances remaining in the Reserve as of December 31, 2020 will be available for sale at the price ceiling. This would include about 40 million allowances anticipated to remain unsold at auction that CARB expects to be transferred under the existing Regulation to the highest Reserve tier prior to 2021.

Table 9 contains staff estimates of the distribution of allowances and other valid instruments for the current three-tier Reserve, the single-tier Reserve that would have been created in 2021 under the current Regulation, and the price ceiling and two containment points being created under the Amended Regulation pursuant to AB 398.

Table 9 relies on several assumptions. First, CARB assumes that no allowances are sold from the Reserve before 2021. Based on existing market supply, emissions trends and modeling, current offset supply, and allowance budgets through 2020, this is a reasonable assumption. Second, CARB assumes at least 40 million allowances remaining unsold at auction will be diverted to the Reserve. This assumption depends on the continued full subscription of joint allowance auctions and should be taken as a minimum amount.

Table 9. Distribution of Allowances In Existing Three-Tier Reserve, Post-2020 Single-Tier (Baseline), and AB 398 Reserve Mechanisms

Tier	Existing Three-Tier Reserve (through 2020)	Post-2020 Single Tier (starting 2021)	AB 398 – post-2020
(million allowances)			
1	40.6	214.2[#]	40.6 (plus portion of 52.4)
2	40.6		40.6 (plus portion of 52.4)
3	80.6*		0
Price Ceiling	none	none	80.6 (40.6+40M unsold)
Other Valid Instruments	none	none	Unlimited (at ceiling)
Total Allowances	161.8	214.2	214.2⍰

* Includes ~40M allowances that remained unsold at auction for greater than 24 months
[#] Includes addition of 52.4M allowances designated to the Reserve by the current Regulation starting in 2021
⍰ Plus unlimited if price ceiling allowances exhausted
Source: CARB staff estimates

As explained in the previous section, replacement of the future vintage borrowing provisions under the existing Regulation with the price ceiling method is unlikely to have any direct impact on market participants. However, market participants could incur a direct cost impact if CARB sets the ceiling price above the current single tier price and if market participants access the ceiling price mechanism.

CARB has not yet finalized a proposal to set the two price containment points and the price ceiling. The spread in prices between the auction reserve price and first price containment point must allow sufficient time to find the GHG reduction opportunities at costs below the first price containment point. Once the first price containment point is accessed, there must be sufficient allowances at that price to allow the market time to identify and undertake additional actions to reduce GHGs before there is a need to access the second price containment point. Higher price containment points may allow the time to find additional GHG reductions below that price value, while lower price containment points may leave some lower cost GHG reductions unrealized. The replacement of the single-tier Reserve with the two Reserve tiers and price ceiling under AB 398 will reintroduce price intervention at a level below the highest tier. Designed right, this will slow the rate of price increases below the price ceiling while ensuring reductions below the price ceiling are realized.

Further, Table 9 makes some assumptions about the distribution of the post-2020 Reserve allowances of 52.4 million. In the table, it is indicated those will be distributed evenly across the two price containment points. CARB is still taking public comment on how to distribute those allowances. Additionally, in a public workshop, CARB indicated the potential to remove approximately 23 million additional allowances from 2021 through 2030 budgets to compensate for the increase in the offset usage limit in 2026.[26] Staff is also still taking comment on that option.

Related to the topic of distribution of allowances is the requirement in AB 398 to "evaluate and address concerns related to overallocation in the state board's determination of the available allowances for years 2021 to 2030, inclusive, as appropriate." CARB staff is continuing to evaluate this issue, but in response to this concern, some stakeholders have commented that CARB should pursue amendments as part of this rulemaking to either de-value or expire any unused allowances remaining after the compliance event for the third compliance period in 2021, or drop the post-2020 caps equal to the quantity of unused pre-2021 allowances that remain from the pre-2021 period. Removing or expiring any allowances that could be purchased as part of an auction will remove lower cost allowances from the Program, increasing scarcity, and potentially requiring compliance entities to purchase higher priced allowances in the price containment points and the price ceiling earlier than anticipated. While the price ceiling is meant to address concerns about higher compliance costs, removing lower cost allowances will increase the likelihood of needing to access the price containment points or price ceiling sooner. The addition of a price ceiling does not obviate the need to design a market that allows for efficient price discovery and identification and action on the lowest cost GHG reduction opportunities first. Additionally, per the existing Regulation and AB 398, during periods of low demand for allowances, any unsold allowances are removed from the market. This mechanism is meant to ensure low demand for allowances does not mute the carbon price signal and it can react to market conditions.

f. Total Costs

As the above assessment explains, producing cost estimates for the provisions in the Amended Regulation is difficult. Estimating the total cost of the Amended Regulation requires many assumptions that likely overstate the total cost of the Amended Regulation compared to the current Regulation. The total cost estimate reflects the incremental cost of the Amended Regulation in the event that the allowance price reaches the price ceiling in 2030.

In the case of the change in the usage limit and DEB requirements for offsets, CARB only identifies the circumstances in which the changes may cause an increase in compliance costs. This is because it is unknown how many offsets would qualify under the eventual DEB requirement and it is unknown whether offset production would increase enough to cause the usage limits to bind. Moreover, if some proportion of offset supply becomes unusable for California entities, staff is not able to estimate how

[26] https://www.arb.ca.gov/cc/capandtrade/meetings/20180302/ct_price_concept_paper.pdf

much of the excess will be used for compliance by Ontario or Québec entities. There may not be any significant additional cost.

In looking at the offset usage limit changes, CARB estimates the additional cost of switching from offsets to allowances by assuming entities use offsets up to the limit and the existing price difference between offsets and allowances remains constant. At the four percent limit in effect from 2021 through 2025, entities would pay an additional $27.9 million per year, an increase of 0.5 percent over the compliance costs assumed under the current Regulation. At the six percent limit in effect from 2026 through 2030, entities would pay an additional $16 million per year, an increase of about 0.3 percent relative to the current Regulation. If the increased use of allowances raised the price of allowances by one percent, costs would increase by about $85 million per year for the 2021-2025 and $65 million per year for 2026-2030.

CARB's analysis shows that the price ceiling in the Lower 2030 Range is set at virtually the same level as the Reserve price in the current Regulation. Thus, even in the unlikely event that allowance prices rise to the price ceiling, from 2021 through 2029, the incremental cost of the Amended Regulation would be zero, as the Lower 2030 Range price ceiling is lower than the current Reserve price until 2030. In 2030, when the price ceiling of the Lower 2030 Range is above the Reserve price of the current Regulation, the incremental statewide costs of the Amended Regulation are estimated to be at most about $115 million. The price ceiling for the Upper 2030 Range exceeds the current Reserve price beginning in 2024, so if allowance prices were to reach the price ceiling under this scenario, the costs would be greater than under the current Regulation. For example, in 2030 assuming allowances prices rise to the price ceiling, the increased cost could be about $1.2 billion under the Amended Regulation.

The remainder of this analysis addresses the cost impacts that could be expected under the worst case scenario in which allowance prices rise to the level of the price ceiling Upper 2030 Range of the Amended Regulation. Costs to covered sectors for the purchase of allowances at the price ceilings are discussed below.

2. Direct Costs on Typical Businesses

As explained above, at this time there are no specific CARB proposals on provisions that will impact the total cost of the Amended Regulation. While there is uncertainty on the final provisions of the Amended Regulation, this section estimates the direct costs on businesses that could result if market prices reach various price ceiling levels. This represents a hypothetical worst-case scenario, since CARB cannot predict when, or if ever, market prices would ever reach any of the price levels.

a. Potential Cost of Emissions Obligations at Price Ceiling

The Amended Regulation does not alter the Auction Reserve Price. In addition, the Amended Regulation could provide some additional relief from high prices compared with the existing Regulation if CARB proposes to set the two price containment points below the planned single tier price of the Reserve under the current Regulation. Entities could face higher compliance costs if CARB sets either price containment price point or price ceiling above the level planned for the single Reserve tier under the current Regulation, and assuming market prices ever rise to that level. Table 10 shows the estimated 2030 price ceiling values for the upper and lower range of values under the Amended Regulation and the single Reserve tier price under the current Regulation.

Table 10. Price Ceilings in Different Years

	2021	2025	2030
	($2018)		
Current Regulation Single Reserve Tier	$75.58	$79.21	$84.86
Lower Range	$65.00	$73.40	$85.44
Upper Range	$65.00	$96.52	$158.23

Table 11 displays the potential costs to industry in 2030 at the prices displayed in Table 10 should the price ceilings be reached.

Table 11. 2030 Potential Costs to Industry at Alternative Price Ceilings

2-digit NAICS	Description	Current Regulation	Lower Range	Upper Range
		(million $2018)		
11	Agriculture, Forestry, Fishing and Hunting	$3.4	$3.4	$6.3
21	Mining, Quarrying, and Oil and Gas Extraction	$831.1	$836.8	$1,549.7
22	Utilities	$3,906.0	$3,933.0	$7,283.3
31-33	Manufacturing	$4,161.7	$4,190.5	$7,760.3
42	Wholesale Trade	$6,162.1	$6,204.7	$11,490.3
44-45	Retail Trade	$163.1	$164.3	$304.2
48-49	Transportation and Warehousing	$1,118.5	$1,126.3	$2,085.7
52	Finance and Insurance	$30.4	$30.6	$56.6
54	Professional, Scientific, and Technical Services	$2.1	$2.1	$3.9
55	Management of Companies and Enterprises	$0.6	$0.6	$1.2
56	Administrative and Support and Waste Management and Remediation Services	$15.2	$15.3	$28.3
61	Educational Services	$43.1	$43.4	$80.4
62	Health Care and Social Assistance	$3.2	$3.2	$6.0
92	Public Administration	$4.8	$4.8	$8.9
	Total	**$16,445.3**	**$16,559.1**	**$30,665.1**

The calculations contained in Table 11 are based on 2016 emissions shares evaluated at the 2030 ceiling price. The estimated incremental cost to industry if the allowance price rises to the price ceiling in 2030 under the Lower 2030 Range is $113.8 million. The estimated incremental cost to industry is $14.2 billion. These cost estimates represent the upper bounds of costs and assume the allowance price rises to the price ceiling in 2030, which is highly uncertain.

3. Direct Costs on Small Businesses

Based on the entities already subject to the Cap-and-Trade Regulation, no small businesses would face a compliance obligation under the Amended Regulation. Small businesses will be indirectly affected by the Cap-and-Trade Program due to the increased price of fossil fuels. Costs will vary based on the sector's use of fossil fuels and their ability to reduce the use of fossil fuels in the production process.

4. Direct Costs on Individuals

Individuals are not directly covered by the Cap-and-Trade Program, but the Amended Regulation could result in a cost to individuals, if the increase in the price of goods based on their compliance cost pass through is higher under the Amended Regulation. Incorporating the cost of Cap-and-Trade Program allowances into the price of carbon-based fuels increases the price of fossil fuels and the price of products based on their use of fossil fuels. For example, with complete cost pass-through, for every $10.00 of allowance price, the price of gasoline could increase by about $0.09 per gallon. This cost will be directly faced by individuals purchasing these fuels in California and will also increase the price of delivered goods and services to Californians. To the extent that the Amended Regulation could result in higher allowance prices than the current Regulation, consumers could face higher fuel price impacts. The future allowance price is highly uncertain, but will be bound by the Auction Reserve Price (which is set through 2030) and the price ceiling, which will be determined throughout the regulatory process.

Consumers may also substitute away from forms of transportation and fuels as well as goods and services that reflect a carbon price. The 2017 Scoping Plan also indicates that the portfolio of climate policies that will achieve the 2030 target would reduce on-road fuel demand by about 45 percent from current levels. This could include, for example, increased travel by air and water where feasible (as aviation and marine emissions, as well as eligible biomass-derived fuels, are excluded from the Program) as other forms of transportation increase in cost. In this way, substitution and other policies directed at the transportation sector could reduce the direct costs of the Amended Regulation on individuals.

D. FISCAL IMPACTS

1. Local government

Currently, some local government entities (e.g., local utilities) are regulated parties in the Cap-and-Trade Program and would have a compliance obligation under the Amended Regulation. These local governments currently face administrative costs as well as costs associated with obtaining and surrendering compliance instruments. It is not anticipated that administrative costs will change under the Amended Regulation. Municipal utilities and public universities currently receive an allocation of allowances so they do not have to cover the full cost of their emissions obligation. To the extent that compliance costs may be higher under the Amended Regulation, local government entities could face higher costs associated with compliance. However, the potential impact is unknown given uncertainty in future emissions and market conditions under the Amended Regulation. There may be additional impacts based on the continuance and appropriation of auction proceeds from the Greenhouse Gas Reduction Fund (GGRF) that are directed to local government.

Local government entities that purchase goods and fossil fuels in California, but are not directly covered by the Program will face higher prices for fossil fuels and products that use fossil fuels if the cost of allowances under Amended Regulation are higher than under the current Program. Local governments could also benefit from new lower carbon technologies and innovations that may be indirect benefits of the Amended Regulation.

2. State Government

Currently, some State government entities are regulated parties in the Cap-and-Trade Program and would have a compliance obligation under the Amended Regulation. Examples include several University of California and California State University campuses. These State entities currently face administrative costs as well as costs associated with obtaining and surrendering compliance instruments. It is not anticipated that administrative costs will change under the Amended Regulation. Public universities currently receive an allocation of allowances so they do not have to cover the full cost of their emissions obligation. To the extent that compliance costs may be higher under the Amended Regulation, State entities could face higher costs associated with compliance. However, the potential impact is unknown given uncertainty in future emissions and market conditions under the Amended Regulation. There may be additional impacts based on the continuance and appropriation of auction proceeds from the Greenhouse Gas Reduction Fund (GGRF) that are directed to local government.

3. CARB

The Amended Regulation would have minimal impact on staffing resources, which could be accommodated through a redistribution of existing staff. The fiscal impact of the

Amended Regulation for CARB is expected to be absorbable and will not result in requests for new positions.

4. Other State agencies

State entities that purchase goods and fossil fuels in California, but are not directly covered by the Regulation, face higher prices for fossil fuels and products that use fossil fuels under the Program. To the extent that the Amended Regulation will result in higher allowance prices, state agencies could face higher fuel prices relative to the current Regulation. However, the impact is not known with certainty.

State entities could potentially benefit from new lower-carbon technologies and innovations that may be indirect benefits of the Amended Regulation.

As with the current Regulation, the Amended Regulation could potentially impact other state agencies based on the continuance and distribution of Greenhouse Gas Reduction Funds (GGRF) that might directed to other state agencies, however the impacts of GGRF funding under the Amended Regulation relative to the current Regulation is unknown and unquantified.

E. MACROECONOMIC IMPACTS

1. Methods for determining economic impacts

This section estimates the cumulative impact of the Amended Regulation on the California Economy. While the Cap-and-Trade Program has a broad impact on the California economy, the targeted provisions of the Amended Regulation are not expected to have a large impact relative to the current Regulation. While the price ceiling provisions of the Amended Regulation could result in a different upper bound for allowance prices than the current Regulation, the overall impact on the California economy is uncertain given future emissions and market conditions. The following analysis focuses on the incremental changes in major economic indicators including employment, personal income, and state gross domestic production (GDP) that result from the Amended Regulation relative to the current Regulation.

The direct costs discussed in Section 2 Direct Costs on Typical Businesses are input into Regional Economic Models, Inc. (REMI), Policy Insight Plus Version 2.1.1 to estimate the possible macroeconomic impacts of the Amended Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.

REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Amended Regulation, pursuant to the requirements of SB 617 and the California Department of Finance. CARB uses the REMI 2.1 single-region, 160-sector model with the model Reference case adjusted to reflect the Department of Finance Conforming

Forecast dated November 2017. These forecasts include California population figures, U.S. real GDP forecast, and civilian employment growth numbers.

The Amended Regulation is simulated in REMI by adjusting production costs for covered sectors to reflect the purchase of Cap-and-Trade Program allowances, the distribution of free allowances, and the transfer of proceeds from the quarterly auction of allowances to sectors that have been identified to receive legislative appropriation of these funds. Based on reported emissions for 2016, the Cap-and-Trade Program covers about 45 different 2 to 4-digit NAICS sectors in the REMI model. CARB recognizes that modeling the Amended Regulation in REMI through changes in production costs for covered entities and modifications to consumption and state spending (reflecting investment of auction proceeds) may not capture the full impact of the Program. For example, several simplistic assumptions are made about how allowance value is returned to the economy (i.e., how much and to which sectors) when in reality revenue return will be more complicated affecting more sectors or different mechanisms of return. However, CARB cannot anticipate how the Legislature will distribute funds from the GGRF in the future. Combined with the expected small percentage impacts on different sectors, assumptions on how the proceeds will be returned will largely determine the pattern of economic impacts.

2. Inputs of the Assessment

The estimated economic impacts of the Amended Regulation are sensitive to modeling assumptions. The direct and indirect costs and benefits of the Amended Regulation estimated in previous sections are translated into REMI variables and used as inputs for the macroeconomic analysis. Direct impacts include the cost of compliance and changes in demand for high carbon goods – relative to the current Regulation. Indirect impacts calculated in previous sections include cost pass through to consumers and any potential changes in state and local tax revenue. The model uses the inputs to calculate additional indirect and induced effects. The additional indirect effects are changes in sales, income or employment within California that supplies good or services to the directly affected industries. Induced effects capture changes within California that result from changes in household spending.

While the Amended Regulation contains provisions that might impact the cost of complying with the Cap-and-Trade Program (including changes to the offset usage limit and DEB criteria), the impact of these provisions is not anticipated to be outside the range of impacts estimated under the current Regulation. These provisions are not anticipated to result in a change in allowance price that is outside the range analyzed for the current Regulation, bound by the Auction Reserve Price and the Reserve price.

As such the macroeconomic modeling focuses on the provision of the Amended Regulation that could result in an incremental economic impact to the California economy. Establishing a price ceiling in the Program could impact the upper bounds on the cost of complying with the Amended Regulation relative to the current Regulation. Specifically, if the price ceiling varies from the top tier of the Reserve under the current

Regulation, there could be macroeconomic impacts related to the Amended Regulation. As previously described in Section A, since the price ceiling has not yet been established, CARB estimates the macroeconomic impact of changing the upper bounds on the cost of compliance under a variety of price paths to the price ceiling values outlined in Table 12.

Whether and when the price ceiling may be reached is highly uncertain as many features in the Program work together to support a smooth and steadily increasing allowance price and the price ceiling is meant to be a safety valve and not a price goal. The 2018 Auction Reserve Price is $14.53, while the most recent auction of State-owned allowances, in May of 2018, cleared at a price of $14.65. For prices to rise from the May auction clearing price to any of the proposed price ceiling levels would require unprecedented rapid allowance price increases. Historically the auction clearing price has tracked largely near the Auction Reserve Price, which increases 5 percent each year. Thus, the annual rate of growth in the auction clearing price has been around 5 percent since the start of the Program. Table 12 presents the annual rates of growth that would be required to get from $14.65 to the price ceiling in a particular year for the Lower 2030 Range and Upper 2030 Range of the Amended Regulation and the Reserve price under the current Regulation.

Table 12. Annual Rate of Growth for Allowance Price to Rise from May 2018 Auction Clearing Price to the Price Ceiling for Selected Years

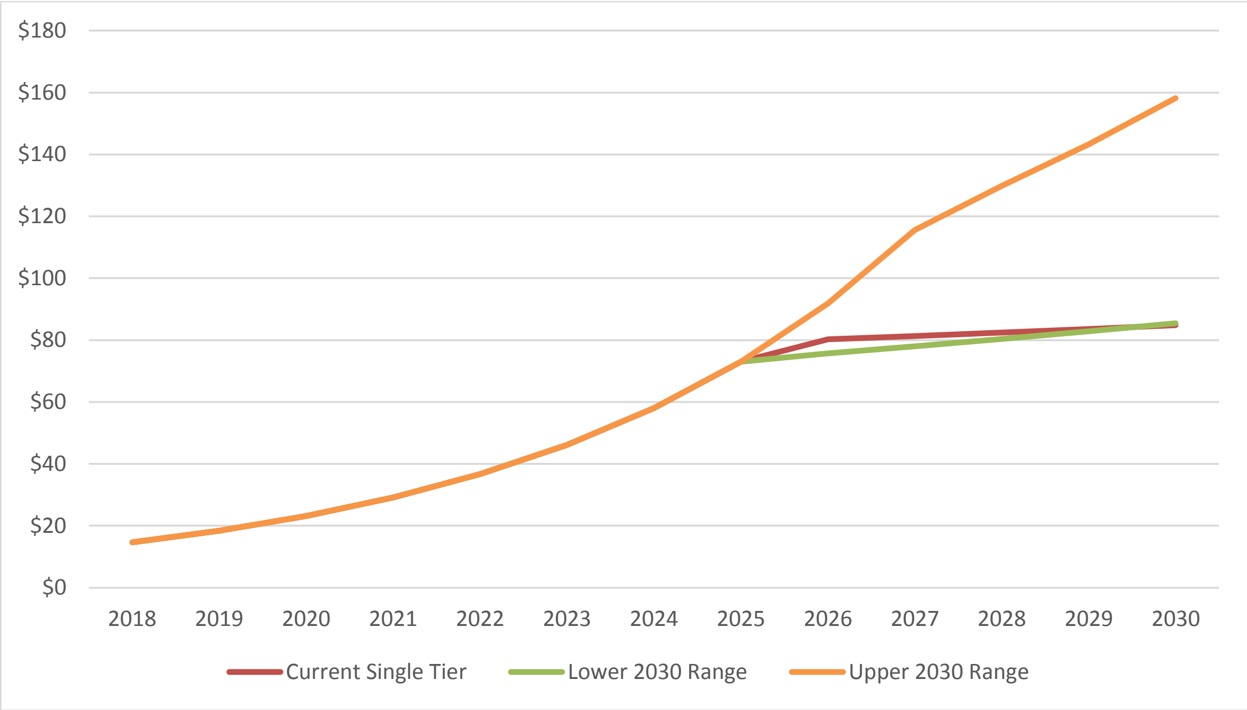
	2018-2021	2018-2025	2018-2030
Current Post-2020 Reserve Price	73%	27%	16%
Lower 2030 Range	64%	26%	16%
Upper 2030 Range	64%	31%	22%

The path of prices is highly uncertain and can result in significantly different economic impacts. While it is highly unlikely that the price ceiling will be reached in any year, there are infinite price path between the current allowance price and a price ceiling. As an illustrative example, prices could increase steadily by the percentages outlined in Table 12 each year, or there could be a period of no growth in allowance prices followed by a period of extremely high growth.

Conducting the economic modeling requires assumptions about the rate of price increase from current allowance price levels to the price ceilings under the Lower 2030 Range and Upper 2030 Range. To create an allowance price path, it is assumed that prices grow at a constant rate of 26 percent per year from the May 2018 auction clearing price of $14.65 to the various price ceilings presented in Table 10.

Figure 2 presents the price path used to reach the price ceiling in this analysis. The macroeconomic impact of the Amended Regulation is the difference between the Reserve price path under the current Regulation (in red) and the price ceiling price paths for the Amended Regulation (the Lower 2030 Range is in green and the Upper 2030 Range is orange). Relative to the current Regulation, the Amended Regulation Upper 2030 Range will result in higher upper bounds for compliance costs relative to the current Regulation. However, it is important to note, that establishing a price ceiling does not mean that the price value will be reached, the price ceiling instead establishes a maximum price per metric ton.

Figure 2. Hypothetical Price Paths Used for REMI Modeling of Ceiling Prices ($2018)



A second important assumption in the modeling is return of allowance value. For this SRIA, we assume the allowance value is returned to the economy to covered sectors for allocation, to the GGRF, or directly to consumers. At price ceiling paths, the amount of valued generated can be substantial. For example, in 2030 the value that could be directed to the GGRF or to consumers ranges from $10 billion to $38 billion (2018 dollars). Where this allowance value is directed makes a difference in the modeling results. In past Cap-and-Trade analyses it was assumed that a constant amount of $2 billion per year was directed to GGRF sectors with the remaining value being returned directly to consumers. In this analysis, it is assumed that 50 percent of returnable value (not including allocation to covered sectors) is directed to GGRF sectors in the percentages presented in Table 13 with the remaining 50 percent being returned directly to consumers. The appropriations in Table 13 are based on legislative appropriation from the GGRF through 2018 and represents an illustrative scenario of potential future disbursement. The return of future revenue through the GGRF will be subject to legislative appropriation. In this manner, as value increases with higher auction-clearing prices, a larger share of the allowance values goes to GGRF sectors.

Table 13. Conceptual Distribution of GGRF Value based on Historic Appropriation of Funds

Strategy	REMI Sector	Percent of Value to Sector
Sustainable Communities and Clean Transportation	Consumer new motor vehicles	12.5%
	Rail transportation	50.0%
	Truck transportation	12.5%
Energy Efficiency and Clean Energy	Consumer Household maintenance	20.0%
	Water, sewage, and other systems	1.0%
Natural Resources and Waste	Forestry; Fishing, hunting, trapping	2.0%
	Waste management and remediation	2.0%
Total per Year		**100.0%**

California Climate Investments projects include affordable housing, renewable energy, public transportation, zero-emission vehicles, environmental restoration, more sustainable agriculture, recycling and much more. At least 35 percent of these investments are made in disadvantaged and low-income communities.[27]

3. Results of the Assessment

The REMI impact of the Amended Regulation on the California economy is presented as the annual incremental change relative to the current Regulation (or baseline). As there is only anticipated to be an economic impact under the Amended Regulation if the price ceiling is different from the Reserve tier under the current Regulation, only the economic impacts for the price ceiling values are presented. As there is no change in the Auction Reserve Price, there is no incremental economic impact of the Amended Regulation at the lower bounds of allowance prices.

As will be seen from the tables below, the macroeconomic modeling suggests the Amended Regulation will only have minor impacts to the California economy. In addition to the tables, which depict estimated impacts for a single year, CARB estimates the change in annualized growth for several economic variables over the study period. CARB calculates that the Amended Regulation would not reduce the growth rates for total state employment or gross state product. CARB estimates that the impacts of the Amended Regulation could reduce growth in statewide personal income by 0.1 percentage points relative to a business as usual or baseline scenario.

a. California Employment Impacts

The California economy is growing, therefore the REMI baseline shows an increase in employment through 2030. Changes in employment growth as a result of the Amended

[27] https://ww2.arb.ca.gov/our-work/programs/california-climate-investments

Regulation are incremental results from growth forecasts in future years. As modeled, the Amended Regulation is anticipated to have a negligible impact on employment through 2030 under the lower and upper range of price ceilings. As shown in Table 14, under the upper range, the estimated impact on employment, relative to the current Regulation, is 0.1 percent in 2030 while there is no estimated impact under either range in 2025. Under the current regulation and the Amended Regulation employment grows at a rate of 0.8 percent.

As presented in Figure 2, the price paths for the Amended Regulation and the current Regulation do not diverge widely after 2025, therefore there is negligible economic impact due to the Amended Regulation until later years. This is largely a result of the price path assumptions discussed above.

Table 14. Estimated Total Employment Impact of the Amended Regulation

	Lower 2030 Range		Upper 2030 Range	
	2025	2030	2025	2030
	(thousands)			
Baseline	24,387	25,332	24,387	25,344
Absolute Change	0.0	2.3	0.0	14.3
Percent Change	0.0%	0.0%	0.0%	0.1%

b. California Business Impacts

Directly covered facilities will be required to acquire and surrender compliance instruments equal to their annual reported and verified emissions. If the Amended Regulation results in higher costs of compliance relative to the current Regulation, the cost of production will increase for covered entities. The Cap-and-Trade Program gives covered facilities the flexibility to either make emissions reductions or purchase compliance instruments, which minimizes their cost of compliance. All other consumers of fossil fuel products such as non-energy intensive industrials and most commercial businesses are not directly covered by the Program, but will pay higher prices for fossil fuels and products that use fossil fuels. To the extent that the price ceiling under the Amended Regulation is higher than the Reserve price of the current Regulation, these entities may face higher prices.

Table 15 presents the estimated changes to sector gross value added from the Amended Regulation in 2025 and 2030. There is no impact in 2025 as the modeled upper bounds price ceilings largely diverge from the current Regulation after 2025. Gross value added is the contribution of each private industry and government to the State's Gross Domestic Product (GDP). For the Lower 2030 Range, impacts to gross value added are barely positive reflecting that the price ceiling in the lower price range scenario is slightly lower than the current Regulation from 2025 until 2030. Estimated sector impacts to gross value added are substantial under the Amended Regulation Upper 2030 Range on the carbon intensive sectors covered by the Cap-and-Trade

Program such as mining and utilities in 2030. These sectors also have the largest compliance obligations. Sectors with positive changes are those that benefit from the return of allowance value and sectors that receive revenue indirectly from increased consumer spending.

Table 15. Sector Impacts Gross Value Added Percent Change from Reference Case

Percent Change	Lower 2030 Range		Upper 2030 Range	
Category	**2025**	**2030**	**2025**	**2030**
Forestry, Fishing, and Related Activities	0.0%	0.0%	0.0%	0.0%
Mining	0.0%	0.1%	0.0%	-4.9%
Utilities	0.0%	0.1%	0.0%	-2.1%
Construction	0.0%	0.0%	0.0%	-0.3%
Manufacturing	0.0%	0.0%	0.0%	-0.4%
Wholesale Trade	0.0%	0.0%	0.0%	-0.2%
Retail Trade	0.0%	0.0%	0.0%	-0.1%
Transportation and Warehousing	0.0%	0.0%	0.0%	-0.1%
Information	0.0%	0.0%	0.0%	0.0%
Finance and Insurance	0.0%	0.0%	0.0%	0.1%
Real Estate and Rental and Leaving	0.0%	0.0%	0.0%	0.0%
Professional, Scientific, and Technical Services	0.0%	0.0%	0.0%	0.0%
Management of Companies and Enterprises	0.0%	0.0%	0.0%	-0.2%
Administrative and Waste Management Services	0.0%	0.0%	0.0%	0.3%
Educational Services	0.0%	0.0%	0.0%	0.1%
Health Care and Social assistance	0.0%	0.0%	0.0%	0.2%
Arts, Entertainment, and Recreation	0.0%	0.0%	0.0%	0.1%
Accommodation and Food Services	0.0%	0.0%	0.0%	0.1%
Other Services, except Public Administration	0.0%	0.0%	0.0%	0.5%

c. Impacts on Investments in California

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy. Table 16 presents gross private domestic investment levels in California under the Amended Regulation and the impact of the Amended Regulation on gross private domestic growth. As modeled, the Amended Regulation will have negligible impacts on private investment growth, resulting in a maximum of one-fourth of one percent reduction in growth under the Upper 2030 Range. The model results are likely the result of increased prices of carbon intensive goods that result from the higher ceiling price under the Upper 2030 Range in 2030.

Table 16. Gross Private Domestic Fixed Investment

	Lower 2030 Range		Upper 2030 Range	
	2025	2030	2025	2030
	(billion $2018)			
Baseline	465	528	465	526
Absolute Change	0.0	0.0	0.0	0.0
Percent Change	0.0%	0.0%	0.0%	-0.4%

d. Impacts on Individuals in California

Table 17 shows the change in growth of personal income in 2025 and 2030. As modeled, there is a negligible increase in personal income under the Lower Range, which is not significantly different from zero and a slight decrease in personal income, one-tenth of one percent, under the Upper Range in 2030. The estimated impact under the Upper Range represents a $34 per person decrease in personal income under the Amended Regulation in 2030 relative to the current Regulation. Again, this modeled result assumes the price ceiling under the Amended Regulation Upper Range is reached in 2030, which is highly uncertain and therefore this estimate should be viewed as an upper bounds. Under the current regulation and the Amended Regulation Personal Income grows at a rate of 2.1 percent.

Table 17. Personal Income

	Lower 2030 Range		Upper 2030 Range	
	2025	2030	2025	2030
	(billion $2018)			
Baseline	2,685	2,984	2,685	2,981
Absolute Change	0.0	0.2	0.0	-1.6
Percent Change	0.0%	0.0%	0.0%	-0.1%

e. Impacts on Gross State Product (GSP)

GSP is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. As presented in Table 18, GSP growth is not estimated to see any impact as a result of the Amended Regulation in 2025. There is a very modest decrease in the growth of GSP, one-tenth of one percent in 2030 under the Amended Range Upper Range estimation. CARB interprets the impact of the Amended Regulation on GSP to as indiscernible in California's $3.4 trillion economy in 2030.[28] As modeled, it would take less than one year for GSP under the Amended Regulation to reach the GSP levels under the current Regulation. Under the current regulation and the Amended Regulation State GDP grows at an annualized? rate of 2.4 percent.

Table 18. Estimate Impact of the Amended Regulation on State Gross Domestic Product

	Lower 2030 Range		Upper 2030 Range	
	2025	2030	2025	2030
	(billion $2018)			
Baseline	3,084	3,467	3,084	3,463
Absolute Change	0.0	0.3	0.0	-3.0
Percent Change	0.0%	0.0%	0.0%	-0.1%

f. Incentives for Innovation

CARB has been evaluating the scope and costs for GHG emissions reductions from industrial facilities in California. This has informed the analysis of the economic impact of the Amended Regulation on the incentives for innovation. The Amended Regulation may increase the incentives for businesses to adopt lower carbon technologies in two ways. First, changes to the offset rules may result in higher allowance and offset prices. Second, if CARB sets the price ceiling and two price containment points above the current Regulation Reserve price, and market prices do rise to the new cost containment points, the Amended Regulation will provide incentives for industrial entities to adopt new technologies.

Table 19 presents a preliminary assessment of abatement opportunities that could become cost-effective for industrial facilities in California facing a carbon price. The costs of many of the abatement opportunities outlined in Table 19 are within the range of abatement or allowance prices anticipated under the Amended Regulation (within both the Lower and Upper Range). The estimates in Tables 19 include simplifying assumptions and are intended to provide a rough estimate of both potential reductions and associated costs for a limited range of technologies and industries. CARB plans to continue researching technology opportunities to provide additional information of the potential pathways to achieve emissions reductions in the industrial sector.

Table 19 includes a preliminary estimate of costs and GHG reductions that may be available for the following technologies: carbon capture and sequestration or CCS, concentrated solar thermal, biogas, boiler electrification, hydrogen production by electrolysis, and technologies specific to the cement sector. For each technology, Table

[28] U.S. Bureau of Economic Analysis, updated May 11, 2017. http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/. Accessed June 21, 2018.

19 includes an estimated range of GHG reduction costs, expressed in dollars per metric ton of carbon dioxide equivalent ($/MT$CO_2$e) and the industries in which this technology can be applied. Further evaluation would be needed to understand the specific opportunities and costs to an individual industrial sector for specific types of technology deployment.

Table 19. GHG reduction costs for technologies with applications in California's industrial sectors

Technology	GHG Reduction Cost Range ($/MT$CO_2$e)	Applicable Industries
Carbon Capture and Sequestration	20 - 120	Hydrogen and ethanol production
Concentrated solar thermal	100	Oil and gas production, Food processing
Biogas	70- 490	All sectors
Boiler electrification	35 - 500	All sectors using steam processes
Hydrogen electrolyzer	35 - 500	All sectors, hydrogen production
Cement sector technologies	-25 – 200*	Cement production

* Negative GHG reduction costs may occur when the savings on energy and material costs from an abatement option are greater than the increase capital and other expenses. Negative GHG reduction costs have been identified in the cement industry with process efficiency improvements and additional blending of supplementary cementitious material. The estimates included in this document were accessed from 2016 SCCER and are consistent with estimates developed by CARB in the 2010 Rulemaking.[29] However, CARB acknowledges that there are minimal cost saving improvements in process efficiency as these upgrades are a matter of normal operation, and additional SCM blending faces a number of barriers including regional availability and common practices (Tanaka 2009).

CARB evaluated GHG reductions from CCS for a variety of applications and found costs to be in the range of $20-$120 MTCO_2e. (CARB 2017c). Concentrated solar thermal technology to generate steam has potential to reduce GHG emissions from California's oil and gas production facilities, and CARB estimates GHG reduction costs of $100/MT$CO_2$e based on public information on projects currently being implemented (Aera Energy 2017, Glasspoint 2018a, Glasspoint 2018b). Industrial facilities can replace natural gas with biogas as a means of reducing GHG emissions, and based on a biogas cost range of $4-$26/MMBtu (Myers Jaffe 2016), this method could achieve reductions at costs in the range of $70-$490/MTCO_2e.

Opportunities exist to reduce GHG emissions by electrifying industrial processes with low cost, renewable electricity that would otherwise need to be curtailed for grid reliability. The economic feasibility of boiler electrification strongly depends on

[29] https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appf.pdf

electricity price, and CARB calculates that GHG reductions are available in the range of \$35-\$55/MTCO_2e for electricity at 3.7 cents/kWh, and \$330-\$500/MTCO_2e for electricity at 10 cents/kWh. GHG reductions from hydrogen electrolyzer technology also strongly depend on electricity price; when used for industrial gas production, CARB finds electrolysis can provide GHG reductions in the cost range of \$35-\$315/MTCO_2e, and when burned at facilities to displace natural gas use, the cost range is \$140-\$1,500/MTCO_2e. Methods of reducing cement plant emissions include approaches unique to the cement sector, such as using a different mix of raw material and burning solid biomass, and studies find that these approaches may achieve GHG reductions at costs in the range of \$36-\$106/MTCO_2e (Gupta 2011) and \$-25-\$200/MTCO_2e (SCCER 2016).

CARB will be using the best available information on abatement opportunities to help inform the implementation of AB 398 requirements on setting the value of the price ceiling and two price containment points. AB 398 directs CARB to consider the role of the carbon price in incenting direct reductions by covered entities, while not setting the price ceiling or price containment points so high as to inflict adverse economic impacts on resident households, businesses, and the state’s economy.

As the information contained in Table 19 represents a preliminary assessment of technologies and costs based on available public information, this information is not incorporated into the economic modeling. While relating the cost of abatement with changes in market price might provide additional information on the price path of allowances under various scenarios of emissions trends, CARB cannot estimate when allowance prices might significantly deviate from the Auction Reserve Price, nor can CARB estimate when, if ever, allowance prices might reach the two price containment points or the price ceiling. Thus, the estimated abatement costs in Table 19 will serve to inform selection of the price containment points and price ceiling by providing a comparative check against the range of allowance prices (including the price ceiling) of the final Amended Regulation.

g. Competitive Advantage or Disadvantage

Allowances are allocated freely to covered industrial sectors to protect against emissions leakage. Assistance factors are one part of the industrial allocation equation. Industry allocation is determined by a product-based benchmark, an amount of output in a given year, an industry specific Assistance Factor and a declining adjustment factor for each budget year. Assistance factors by budget year are presented in Table 20. While assistance factors for 2021-2030 are not specified in the current Regulation, AB 398 provides direction that all leakage categories receive an assistance factor of 100 percent during this period.

Table 20. Assistance Factors by Budget Year in Current Regulation

Leakage Risk	2013-2014	2015-2017	2018-2020	2021-2030
High	100%	100%	100%	Not specified
Medium	100%	100%	75%	Not specified
Low	100%	100%	50%	Not specified

A 100 percent assistance factor does not translate to any entity receiving all the allowances they need to comply with the current Regulation. The assistance factor is one of four variables in the allocation equation. CARB estimates that even with a 100 percent assistance factor, if industrial output remained constant, industry free allocation would decrease by 50 percent by 2030. Board Resolution 17-21 directs CARB to propose regulatory amendments to provide a quantity of allocation, for the purposes of minimizing emissions leakage, to industrial entities for 2018 through 2020 by using the same assistance factors in place for 2013 through 2017. Thus, all leakage risk categories are to have an assistance factor of 100 percent for the 2018-2020 period.

For the 2018-2020 period, the proposed increase in assistance factors will provide a greater number of free allowances to some covered entities. For example, for the 2018 allowance allocation, covered entities would receive about 7 million additional allowances under the change to 100 percent assistance factor. These additional allowances for the single year 2018 have a value of about $100 million when evaluated at the 2018 Auction Reserve Price of $14.53.

The effect of this change is that value that would have gone to State government will now be going to covered industrial entities, so it reduces the amount of allowance value to GGRF. Assuming that 2018 industrial output remains constant, over the full 2018-2020 period, the amount of additional allowances would be about 20.3 million (less than 2 percent of the overall third compliance period allowance budget), which when valued at the 2018 Auction Reserve price would be worth over $310 million (2018 dollars). These amounts will change based actual output levels and prices.

For post-2020, AB 398 directs CARB to set industry assistance factors for allowance allocation commencing in 2021 at the levels applicable in the compliance period of 2015 to 2017, inclusive. This means that under the Amended Regulation all leakage risk categories are to have an assistance factor of 100 percent for the 2021-2030 period.

As described in Table 5, this SRIA takes the baseline case for the 2021-2030 period as the current 50 percent, 75 percent, and 100 percent leakage assistance factors under the current Regulation for 2018 through 2020. As such, the impact presented here is in reference to this baseline case for the 2021-2030 period. Again, assuming that 2018 industrial output remains constant the amount of allowances allocated to covered industrial sectors would be about 360 million between 2021 and 2030, which when valued at the Auction Reserve Price would be worth over $7.5 billion (2018 dollars). These amounts will change based on actual output levels and prices.

Note that any increase in allocation to covered industrial sectors would reduce annual auction budgets on a one-to-one basis. This would reduce the amount of auction proceeds distributed to the GGRF. In the previous paragraph, staff estimated that the increase in allocation could be worth about $7.5 billion (2018 dollars) to industrial covered entities. This would be the amount by which the GGRF is reduced from 2021 through 2030.

h. Creation or Elimination of Businesses

The Amended Regulation is unlikely to lead to the elimination of businesses in California. While similar businesses outside California do not currently have to account for carbon costs, the incremental economic impact? of the Amended Regulation (relative to the current Regulation) is negligible and is highly unlikely to result in business elimination in California. As the price ceiling modeled in the Amended Regulation Lower Range is lower than the Reserve price under the current Regulation, there will be no elimination of business as a result of the Amended Regulation. If the price ceiling is reached under the Amended Regulation Upper Range, where the price ceiling is higher than the Reserve price of the current Regulation, businesses could face higher compliance costs which could lead to the small possibility of the elimination of businesses in California. However, this is highly uncertain and given the negligible impact of the Amended Regulation on the overall California economy, unlikely.

The Amended Regulation may also provide a small incentive for the creation of businesses in California given the price certainty provided by a price ceiling.

4. Summary and Agency Interpretation of the Assessment Results

As modeled, CARB estimates the Amended Regulation will have a minor net impact on the California economy relative to the current Regulation. While there is uncertainty in the net impacts of several provisions, the Amended Regulation continues to provide a strong market signal for innovation and shifts to lower carbon technologies and goods. The Amended Regulation is unlikely to have significant net impacts relative to the current Regulation, and will do so only if the price ceiling is higher than the Reserve price under the current Regulation and only if accessed.

F. ALTERNATIVES

In addition to the policy scenario outlining the estimated impact of the Amended Regulation, CARB evaluated two alternatives that represent combined comments from stakeholders and staff analysis. Alternative 1 reflects recommendations by stakeholders who contend a high price ceiling and high cost containment points are necessary to maintain incentives for onsite emissions reductions. Alternative 2 reflects recommendations by stakeholders who contend that cost containment prices should be low enough to provide an early warning of unduly tight markets. CARB only considered alternatives that meet the legislative requirements under AB 398.

1. Alternative 1

Alternative 1 sets the price ceiling well above the level of the Reserve price under the current Regulation as well as the range of price ceiling values in the Amended Regulation Lower and Upper 2030 Ranges (Table 21). This alternative was informed by stakeholder comments during public workshops, in particular, stakeholders advocating for higher end ceiling prices.

Table 21. Price Containment Points for Alternative 1

Year	Auction Reserve Price	Point 1	Point 2	Price Ceiling
	($2018)			
2021	$16.82	$62.81	$70.68	$78.52
2022	$17.66	$70.75	$79.60	$88.45
2023	$18.54	$79.35	$89.49	$99.62
2024	$19.47	$89.03	$100.62	$112.22
2025	$20.45	$99.91	$113.15	$126.40
2026	$21.47	$112.15	$127.26	$142.37
2027	$22.54	$125.91	$143.14	$160.37
2028	$23.67	$141.39	$161.01	$180.63
2029	$24.85	$158.81	$181.14	$203.46
2030	$26.09	$178.41	$203.79	$229.18

The May 2018 auction clearing price was $14.65, so the market would have to experience a tremendous increase in allowance prices for the higher Alternative 1 Reserve and price ceiling prices to have any economic impact. Table 22 shows the annual rate of growth needed for allowance prices to reach price ceiling for three selected years. For example, reaching the price ceiling in 2030 would require that the allowance price rise by 26 percent per year, beginning in 2018.

Table 22. Annual Rate of Growth for Allowance Price to Rise from May 2018 Auction Clearing Price to Price Ceiling In Selected Years

	Year		
	2021	**2025**	**2030**
Annual Price Growth Rate	75%	36%	26%

a. Costs (Total and Incremental)

Total costs would be higher under Alternative 1 than under the price ceilings assessed for the Amended Regulation if the market price for allowances rises above the price ceilings analyzed in the Amended Regulation Lower and Upper Range. The price ceiling for Alternative 1 is higher than the price ceilings of the Amended Regulation from 2021 through 2030, $145 higher than the Lower Range and $71 higher than the Upper Range in 2030.

b. Benefits (Total and Incremental)

Hypothetically, if the allowance price reaches the price ceiling early in the post-2020 period under Alternative 1, there may be an incentive for entities to make emissions reductions sooner than under the Amended Regulation. This may result in avoided environmental damages, which can be valued using the Social Cost of Carbon (SCC). The SCC provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future. Table 5 in Section A presents the potential avoided costs on a per metric ton basis. The incremental benefit resulting from Alternative 1 is highly uncertain and the values in Table 5 provide an estimate of the total potential avoided costs from expedited emissions reductions.

c. Costs

Table 23 displays the potential costs to industry in 2030 if allowance prices reach the Alternative 1 price ceiling. The calculations assume the distribution of emissions across sectors is the same in 2030 as it was in 2016 evaluated at the 2030 price ceiling.

Table 23. Potential Costs to Industry of Alternative 1 at 2030 Price Ceiling

2-digit NAICS	Description	Alternative 1 (million $2018)
11	Agriculture, Forestry, Fishing and Hunting	$9.1
21	Mining, Quarrying, and Oil and Gas Extraction	$2,244.5
22	Utilities	$10,549.1
31-33	Manufacturing	$11,239.9
42	Wholesale Trade	$16,642.4
44-45	Retail Trade	$440.6
48-49	Transportation and Warehousing	$3,021.0
52	Finance and Insurance	$82.0
54	Professional, Scientific, and Technical Services	$5.7
55	Management of Companies and Enterprises	$1.7
56	Administrative and Support and Waste Management and Remediation Services	$41.0
61	Educational Services	$116.5
62	Health Care and Social Assistance	$8.7
92	Public Administration	$12.9
	Total	**$44,415.1**

The estimated total cost to industry in 2030 under Alternative 1 is $44.42 billion. This cost is $13.8 billion more than the estimated cost under the Upper 2030 Range of the

Amended Regulation, $27.9 billion more than the estimated cost under the Lower 2030 Range, and $28 billion more than the current Regulation.

d. Economic Impacts

The costs described in Table 23 are input into REMI to assess the macroeconomic impacts of Alternative 1. Alternative 1 would likely result in increased costs to covered entities relative to the Amended Regulation, if allowance prices rise above the price ceiling in the Upper 2030 Range under the Amended Regulation.

This possibility highlights the importance of the provision in the Amended Regulation to set the assistance factors for covered industrial entities eligible for allocation to 100% (see Table 5 in section A above, along with a discussion of the changes in section A.2.b Proposed Changes.) An entity receiving an allocation of allowances equal to its emissions would be insulated from the allowance price increases that could occur under Alternative 1. Importantly, a 100 percent assistance factor does not mean businesses get all the allowances they need to comply with the Program—they still need to reduce emissions onsite or seek out additional allowances. Allocated allowance levels drop every year per the cap adjustment factor, which tracks the overall cap decline. By 2030 businesses will receive about half of the allowances they receive today. Price increases later in the period could potentially pose a greater risk of leakage because of the reduced level of allocation.

The macroeconomic modeling of Alternative 1 is presented below.

i. Employment Impacts

As modeled, there is slightly more growth in California employment under Alternative 1 compared to the Amended Regulation. As presented in Table 24, in 2030, there is employment growth of 0.1 percent under the Amended Regulation Upper Range relative to a 0.2 percent increase under Alternative 1. This growth, which is not significantly different from zero, is due to the return of allowance value at the higher price ceiling under this alternative. This result assumes that the price ceiling is reached in 2030, which is highly uncertain. In addition, the growth in employment is highly dependent on the assumptions surrounding the return of allowance value through the GGRF and directly to consumers as explained previously.

Table 24. Estimated Employment Impacts under Alternative 1

	Alternative 1	
	2025	2030
	(thousands)	
Current Regulation	24,387	25,378
Absolute Change	0.0	47.8
Percent Change	0.0%	0.2%

ii. Business Impacts

The impact to business as modeled using sector gross value added is more extreme under Alternative 1 relative to the Amended Regulation. If the price ceiling of Alternative 1 were to be reached, carbon intensive sectors like mining and utilities would see an increase in the slowing of growth in gross value added in 2030 relative to the Amended Regulation. However, sectors like accommodation and food services and health care and social assistance, would see increased growth due to the higher price celling and higher return of allowance value relative to the Amended Regulation. Table 25 presents the impact to sector gross valued added under Alternative 1.

Table 25. Sector Gross Value Added Impacts under Alternative 1

Percent Change	**Alternative 1**	
Category	**2025**	**2030**
Forestry, Fishing, and Related Activities	0.0%	0.1%
Mining	0.0%	-7.9%
Utilities	0.0%	-3.4%
Construction	0.0%	-0.4%
Manufacturing	0.0%	-0.6%
Wholesale Trade	0.0%	-0.4%
Retail Trade	0.0%	0.0%
Transportation and Warehousing	0.0%	-0.1%
Information	0.0%	0.0%
Finance and Insurance	0.0%	0.3%
Real Estate and Rental and Leaving	0.0%	0.1%
Professional, Scientific, and Technical Services	0.0%	0.0%
Management of Companies and Enterprises	0.0%	-0.2%
Administrative and Waste Management Services	0.0%	0.6%

Educational Services	0.0%	0.3%
Health Care and Social assistance	0.0%	0.3%
Arts, Entertainment, and Recreation	0.0%	0.2%
Accommodation and Food Services	0.0%	0.2%
Other Services, except Public Administration	0.0%	1.1%

iii. Impacts to Investments in California

Table 26 shows the change in growth of gross private domestic fixed investment under Alternative 1. As modeled, Alternative 1 results in a decrease in gross domestic private investment relative to the current Regulation and also a decrease relative to the Amended Regulation.

Table 26. Gross Domestic Private Investment

	Alternative 1	
	2025	**2030**
	(billion $2018)	
Current Regulation	465	526
Absolute Change	0	0
Percent Change	0.0%	-0.4%

iv. Personal Income

Table 27 shows the change in growth of personal income in 2025 and 2030 under Amendment 1. As modeled there is a negligible decrease in personal income under Alternative 1, if the allowance price rises to the price ceiling. The estimated impact is not different from the Amended Regulation and represents a $27 per person decrease in personal income under Alternative 1 relative to a maximum of $34 per person decrease under the Amended Regulation Upper Range.

Table 27. Estimated Personal Income under Alternative 1

	Alternative 1	
	2025	**2030**
	(billion $2018)	
Current Regulation	2,685	2,982
Absolute Change	0.0	-1.3
Percent Change	0.0%	0.0%

v. GDP

As presented in Table 28, Alternative 1 is anticipated to have a negligible impact on the California economy as measured by gross state product. The impact of Alternative 1 on the California economy is not different from the Amended Regulation, which as modeled resulted in an estimated slowing of growth of 0.1 percent under the Upper Range in 2030.

Table 28. Estimated impact of Alternative 1 on State Gross Domestic Product

	Alternative 1	
	2025	**2030**
	(billion $2018)	
Current Regulation	3,084	3,464
Absolute Change	0.0	-2.7
Percent Change	0.0%	-0.1%

e. Cost-Effectiveness

Alternative 1 is designed to achieve the same amount of emissions reductions as the Amended Regulation. However, the alternative includes higher prices for the Reserve tiers and the price ceiling than the baseline or Amended Regulation. If the market tightens, allowance prices could rise above the price ceilings of the Amended Regulation Upper and Lower 2030 Ranges and Alternative 2. This would result in much higher compliance costs. Therefore, Alternative 1 is likely less cost-effective than the Amended Regulation.

f. Reason for Rejecting

Alternative 1 would likely result in increased costs and be less cost-effective than the Amended Regulation. While it is very unlikely the price ceiling would need to be accessed, if it were, the costs for compliance would be three times higher than the current Regulation and the potential for leakage would be increased. Therefore, this alternative does not appear to be a viable alternative to the Amended Regulation.

2. Alternative 2

Alternative 2 sets the price ceiling well below the level of the Reserve under the current Regulation as well as the range of price ceiling values assessed for the Amended Regulation. This alternative was informed by stakeholder comments during public workshops, in particular stakeholders advocating for lower end ceiling prices. Specifically, this alternative sets the 2021 price ceiling at $50 in real 2018 terms, and then escalates to maintain a set real distance between the ceiling and the Auction Reserve Price ($33.18).

Table 29. Price Containment Points for Alternative 2

Year	Auction Reserve Price	Point 1	Point 2	Price Ceiling
	($2018)			
2021	$16.82	$27.88	$38.94	$50.00
2022	$17.66	$28.72	$39.78	$50.84
2023	$18.54	$29.60	$40.66	$51.72
2024	$19.47	$30.53	$41.59	$52.65
2025	$20.45	$31.51	$42.56	$53.62
2026	$21.47	$32.53	$43.59	$54.65
2027	$22.54	$33.60	$44.66	$55.72
2028	$23.67	$34.73	$45.79	$56.85
2029	$24.85	$35.91	$46.97	$58.03
2030	$26.09	$37.15	$48.21	$59.27

To reach the Alternative 2 price ceiling would require less of a change from the current May 2018 auction clearing price of $14.65 compared with Alternative 1. Reaching the Alternative 2 price ceiling in 2030 would require that the allowance price rise by 12 percent per year (Table 30).

Table 30. Annual Rate of Growth for Allowance Price to Rise from May 2018 Auction Clearing Price to Price Ceiling for Selected Years

	2018-2021	2018-2025	2018-2030
Alternative 2	51%	20%	12%

a. Costs (Total and Incremental)

Total costs would be lower under Alternative 2 than under the price ceilings assessed for the Amended Regulation. The price ceiling for Alternative 2 is lower than the price ceilings of the Amended Regulation from 2021 through 2030, $22 lower than the Lower Range and $95 lower than the Upper Range in 2030.

b. Benefits (Total and Incremental)

There are no incremental benefits under Alternative 2 relative to the current Regulation. Hypothetically, the low price ceiling under Alternative 2 may delay or prevent emissions reductions from occurring. This may result in additional environmental damages, which can be valued using the Social Cost of Carbon (SCC). Table 7 presents the potentially avoided costs on a per metric ton basis. As any potential incremental dis-benefit resulting from Alternative 2 is highly uncertain, the values in Table 7 provide an estimate of the total potential additional costs.

c. Costs

Table 31 displays the potential costs to industry in 2030 evaluated at the 2030 price ceiling under Alternative 2. The calculations assume the distribution of emissions across sectors is the same in 2030 as it was in 2016.

Table 31. 2030 Potential Costs to Industry of Alternative 2 Price Ceiling

2-digit NAICS	Description	Alternative 2 (million $2018)
11	Agriculture, Forestry, Fishing and Hunting	$2.4
21	Mining, Quarrying, and Oil and Gas Extraction	$580.5
22	Utilities	$2,728.3
31-33	Manufacturing	$2,907.0
42	Wholesale Trade	$4,304.3
44-45	Retail Trade	$114.0
48-49	Transportation and Warehousing	$781.3
52	Finance and Insurance	$21.2
54	Professional, Scientific, and Technical Services	$1.5
55	Management of Companies and Enterprises	$0.4
56	Administrative and Support and Waste Management and Remediation Services	$10.6
61	Educational Services	$30.1
62	Health Care and Social Assistance	$2.2
92	Public Administration	$3.3
	Total	**$11,487.2**

The total estimated cost of Alternative 2 to industrial sectors is $11.5 billion in 2030. This total cost is $19.2 billion less than the estimated cost of the Upper 2030 Range of the Amended Regulation, $5.1 billion less than the cost of the Lower 2030 Range, and $5.0 billion less than the 2030 estimated industrial cost under the current Regulation.

d. Economic Impacts

The costs described in Table 31 are input into REMI to assess the macroeconomic impacts of Alternative 2. Alternative 2 would likely result in decreased costs to covered entities relative to the Amended Regulation, if market prices rise above the range assessed for the Alternative 2. If this were to occur, the cost of compliance could be higher under the Amended Regulation relative to Alternative 2. The macroeconomic modeling of Alternative 2 is presented below.

i. Employment Impacts

As modeled, there is slightly slower in California employment under Alternative 2 compared to the Amended Regulation. As presented in Table 32, in 2030, there is employment growth of 0.1 percent under the Amended Regulation Upper Range relative to no change under Alternative 2. Under Alternative 2, there is a slight slowing of employment growth of 0.1 percent in 2025. This is largely the result of a more gradual increase in the modeled allowance price path under Alternative 2. The magnitude of the impact is extremely small and not different from zero, but the change in employment sign is due to a smaller return of allowance value in early years under the Amended Regulation relative to Alternative 2.

Table 32. Estimated Employment Impacts under Alternative 2

	Alternative 2	
	2025	**2030**
	(thousands)	
Current Regulation	24,374	25,339
Absolute Change	-13.0	8.7
Percent Change	-0.1%	0.0%

ii. Business Impacts

The impact to business as modeled using sector gross value added is more extreme under Alternative 1 relative to the Amended Regulation. If the price ceiling of Alternative 2 were to be reached, nearly all sectors would see an increase in the growth of gross value added in 2025 and 2030 relative to the Amended Regulation. This is due to the lower price ceiling, and therefore lower maximum cost of compliance, under Alternative 2. Table 33 presents the impact to sector gross valued added under Alternative 2.

Table 33. Sector Gross Value Added Impacts under Alternative 2

Percent Change	Alternative 2	
Category	**2025**	**2030**
Forestry, Fishing, and Related Activities	0.0%	0.0%
Mining	0.7%	2.9%
Utilities	0.6%	1.2%
Construction	0.0%	0.3%
Manufacturing	0.1%	0.3%
Wholesale Trade	0.1%	0.2%
Retail Trade	0.0%	0.1%
Transportation and Warehousing	0.0%	0.2%
Information	0.0%	0.0%
Finance and Insurance	-0.1%	0.0%
Real Estate and Rental and Leaving	0.0%	0.0%
Professional, Scientific, and Technical Services	0.0%	0.1%
Management of Companies and Enterprises	0.0%	0.2%
Administrative and Waste Management Services	-0.1%	-0.1%
Educational Services	-0.1%	0.0%
Health Care and Social assistance	-0.1%	0.0%
Arts, Entertainment, and Recreation	-0.1%	0.0%
Accommodation and Food Services	0.0%	0.0%
Other Services, except Public Administration	-0.2%	-0.2%

iii. Impacts to Investments in California

Table 34 shows the change in growth of gross private domestic fixed investment under Alternative 2. As modeled, Alternative 2 results in a small increase in gross domestic private investment relative to the current Regulation and also an increase relative to the Amended Regulation, which is negligible given the uncertainty in the analysis.

Table 34: Estimated Impact on Gross Domestic Private Investment under Alternative 2

	Alternative 2	
	2025	**2030**
	(billion $2018)	
Current Regulation	465	530
Absolute Change	0.2	0.0
Percent Change	0.0%	0.3%

iv. Personal Income

Table 35 shows the change in growth of personal income in 2025 and 2030 under Amendment 2. As modeled there is a negligible increase in personal income under Alternative 2, if the allowance price rises to the price ceiling. The estimated impact represents a $39 per person increase in personal income under Alternative 2 relative to a maximum of $34 per person decrease under the Amended Regulation Upper Range. The lower price ceiling relative to the current Regulation and the Amended Regulation could result in a net increase in personal income under this alternative. However, the results are highly uncertainty.

Table 35. Estimated Personal Income under Alternative 2

	Alternative 2	
	2025	**2030**
	(billion $2018)	
Current Regulation	2,685	2,985
Absolute Change	0.1	1.8
Percent Change	0.0%	0.1%

v. GDP

As presented in Table 36, Alternative 2 is anticipated to have a negligible impact on the California economy as measured by gross state product. The impact of Alternative 2 on will result in a slight increase in the growth of the California economy relative to the current Regulation, as well as the Amended Regulation in 2030. As modeled, Alternative 2 will not change the rate of growth of the California economy in 2025. This is relative to the Amended Regulation, which results in an estimated slowing of growth of 0.1 percent under the Upper Range in 2030 but no change in growth in 2025 or under the Lower Range.

Table 36. Estimated impact of Alternative 2 on State Gross Domestic Product

	Alternative 2	
	2025	**2030**
	(billion $2018)	
Current Regulation	3,084	3,469
Absolute Change	-0.3	3.3
Percent Change	0.0%	0.1%

e. Cost-Effectiveness

Alternative 2 is designed to achieve the same amount of emissions reductions as the Amended Regulation. However, the alternative includes lower prices for the price containment points and the price ceiling than the current Regulation or the Amended Regulation. If demand for allowances rises, allowance prices would be constrained by the Alternative 2 price ceiling which is lower than the price ceiling of the Amended Regulation. This could result in lower compliance costs but if the price ceiling is reached, the 2030 GHG reduction target would be met only through metric ton for metric ton reductions at the price ceiling and not through reductions from capped sectors.

f. Reason for Rejecting

The price ceiling in Alternative 2 may be too low to incent the abatement technologies described in Table 19 to achieve the GHG reductions necessary to achieve the State's 2030 reduction target. To achieve the 2030 GHG reduction target, the program may then have to rely on the metric ton for metric ton reductions CARB identifies to sell at the price ceiling. Reliance on these reductions, along with a price ceiling that may be too low to be accepted by other jurisdiction may jeopardize existing and future linkages. Therefore, Alternative 2 does not appear to be a viable alternative to the Amended Regulation.

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