KEY GOVERNANCE ISSUES **IN CALIFORNIA'S CARBON CAP-AND-TRADE SYSTEM**

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CALIFORNIA-CHINA CARBON MARKET PROJECT INTRODUCTION

As of 2021, 30 emissions trading systems were in force globally, covering 16-17% of global greenhouse gas (GHG) emissions.* The finalization of the Paris Agreement rulebook for international cooperation through carbon markets has cleared the way for the expansion of emissions trading and carbon pricing worldwide.**

This project is a collaboration among researchers from two major jurisdictions engaged in emissions trading: China – with a rate-based emissions trading system commenced in 2021 that is the world's largest by emissions covered; and California – which has operated an economy-wide greenhouse gas emissions trading system since 2012.

Researchers at Tsinghua University, the California-China Climate Institute, UCLA School of Law, and Wuhan University convened a series of projects and events to share ideas and best-practices and to discuss ways to improve the design and implementation of emissions trading systems. The accompanying reports, (i) The Theory and Practice of China's Carbon Emissions Trading System – Key Issues in China's National ETS and Case Study of Hubei Pilot ETS; and (ii) Key Governance Issues in California's Carbon Cap-and-Trade System, are outputs of this collaboration. The project also included a series of private dialogues on various aspects of emissions trading system design, including on data quality; compliance; monitoring, reporting, and verification (MRV); auctions; allowance allocation approaches; offsets; and the use of financial instruments in carbon markets.

Our collaboration has been guided by the goal of improving understanding of the respective emissions trading systems in China and California. Moreover, it served to explore ways to improve environmental ambition, to ensure market integrity, and to improve the policy environment for climate action. Key design considerations discussed include, among other things, setting caps and benchmarks at appropriately ambitious levels, utilizing auctions and other measures to create an effective price signal, establishing MRV and enforcement systems to ensure data quality and the integrity of emissions reductions, properly structuring offset programs, and channeling market revenues toward environmental objectives. Our dialogues included invaluable assistance from Chinese and California regulators and researchers involved in the design and operation of emissions trading systems.

As a closing note, we reiterate our firm belief in the importance of continued international collaboration on climate change policy. This work, we hope, will serve to make complex emissions trading systems more transparent to the world and to lay the groundwork for improving the effectiveness of climate change policy and regulation.

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* *See Carbon Pricing Dashboard*, World Bank (last visited Apr. 6, 2022), https://carbonpricingdashboard.worldbank.org/map_data. ("In 2021, these initiatives would cover 8.73 GtCO2e, representing 16.1% of global GHG emissions."); *see also* Int'l Carbon Action P'ship (ICAP), Emissions Trading Worldwide: Status Report 2022, at 36–37, https://icapcarbonaction.com/system/files/document/220330_icap_report_rz_web.pdf.

** These are rules under Article 6 of the Paris Agreement agreed upon at COP26 in Glasgow. Simon Evans et al., *COP26: Key Outcomes Agreed at the UN Climate Talks in Glasgow*, Carbon Brief (Nov. 15, 2021), https://www.carbonbrief.org/cop26-key-outcomes-agreed-at-the-un-climate-talks-in-glasgow.

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ACRONYMS

BAU	Business-as-usual
CalEPA	California Environmental Protection Agency
CARB	California Air Resources Board
CEMS	Continuous Emission Monitoring Systems
CO_2	Carbon dioxide
DACs	Disadvantaged communities
EITE	Emissions-intensive, trade-exposed
EPEs	Electric power entities
ETS	Emissions Trading System
GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse gas
GWP	Global warming potential
HFC	Hydrofluorocarbon
IEMAC	Independent Emissions Market Advisory Committee
IOUs	Investor-owned utilities
LAO	Legislative Analyst's Office
LCFS	Low Carbon Fuel Standard
MRV	Monitoring, reporting, and verification
MRR	Regulation for the Mandatory Reporting of Greenhouse Gas Emissions
$MTCO_2e$	Metric tons of carbon dioxide equivalent
MWh	Megawatt hour
NO_x	Nitrogen oxides
PM	Particulate matter
RPS	Renewable Portfolio Standard
SO_2	Sulfur dioxide

PREFACE

This report on California's experience in greenhouse gas emissions trading is part of a broader collaboration on emissions trading in China and California. The framing of the report arose out of informal discussions among the project participants on emissions trading system design. The topics covered reflect areas of particular interest to Chinese researchers at the current stage of development of the Chinese national greenhouse gas emissions trading system. The report also highlights debates about the pros and cons of emissions trading as a regulatory tool to alert Chinese emissions trading system designers to issues that may arise during program development and operation.

While the content of this report arose out of this specific context, we hope that the report will be useful to regulators and researchers in other jurisdictions contemplating emissions trading system design and implementation.

CHAPTER ONE
INTRODUCTION

The purpose of this report is to describe and analyze selected aspects of California's statewide greenhouse gas (GHG) cap-and-trade program, which went into effect in 2012. The system is one component of California's overall strategy for achieving its state-wide greenhouse gas emissions reduction targets. As countries around the world consider the use of emissions trading, we hope this analysis will help regulators to increase environmental ambition, improve the integrity of emissions reductions, and take advantage of political and economic opportunities created by emissions trading.

This report will begin with a brief review of debates over the advantages and disadvantages of emissions trading, in theory and practice. It will then provide an overview of California's overall strategy on climate change and a description of key elements of the cap-and-trade program. The discussion of cap-and-trade design elements will cover such features as: cap setting, use of auction proceeds, requirements for offsets, monitoring and verification requirements for emissions data, and program accountability and evaluation measures. The report will conclude with a summary of lessons from California.

In light of the urgent need for more ambitious global climate action,[1] we urge regulators to consider carefully the challenges California's GHG emissions trading system (ETS) has faced and the opportunities for emissions reduction the ETS has enabled.

[1] *See, e.g.*, Intergovernmental Panel on Climate Change (IPCC), Climate Change 2022: Mitigation of Climate Change (2022), https://www.ipcc.ch/report/ar6/wg3/.

CHAPTER TWO
CURRENT DEBATES OVER EMISSIONS TRADING

We briefly summarize key debates regarding the advantages and disadvantages of emissions trading systems. In particular, we hope that discussion of critiques of emissions trading systems will help designers of fledgling programs to learn from challenges faced in California and elsewhere.

A | ADVANTAGES

Emissions trading arose as a response to shortcomings of traditional command-and-control regulation. The main argument in favor of emissions trading is the potential to achieve environmental objectives at least cost. Traditional command-and-control regulation typically offers little flexibility to companies in how and where to reduce emissions and fails to take advantage of the fact that some polluters can reduce emissions more cheaply than others. In a cap-and-trade system, firms meet their compliance obligations by reducing emissions or purchasing allowances under the constraints of a fixed cap on emissions. In this way, firms can determine for themselves the lowest-cost approach to compliance, while the cap ensures a maximum limit on emissions. In a properly structured market, trading gives firms with lower marginal abatement costs an incentive to reduce emissions "beyond compliance" and to sell unused allowances on the market to firms for whom allowance purchases would be the most cost-effective means of compliance. More generally speaking, cap-and-trade systems can provide a steadily increasing price signal to emitters (*e.g.*, through a price floor and a declining cap). Through such a system, environmental goals may be achieved at lower aggregate cost of compliance.

An early example of the efficiency gains achievable through trading in the United States (US) was the inter-refinery averaging of lead in gasoline, which helped transition mid-sized refineries with relatively high de-leading costs.[2] The program was only in effect for a few years, however. A larger, more sustained emissions trading program - the US sulfur dioxide (SO_2) emissions trading program (authorized by the Clean Air Act Amendments of 1990) - also demonstrated cost reductions.[3] One-third of such cost savings could, however, be attributed to fuel switching to low-sulfur coal that had begun to happen prior to the cap-and-trade program, as the result of regulatory changes that lowered the cost of shipping low-sulfur coal.[4]

Proponents of emissions trading also argue that such systems are administratively less burdensome to operate and carry out enforcement. As such, emissions trading systems should be more easily expanded to cover diverse sources of emissions.

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[2] *See generally* Richard G. Newell & Kristian Rogers, *The U.S. Experience with the Phasedown of Lead in Gasoline*, Res. for the Future (2003), https://web.mit.edu/ckolstad/www/Newell.pdf; Suzi Kerr & Richard G. Newell, *Policy-Induced Technology Adoption: Evidence from the U.S. Lead Phasedown*, *in* Controlling Automobile Air Pollution 193, 193-219 (Virginia McConnell ed., 2018); Hugh S. Gorman & Barry D. Solomon, *The Origins and Practice of Emissions Trading*, 14 J. Pol'y Hist. 293, 303–08 (2002).

[3] *See* Curtis Carlson et al., *Sulfur Dioxide Control by Electric Utilities: What Are the Gains from Trade?*, 108 J. Pol. Econ. 1292 (2000) (projecting expected savings of about 43% by 2010, versus the least-cost alternative command-and-control approach); Nathaniel O. Keohane, *What Did the Market Buy? Cost Savings under the U.S. Tradeable Permits Program for Sulfur Dioxide*, Yale Ct. for Envtl. L. & Pol'y Working Paper (Oct. 15, 2003), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=465320 (estimating that the trading system created savings between 16 and 25% between 1995 and 1999, compared to the least-cost alternative command-and-control approach).

[4] *See* Richard Schmalensee & Robert N, Stavins, *The SO2 Allowance Trading System: The Ironic History of a Grand Policy Experiment*, 27 J. Econ. Persp. 103, 110-12 (2013).

B | DISADVANTAGES

In recent years, emissions trading has come under sustained criticism that the systems have not lived up to their theoretical promise. In the climate context, the most salient concern is that emissions trading's effects on decarbonization have simply been too incremental and that such modest environmental impacts are inadequate given the demands for rapid decarbonization reflected in Paris Agreement goals and domestic carbon neutrality targets.[5]

These critiques have focused on the role of political-economy factors in weakening the environmental ambition of emissions trading systems. Such systems have often been established with relatively modest targets and assumptions about growth and technology change.[6] Concerns about economic impact and political buy-in have contributed to relatively soft design elements, such as overallocation of allowances resulting in significant allowance surpluses, free allocations of allowances that constrain price impact, and limits on sectoral coverage.[7] Emissions reductions achieved are thought to be driven by other "complementary" measures, rather than the ETS itself.[8] What's more, it has been politically difficult to make emissions trading systems more environmentally stringent in the later years of a program.

The application of emissions trading systems across multiple sectors and the focus on a highly visible carbon price has generated sustained industry opposition and public concern about the costs of regulation, resulting in conservative design choices. Fossil fuel industries have historically been particularly active in seeking to weaken the ambition of trading systems.[9] Concerns about impact on electricity and fuel costs to consumers have also limited the environmental ambition of trading systems. Considerations of excessive cost to industry are sometimes framed in terms of a policy interest in protecting "energy intensive, trade exposed" industries and avoiding "leakage" of emissions (*i.e.*, increasing regulatory costs to a point that drives firms to shift production and associated GHG emissions outside of the regulated jurisdiction).[10] In limited instances where prices have risen to "excessive" levels, regulators have stepped in to mitigate price impacts.[11]

These dynamics have meant that allowance prices in carbon emissions trading systems have been low. This was true most notably in the first to third phases of the European Union (EU) ETS, although prices have been rising as the EU takes measures to meet new carbon neutrality targets.[12] In recent years, industry opponents have taken to supporting carbon pricing initiatives seemingly *because* of their relatively light regulatory impact, the ability to negotiate industry-favorable compromises such as preemption of other regulations, and the reputational benefits for industry of supporting *some* form of regulation as support for climate action has grown.[13] The effects of such dynamics can be seen in the design, for example, of the EU ETS, California carbon ETS, and the provisions

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[5] *See* Jessica F. Green, *Does Carbon Pricing Reduce Emissions? A Review of Ex-Post Analyses*, 16 Env't. Rsch. Letters (2021); William Boyd, *The Poverty of Theory: Public Problems, Instrument Choice, and the Climate Emergency*, 46 Colum. J. Env't L. 399 (2021); Danny Cullenward & David Victor, *Making Climate Policy Work* (2020).

[6] Jesse D. Jenkins & Valerie J. Karplus, *Carbon Pricing under Binding Political Constraints* 6 U.N. Univ. Working Paper (Apr. 2016), https://www.wider.unu.edu/sites/default/files/wp2016-44.pdf.

[7] *See supra*, note 5.

[8] This may be by design, such as in case of the California GHG ETS, which serves as a backstop to other policies like the Renewable Portfolio Standard or the Low Carbon Fuel Standard.

[9] *See, e.g.,* Michael E. Mann, *The New Climate War: The Fight to Take Back Our Planet* (2021).

[10] For example, California's cap-and-trade program provides free emissions credits to certain industries for the purposes of "transition assistance" and to prevent leakage. These measures are meant to blunt the near- and longer-term economic impacts of the program, but can reduce environmental ambition. *See generally Allowance Allocation to Industrial Facilities*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/allowance-allocation/allowance-allocation-industrial.

[11] This occurred, for example, within California's Regional Clean Air Incentives Market (RECLAIM) program - an emissions trading system for NO_x and SO_x pollution - during the 2000 California electricity crisis. *See* US Envtl. Prot. Agency, *An Overview of the Regional Clean Air Incentives Market (RECLAIM)* 6-10 (2006), https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.187.7379&rep=rep1&type=pdf.

[12] Nina Chestney, *EU Carbon Price Hits Record High above 45 Euros a Tonne*, Reuters (Apr. 20, 2021), https://www.reuters.com/business/energy/eu-carbon-price-hits-record-high-above-45-euros-tonne-2021-04-20/. Prices have also been low - at or near the price floor - for most of the history of the California cap-and-trade program, and have also increased recently. CARB, *California and Québec Carbon Allowance Prices* (2022), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/carbonallowanceprices.pdf. The Regional Greenhouse Gas Initiative (RGGI), in the northeastern US, has had even lower prices for most of its history, exceeding $10 per ton for the first time in December 2021. *Auction Results*, RGGI (last visited Apr. 20, 2022), https://www.rggi.org/auctions/auction-results.

[13] *See* Jennifer A. Dlouhy & Leslie Kaufman, *How the Oil Lobby Learned to Love Carbon Taxes*, Bloomberg Green (Mar. 4, 2021), https://www.bloomberg.com/news/articles/2021-03-04/how-the-oil-lobby-learned-to-love-carbon-taxes.

of the failed Waxman-Markey bill, which would have established a nationwide emissions trading system in the United States in 2010.[14]

The theoretical administrative simplicity of emissions trading systems also may not carry over to all regulatory systems, particularly those in the developing world where capacity issues are commonplace. Establishing an effective trading market depends on technical expertise to create emissions inventories; monitoring, reporting, and verification systems; and robust market monitoring and regulatory enforcement capacity. Capacity in these areas is particularly strong in the major jurisdictions that have pioneered emissions trading: the US federal government, California, Quebec, and the EU. It will be difficult in jurisdictions with less capacity to design and run effective trading systems, to guarantee data integrity and transparency, and to protect against market manipulation. In short, we should be cautious about assuming that market measures would be easier to implement than traditional command-and-control measures in many parts of the world.

Finally, emissions trading systems have been criticized for unjust distributional (*i.e.*, environmental justice) consequences. Pollution sources and other environmental hazards in California are disproportionately located in areas with lower incomes and higher percentages of people of color residents.[15] While GHGs do not generally cause local harms, the process of reducing GHGs could also reduce other pollutants by, for example, reducing the total amount of fuel burned at a facility or leading to air-filtration systems that reduce co-pollutants as well as GHGs. Critics are concerned that the ETS approach creates the possibility of inequitable pollution burdens; however, evidence on the actual equity impacts of the GHG ETS is sparse and mixed.[16]

The following sections describe key components critical to the governance of California's cap-and-trade program. The debates over emissions trading in general described above are relevant to the California context. The carbon cap-and-trade system is seen as an important component of the state's overall climate strategy and a generator of significant revenue to be used for environmental and social purposes. It is also an example of a system with strong experience in monitoring, reporting, and verification. At the same time, the system has faced sustained criticisms regarding potential overallocation of allowances, low allowance prices, limited emissions reductions among covered entities, offset integrity, and environmental justice, among other things.

We note these criticisms as a means of clarifying that there is much to be learned from *both* the purported strengths and weaknesses of the California system, and to highlight that California's system - like China's - is a work in progress that demands continual and sustained efforts at reform given the urgency of climate action today.

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[14] Even if it had passed, the Waxman-Markey bill nonetheless contained provisions to keep costs low and give large amounts of free allocations to energy-intensive heavy industry and natural gas and electricity distribution companies to reduce impacts on energy consumers, weakening the plan's emission cutting ambitions in the energy sector. *See* Jenkins & Karplus, *supra* note 6, at 7. *See also supra* note 10 (discussing the California cap-and-trade program's free allocations to industry).

[15] *See, e.g.*, Lara Cushing et al., *Racial/Ethnic Disparities in Cumulative Environmental Health Impacts in California: Evidence from a Statewide Environmental Justice Screening Tool (CalEnviroScreen 1.1)*, 105 Am. J. Pub. Health 2341 (2015).

[16] *See, e.g.*, Danae Hernandez-Cortes & Kyle C. Meng, *Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market* (Nat'l Bureau of Econ. Rsch., Working Paper, 2021), https://www.nber.org/system/files/working_papers/w27205/w27205.pdf; Lara Cushing et al., *Carbon trading, Co-Pollutants, and Environmental Equity: Evidence from California's Cap-and-Trade Program (2011–2015)*, 15 PLoS Med. 7 (July 10, 2018), https://doi.org/10.1371/journal.pmed.1002604; Laurel Plummer et al., *Impacts of Greenhouse Gas Emission Limits Within Disadvantaged Communities: Progress Toward Reducing Inequities*, Office of Environmental Health Hazard Assessment (OEHHA), 31-43 (Feb. 2022), https://oehha.ca.gov/media/downloads/environmental-justice/impactsofghgpoliciesreport020322.pdf.

CHAPTER THREE
CALIFORNIA'S EMISSIONS TRADING SYSTEM

A | REGULATORY FRAMEWORK AND THE SCOPING PLAN PROCESS

California's state-wide cap-and-trade program for greenhouse gases was authorized among a set of policies designed to achieve the state's broader climate change goals. In 2006, AB 32, the California Global Warming Solutions Act, set the goal of reducing greenhouse gas emissions to 1990 levels by 2020.[17] In 2015, SB 32 codified a more stringent reduction target of 40% of 1990 levels by 2030.[18] In 2018, Executive Order B-55-18 set the further target of achieving statewide carbon neutrality by 2045.[19] In connection with these targets, the California Air Resources Board (CARB) was directed to prepare Scoping Plans on how to achieve reductions, coordinating policies from all economic sectors. The first Scoping Plan was presented in 2008 and CARB was directed to update the Scoping Plan at least once every five years thereafter. Scoping Plan updates were released in 2013 and 2017, and an update for 2022 is currently in progress.[20]

AB 32 authorized CARB to develop market-based compliance mechanisms for achievement of the state's GHG emissions reduction goal. In response, CARB developed and adopted cap-and-trade regulations in 2011 for an ETS launch in 2012. Compliance obligations for electricity generators and large industrial facilities commenced in 2013. Distributors of transportation fuels, natural gas, and other fuels were phased in in 2015. The California ETS regulations have been amended eight times since their initial adoption to reflect additional legislation and CARB-directed changes.[21] AB 398 (2017) extended the ETS from 2020 to 2030 and added other requirements including a hard price ceiling for compliance, a ban on using projects without direct environmental benefits to California for more than one half of total offset limits, and the preemption of local regulation of CO_2 for facilities covered by the ETS.[22] Pursuant to AB 398, CARB's last set of amendments to the program was adopted in 2018.

CARB considers the cap-and-trade program to be a key component of California's climate strategy, but the program is also considered a backstop that supports a broader portfolio of climate programs. These include the Low Carbon Fuel Standard (LCFS), which creates a market-based system for reducing the carbon intensity of transportation fuels consumed in California,[23] and the Renewables Portfolio Standard (RPS), which requires all electric utilities to utilize a certain percentage of renewable resources in their sales.[24] The last Scoping Plan, approved in 2017,

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[17] Cal. Health & Safety Code §§ 38500 *et seq.* (West).

[18] *Id.* § 38566.

[19] Cal. Exec. Order B-55-18 to Achieve Carbon Neutrality (Sept. 10, 2018), https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.

[20] The Scoping Plans and related materials are available at *AB 32 Climate Change Scoping Plan*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan.

[21] For a list of amendments to the cap-and-trade program, *see Cap-and-Trade Regulation*, CARB (last visited May 2, 2022), https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/cap-and-trade-regulation.

[22] For a general summary of which elements of the ETS were introduced by AB 398, *see* Ctr. for Climate & Energy Solutions, *Summary of California's Extension of Its Cap-and-Trade Program* (2017), https://www.c2es.org/wp-content/uploads/2017/09/summary-californias-extension-its-cap-trade-program.pdf.

[23] *See Low Carbon Fuel Standard*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/about.

[24] *See Enforcement of the Renewables Portfolio Standard*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/enforcement-renewables-portfolio-standard; Cal. Pub. Util. Code §§ 399.11 *et seq.* (West).

laid out CARB's path to achieving California's 2030 target, and relied on all of these programs,[25] as well as the Advanced Clean Cars Program, which more broadly regulates both greenhouse gas emissions and criteria pollutants from vehicles;[26] a variety of policies to improve energy efficiency and decarbonize buildings; and the Sustainable Freight Action Plan, which provides recommendations on making freight transportation and infrastructure more clean and efficient.[27] Through all of these measures, California achieved its 2020 emission reduction target four years ahead of schedule (in 2016).[28] As mentioned above, in 2021, California launched its most recent Scoping Plan efforts to assess progress towards achieving the Senate Bill 32 2030 target and lay out a path to achieve carbon neutrality by mid-century; CARB is expected to finalize the Scoping Plan update before the end of 2022.[29]

The 2017 Scoping Plan includes four alternative scenarios to achieve the state's 2030 emission reduction targets.[30] These alternatives were measured against a business-as-usual (BAU) scenario of emission levels if California took no further action beyond already required or existing policies.[31] The Scoping Plan scenario, which continues the use of cap-and-trade, and which was ultimately adopted by CARB, found that a portfolio approach which included the cap-and-trade program would enable the state to achieve its 2030 target with greater certainty than the scenarios that did not include the cap-and-trade program and at a lower cost than most.[32] The 2017 Scoping Plan also estimated greenhouse gas emission reductions per measure for 2021-2030.[33] After achieving cumulative emissions reductions equivalent to 385 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) through "prescriptive measures" like LCFS and RPS, the plan attributes to the cap-and-trade program the remaining 236 $MMTCO_2e$ of reductions needed to meet required targets.[34] As CARB characterizes the 2017 plan, the cap-and-trade program is "designed to fill the gap in the required emissions reductions over and above what it achieved by the prescriptive measures."[35]

The figure below illustrates CARB's estimated cumulative greenhouse gas reductions by measure under the Scoping Plan scenario as of the time of the Scoping Plan publication. Both the RPS program (due to SB 100)[36] and the LCFS program (due to CARB regulations)[37] subsequently became more stringent than modeled in the 2017 Scoping Plan, increasing the contribution to emissions reduction from those "complementary" measures.

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[25] CARB, California's 2017 Climate Change Scoping Plan 22 (Nov. 2017), https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf [hereinafter 2017 Scoping Plan].

[26] *See Advanced Clean Cars Program*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about.

[27] *See The California Sustainable Freight Action Plan*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/california-sustainable-freight-action-plan/about.

[28] *See* CARB, *California Greenhouse Gas Emissions for 2000 to 2019, Trends of Emissions and Other Indicators* 3 (July 2021), https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2019/ghg_inventory_trends_00-19.pdf.

[29] *See Scoping Plan Meetings & Workshops*, CARB (last visited May 2, 2022), https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/scoping-plan-meetings-workshops.

[30] *See* 2017 Scoping Plan, *supra* note 25, at 22

[31] *Id.*

[32] *See* CARB, California's 2017 Climate Change Scoping Plan appx. E, at 77 (Nov. 2017), https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/2030sp_appe_econ_final.pdf (results from CARB's economic analysis predicting that a mix of cap-and-trade and prescriptive policies had the highest likelihood of achieving 2030 carbon target, and that the mix would produce costs almost as low as the cheapest alternative that did not include cap-and-trade, Alternative 2, which had a very low likelihood of achieving the 2030 limit).

[33] 2017 Scoping Plan, *supra* note 25, at 28.

[34] *Id.*

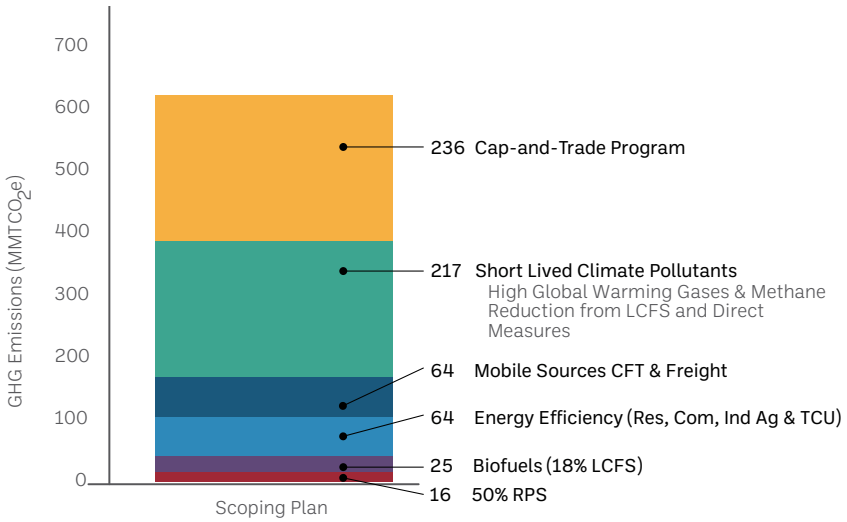
[35] *Id.* at 29.

[36] *See* SB 100 of 2018 §§ 3-4 (codified at Cal. Pub. Utils. Code §§ 399.15, 399.30) (increasing the 2030 target for share of renewable energy in California generation from 50% to 60%).

[37] The LCFS sets carbon-intensity benchmarks for transportation fuel for each year. 17 Cal. Code Regs. § 95484(b)-(c). The program originally targeted a reduction of 10% below the 2010 baseline by 2020. CARB, *Initial Statement of Reasons for Proposed Rulemaking: Proposed Amendments to the Low Carbon Fuel Standard* 1 (2011), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2011/lcfs2011/lcfsisor.pdf. The 2017 Scoping Plan assumed that the program would be extended to a new target of 18% below the 2010 baseline by 2030. 2017 Scoping Plan, *supra* note 25, at 25. CARB's extension of the program ultimately targeted a 20% reduction by 2030, however, 2 percentage points more stringent than the reduction assumed in the 2017 Scoping Plan. CARB, *Final Regulation Order: Low Carbon Fuel Standard* 63-64, § 95484(b), tbls. 1-2 (2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/lcfs18/frolcfs.pdf?_ga=2.183888998.1540952166.1651100661-1487311219.1634140489.

2017 SCOPING PLAN SCENARIO

Estimated Cumulative GHG Reductions by Measure (2021-2030)[38]



Work on the 2022 Scoping Plan update is currently underway, with CARB convening public workshops on the matter in the past year.[39] The update will assess California's progress toward achieving the 2030 target and long-term carbon neutrality.[40] In a departure from previous Scoping Plans, this update will be geared towards a longer-term approach rather than changes to specific programs. As such, after the update is finalized in mid-2022, CARB will engage in additional analysis to evaluate such changes, including any revisions to the cap-and-trade program and other programs.[41] At present there are some signals that cap-and-trade may play a reduced role going forward,[42] but the planning process is very much still in process as of this writing.

B | PROGRAM OVERVIEW

California's cap-and-trade program is an emission trading system that sets a gradually declining cap on greenhouse gas emissions and allows trading of credits within that cap. In doing so, it creates a firm upper limit on emissions allowable by the covered sources and gives the regulated parties discretion in how to comply. These covered entities can purchase allowances from an auction, trade such allowances, or use offsets (subject to regulatory limits). Entities can also bank allowances to be used in the future. For purposes of the program "greenhouse gases" are defined as carbon dioxide, methane, nitrogen trifluoride, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, and other fluorinated gases.[43]

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[38] 2017 Scoping Plan, *supra* note 25, at 28.

[39] *Scoping Plan Meetings & Workshops*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/scoping-plan-meetings-workshops.

[40] *See* Benjamin Storrow, *Price Hike Marks New Era for Calif. Cap and Trade*, Climate Wire (Jan. 3, 2022), https://www.eenews.net/articles/price-hike-marks-new-era-for-calif-cap-and-trade/ ("A CARB spokesman confirmed the agency is focused on the state's long-term vision for carbon neutrality."); *see also* CARB, *2022 Scoping Plan Update – Scenario Concepts Technical Workshop* (Aug. 17. 2021), https://ww2.arb.ca.gov/sites/default/files/2021-08/carb_presentation_sp_scenarioconcepts_august2021_0.pdf; *2022 Scoping Plan Update – Building Decarbonization Workshop*, CARB (Dec. 13, 2021), https://ww2.arb.ca.gov/resources/documents/sp22-buildings-ws ("The... [u]pdate will assess progress towards achieving the Senate Bill 32 (SB 32) 2030 target and lay out a path to achieve carbon neutrality no later than 2045.").

[41] *FAQ Cap-and-Trade Program*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/resources/documents/faq-cap-and-trade-program ("The AB 32 Scoping Plan cannot make changes to any regulation such as the Cap-and-Trade Regulation, which is only possible through a separate process with statutory mandates for specific types of economic and environmental analyses and public process prior to Board consideration.").

[42] Dan McGraw, *Carbon Market to Play Smaller Role in California's Long-Term Climate Strategy with Additional Policies, Official Says*, Carbon Pulse (June 25, 2021), https://carbon-pulse.com/132292/; Dan McGraw, *California Evaluating Future Role of Carbon Market, Despite Official's Comments -Sources*, Carbon Pulse (Feb. 2, 2021), https://carbon-pulse.com/120597/.

[43] 17 Cal. Code Regs. § 95802(a) (West) (definition of "Greenhouse Gas"); 17 Cal. Code Regs. § 95810 (West).

California's cap-and-trade program covers multiple sectors of the economy. The program initially covered only electricity generators and large industrial facilities, including electricity imported from out of state, emitting at or above 25,000 metric tons of CO_2 equivalent ($MTCO_2e$) annually starting January 1, 2013.[44] The scope increased after January 1, 2015 to other sectors including suppliers[45] of petroleum, natural gas, and other fuels.[46] After this expansion, the program covered 450 entities. As of 2021, the cap-and-trade program covers about 74% of California's GHG emissions.[47]

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[44] For a detailed explanation of the covered entities of the electricity sector see Cal. Pub. Util. Comm'n, Public Utilities Commission, *Order Instituting Rulemaking to Address Utility Cost and Revenue Issues Associated with Greenhouse Gas Emission*, Decision 12-12-033, at 13 (2012), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M040/K631/40631611.PDF (for imported electricity, the covered entity is the first entity to deliver electricity onto the California grid).

[45] "Supplier" means a producer, importer, exporter, position holder, interstate pipeline operator, or local distribution company of a fossil fuel or an industrial greenhouse gas. 17 Cal. Code Regs. § 95802 (West).

[46] CARB, Climate Change Scoping Plan: A Framework for Change 31 (Dec. 2008), https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/document/adopted_scoping_plan.pdf [hereinafter 2008 Scoping Plan]; CARB, *Overview of ARB Emissions Trading Program* (Sept. 2, 2015), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/guidance/cap_trade_overview.pdf.

[47] *See* Int'l Carbon Action P'ship (ICAP), Emissions Trading Worldwide: Status Report 2022, at 88, https://icapcarbonaction.com/system/files/document/220408_icap_report_rz_web.pdf; *see also Mandatory GHG Reporting - Reported Emissions*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/mrr-data; CARB, 2000–2019 GHG Emissions Trends Report Data (updated on Apr. 1, 2022), https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000_2019_ghg_inventory_trends_figures_04-01.xlsx.

CHAPTER FOUR
KEY DESIGN ELEMENTS

The remainder of this report will describe in greater detail several specific topics in the governance of the California GHG cap-and-trade program, including cap-setting; use of auction proceeds; offsets; monitoring, reporting, and verification; and program evaluation mechanisms. As stated above, the specific topics covered here were determined through a series of informal conversations among researchers at Tsinghua, CCCI, and UCLA.

A | CAP-SETTING

CARB sets an annual cap, or limit on the total amount of permissible GHG emissions by all covered entities. It then creates tradable allowances equal to the amount of the cap, which are distributed to regulated sources either for free, via auction, or through trading with other entities. One allowance equals one metric ton of carbon dioxide equivalent emissions, based on the 100-year global warming potentials included in CARB's Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR).[48]

The cap declines every year to help achieve the statewide GHG emissions reduction targets. CARB has set statewide annual allowance budgets for budget years 2013-2050. The program started with a cap of 162.8 $MMTCO_2e$ in 2013 - about 37% of the state's emissions, by CARB's estimate - and raised the cap to 394.5 $MMTCO_2e$ in 2015 - 77% of statewide emissions - when it began to include fuel suppliers.[49] These caps were set based on the projected amount of emissions from included sectors in 2012 and 2015.[50] CARB then identified a 2020 cap of 334.2 $MMTCO_2e$, based on the economy-wide target of 427 $MMTCO_2e$,[51] and mandated a "straight-line" path between the 2015 and 2020 caps; that is, the caps decrease by the same amount (12 $MMTCO_2e$ annually) each year.[52]

The 2021-2030 caps were established based on the new target set by SB 32, following a similar approach. CARB applied the same cap-to-target ratio used for the 2020 budgeting (77.5%) to the SB 32 economywide target of 258.6 $MMTCO_2e$ by 2030, resulting in a 2030 cap of 200.5 $MMTCO_2e$ (*i.e.*, 77.5% of 258.6).[53] CARB also continued the "straight-line" approach from 2015 to 2020, resulting

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[48] 17 Cal. Code Regs. § 95802(a) (West) (definition of "Carbon Dioxide Equivalent"); Regulation for the Mandatory Reporting of Greenhouse Gas Emissions, 17 Cal. Code Regs. § 95102(a) (West) (definitions of "Carbon dioxide equivalent" and "Global warming potential"). These regulations currently use the federal values in 40 C.F.R. § 98, Subpt. A, Tbl. A-1. The federal equivalency values, in turn, are generally based on the values used by the IPCC. *See, e.g.*, 79 Fed. Reg. 73,749, 73,753 (Jan. 1, 2015) (noting that the values used by the federal government are based on the IPCC's Second, Fourth, and Fifth Assessment Reports).

[49] ICAP, *USA – California Cap-and-Trade Program* (2021), https://icapcarbonaction.com/en/ets/usa-california-cap-and-trade-program; Independent Emissions Market Advisory Committee (IEMAC), 2020 Annual Report of the Independent Emissions Market Advisory Committee, 2 (2020), https://calepa.ca.gov/wp-content/uploads/sites/6/2021/01/2020-ANNUAL-REPORT-OF-THE-INDEPENDENT-EMISSIONS-MARKET-ADVISORY-COMMITTEE_FINAL_a.pdf.

[50] CARB, *California's Cap-and-Trade Program: Final Statement of Reasons*, 165 (2011), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2010/capandtrade10/fsor.pdf (specifically, the budget was set to projected emissions from the first year of a sector's inclusion in the program; although 2012 was no longer a compliance year, it was still used as the starting point).

[51] *Id.* at 164 ("The Scoping Plan clearly articulated that the primary goal of AB 32 is to reduce GHG emissions to 1990 levels, which CARB established in its 2004 GHG inventory as being 427 MMT."). The economy-wide target is CARB's estimate of the state's 1990 emissions, as required by AB 32. *See* Cal. Health & Safety Code § 38550 (West).

[52] 17 Cal. Code Regs. § 95841(a) (West).

[53] CARB, *Staff Report: Initial Statement of Reasons, App. D to Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation*, 7-8 (2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/capandtrade18/ct18398.pdf?_ga=2.65568110.1719232368.1634231775-1158618940.1627694642#page=7. The 77.5% figure is calculated using 431 $MMTCO_2e$ as the 2020 target, rather than 427 $MMTCO_2e$, because the 2020 targets were recalculated after the global-warming factors of some gases were changed in 2014. See CARB, First Update to the Climate Change Scoping Plan 24 (2014), https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf.

in an annual decline of about 13.4 $MMTCO_2e$ annually from 2021 to 2030.[54] After 2030, the annual budget is currently set to continue declining until 2050, but at half the 2021-2030 rate; that is, at 6.7 $MMTCO_2e$/year.[55]

Allowances are available in two primary ways: auction and free allocation. CARB holds quarterly auctions where it offers a specified number of allowances based on the allowance budget, subject to price controls.[56] CARB also gives free allowances to industrial entities, electrical distribution utilities, natural gas suppliers and other entities.[57] The allowances allocated to investor-owned utilities (IOUs) must be consigned to auction, with proceeds required to be used in specified ways.[58]

B | AUCTION PROCEEDS

At present, more than two-thirds of the allowances budgeted for a given year in the cap-and-trade program are sold at auction.[59] These auctions, which generate billions of dollars a year,[60] are used to advance various policy priorities through two main revenue streams: revenues from the allowances sold directly by the state and deposited in the Greenhouse Gas Reduction Fund, which funds various climate-related projects; and proceeds from consignment auctions, where freely allocated allowances to investor-owned utilities are sold at auction and revenues are required by law to be used for the benefit of utility customers. These revenue streams are described in detail below.

1 | The Greenhouse Gas Reduction Fund

A substantial portion of auction proceeds - about two-thirds for the February 2022 auction - go to the Greenhouse Gas Reduction Fund (GGRF).[61] These are the proceeds from the sales of state-owned allowances. GGRF funds are then appropriated by the state legislature for use in specified programs related to climate change.[62] As of early 2022, about $19.2 billion in cap-and-trade auction proceeds had gone to the fund,[63] and as of November 2021 about $10.5 billion had been used in implemented projects.[64]

GGRF funds may only be used for projects that advance California's GHG reduction goals.[65] That said, funded projects may serve other purposes in addition to reducing GHG emissions, and the law includes specific additional goals to be pursued "where applicable and to the extent feasible."[66] These include economic, environmental, and public-health co-benefits; mitigation efforts; local economic development; and investment in "the most disadvantaged communities and households."[67]

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54 *See* ICAP, *supra* note 49, at 2.

55 17 Cal. Code Regs. § 95841(b) (West).

56 *See generally* 17 Cal. Code Regs. §§ 95910-95915 (West).

57 *See generally id.* §§ 95890-95895.

58 *Id.* §§ 95892(d), 95893(d).

59 This figure changes from year to year, depending on the number of allowances freely allocated and other factors. For 2021, about 70% were sold at auction. *See Auction Notices and Reports*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/auction-information/auction-notices-and-reports (total sales at auctions in 2021 of 2021 allowances was about 198.4 million, and about 25.9 million allowances were sold in advance auctions in 2018); 17 Cal. Code Regs. § 95841, Table 6-2 (total 2021 allowances budgeted were 320.8 million).

60 CARB, *Summary of Proceeds to California and Consigning Entities* (updated in Mar. 2022), https://ww2.arb.ca.gov/sites/default/files/2020-09/proceeds_summary.pdf.

61 *Id. See generally* 17 Cal. Code Regs. § 95870(i); Cal. Govt. Code § 16428.8 (West); Cal. Health & Safety Code §§ 39710 *et seq.* (West).

62 Cal. Health & Safety Code § 39712(a)(2) (West).

63 *See* CARB, *supra* note 59.

64 Cal. Climate Investments, Annual Report To The Legislature On California Climate Investments Using Cap-And-Trade Auction Proceeds, at i, 6 (Apr. 2022), https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/cci_annual_report_2022.pdf. There are several stages between auction proceeds being paid into the fund and projects being implemented: the state legislature must appropriate or authorize use of the funds, the relevant agency must allocate those funds to programs, the specific recipients of the funds must be selected, the funds must be awarded to individual projects, and, finally, the projects themselves must begin creating benefits before the state considers the funding to be implemented. *Id.* at 8. There is therefore a substantial lag between funds that are received by the GGRF and funds that are implemented in projects.

65 Cal. Health & Safety Code § 39712(a) (West).

66 *Id.* § 39712(b) (West).

67 *Id.*

In addition to these general goals, the GGRF has specific requirements for investing GGRF funds in specified "priority populations." 25% of GGRF funds are required to go to projects that are both located in "disadvantaged communities" and benefit residents of those communities.[68] "Disadvantaged communities" are identified by the California Environmental Protection Agency (CalEPA) according to a complex ranking system called CalEnviroScreen, which ranks census tracts by both pollution burdens, such as concentrations of pollutants and proximity to waste sites, and the vulnerability of the population, measured by health and socioeconomic indicators.[69] CalEPA designates the highest-indexed quartile of census tracts - that is, the 25% of census tracts with the highest combined score on the CalEnviroScreen indicators - as "disadvantaged communities" eligible for the prioritized GGRF investments.[70]

An additional 10% of GGRF funds have been earmarked for low-income households and communities since 2017.[71] These are distinguished from "disadvantaged communities" in that they are defined by income, rather than by the CalEnviroScreen factors. Specifically, these funds must be spent either on investments that benefit low-income households, or on investments that are located in and benefit low-income census tracts.[72] Households and census tracts are designated as "low income" by reference to the median income of the county in which they are located, meaning that areas and families that earn high incomes relative to the state as a whole can be considered "low income" if they are located in a particularly wealthy county.[73] Half of these low-income funds (that is, 5% of the total GGRF funding) must be invested in areas within a half-mile of the "disadvantaged communities" described above.[74]

2 | Return of auction sales to utility customers

In addition to the sales of state-owned allowances, the state also regulates the use of the proceeds from allowances sold on consignment. These are allowances that are allocated for free to privately and publicly owned electric utilities and natural-gas providers, but which must be put up for auction rather than used by those utilities.[75] CARB sells the allowances along with the rest of the auctioned allowances at quarterly auctions. The revenue from those sales is then returned to the utilities. However, the utilities have strict limits on what they can do with this money, and nearly all of it must be returned to their customers. Thus, the allocation of allowances to investor-owned utilities primarily serves to transfer auction revenue value to utility customers.[76]

The end result of this process is that nearly all the auction proceeds that do not go to the GGRF - a little less than a third in the most recent auction - are paid to utility customers as

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[68] *Id.* § 39713(a). Prior to 2017, only 10% of these funds were required to be located in those communities; the requirement that all of the investments counted toward the 25% requirement be located in those communities was added by AB 1550.

[69] *See generally* Cal. Envtl. Prot. Agency, *Designation of Disadvantaged Communities Pursuant to Senate Bill 535 (De Leon)* (Apr. 2017), https://calepa.ca.gov/wp-content/uploads/sites/6/2017/04/SB-535-Designation-Final.pdf. A "census tract" is a statistical area smaller than a county, with a population of between 1,200 and 8,000 people. *See Glossary: Census Tract*, U.S. Census (visited Oct. 25, 2021), https://www.census.gov/programs-surveys/geography/about/glossary.html#par_textimage_13/. The fourth version of the CalEnviroScreen index, which is the latest as of this writing, is available at *CalEnviroScreen 4.0*, Cal. Office of Environmental Health Hazard Assessment (Oct. 20, 2021), https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40.

[70] *See* Cal. Envtl. Prot. Agency, *supra* note 69.

[71] Prior to 2017, this additional 10% did not have to be additional to the 25% earmarked for disadvantaged communities and had looser restrictions. *Compare* Cal. Stats. 2012, c.830 (SB 535), § 3 (setting requirements from 2013-2016), *with* Cal. Stats. 2016, c.359 (AB 1550), § 1 (setting requirements from 2017 onward).

[72] Cal. Health & Safety Code § 39713(b)-(d) (West).

[73] Specifically, "low-income" is defined as income that is 80% or less of either the median income of the state or the median income of the county in which they are located. Cal. Health & Safety Code § 39713(d); *see also* CARB, *Identification of Low-Income Communities under AB 1550: Methodology and Documentation for Maps* (Updated on May 2021), https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/kml/ab1550_maps_documentation.pdf.

[74] Cal. Health & Safety Code § 39713(c) (West).

[75] Note that California also allocates free allowances to publicly or cooperatively owned utilities, as well as to industrial manufacturers; these are not subject to the requirement to sell the allowances on commission.

[76] The complexity of this process is likely due to legal issues that are specific to California. One factor seems to be restrictions on increasing taxes, which in California is more difficult than enacting environmental laws. If the state had used its auction revenues in ways that do not support California's climate change goals, the courts may have considered the program to be a tax rather than a climate regulation. *See* Cal. Chamber of Com. v. State Air Res. Bd., 10 Cal. App. 5th 604 (Ct. App. 3d Dist. 2017) (noting that a lower court considered the use of revenues in assessing whether the cap-and-trade auctions were a tax, but ultimately deciding the issue on a different basis). Since these issues are not relevant in the Chinese context, this report does not discuss the specifics of the consignment program, and instead focuses on the policy goal behind it: reducing the impact of increased energy prices on consumers.

an on-bill credit.[77] The vast majority of these payments go to residential consumers.[78] Since 2016, all payments to residential customers are on a "non-volumetric" basis, meaning that each of a utility's customers gets the same amount of credit on their bill, regardless of how much power they use.[79] The non-volumetric return is intended to reduce the cost impact of the cap-and-trade program on consumers while retaining the incentive to use less energy created by requiring utilities to purchase allowances in the first place.[80] Credits can vary widely by year and by utility provider, but households generally receive around $70 to $80 per year in electricity credits, and, if they use natural gas, an additional $15 to $25 per year in natural-gas credits.[81] A total of about $6.5 billion was returned to households between 2013 and 2020.[82]

Private electric utilities also return a small portion of their auction revenues to small businesses, defined as businesses whose peak electricity use is less than 20 kilowatts for at least nine months each year.[83] As of 2022, the small-business credit is equal to the residential credit, meaning that residential customers will get two flat credits each year, likely in the range of $70 to $80.[84] This replaces the system in place through 2021, which was volumetric, meaning that it reduced the amount that small businesses pay per kilowatt-hour rather than being provided as a flat credit. The volumetric rate was calculated to offset the electricity price increases resulting from the cap-and-trade program, but at a declining rate: it offset 100% of the price increase in 2015 and declined by 10 percentage points each year afterward, to 50% in 2020,[85] and returned about $384 million to small businesses between 2013 and 2020.[86] The shift from a volumetric credit to a flat credit is intended to strengthen the incentive for small businesses to conserve electricity, while still preventing leakage.[87]

Finally, some of the revenues from the auction of private electric utilities' allocations are returned to "emissions-intensive, trade-exposed" (EITE) customers, who would bear especially high costs from energy-price increases resulting from the cap-and-trade program. EITE facilities include

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[77] *See* CARB, *supra* note 60. A small percentage of auction proceeds - about 4% in the latest auction, *see id.* - are paid to publicly or cooperatively owned utilities, which generally use these funds to fund renewable-energy projects. *See* CARB, *Cap-and-Trade Program: Summary of 2013-2019 Electrical Distribution Utility Allocated Allowance Value Usage* 10-13 (2021), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/allowanceallocation/edu_2013to2019useofvaluereport.pdf.

[78] CARB, *Cap-and-Trade Program: Summary of 2013-2019 Electrical Distribution Utility Allocated Allowance Value Usage* 6 (86.2% of consignment auction revenue for private electric utilities returned to residential consumers as of 2019); CARB, *Cap-and-Trade Program: Summary of 2015-2019 Natural Gas Supplier Allocated Allowance Value Usage* 5 (2021), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/allowanceallocation/ngs_2015to2019useofvaluereport.pdf (starting in 2018, all consignment auction revenue for private natural-gas utilities not otherwise allocated by the state or for administrative costs must be returned to residential consumers).

[79] 17 Cal. Code Regs. §§ 95892(d)(3)(D), 95893(d)(3)(C).

[80] *See* CARB, Proposed Amendments to the California Greenhouse Gas Emissions and Market-Based Compliance Mechanisms: Initial Statement of Reasons 164 (2013), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2013/capandtrade13/capandtrade13isor.pdf (describing rationale for natural gas allowance allocation); CARB, Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms: Initial Statement of Reasons 200-01 (2016), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2016/capandtrade16/isor.pdf (describing rationale for electric power).

[81] A full list of credit amounts by year and by utility is available at available at *California Climate Credit*, Cal. Pub. Util. Comm'n, https://www.cpuc.ca.gov/climatecredit/.

[82] CARB, *Cap-and-Trade Program: Summary of 2013-2020 Electrical Distribution Utility Allocated Allowance Value Usage* 6 (2022), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/allowanceallocation/edu_2013to2020useofvaluereport.pdf (86% of $6.4 billion returned to residential customers; note that this includes a volumetric credit program that has since been discontinued); CARB, *Cap-and-Trade Program: Summary of 2015-2020 Natural Gas Supplier Allocated Allowance Value Usage* 5 (2022), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/allowanceallocation/ngs_2015to2020useofvaluereport.pdf (25% of $3.79 billion returned to residential customers).

[83] Cal. Pub. Util. Comm'n, *Decision Adopting Greenhouse Gas Allowance Revenue Formula And Distribution Methodology for Small Business Customers*, 13-12-002, at 5 (2013), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M082/K829/82829359.PDF.

[84] Cal. Pub. Util. Comm'n, *Decision Adopting Customer Climate Credit Updates*, 21-08-026, at 64 (2021), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M402/K296/402296732.PDF.

[85] *See generally id.* (creating program); Cal. Pub. Util. Comm'n, *Decision Addressing Threshold and Near Term Issues*, 20-10-002, at 11-13 (2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M348/K734/348734605.PDF (maintaining credit at 50% of the Cap-and-Trade price increase).

[86] CARB, *Summary of 2013-2020 Electrical Distribution Utility Allocated Allowance Value Usage*, *supra* note 82, at 6 (small-business program returned 6% of $6.4 billion).

[87] Cal. Pub. Util. Comm'n, *Decision Adopting Customer Climate Credit Updates*, 21-08-026, at 36-37 (2021), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M402/K296/402296732.PDF.

all facilities that receive free allowance allocations, as well as facilities that operate in the same industries but have low enough emissions that they are not covered by cap-and-trade. The amount of credit is calculated based on the production of the particular facility.[88] Thus, the EITE credits offset the increased cost of electricity resulting from the cap-and-trade in essentially the same way that industry allocations offset the cost of purchasing allowances. This program returned about $390 million to EITE facilities between 2013 and 2019.[89]

A small percentage of auction proceeds goes to other programs. About 5% of the proceeds represent voluntary consignments by publicly or cooperatively owned utilities, which have more freedom to use their consignment sales revenue.[90] These funds are generally used either for renewable-energy and energy-efficiency programs, or to offset the cost of purchasing allowances in other years; these programs have resulted in about $466 million in renewable-energy projects and about $167 million in energy-efficiency projects between 2013 and 2020.[91] In addition, the state has required $50 million per year of natural-gas utilities' consignment revenues to be set aside for paying for building-decarbonization programs.[92]

3 | Challenges in the use of auction proceeds

a | Stability of funding

Both the GGRF and the credits provided to utility customers ultimately depend on auction revenues. This creates substantial variability in funding levels from one year to the next. For example, GGRF funding has swung from below $900 million in the 2016-2017 fiscal year to over $3 billion in the 2018-2019 fiscal year; it may reach $4 billion in the 2021-2022 fiscal year.[93]

There are some stabilizing mechanisms built into the system. The price floor, which increases at a real rate of 5% per year, ostensibly guarantees a minimum level of funding for the GGRF. However, if demand is low enough at auction, some allowances will simply go unsold.[94] It is important to note in this context that California privileges allowances sold on consignment over allowances sold on the state's behalf. This means that, when there is not sufficient demand to sell all the allowances offered, the consigned allowances are sold first.[95] As a result, the funds returned to utility customers are slightly more stable than funding for the GGRF.

The flip side of price instability is that funding sometimes increases unexpectedly. This has happened over the last several auctions, which have seen record-setting prices.[96] The budget for the GGRF is set on an annual basis, and although about 65% of the revenues are automatically allocated for certain categories of projects, the remainder needs to be allocated each year. The 2021-2022 fiscal-year budget already had $732 million more in revenue than was expected by the end of 2021, and if prices remain high, could have a $1.7 billion surplus.[97] This is mostly an opportunity, but it does highlight the difficulties inherent in planning around a volatile revenue source.

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88 *See generally* Cal. Pub. Util. Comm'n, *Decision Adopting Greenhouse Gas Allowance Revenue Allocation Formulas and Distribution Methodologies for Emissions-Intensive and Trade-Exposed Customers*, 11-03-012 (2014), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M144/K130/144130487.pdf.

89 CARB, *Summary of 2013-2019 Electrical Distribution*, *supra* note 77, at 6 (EITE program returned 7.1% of $5.48 billion).

90 *See* CARB, *supra* note 60.

91 *See* CARB: *Cap-and-Trade Program: Summary of 2013-2020 Electrical Distribution Utility Allocated Allowance Value Usage*, *supra* note 82, at 12 (renewable energy is 14%, and energy efficiency 5%, of $3.33 billion in auction revenues spent).

92 Cal. Pub. Util. Comm'n, *Decision Establishing Building Decarbonization Pilot Programs*, 20-03-027 (2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772660.PDF.

93 See CARB, *supra* note 60. The 2021-2022 fiscal year has only had three quarterly auctions, but has already generated over $3.4 billion for the GGRF. *Id.* Revenues to the GGRF were lower than $900 million between 2012 and 2014, *id.*, but this is because fuel suppliers were not yet included in the cap-and-trade program and therefore far fewer allowances were auctioned.

94 This happened most recently in May 2020, when only about 23 million of the 66 million allowances available were sold. CARB, May 2020 Auction #23 Summary Results Report (May 28, 2020), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/auction/may-2020/summary_results_report.pdf?_ga=2.97515993.73140785.1642018425-1158618940.1627694642.

95 For example, in the May 2020 auction about 18 million allowances were sold on consignment, while only about 1.5 million were sold by California. (Some allowances were also sold by Québec, who also participated in the auction.) *Id.*

96 CARB, *California and Québec Carbon Allowance Prices*, *supra* note 12.

97 *See generally* Legislative Analyst's Office (LAO), *Cap-And-Trade Auction Update and GGRF Projections* 1-3 (2021), https://lao.ca.gov/reports/2021/4480/cap-and-trade-120621.pdf.

b | Targeting of "priority populations" in the GGRF

According to state reporting, about half of implemented GGRF funding has gone to projects located in and benefiting "priority populations" - exceeding the 35% requirement.[98] However, there are two reasons to question whether this accurately represents the benefit of GGRF projects to disadvantaged and low-income Californians.

First, the definition of "low income" households for GGRF purposes includes areas that have quite high incomes relative to the state as a whole. Whether a household or census tract is "low-income" is based on either the median income of the state or the median income of the county in which they are located, whichever is higher.[99] Because of the income disparities in California, this means that a household or census tract that earns much more than the statewide median, but is located in a high-income county, may still be "low-income" for purposes of the GGRF. To take an extreme example, a four-person household in San Francisco would qualify as "low income" if they made $146,000 in 2021 - about 60% above the median income for the state.[100]

Second, projects that serve large areas and populations, such as new rail lines, are counted as benefiting "priority populations" as long as any portion of their service area includes eligible households or census tracts.[101] This could mean that projects with only minimal benefits for targeted groups are being counted toward the total benefits for "priority populations." For example, as of 2016, 62% of GGRF funding in Orange County was reportedly spent on projects within "disadvantaged communities" (DACs) as identified by CalEPA. But nearly 80% of that DAC funding (nearly half of the total GGRF funding) went toward a single project: purchasing new equipment for an intercity rail line. The new transportation equipment likely served some DACs, and was therefore counted as a DAC project, but was not a targeted investment that would primarily benefit DACs.[102]

C | OFFSETS

Apart from submitting allowances, covered entities can satisfy a small percentage of their compliance obligation by funding emissions-reduction or carbon-sequestration projects. Offsets are meant to help with cost-containment (*i.e.*, by identifying lower cost emissions reductions), to achieve reductions in non-covered sectors, and to promote climate diplomacy with other states/regions. Pursuant to AB 32, these projects must be real, quantifiable, permanent, verifiable, enforceable, and additional to what is required by law and to what would otherwise occur in a conservative business-as-usual scenario.[103] An offset that is "real" would result in actual carbon emissions reductions without inaccurate reporting or leakage of emissions to another area, product, or process in lieu of actual reductions.[104] An offset that is "permanent" would create long-term emission reductions, even with unintentional reversals

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[98] *Id.* at 22.

[99] Cal. Health & Safety Code §39713(d) (West); CARB, Identification of Low-Income Communities under AB 1550: Methodology and Documentation for Maps, *supra* note 73.

[100] Cal. Dept. of Housing & Community Dev., *Revised State Income Limits for 2021* 11 (Dec. 31, 2021), https://www.hcd.ca.gov/grants-funding/income-limits/state-and-federal-income-limits/docs/income-limits-2021.pdf. This discrepancy is partially a result of how the "low-income" rate is calculated: because "low-income" designations were originally designed for housing assistance, the income threshold is raised in areas with high housing costs, to the extent that the "low income" threshold can be quite close to, or even exceed, the median income of the county. In San Francisco's case, the "low income" threshold is only about 2% below the median income.

[101] *See* Kim Serrano, *Greenhouse Gas Reduction Fund Investments in and around Orange County*, Univ. of California Irvine Community Resilience Projects (2017), https://communityresilience.uci.edu/wp-content/uploads/2018/02/UCI-OC-GGRF-Report-FINAL-1.pdf.

[102] *See id.* at 15-17.

[103] Each of these terms is defined in 17 Cal. Code Regs. § 95802(a).

[104] The program defines "real" to mean, in the context of offset projects, "that GHG reductions or GHG enhancements result from a demonstrable action or set of actions, and are quantified using appropriate, accurate, and conservative methodologies that account for all GHG emissions sources, GHG sinks, and GHG reservoirs within the offset project boundary and account for uncertainty and the potential for activity-shifting leakage and market-shifting leakage." 17 Cal. Code Regs. § 95802(a).

from events such as wildfires.[105] And an offset that is "additional" would reduce carbon beyond would otherwise occur without the offset.[106]

To ensure that these legal requirements are met, CARB requires offset projects to conform to "Compliance Offset Protocols." CARB currently issues credits (called "offset credits" or "offsets") under six approved Compliance Offset Protocols for the following project activities:

- capturing and destroying methane generated by manure from livestock;
- capturing and destroying methane from mining projects;
- destroying ozone-depleting substances;
- reducing GHG emissions from rice cultivation;
- growing or preserving forests within the United States; and
- planting trees in urban areas.[107]

All offset projects must be located within the United States,[108] and each offset credit is meant to represent one $MTCO_2e$, just like an allowance.[109]

Entities can use up to a quantitative usage limit of offset credits against their emissions obligations, meaning that a covered entity can surrender offset credits on a one-to-one ratio for a small percentage of their actual emissions. Offsets were limited to 8% of entities' emissions obligations corresponding to their 2013-2020 emissions; AB 398 reduced that limit to 4% for emissions from 2021-2025, and 6% for emissions from 2026-2030.[110] In addition, AB 398 specified that no more than one half of the quantitative usage limit may be sourced from projects that do not provide direct environmental benefits in the state.[111]

The number of offset credits issued for a project is based on the underlying technical requirements of the applicable Compliance Offset Protocol. As noted above, each credit represents a ton of CO_2e reduction or removal that is "real, additional, quantifiable, permanent, verifiable, and enforceable."[112] Most of these requirements are addressed by strictly limiting the types of projects that are eligible and providing specific quantification methods and calculations for determining the number of GHGs reduced. In addition, the Compliance Offset Protocol for U.S. Forest Projects includes provisions to minimize leakage, which is to say, provisions to ensure credited activities represent real emissions reductions, rather than shifting those activities (and emissions) to another area. This same protocol also contains provisions to ensure the "permanence" of emissions reductions, including the inclusion of a "forest buffer account," which is a sort of insurance mechanism against unintentional reversals from disturbances such as wildfires, pest infestations, and drought.[113]

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[105] The program defines "permanent" to mean, in the context of offset projects, "either that GHG reductions and GHG removal enhancements are not reversible, or when GHG reductions and GHG removal enhancements may be reversible, that mechanisms are in place to replace any reversed GHG emission reductions and GHG removal enhancements to ensure that all credited reductions endure for at least 100 years." 17 Cal. Code Regs. § 95802(a).

[106] The program defines "additional" to mean, in the context of offset projects, "greenhouse gas emission reductions or removals that exceed any greenhouse gas reduction or removals otherwise required by law, regulation or legally binding mandate, and that exceed any greenhouse gas reductions or removals that would otherwise occur in a conservative business-as-usual scenario." 17 Cal. Code Regs. § 95802(a).

[107] *See generally Compliance Offset Program*, CARB (last visited Oct. 25, 2021), https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program (linking to offset protocols). Of these protocols, the U.S. Forest Projects protocol is responsible for the majority of offset credits. *See ARB Offset Credit Issuance Table*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/arb-offset-credit-issuance. *See also* Danny Cullenward & Dallas Burtraw, *Draft IEMAC Report Offsets Chapter* 2 (Jan. 11, 2022), https://calepa.ca.gov/wp-content/uploads/sites/6/2022/01/2022_01_13_IEMAC_Report_carbon_offsets_chapter_a-1.pdf.

[108] 17 Cal. Code Regs. § 95973(a)(3).

[109] *Id.* § 95980(a).

[110] *Id.* § 95854(b).

[111] *See* AB 398; *see also* 17 Cal. Code Regs. § 95854(e). *See generally Direct Environmental Benefits in the State (DEBS)*, CARB (last visited Apr. 18, 2022), https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/direct-environmental-benefits.

[112] *Id.* 17 Cal. Code Regs. § 95970(a)(1).

[113] *See generally U.S. Forest Projects – June 25, 2015*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols/us-forest-projects/2015; CARB, *Compliance Offset Protocol U.S. Forest Projects* 132 (June 25, 2015), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/protocols/usforest/forestprotocol2015.pdf.

California's Compliance Offset Program has been one of the most criticized elements of California's GHG ETS, and these critiques, including with respect to permanence, leakage, and whether reductions are real, are discussed further below.

California's offset market offers lessons in the challenges for ensuring the environmental integrity of emissions reductions; if offsets are not real and allow additional emissions outside the cap, they can undermine goals of the market. Several concepts stemming from AB 32's requirements for offsets help to give the idea of integrity substance. Because most of California's offsets come from improved forest management projects,[114] as with most offset projects worldwide,[115] we'll examine some of the mechanisms California uses to address these integrity concerns in the forest context.

1 | Offset requirements: real, additional, and permanent

Offsets must be *real*, with carbon emission reductions actually taking place and not inaccurately accounted for. An important subset of being real is that offsets should account for any *leakage*, or shifting emissions to another area, product, or process rather than actually reduced.[116] Leakage is a concept that applies to the cap-and-trade program beyond offsets, but is especially relevant to this context. For example, protecting one forest from logging may only incentivize logging in a nearby forest. California's cap-and-trade program attempts to account for this in two ways, labeled as (1) activity shifting leakage, when harvest shifts to areas outside a project's boundaries, and (2) market shifting leakage, when increased harvest occurs due to a project's effects on market demand.[117] CARB estimates leakage of 20% of the difference between actual harvests and baseline harvests for the first, and 80% of the reduction in wood products for the second, which are subtracted from offset credits.[118] CARB has been criticized for underestimating leakage,[119] but has countered that such criticisms misrepresent how leakage is accounted for in the protocol.[120] The uncertainties inherent in the assumptions of the relevant protocols raise the possibility of over-crediting for offsets, and represent a basic risk in the use of offsets.[121]

Offsets must also have *additionality*, by sequestering carbon beyond what otherwise would have occurred without the offset purchase. This can be conceptualized as the difference between actual project activities and those in a business-as-usual baseline.[122] The challenge is determining such a baseline given the lack of information and the subjectivity that process inevitably entails.[123] There is uncertainty both in predicting growth and harvests for 100 years and predicting what would have happened without the offset program.[124]

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[114] *ARB Offset Credit Issuance*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/arb-offset-credit-issuance. *See also* Cullenward & Burtraw, supra note 107, at 2 (the U.S. Forest Projects protocol is responsible for about 80% of all offset credits in the program).

[115] See Voluntary Registry Offsets Database, Berkeley Public Policy (last visited Apr. 20, 2022), https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database (almost half of offsets across the world involve carbon storage in trees).

[116] CARB, *U.S. Forest Offset Projects* 9 (2019), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/offsets/overview.pdf.

[117] *Id.* The program defines activity-shifting leakage as "increased GHG emissions or decreased GHG removals that result from the displacement of activities or resources from inside the offset project's boundary to locations outside the offset project's boundary as a result of the offset project activity" and market-shifting leakage as "increased GHG emissions or decreased GHG removals outside an offset project's boundary due to the effects of an offset project on an established market for goods or services." 17 Cal. Code Regs. § 95802(a).

[118] *Id.* at 10.

[119] In particular by Barbara Haya, Policy Brief: The California Air Resources Board's U.S. Forest Offset Protocol Underestimates Leakage 1 (May 7, 2019), https://gspp.berkeley.edu/assets/uploads/research/pdf/Policy_Brief-US_Forest_Projects-Leakage-Haya_4.pdf. *See also* Grayson Badgley et al., Systematic Over-Crediting in California's Forest Carbon Offsets Program, 28 Global Change Biology 1433 (2022), https://doi.org/10.1111/gcb.15943 (arguing that "[r]ather than improve forest management to store additional carbon, California's forest offsets program creates incentives to generate offset credits that do not reflect real climate benefits").

[120] *See* CARB, *U.S. Forest Offset Projects* (2019), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/offsets/overview.pdf; CARB, *California's Compliance Offset Program FAQ* (Oct. 2021), https://ww2.arb.ca.gov/sites/default/files/2021-10/nc-forest_offset_faq_20211027.pdf.

[121] For greater detail on the debate, see Andrea Tuttle, *Forests are Complicated Enough—Let's Not Make It Worse!: Refuting Claims against California's Forest Offset Protocol*, Pacific Forest Trust, https://www.pacificforest.org/california-forest-offsets-tuttle/.

[122] T. Ruseva et al., *Additionality and Permanence Standards in California's Forest Offset Protocol: A Review of Project and Program Level Implications*, 198 J. of Env't Mgmt. 277, 280 (Aug. 2017), https://www.sciencedirect.com/science/article/pii/S0301479717304309.

[123] *Id.*

[124] *Id.* at 282.

To assess if a given GHG mitigation may have otherwise occurred, CARB staff try to establish if a given method is common practice in the geographic area, taking into consideration prevalence of the technology or mitigation in the sector, cost barriers that would prevent the technology or mitigation in the absence of offset credit revenue, and other factors.[125] Different types of projects are also subject to different additionality requirements; the baseline for avoided conversion projects use market value of alternative land use, while the baseline for improved forest management projects involves the area's initial carbon stocking levels.[126] Evaluation of additionality requirements is difficult because it is inherently counterfactual.

In addition, offsets must have *permanence*, or long-term durability, which in California is used to refer to a requirement that an offset project's carbon reductions endure for at least 100 years. In other words, permanence is about what happens when an offset project releases emissions due to a usually unforeseen event after credits have been granted. The most typical example in the California context would be the destruction of forests due to a wildfire event, especially given the higher rates of extreme wildfire events where many of these forest carbon projects are located due to climate change.[127] California's cap-and-trade program provides for a buffer to correct such unintentional reversals in its forest sequestration projects.[128] The regulation demands a portion of offset credits issued to a forest offset project be placed into a "Forest Buffer Account."[129] The amount a particular project must place into the buffer is dependent on the project's reversal risk, which CARB determines based on financial, management, social, and natural disturbance factors.[130] When an unintentional reversal like the burning of a forest offset occurs, the project operator must notify CARB and the project registry within 30 days and provide an estimate of remaining carbon stocks in the project within 23 months.[131] CARB will thereafter retire credits from the buffer to account for the loss.[132] This system works much like an insurance policy to balance out reversals.[133] As such wildfires grow more intense and expansive, the credits in the buffer pool may not be enough to account for the losses. As of April 20, 2022, 31,627,737 credits had been placed in the buffer pool.[134] Although the last few years have had California's worst wildfire seasons to date, the almost two-year timing requirement in the Compliance Offset Protocol to accurately calculate any lost carbon makes it difficult to tell whether the buffer pool is depleting in a concerning manner. However, according to CARB's reporting, as of October 2021, out of the more than 30 million buffer pool credits, 1,124,762 had been retired due to unintentional reversals, including retiring 847,895 offsets due to a fire on one project.[135]

2 | Challenges in the use of offsets

Beyond integrity, however, successful implementation of the offset program - even one that is "real, additional, quantifiable, permanent, verifiable, and enforceable" - has inherent drawbacks. Like other aspects of California's cap-and-trade system, offsets have come under criticism on environmental justice grounds. The argument is that the offset provisions create perverse

[125] CARB, *California Air Resources Board's Process for the Review and Approval of Compliance Offset Protocols in Support of the Cap-and-Trade Regulation* 8 (May 2013), http://ww2.arb.ca.gov/sites/default/files/cap-and-trade/compliance-offset-protocol-process.pdf.

[126] Ruseva et. al, *supra* note 122, at 283.

[127] *See* Emily Pontecorvo & Shannon Osaka, *California is Banking on Forests to Reduce Emissions. What Happens When They Go Up in Smoke?*, Grist (Oct 27, 2021), https://grist.org/wildfires/california-forests-carbon-offsets-reduce-emissions/; *see also* William Anderegg et al., Letter from Group of Concerned Scientists to Gavin McCabe, Chair of Compliance Offset Protocol Task Force (Nov. 5, 2020), https://www.arb.ca.gov/lists/com-attach/18-ab398offsetreport-ws-VjVTNFAjBTQAWVA2.pdf (citing the fact that 2020 has shattered California fire records and arguing the forest buffer pool contributions from project likely needs substantial increase rather than decrease).

[128] 17 Cal. Code Regs. § 95983.

[129] *Id.* § 95983(a).

[130] CARB, *Compliance Offset Protocol U.S. Forest Projects* 132 (June 25, 2015), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/protocols/usforest/forestprotocol2015.pdf.

[131] *Id.* § 95983(b).

[132] CARB also determines whether the reversal was unintentional, as opposed to intentional reversals which follows different procedures. *Id.* § 95983(b)-(c).

[133] For a condensed explanation of the process, see Brook J. Detterman & Kirstin K. Gruver, *Wildfires Burn Carbon Offsets*, Nat'l L. Rev. (Sept. 22, 2020), https://www.natlawreview.com/article/wildfires-burn-carbon-offsets.

[134] *ARB Offset Credit Issuance Table*, CARB (last visited April 20, 2022), https://ww3.arb.ca.gov/cc/capandtrade/offsets/issuance/arboc_issuance.xlsx (accessed April 20, 2022).

[135] CARB, *California's Compliance Offset Program FAQ* 5 (Oct. 2021), https://ww2.arb.ca.gov/sites/default/files/2021-10/nc-forest_offset_faq_20211027.pdf.

incentives for continued, even increased, local pollution within California since reductions occur elsewhere; although GHG is a global pollutant, industrial activity often comes with local co-pollutants like particulate matter (PM) and nitrogen oxides (NO_x) or other effects like noise, dust, and diesel traffic.

Initially, rather than restricting emissions across the board in-state, the vast majority of offset credits (75%) in the first three years of California's cap-and-trade program were purchased outside the state.[136] Moreover, 52% of regulated facilities reported an increase in in-state GHG emissions.[137] Currently, a regulated entity may only source up to half of its total potential offsets in projects that do not generate benefits within California; CARB has interpreted this to mean the rest must be from projects geographically located within (or that avoid emissions within) the state.[138] Although this helps limit some of the co-benefits from taking place out of state, it does nothing to reduce any inequities occurring within it, for example if pollution continues within a city while purchasing offsets in a forest without much population. To the extent that reductions within the ETS would reduce other air pollutants or negative impacts from industrial production, each offset represents a missed opportunity. And as a general matter, the fact that nearly all offsets have come from non-urban forestry projects suggests public-health co-benefits are reduced.

D | MONITORING, REPORTING, AND VERIFICATION

California's cap-and-trade program uses a pre-existing system for monitoring, reporting, and verification (MRV) of GHG emissions. The regulatory system used by California, called the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR), applies to all large sources of GHG emissions in California, but was specially adapted to cap-and-trade when the latter regulation was developed.[139] Thus, the MRR has been in place even longer than the cap-and-trade program, and CARB used data from the MRR to develop the program.

This report will discuss the general approach to MRV taken by California, as well as some of the ongoing difficulties faced by the MRR.[140]

1 | General scheme of the MRR

a | Coverage

The MRR applies to essentially all facilities that emit greenhouse gases with a global-warming potential of 10,000 $MTCO_2e$ or more in a year.[141] In addition, facilities in certain industries are covered even if their emissions are less than 10,000 $MTCO_2e$ per year: continuously operated generators; refineries; manufacturers of cement, lime, or nitric acid; and facilities with CO_2 sequestration or injection.[142] There are some exclusions: most notably, certain landfills and manure-management systems, temporary or portable generators, and K-12 schools.[143] However, the MRR ultimately covers

[136] Lara Cushing et al., *Carbon trading, Co-Pollutants, and Environmental Equity: Evidence from California's Cap-and-Trade Program (2011–2015)*, PLoS Med. (July 10, 2018), https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002604; Robert Sanders, *California's Cap-and-Trade Air Quality Benefits Go Mostly out of State*, Berkeley News (July 10, 2018), https://news.berkeley.edu/2018/07/10/californias-cap-and-trade-air-quality-benefits-go-mostly-out-of-state/.

[137] Cushing et al., *supra* note 136.

[138] 17 Cal. Code Regs. § 95989(a).

[139] *See* Regulation for the Mandatory Reporting of Greenhouse Gas Emissions, 17 Cal. Code Regs. Art. 2 [hereinafter MRR]. For a brief summary of the history of the MRR, see CARB, *Proposed Amendments to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions* 1-2 (2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/ghg2018/isor.pdf. For previous versions of, and supporting documents for, the MRR, see *Mandatory Greenhouse Gas Reporting Regulation*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/mrr-regulation.

[140] The MRR includes detailed technical guidelines for its implementation, which are beyond the scope of this report, but may be found for reference purposes at MRR §§ 95110-95125, 95150-95158.

[141] *See generally* MRR § 95101.

[142] MRR § 95101(a)(1)(A).

[143] MRR § 95101(f).

all facilities and firms required to report under the cap-and-trade program, plus a margin of firms that do not meet the threshold for the cap-and-trade program but may eventually.[144]

The MRR requires reporting of certain upstream and downstream emission sources. Electricity providers (including electricity importers and exporters) must report the GHGs emitted in generating the electricity that they supply.[145] Similarly, fuel suppliers must report the GHGs that will be emitted when the fuel they supply to in-state users is consumed (if they supply sufficient fuel to generate 10,000 $MTCO_2e$ or more in a year).[146] Because the reporting entity in these cases often does not control the facility that actually emits GHGs, additional calculations are used to estimate the amount of emissions to assign to each entity; these are discussed in more detail below.

The MRR requires only reporting of CO_2, methane, and nitrous oxide, but no other GHGs.[147] This excludes certain fluorinated gases with high global-warming potentials (high-GWP gases). High-GWP gas emissions primarily come from hydrofluorocarbons (HFCs), which have seen increased use as replacements for ozone-depleting substances that have been prohibited by other environmental laws, though they may also come from power generation and semiconductor manufacturing.[148] High-GWP gases are currently regulated under separate, command-and-control requirements.[149]

b | Monitoring requirements

The MRR includes two levels of monitoring and reporting requirements. The less stringent level is used by facilities that are not included in the cap-and-trade program, but still report because they have annual GHG emissions greater than 10,000 $MTCO_2e$.[150] The process for the more stringent level is described below.

Many GHG emissions will come from burning fuel for heat or energy. Emissions from fuel consumption are measured by one of four approaches, or "tiers," with lower tiers using more default values, and higher tiers using more direct sampling. For CO_2, Tier 1 requires measuring the quantity of fuel consumed, Tier 2 requires measuring the amount of heat produced by burning fuel, Tier 3 requires measuring the carbon content of the fuel consumed, and Tier 4 (which is generally optional) uses a continuous emissions monitoring system (CEMS), or similar technology, to directly measure the amount of CO_2 flowing through a stack. The requirements for measuring methane and nitrous oxide generally follow Tier 1 (using default values for the amount of emissions per unit of fuel) or Tier 3 (using chemical analysis to determine the amount of emissions, assuming complete combustion).[151]

In addition to the emissions produced by power and heat, the MRR requires industrial manufacturers to report emissions produced by their specific manufacturing processes. These necessarily vary by industry, but there are some common aspects. As with fuel consumption, if a facility is under an obligation to use CEMS for some other regulatory purpose, it will also need to use the CEMS in reporting CO_2 emissions.[152] For facilities that do not use CEMS, emissions are generally calculated by monitoring the carbon content of materials consumed in the industrial process, using default

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[144] CARB estimates that the MRR covers roughly 80% of GHG emissions. CARB, *Mandatory Greenhouse Gas Reporting 2020 Emissions Year Frequently Asked Questions* 1 (Nov. 4, 2021), https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/2020mrrfaqs.pdf. California maintains a separate inventory that attempts to capture all GHG emissions in the state, and is updated annually; this inventory supplements data reported under the MRR with other data sources. *Current California GHG Emission Inventory Data*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/ghg-inventory-data.

[145] MRR § 95101(d)(1)-(2); *see also id.* §95111(a) (detailing reporting requirements by source and destination).

[146] MRR § 95101(c).

[147] *See generally* MRR §§ 95110-95124, 95152; 40 C.F.R. Subpts. N-Y (federal requirement referenced by the MRR).

[148] *See GHG Descriptions & Sources in California*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/ghg-descriptions-sources.

[149] *See generally* 17 Cal. Code Regs. §§ 95320-95398 (setting maximum emissions rates and prohibiting the use of specified technologies and chemicals).

[150] *See* MRR § 95103(a).

[151] *See generally* MRR § 95115.

[152] MRR § 95110(b); 40 C.F.R. § 98.83(a) (cement); MRR § 95114(d); 40 C.F.R. § 98.163(a), (c) (hydrogen); MRR § 95116; 40 C.F.R. § 98.143(a) (glass); MRR § 95117; 40 C.F.R. § 98.193(a) (lime); MRR § 95120; 40 C.F.R. § 98.173(d) (iron and steel); MRR § 95124; 40 C.F.R. § 98.183(a) (lead).

factors where necessary.[153] Additionally, the MRR requires manufacturers to report additional parameters regarding the amount of materials consumed or produced.[154]

Fuel suppliers - including refiners and importers of fuel - must report the GHGs that would be generated if all of their fuel is consumed.[155] Suppliers are not required to report GHGs from fuel that is destined for use outside of California, or for use in ships or planes.[156] The emissions from fuel suppliers are calculated based on standard emissions factors for each type of fuel, multiplied by the quantity of fuel produced or imported.[157]

A separate set of monitoring requirements apply to oil and gas production, transmission, and storage.[158] These sectors must monitor several additional types of emissions that are particular to their work, including: equipment leaks, vents, flares, emissions from produced water, and emissions from blowdowns prior to servicing equipment.[159]

c | Missing data

Facilities that are missing the data necessary for their emissions calculations must replace that data with estimates. The required process for replacing data varies by industry and sector. As a general matter, when small portions of data are missing, a facility may use its best estimate to replace the data.[160] If larger portions of data are missing, the data must be replaced with the highest values recorded during a specified "look-back" period, which increases with the extent of data missing.[161]

Data from a CEMS are treated differently, though the process follows the same philosophy of using increasingly conservative replacement values for larger gaps in the data. Generally, missing values for small time periods may be replaced by the average of the values for the hour immediately before and immediately after the gap in monitoring data.[162] For longer periods of outages, the facility must use the 90th percentile of the relevant measurement taken over the previous 720 hours of operation (i.e., 30 days, if the monitoring is active on a 24/7 basis).[163] And for outages that represent a greater percentage of the data, the maximum value over a specified look-back period must be used, as for non-CEMS missing data.[164]

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[153] MRR § 95110(b); 40 C.F.R. § 98.83(c)-(d) (cement); MRR § 95114(d); 40 C.F.R. § 98.163(b) (hydrogen); MRR § 95115; 40 C.F.R. § 98.143(b)-(c) (glass); MRR § 95117; 40 C.F.R. § 98.193(b)-(c) (lime); MRR § 95118; 40 C.F.R. §§ 98.223(a)-(e), (g)-(h), 98.224(f) (nitric acid); MRR § 95119; 40 C.F.R. § 98.273(a)(3), (b)(3), (c)(3), (d) (pulp and paper); MRR § 95120; 40 C.F.R. § 98.173(b)-(c) (iron and steel); MRR § 95124; 40 C.F.R. § 98.183(b)(2) (lead).

[154] MRR § 95110(d) (cement producers report amount of clinker consumed and produced, and the amount of cement substitute, limestone, and gypsum consumed); *id.* § 95114(e) (hydrogen producers must report carbon and hydrogen content of feedstock); *id.* § 95116(d) (glass manufacturers must report quantity of glass produced); *id.* § 95117(d) (lime manufacturers must report quantity of dolime produced); *id.* § 95118(d) (nitric acid producers must report quantity of nitric acid produced); *id.* § 95119(d) (pulp and paper producers must report quantity of specified recycled paper products); *id.* § 95120(d) (iron and steel manufacturers must report quantity of iron and steel products, together with description of product and processes used); *id.* § 95124(d) (lead producers or recyclers must report production of lead and lead alloy).

[155] MRR §§ 95121(a), 95122(a).

[156] MRR §§ 95121(a), 95122(a).

[157] MRR §§ 95121(b)(1)-(2), 95122(b); 40 C.F.R. § 98.403, table MM-1 (CO_2); MRR §§ 95121(b)(3), table 2-4, 95122; 40 C.F.R. § 98.33(c) (methane and nitrous oxide).

[158] *See generally* MRR §§ 95150-95158.

[159] The specific emission sources that must be monitored vary by sector and process. *See* MRR §§ 95152(b)-(j), 95153, 95154(a).

[160] *E.g.*, MRR § 95110(c)(2)(A) (if a cement producer has captured at least 90% of the data on carbonate content of its raw materials, it "must substitute for each missing value using the best available estimate of the parameter, based on all available process data").

[161] *E.g.*, MRR § 95110(c)(2)(B)-(C) (if a cement producer has captured 80-90% of the carbonate content of its raw materials, it must use the highest value recorded in the current year or the prior two years; if it captured less than 80% of the data, it must use the highest value it has ever recorded). Note that facilities are required to retain records of their recorded data for at least ten years. MRR § 95105(a). For a general description of the system, see CARB, *Initial Statement of Reasons for Rulemaking: Revisions to the Regulation for Mandatory Reporting of Greenhouse Gas Emissions* 11-12 (Oct. 28, 2010), available at https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2010/ghg2010/ghgisor.pdf.

[162] 40 C.F.R. §§ 75.33(b)(1)(i), (b)(2)(i), 75.35(d) (applies to outages of up to 24 hours if the outage represents 5% or less of the total data collected, or outages of up to 8 hours if the outage represents 10% or less of the total data collected).

[163] 40 C.F.R. §§ 75.33(b)(1)(ii), (b)(2)(ii), 75.35(d).

[164] 40 C.F.R. §§ 75.33(3)-(4), 75.35(d).

d | Reporting and recordkeeping requirements

Facilities subject to the MRR are required to report their emissions annually to CARB. In addition to the emissions data described above, these reports must include information about the facility itself, such as location and ownership, and the total amount of electricity or heat imported to or exported from the facility.[165] All reports must be made through the California Electronic Greenhouse Gas Reporting Tool (Cal e-GGRT).[166] The Cal e-GGRT includes specific modules covering all reporting requirements in the MRR and provides some basic data-validation functions.[167]

Facilities are also required to keep records of their GHG reporting for ten years.[168] This must include the reports themselves, data and calculations supporting the report, and a monitoring plan describing how reports are made and listing the positions responsible for data collection.[169] The facilities must provide all records to CARB for inspection upon request.[170]

Companies that import, export, or make retail sales of electricity (called "electric power entities" or EPEs) are required to report the emissions used to generate the electricity they handle.[171] These emissions are calculated based on the total electricity imported, exported, or sold by the EPE, along with an "emissions factor."[172]

If an EPE generates its own power, or buys power under a written contract specifying the source of the power, it uses the emissions factor for that particular source, which is calculated based on the generator's reports.[173] The emissions factor may be zero for renewable-energy or nuclear sources, in which case the EPE may report zero CO_2e emissions for that portion of the electricity that it handles.

If an EPE cannot show it is receiving power from a particular source, it must use a separate emissions factor for "unspecified" power.[174] The unspecified-power emissions factor is currently 0.428 $MTCO_2e$ per megawatt hour (MWh).[175] This factor, based on a joint evaluation of emissions and power generation by the governments in the Western Climate Initiative, was originally meant to be recalculated for each three-year compliance period;[176] however, it has not been updated since 2010.[177]

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[165] MRR § 95104(a)-(d); 40 C.F.R. § 98.3.

[166] MRR § 95104(e); *see also Mandatory GHG Reporting – Online Reporting Tool*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/mrr-tool.

[167] *See* Slides from Cal e-GGRT, *Kick-Off Meeting* 13-19 (Mar. 1, 2012), https://www.arb.ca.gov/cc/reporting/ghg-rep/tool/registration1page.pdf?_ga=2.29127736.54574390.1639761017-1158618940.1627694642.

[168] MRR § 95105; 40 C.F.R. § 98.3(g)-(h).

[169] MRR § 95105(c)-(d); 40 C.F.R. § 98.3(g).

[170] MRR § 95105(b).

[171] MRR § 95101(d).

[172] MRR § 95111(b).

[173] MRR § 95111(b)(2). CARB uses GHG emissions reporting under the MRR for generators that are subject to the MRR, and reporting under a national GHG reporting system for generators that are subject to that system. MRR § 95111(b)(2)(A)-(B). If a generator does not report to either system, CARB calculates its emissions based on reported heat output (required under a separate national program) and the benchmarked emissions per unit of heat for the particular type of fuel used by the generator. MRR § 95111(b)(2)(C). CARB then divides the amount of emissions for a given year by the amount of electricity generated by the facility in that year to arrive at the emissions factor.

[174] MRR § 95111(b)(1).

[175] *Id.*

[176] CARB, *Initial Statement of Reasons for Rulemaking: Revisions to the Regulation for Mandatory Reporting of Greenhouse Gas Emissions* 168 (2010), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2010/ghg2010/ghgisor.pdf. At the time, the Western Climate Initiative included seven U.S. states - Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington - and four Canadian provinces - British Columbia, Manitoba, Ontario, and Québec.

[177] CARB did conduct a preliminary review in 2018 and determined that no update was needed. *See CARB, Amendments to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions: Final Statement of Reasons* 38 (Dec. 2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/ghg2018/fsor.pdf.

e | Third-Party Verification

Facility reports must be verified by a CARB-accredited third-party service with the necessary expertise.[178] In the first year of each three-year compliance period, verifiers must conduct a "full verification," which includes site visits and creating a "sampling plan" that identifies points that have a high risk of making the report inaccurate, because the data are either particularly likely to be inaccurate or are particularly important to the final report.[179]

In subsequent years during the same compliance period, a verification team can generally perform a "less intensive verification."[180] This requires only data checks and review of the reporting entity's documentation, based on the sampling plan created in the full verification process. Covered entities must switch verifiers at least once every six years, and may not use the previous verifier for at least three years after switching.[181]

The verifier must then submit its verification report to an independent reviewer, who must agree with the verification results.[182] Both the head of the verification team and the lead reviewer must certify that they have completed the required review under penalty of perjury.[183]

CARB oversees the verification process. If the reporting entity refuses to correct errors raised by the verification team, CARB adjudicates the dispute, and, if it agrees that the verification team is correct, determines the amount of emissions the reporting entity is responsible for.[184] Likewise, CARB may refuse a verification report and assign verification to a new verifier if it finds conflicts of interest or errors.[185] CARB also brings enforcement actions when it discovers errors in measurement or calculation that are not corrected in the verification process.

f | Enforcement

CARB considers enforcement of MRR requirements to be an important means of maintaining the cap-and-trade program's integrity. It pursues enforcement actions even against violations that it believes were the result of error or misunderstanding. CARB also posts each of its completed enforcement actions on its public website, which may increase the deterrent effect of its enforcement actions.[186]

CARB has brought 33 enforcement actions since 2013, with an average of $157,330 in penalties.[187] The first year of MRR violations were mostly either for reporting late or for failing to satisfy the independent verifier. These were more numerous but tended to yield lower settlements.[188] In more recent years, enforcement for late reporting and verification-related issues has mostly disappeared (possibly due to increased compliance), leaving larger but less frequent enforcement actions for reporting errors.[189]

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[178] MRR § 95103(f); *see also generally* MRR §§ 95132-95133 (accreditation and conflict-of-interest requirements). For more detail on accreditation requirements, see MRR § 95132.

[179] *See generally* MRR § 95131.

[180] MRR § 95130(a). This requires that there be no uncorrected errors in the full verification, and that the same verification entity be used for the less-intensive verifications.

[181] MRR § 95130(2)-(3).

[182] MRR § 95131(c)(2).

[183] MRR § 95131(c)(3)(D).

[184] MRR § 95131(c)(4)-(5).

[185] MRR § 95131(e).

[186] *See MRR Enforcement Activities*, CARB (last visited Apr. 20, 2022), https://ww2.arb.ca.gov/resources/documents/mrr-enforcement.

[187] *See id.* CARB has settled, rather than litigated, all of its enforcement actions.

[188] There were 21 settlements completed in 2013-14, with an average penalty of about $76,000. Data from *id.*

[189] There were 12 settlements completed in 2015-2020, with an average penalty of about $300,000. Data from *id.*

2 | Difficulties in California's MRV program

a | Determining the emissions from imported electricity

Many electricity generators or wholesalers provide power to buyers both inside and outside of California. But only the power that is sold to California buyers needs to be accounted for under an ETS program.[190] Therefore, it is more expensive to use electricity from high-GHG sources in California, and, conversely, low- and zero-GHG sources are more valuable in California. The result is that it will be more profitable to sell electricity from low-GHG sources to California, and electricity from high-GHG sources elsewhere.

This creates the possibility for leakage: rather than reducing the overall GHG emissions from power generation, electricity suppliers may simply sell the low-GHG power to California buyers and the high-GHG power elsewhere. Because of the nature of the power grid, there is typically no physical change needed to sell power to a different buyer. Essentially, the electricity supplier only needs to write a new contract saying that the power they're providing to a California buyer comes from a specific, low-GHG source; this phenomenon is therefore called "contract shuffling," or alternatively "resource shuffling."[191]

Resource shuffling is prohibited under the cap-and-trade program.[192] However, CARB excludes a number of activities from its definition of resource shuffling that could achieve the same effect. This includes California utilities purchasing clean power to meet the state's renewable portfolio standard, several types of short-term purchase agreements, and any divestment from a generation source for a reason other than reducing cap-and-trade compliance liability. Thus, even full nominal compliance with the resource-shuffling prohibition could result in leakage.[193] CARB has reported that, as of February 2020, it has found no indication of activity that meets its definition of resource shuffling.[194]

b | Unspecified-source emissions factor

A related problem is the selection of an emissions factor for unspecified sources. Although the amount of unspecified electricity is under 10% in California, it can be substantially higher for individual suppliers.[195] Perhaps more importantly, having an emissions factor below the actual emissions of a given source creates a powerful incentive not to specify the source in the first place. The typical coal-fired power plant that CARB lists as a specified source has an emissions factor of 1 to 1.2 $MTCO_2e$, more than double the unspecified emissions factor, and even some smaller natural-gas generators have emissions factors higher than the unspecified factor.[196] Thus, if an EPE lists a coal-fired or small natural-gas generator as a specified source, it could have a substantially higher compliance obligation than it would have if it used the unspecified-source default instead.

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[190] Another GHG ETS exists in the United States - the Regional Greenhouse Gas Initiative (RGGI) - but it applies only to electricity generators, not users of electricity generated elsewhere. *See Elements of RGGI*, RGGI (last visited Apr. 20, 2022), https://www.rggi.org/program-overview-and-design/elements.

[191] *See, e.g.*, Meredith Fowlie & Danny Cullenward, *Report on Emissions Leakage and Resource Shuffling*, IEMAC (Sept. 2018), https://calepa.ca.gov/wp-content/uploads/sites/6/2018/09/6e.-IEMAC_Meeting_Materials_9-21-18__Fowlie_and_Cullenward_Report_on_Emissions_Leakage.pdf.

[192] 17 C.C.R. § 95852(b)(2).

[193] For a full discussion of how resources shuffling might lead to carbon leakage under the cap-and-trade program, see Danny Cullenward, *How California's Carbon Market Actually Works*, 70 Bull. Atomic Scientists 5, at 35-44 (2014), https://journals.sagepub.com/doi/pdf/10.1177/0096340214546834.

[194] CARB, *Review of Potential for Resource Shuffling in the Electricity Sector* (Feb. 2020), https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/guidance/resource_shuffling_faq.pdf.

[195] *See, e.g., 2019 Power Content Label: Southern California Edison* 4 (Oct. 2020), https://www.energy.ca.gov/filebrowser/download/3265 (statewide power mix has 7.3% unspecified; Southern California Edison has 32.6% unspecified).

[196] *See* CARB, *ONE* sheet "EF List" (2021), *available at* https://ccdsupport.com/confluence/download/attachments/112035331/ONE.xlsm (listing the emissions factors for specified sources reported under MRR). The lowest emissions factor CARB lists for a primarily coal-fired power plant is 0.9357 $MTCO_2e$/MWh, for the Intermountain Power Project in Utah; the highest is 1.2355 $MTCO_2e$/MWh, for Wyodak in Wyoming. *Id.* CARB also lists 24 specified power plants that primarily use natural gas and have emissions factors higher than the unspecified-source factor (out of 70 specified natural-gas generators total); these range from the Ocotillo facility in Arizona, with an emissions factor of 0.5262 $MTCO_2e$/MWh, to the Whitehorn Generating Station in Washington, with an emissions factor of 0.9994 $MTCO_2e$/MWh. *Id.* These higher-emission generators tend to be much smaller than the generators with lower emissions: the median facility using primarily natural gas with an emissions factor higher than the unspecified factor produces about 133.4 terawatt hours (TWh) of electricity annually, while the median natural-gas facility with a lower emissions factor produces about 2,344 TWh of electricity annually. *Id.*

The current emissions factor was set in 2010, based on a sector-wide analysis of average emissions per unit of electricity. But the market has changed over the past decade, and a different factor may now be appropriate. Additionally, use of the average emissions for a given amount of electricity does not necessarily reflect the marginal cost of each additional MWh; for example, if California had a rapid increase in demand for electricity, that might be met by older and less efficient power generators that are currently offline, meaning that the additional power would release more emissions than assumed by the use of the default emissions factor. The Independent Emissions Market Advisory Committee (IEMAC) has recommended recalculating the unspecified emissions factor and assessing the appropriateness of an emissions factor based on average, rather than marginal, emissions.[197]

c | Measurements of methane emissions

Finally, there is reason to believe that methane emissions at some facilities - particularly refineries - are substantially underestimated in the MRR. The MRR uses a "bottom-up" approach, meaning that GHG emissions are calculated by summing the actual or estimated emissions from individual processes at individual facilities. Researchers have compared that to "top-down" estimates of methane taken from observations of GHG concentrations, and found that, generally speaking, the MRR reports underestimate the amount of methane that is emitted from some facilities.[198]

The problem appears to be particularly pronounced with refineries. A 2017 study of three refineries using sampling from an airplane flying over the facilities found that their methane emissions were, on average, an order of magnitude higher than the facilities had reported to CARB through the MRR.[199] A similar study was conducted in 2020, with similar results.[200] Notably, both studies found that the bottom-up CO_2 measurements provided under the MRR were roughly similar to the researchers' observations, implying that the problem is particular to methane.

The researchers involved in the 2020 study believe that this is because CO_2 emissions primarily come from fuel consumption, while methane emissions primarily come from leaks or flares.[201] Emissions from fuel consumption are relatively straightforward to estimate because the amount of fuel consumed can be directly measured, the carbon content of the fuel can be measured or else easily estimated from fuel type, and any emissions travel through a clearly defined exhaust passage. Emissions from leaks, by contrast, can occur at many different points in an industrial process for many different reasons, and the quantity of gas that is flared is difficult to estimate.

E | ACCOUNTABILITY AND REGULAR EVALUATION

Finally, we note that an important part of any new and complex system is continual review to ensure that integrity is maintained and ambition is maximized. Such review can occur as part of California's Scoping Plan process, which develops the state's legislatively-required climate change action plan at least every five years. Part of that role in California's cap-and-trade program is served by the Independent Emissions Market Advisory Committee (IEMAC), which publishes regular reports on the performance of the cap-and-trade program. More general oversight is provided by the Legislative Analyst's Office (LAO), which reviews the actions of the state's administrative agencies, including CARB's management of the cap-and-trade program.

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[197] Fowlie & Cullenward, *supra* note 191, at 12.

[198] *See* Abhinav Guha et al., *Assessment of Regional Methane Emission Inventories through Airborne Quantification in the San Francisco Bay Area*, 54 Env't Sci. & Tech. 9254, 9255 (2020) (collecting sources).

[199] Mehrotra et al., *Airborne Methane Emissions Measurements for Selected Oil and Gas Facilities across California*, 51 Env't Sci. & Tech. 12981 (2017).

[200] Guha et al., *supra* note 198, at 9259.

[201] *Id.*

1 | IEMAC

IEMAC was established in 2017, as part of the changes made to the cap-and-trade program under AB 398. The commission has five expert members: three appointed by the governor and one each appointed by the State Senate and State Assembly, which are the two houses of California's legislative branch.[202] Thus, IEMAC primarily consists of representatives of the administration, which will presumably support CARB's position, but will also always include representatives of the legislature, which authorized the cap-and-trade program and has authority to require changes to it. An observer position is reserved for a representative of the LAO.[203]

IEMAC's primary role is to produce annual reports and hold public meetings on "the environmental and economic performance" of the cap-and-trade program.[204] IEMAC uses these reports to isolate a few key issues and recommend changes to CARB regulations for each issue.[205] IEMAC's first report, in 2018, was also submitted directly to CARB and considered as part of CARB's development of regulations to comply with AB 398.[206]

2 | LAO

The LAO has the general responsibility of reviewing the state administrative agencies' implementation of laws passed by the state legislature. Although the LAO is not assigned any particular role in the cap-and-trade program, its recommendations are seriously considered because of its longstanding role in California policymaking, expertise, and connection with the legislature. The LAO does not generally make policy recommendations, but does forecast the impact of various policy choices.

The LAO has produced a number of influential reports on the cap-and-trade program. Its assessment of the likely oversupply of allowances formed the basis for CARB's own prediction of allowance oversupply in its AB 398 rulemaking.[207] A related report noted the possibility that banked allowances could allow facilities to emit far more GHGs than expected in the late 2020s, potentially causing California to miss its 2030 emissions target;[208] that study is regularly referenced in reporting on the cap-and-trade program.[209] The LAO also reports on the budget for the GGRF, most recently alerting the legislature to the greatly increased allowance prices at the November 2021 auction, and proposing alternative revenue predictions based on the price increase.[210]

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[202] Cal. Health & Safety Code § 38591.2(b)(1)(A) (West). Members must be "experts on emissions trading market design," *id.*, with "academic, nonprofit, and other relevant backgrounds" and without conflicts of interest, *id.* § 38591.2(b)(2).

[203] *Id.* § 38591.2(b)(1)(B).

[204] *Id.* § 38591.2(c).

[205] *See, e.g.*, IEMAC, *supra* note 49 (making recommendations for each of six items reviewed).

[206] *See* CARB, *Comment 43 for Cap and Trade 2018* (last visited Apr. 20, 2022), https://www.arb.ca.gov/lispub/comm/iframe_bccommprt.php?listname=ct2018#page=43 (IEMAC's submittal of the 2018 report); CARB, *Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Responses: Public Hearing to Consider the Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms* (2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/capandtrade18/ct18fsor.pdf?_ga=2.131692361.73140785.1642018425-1158618940.1627694642 (document summarizing all received comments and CARB's responses, including many references to IEMAC's 2018 report).

[207] *See* CARB, *Initial Statement of Reasons: Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation* Appx. D 10 (2018), https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/capandtrade18/ct18398.pdf?_ga=2.55603309.73140785.1642018425-1158618940.1627694642 (citing letter from LAO to AM Cristina Garcia (June 26, 2017), *available at* https://lao.ca.gov/letters/2017/Garcia-cap-and-trade-062617.pdf).

[208] LAO, Cap-and-Trade Extension: Issues for Legislative Oversight 6-9 (2017), https://lao.ca.gov/reports/2017/3719/cap-trade-extension-121217.pdf.

[209] *See, e.g.*, David Roberts, *California's Cap-and-Trade System May be Too Weak to Do Its Job*, Vox (Dec. 13, 2018), https://www.vox.com/energy-and-environment/2018/12/12/18090844/california-climate-cap-and-trade-jerry-brown; Julie Cart, *Checking the Math on Cap and Trade, Some Experts Say It's Not Adding Up*, CalMatters (May 22, 2018), https://calmatters.org/environment/2018/05/checking-the-math-on-cap-and-trade-some-experts-say-its-not-adding-up/; Rachel Becker, *California Says It Will Review Cap-and-Trade amid Growing Criticism*, CalMatters (Feb. 18, 2021), https://www.kqed.org/science/1972789/california-says-it-will-review-cap-and-trade-amid-growing-criticism (quoting LAO representative discussing same finding).

[210] LAO, *Cap-And-Trade Auction Update and GGRF Projections* 1-3 (2021), https://lao.ca.gov/reports/2021/4480/cap-and-trade-120621.pdf. This was also picked up by news media. *See, e.g.*, Sameea Kamal, *The California Legislature is Back: What to Expect in 2022*, CalMatters (Jan. 3, 2022), https://calmatters.org/politics/2022/01/california-legislature-what-to-expect-in-2022/.

3 | Difficulties in oversight

The LAO appears to be effectively highlighting major issues in the management of the cap-and-trade program. However, it does not have a mandate to issue regular reports, and instead investigates issues when asked to do so by a lawmaker or when it deems it useful. This means that the LAO's reports are primarily reactive to issues that arise, rather than proactively attempting to anticipate and plan for potential issues.

It is still too early to determine the effectiveness of IEMAC, but early indications are that CARB has not used the commission's recommendations in crafting policy. The only major test of IEMAC's influence was in 2018, with CARB's overhaul of the cap-and-trade regulations in response to AB 398. IEMAC submitted a report to CARB noting several changes that it recommended for the regulation, but for the most part CARB did not consider them.[211] Part of the problem may have been that IEMAC did not have time to issue its report prior to the beginning of the 2018 cap-and-trade amendments, and therefore its proposals were available to CARB only after CARB had finished designing the new rule.

[211] *See, e.g.*, CARB, *Final Statement of Reasons for Rulemaking*, *supra* note 206, at 38, 88-90, 99, 163, 301 (noting IEMAC's suggestions but dismissing them as either outside the scope of the rulemaking or as something that IEMAC itself should be doing).

CHAPTER FIVE
LESSONS FROM CALIFORNIA

While China's ETS exists in a different context and has somewhat different goals, California's experience with its cap-and-trade program offers a number of general lessons that may be helpful in developing China's national GHG ETS. We divide these lessons into three categories: "Ambition," "Integrity," and "Opportunity."

A | AMBITION

The primary purpose of an ETS is to achieve emissions reductions as cost-effectively as possible; or, put differently, to achieve as much emissions reductions as possible for a given level of societal cost. Thus, this report thinks of the "ambition" of the ETS as the level of emissions reductions that are achievable under the rules of the system.

One strategy that California has used to maximize ambition is to frame its ETS in terms of the total volume of GHGs emitted (mass-based), rather than GHG emissions per unit of productivity (rate-based). A mass-based approach guarantees a certain level of economy-wide GHG reductions, whereas a rate-based approach leaves open the possibility that increases in absolute consumption will undercut per-unit efficiency gains. In California, this approach allows the cap-and-trade program to serve as a "backstop" to the state's other climate policies. The state can set the cap-and-trade program's emissions budget based on the amount of emissions reductions it wants to achieve, and if the non-ETS policies fail to reduce emissions sufficiently, the price of allowances in the ETS will increase, putting additional pressure on covered entities to cut emissions.[212]

Another strategy, which flows from the choice to use mass-based metrics, is that California subjects all covered facilities in a given industry to the same compliance requirements, rather than benchmarking each facility based on its size or fuel type. By forcing various types of facilities to compete against each other for emissions reductions, this approach incentivizes both the owners and downstream purchasers to look for the most efficient technology available. This effect is most visible in California's electricity supply, where power providers and end users have been incentivized to switch from coal to natural gas, and from natural gas to renewables. As a result of this and other policies, California has managed to reduce both coal and natural gas in its energy mix, in favor of renewable energy.[213]

B | INTEGRITY

In order to achieve its ambition, an ETS must also ensure that it accounts for all the emissions it covers. Just as importantly, ETS design should be careful not to incentivize bad behavior that could lead to increased harms, such as exacerbating inequities in pollution burdens. This report refers to these concerns as an ETS' "integrity."

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[212] *See, e.g.*, Elec. Power Research Inst., *Exploring the Interaction Between California's Greenhouse Gas Emissions Cap-and-Trade Program and Complementary Emissions Reduction Policies* 1-7 to 1-8 (2013), https://www.epri.com/research/products/000000003002000298.

[213] *Compare, e.g.*, Cal. Energy Comm'n, *2014 Total Electricity System Power* (2016), https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2020-total-system-electric-generation/2014 (in 2014, California's electricity mix included 6% coal, 44% natural gas, and 20% renewables), *with* Cal. Energy Comm'n, *2020 Total System Electric Generation*, https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2020-total-system-electric-generation (in 2020, California's electricity mix included 3% coal, 37% natural gas, and 33% renewables). It is difficult to disentangle the impacts of the cap-and-trade program on this shift in energy profile from the effect of other climate policies such as its renewable portfolio requirements, but the important thing is that both the cap-and-trade program and the requirement to directly purchase renewables encourage fuel-switching.

A key lesson from California's experience in maintaining ETS integrity is constant reassessment of the program, ideally by independent institutions. One example of the need for review comes from the refinery sector: despite the cap-and-trade program's extremely detailed provisions for MRV, researchers have found evidence that refineries are emitting much more methane than is captured in their reports. They discovered this discrepancy not by review of refineries' policies or reports, which was already being done by third-party verifiers, but by directly measuring the air column above those refineries. Independent review of the policies themselves can also be helpful; in California, the IEMAC and LAO provide performance assessments and projections from outside the CARB bureaucracy.[214] The periodic, public Scoping Plan process also provides occasion to reconsider ETS design.

Another means of protecting integrity is to limit the use of alternative compliance options, such as offsets. The cap-and-trade program's offset program includes protocols that are designed to ensure that offset projects actually achieve the climate benefits that they claim. Still, because of the long timeline of the most popular offset project type - reforestation and forest conservation - and uncertainties related to the offset protocol methodologies, there are serious questions as to whether offsets are, in fact, reducing atmospheric GHGs. Since the beginning of California's program, the state has limited entities' offset usage to 8% of their total compliance obligations, and then further reduced that limit in 2017.[215]

Integrity also requires preventing unintended impacts that would increase the social cost of an ETS program. One major concern with the cap-and-trade program is that allowing variation in GHG reductions between facilities could cause locally harmful pollutants to concentrate in politically or economically marginalized areas, exacerbating or perpetuating economic and racial inequality. While initial research found that facilities that increased their emissions after the cap-and-trade program took effect were more likely to be located in areas with higher rates of poverty and higher rates of people of color population populations, later studies have produced mixed conclusions as to the effect of the program on preexisting environmental disparities.[216]

C | OPPORTUNITY

Finally, this report indicates a number of areas where an ETS can create positive impacts beyond efficient emissions reductions - what we call an ETS' "opportunity."

A major opportunity created by the cap-and-trade program is the revenue from sales of allowances. By auctioning off a large part of the ETS' allowances, rather than giving them all away for free, California created a substantial source of funding. The state now uses that money to make up for market failures: it directs funding to historically marginalized areas, which can theoretically improve equity; it invests in public infrastructure that would otherwise be ignored; and it reduces the impact of energy-price increases passed on by utilities to their customers. Thus, the Californian experience shows that auctioning a large number of allowances, and minimizing free allocation of allowances, creates the opportunity for more effective and targeted climate action.[217]

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[214] *See supra* § IV.E.

[215] *See supra* § IV.C.

[216] *See* Cushing et al., *supra* note 15; *see also* Hernandez-Cortes & Meng, Cushing et al., *supra* note 16.

[217] *See supra* § IV.B.

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