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California's Cap-and-Trade Market for
Greenhouse Gas Allowances, Holding Limits
and Changes Needed to AB 32 Rules

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ABSTRACT

In 2006, the California Air Resources Board (ARB) established a cap-and-trade market (C&T) for greenhouse gases (GHG) under Assembly Bill 32 (AB 32). This paper reviews the AB 32 program, presents market results through 2014, and examines the background and effects of ARB’s complex Holding Limit (HL) + Limited Exemption (LE) rules. Example compliance strategies for hypothetical high-emitting firms show that these firms must irrevocably transfer most of their California Carbon Allowances (CCAs) into Compliance Accounts, in order to create enough LE to allow banking of sufficient CCAs to comply. Hence, high-emitting firms will be able to trade only a fraction of their CCAs. If the CCA market tightens significantly, the sequestered surplus CCAs could represent an essential supply for keeping prices down.

Through December 2014, nine quarterly auctions have been held for CCAs with different vintages. Because the supply of current vintage CCAs exceeds covered GHG emissions, CCA prices remained around \$12/tonne until the end of 2014, when prices increased to \$12.60/tonne. The CCA supply surplus is expected to continue, provided reductions from “complementary” measures, i.e., reductions outside the C&T program, are achieved. However, under some potential market conditions, CCA prices could exceed the \$45.20/tonne price for allowances that would be auctioned upon request from the Allowance Price Containment Reserve (APCR), in order to limit CCA prices.

In 2015, the AB 32 market expands beyond the electric power and industrial sectors covered during the first compliance period, CP1: 2013-2014. More than doubling the size of the allowance market, fuel suppliers and distributors are included in compliance periods, CP2: 2015-2017, and CP3: 2018-2020. Along with the increase in size, potential causes of higher CCA prices and increased volatility are several existing market design features: **1)** the “one-way” Compliance Account from which allowances may not be removed, reducing the supply available for trading, **2)** the limited quantity of allowances in the APCR, potentially allowing uncapped prices, and **3)** rules that limit allowance ownership (Holding Limits [HL] + Limited Exemptions [LE]). Limited Exemptions are needed by high-emitting firms that have annual emissions greater than the HL, but LE are created only when a firm irrevocably transfers CCAs into its Compliance Account. Experimental research and auction simulations have found that tight holding limits can substantially lower the number of allowances available for trade, lowering liquidity, increasing volatility, and impairing the ability of traders to smooth prices over time. Hence, ARB’s rules may encourage market manipulation, rather than prevent it.

In order to make the AB 32 program more efficient and to provide a better model for future regional applications, this paper recommends that the Air Resources Board:

- 1) Add a hard price cap above the Allowance Price Containment Reserve prices, thus, preventing possible unlimited price increases, if the limited APCR allowances are exhausted.
- 2) Remove the “one-way” restriction on the Compliance Account to allow trading of surplus allowances that are otherwise trapped in these accounts. This would enable more efficient trading, especially when the CCA supply/demand balance tightens.
- 3) Modify the Holding Limits and Limited Exemption rules by examining the fixed annual Holding Limits and adjusting them as needed to allow all firms to trade efficiently.



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1. THE CALIFORNIA ALLOWANCE MARKET TO 2015

a. The Cap-and-Trade Program

California’s cap-and-trade program is a market-based approach that caps overall emissions of greenhouse gases (GHG) from electricity, industrial, commercial and residential sectors and transportation fuels. Cap-and-trade requires California Carbon Allowances (CCAs) to be acquired, banked and surrendered for each metric ton (tonne or MT) of emissions from facilities with carbon dioxide equivalent (CO₂e) emissions over 25,000 tonnes/year. The covered greenhouse gas emission sources contribute to services, commodities and products produced in or delivered to California consumers.

The cap-and-trade rules operate under legislation (Assembly Bill 32, AB 32, the California Global Warming Solutions Act of 2006) that requires monitoring, tracking and compliance obligations for all covered sources. The first compliance period for emissions spanned two years, 2013 and 2014. CCAs for verified emissions during this period must be surrendered by November 1, 2015. Two subsequent three-year compliance periods are 2015-2017 and 2018-2020 with CCA surrender dates, November 1, 2018 and November 1, 2021. Starting in 2014, allowances covering 30% of the previous year’s emissions must be surrendered by November 1, leaving any remainder to be surrendered in the year following the compliance period.

The cap-and-trade program, developed and administered by the California Air Resources Board (ARB), covers 75% to 85% of statewide total GHG emissions. About 350 companies are covered during the first compliance period (CP1), while over 700 companies will participate in the second compliance period, CP2. During CP1, electric power plants, refineries and other industrial facilities are the primary covered sources. In 2015, the market expands to include fuel suppliers and distributors. In order to bring the fuels and transportation sectors under the economy-wide umbrella, the overall CO₂e emissions cap will increase from 162.8 million tonnes (million metric tons or MMT) in 2013 to 394.5 million tonnes in 2015, then decline by about 3.4% per year to 2020. Overall GHG emissions decreased from 466 MMTCO₂e in 2000 to 459 MMTCO₂e in 2012. Although the business-as-usual (BAU) projection for 2020 is 509 MMTCO₂e, the mandated AB 32 goal is 431 million tonnes in 2020, which is the level of California’s CO₂e emissions in 1990. After 2020, the goal is to further reduce overall CO₂e emissions by 80% below 1990 levels, but no formal post-2020 program is in place. The first update to ARB’s Scoping Plan, released in May 2014, discusses California’s existing programs to reduce statewide GHG emissions back to the 1990 level and highlights the need to plan for post-2020 emission reductions.¹

Contributing to GHG reductions are “Complementary” measures outside of the Cap-and-Trade program:

- Energy Efficiency Standards,
- Low Carbon Fuel Standard (LCFS),
- 33% Renewable Portfolio Standard,
- Advanced Clean Cars,



- California Solar Initiative,
- Mandatory Commercial Recycling,
- High Speed Rail, and
- Water Efficiency programs.

In order to meet the statewide emissions goal, the Complementary measures must deliver significant reductions, as shown in Table 1. Forecasted BAU emissions in the absence of these programs were projected to be 509 million tonnes. If the Complementary measures do not deliver their intended reductions by 2020, the Cap-and-Trade program cap will be adjusted, so that the statewide target of 431 million tonnes CO₂e can be met.

Table 1. AB 32 Emission Reductions in 2020 by Program to Reach the 2020 Goal

Category	2020 (MMTCO ₂ e)**
AB 32 Forecast Emissions (2020 BAU)	509
Expected Sector-based Reductions	
Energy	25
Transportation	23
High Global Warming Potential Gases	5
Waste	2
Cap-and-Trade Reductions*	23* up from 18
2020 AB 32 Limit	431 up from 427

* Cap-and-Trade emission reductions depend on the emission forecast.

** Based on AR4 GWP values.

By the third compliance period ARB will prepare a comprehensive energy plan to describe California’s long-term GHG reduction goals. Among the issues this plan will address are:

- Post-2020 program elements, including 2030 and mid-term emission targets,
- Cost containment issues,
- Integration and linkage with other geographic regions,
- Compliance with EPA’s June 2014 Clean Power Plan,² which requires reductions from the electric power sector.

As of January 1, 2014, the California and Quebec allowance markets were formally linked. Allowances may be surrendered to satisfy compliance obligations in one or the other programs. The Quebec program is smaller than California’s: covered GHG emissions in Quebec were about 82.5 million tonnes in 2010, and the 2020 cap is 69.7 million tonnes. Business-as-usual (BAU) emissions in 2020 in the absence of Quebec’s C&T program were projected to be about 84 million tonnes. Since Quebec’s electric power sector relies on hydro-electric resources for 95% of its generation, the marginal costs of emission reductions in the province are expected to be higher than in California. Specific elements of the CA-Quebec linkage agreement include:



- Completely fungible GHG allowances using Compliance Instrument Tracking System Service (CITSS) accounts,
- Linked allowance auction floor prices in U.S. and Canadian dollars,
- Provisions for termination of the agreement,
- Different offset location and liability/risk requirements,
- Revised allowance holding limits for the combined markets, and
- Allowance holding limits in both jurisdictions that are lower than the annual allowance needs of some large emitters.

b. California’s GHG Emissions

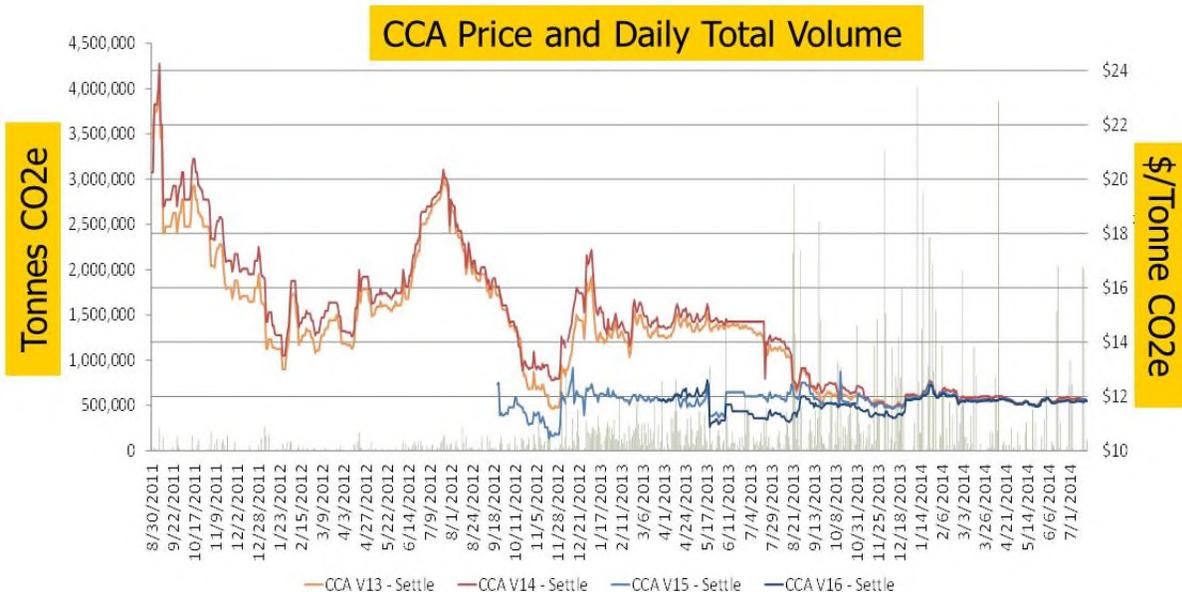
Reaching ARB’s 2020 emissions target of 431 MMTCO₂e requires reductions below whatever BAU emissions would have been in year 2020 without the reduction measures listed in Table 1. Emissions of greenhouse gases covered by AB 32’s C&T program in CP1 declined from 149.95 MMTCO₂e in 2012 to 144.44 MMTCO₂e in 2013, a decline of 3.7 percent. Including those emissions that will be added in 2015, total verified CP1+ CP2 emissions in 2013 from 750 reporting entities were 348.48 MMTCO₂e, down from 2012 by 1.5%. Although this level is below the 2018 cap and would almost meet the 2019 cap, it is clearly subject to future fluctuations and changes. The biggest percentage change from 2012 came from the reduced emissions calculated for electricity imports from out-of-state, which were down about 13 percent, a decrease of 5.36 MMTCO₂e. Some of this reduction was due to importing more power from “specified” emission sources that have lower emission rate factors than “unspecified” power imports. Hence, emissions from imported power resources represent one of the largest sources of uncertainty in calculations of covered emissions.

c. Allowance Prices to the end of 2014

After exceeding \$19/tonne in July 2012, CCA prices declined in a relatively weak market to around \$12/tonne during most of 2014. Recent CCA prices reflect the belief that the supply of current vintage allowances (i.e., V2013 or V2014 allowances) exceeds covered emissions throughout CP1. Figure 1 shows the prices for 2013 to 2016 CCA vintages from the inception of the CCA market in 2011. (InterContinental Exchange data.) Advance allowances, which in 2014 were for years 2015-2017, are first released to the auction market three years prior to each vintage year and after the initial year are not auctioned again until the vintage year. After acquisition and recording in the proper Compliance Instrument Tracking System Service (CITSS) accounts, current and advance allowances may be traded in the secondary market.



Figure 1. California Carbon Allowance Prices and Volumes to August 2014



Data Source: InterContinental Exchange

In November 2012, the ARB held California’s first GHG allowance auction. Nine quarterly auctions have been held to date. Summary statistics are given in Tables 2 and 3.

Table 2. Auction Results for ARB’s First Five Carbon Allowance Auctions

Auction Date	Vintage Year	# Offered	# Sold	# Qualified Bids/ # Available	Reserve Price (\$/tonne)	Clearing Price (\$/tonne)	Bought by Qualified Compliers	# Qualified Bidders
November 14, 2012	2013	23,126,110	23,126,110	1.06 (3.10)	10.00	10.09	97.0%	73
November 14, 2012	2015	39,450,000	5,576,000	0.14	10.00	10.00	91.0%	
February 19, 2013	2013	12,924,822	12,924,822	2.47	10.71	13.62	88.2%	91
February 19, 2013	2016	9,560,000	4,440,000	0.46	10.71	10.71	100.0%	
May 16, 2013	2013	14,522,048	14,522,048	1.78	10.71	14.00	90.2%	81
May 16, 2013	2016	9,560,000	7,515,000	0.79	10.71	10.71	86.5%	
August 16, 2013	2013	13,865,422	13,865,422	1.62	10.71	12.22	95.5%	79
August 16, 2013	2016	9,560,000	9,560,000	1.69	10.71	11.10	96.3%	
November 19, 2013	2013	16,614,526	16,614,526	1.82	10.71	11.48	96.2%	77
November 19, 2013	2016	9,560,000	9,560,000	1.64	10.71	11.10	91.3%	



Table 3. Auction Results for ARB’s 2014 Carbon Allowance Auctions

Auction Date	Vintage Year	# Offered	# Sold	# Qualified Bids/ # Available	Reserve Price (\$/tonne)	Clearing Price (\$/tonne)	Bought by Compliers	# Qualified Bidders
February 19, 2014	2014	19,538,695	19,538,695	1.27	11.34	11.48	84.5%	71
February 19, 2014	2017	9,260,000	9,260,000	1.11	11.34	11.38	83.5%	
May 16, 2014	2014	16,947,080	16,947,080	1.46	11.34	11.50	89.5%	74
May 16, 2014	2017	9,260,000	4,036,000	0.44	11.34	11.34	100.0%	
August 18, 2014	2014	22,473,043	22,473,043	1.14	11.34	11.50	87.7%	71
August 18, 2014	2017	9,260,000	6,470,000	0.70	11.34	11.34	89.2%	
November 25, 2014	2014	23,070,987	23,070,987	1.73	11.34	12.10	97.6%	83
November 25, 2014	2017	10,787,000	10,787,000	1.92	11.34	11.86	85.2%	

Participation in the August 2014 auction was not robust, due to recognition that the supply of V2013 and V2014 allowances was in excess of expected CP1 emissions. Bids for “current” allowances only exceeded the awarded allowances by 14%, i.e., only 14% of the bids failed.³ As a result, the clearing price of \$11.50/tonne was close to the 2014 annual auction reserve price, \$11.34/tonne. The August auction for V2017 “advance allowances” sold only 70% of the offered allowances, which, therefore, cleared at the 2014 auction reserve price. In both auctions about 88% of the allowances were purchased by firms with compliance obligations. However, there were only 71 bidders. Indeed, by August only about 100 different firms had submitted auction bids, despite the fact that about 360 firms were covered entities in CP1. Many industrial firms, such as Energy Intensive, Trade Exposed (EITE) companies facing strong competition from firms located outside California, have received free allocations of allowances from ARB. Hence, these firms apparently did not feel the necessity to participate in the first eight ARB auctions.

Participation in the November 2014 quarterly auction was considerably more robust. This was the first California-Quebec joint allowance auction. Its clearing price was \$12.10/tonne, \$0.60/tonne higher than in August. Probably, not coincidentally, this clearing price was the same as the 2015 minimum annual auction reserve price released by ARB after the auction. (Bidders could reasonably forecast the annual auction reserve price that would apply throughout 2015 and decided that it would be a good price to bid.) Qualified bids exceeded the number sold by 73%, indicating a robust price signal. In addition, the auction for V2017 “advance allowances” sold all offered allowances at a clearing price of \$11.86 with qualified bids exceeding the number of allowances sold by 92%, the highest percentage to date. This is notable, because the August advance auction was undersubscribed. The increased number of qualified bidders, 83, combined with the approach of CP2, the mandatory annual escalation of the auction reserve price (i.e., the auction price floor), California’s ongoing drought and economic recovery, as well as the declining annual emissions cap, all contributed to rising

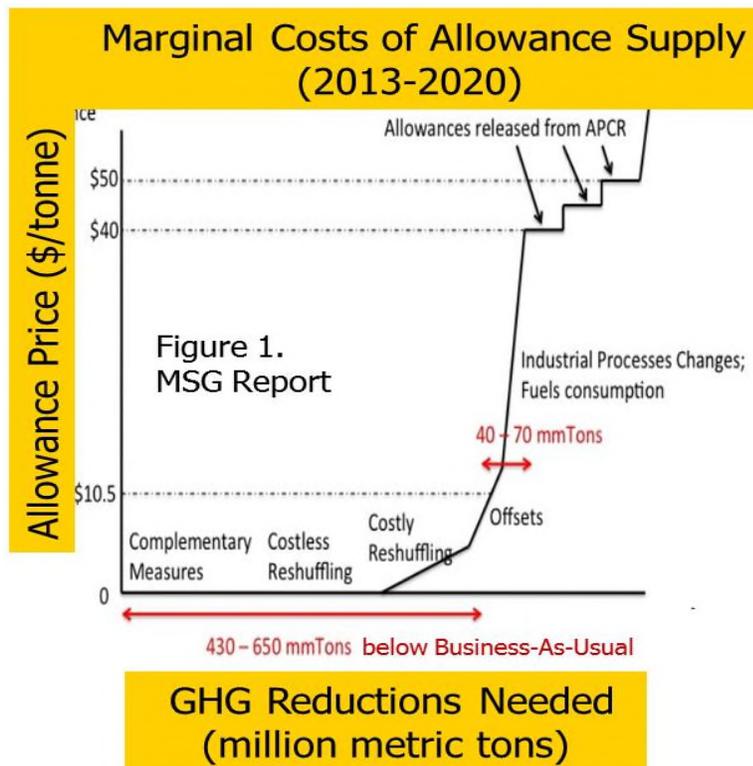


CCA prices. Of the 83 qualified bidders, 16 are responsible for emissions that begin coverage in 2015, while 10 of these 16 also have emissions covered in CP1. This was also the last auction to sell V2017 CCAs until 2017, when 2017 vintage allowances will next be auctioned. The November 2014 auction demonstrated that firms with CP2 obligations are hedging forward prices and uncertainty by banking CP2 allowances, even though the V2017 CCAs can’t be used to comply until 2018.

d. Allowance Price Forecasts and the Allowance Price Containment Reserve

In 2014, members of the ARB’s Market Simulation Group (MSG) prepared a report discussing the “Competitive Supply/Demand Balance in the California Allowance Market and the Potential for Market Manipulation.”⁴ Figure 2 illustrates their estimate of the marginal costs of achieving the cumulative reductions needed under all of California’s carbon reduction programs from 2013 through 2020. In a purely competitive market, the price of CCAs would equal the marginal cost of achieving the last tonne of reduction needed to balance allowance supply and demand as trades occur. The cumulative level of reductions achieved in 2020 to satisfy the carbon emissions cap will determine where on the supply curve the last reduction in 2020 will occur. However, the reductions needed to meet the 2020 cap are uncertain, as are the costs of reduction measures. If some measures, such as the Complementary measures shown below at zero cost to the C&T program, do not occur, this allowance supply curve would be shifted to the left. As a result, in order to reach the 2020 target, the GHG reductions required to achieve the cap would have higher marginal costs, resulting in higher CCA prices.

Figure 2. Market Simulation Group Allowance Supply Curve





As illustrated, the MSG estimated an eight-year CCA supply curve, which is quite steep (inelastic), especially when 2020 prices exceed \$11/tonne. However, the failure to achieve only 40-70 million tonnes of emission reductions prior to 2020 could increase the estimated allowance price quite rapidly up from the floor price to the APCR first tier price.⁵ The MSG has estimated a probability distribution for potential allowance prices under numerous possible market scenarios between 2013 and 2020. Based on its analysis, MSG projects a bi-modal probability distribution with the most likely price paths remaining near the auction floor price (the annual auction reserve price). Other important, but less likely, high price outcomes are above the APCR first-tier price. In MSG’s analysis, there are relatively few scenarios with prices mid-way between the floor price and the APCR first tier price, because the supply curve shown in Figure 2 is so inelastic, and because the total quantity of CCAs over the period is fixed.

Significantly, MSG assumed perfect trading of all allowances over the 2013-2020 period, as well as no net banking of allowances by market participants.⁶ MSG assumed the AB 32 market will end in 2020 with no participants having a shortfall or a surplus of CCAs. However, carbon reductions beyond 2020 have been an important element of California’s stated goals since 2005, including an executive order by Governor Schwarzenegger.⁷ In fact, banking of allowances is an element of prudent compliance strategies in all successful cap-and-trade markets. Banking occurs in order to account for future uncertainties, to ensure compliance while smoothing prices over time and minimizing expected compliance costs, and to hedge against scenarios with possibly very high allowance prices.⁸ To the extent that reasonable banking strategies can be employed in California, the available supply of CCAs would be reduced, since some CCAs will remain in banks, and prices would be higher than estimated by the MSG.

Even though the MSG’s most likely market scenarios between now and 2020 are expected to keep CCA prices near the rising auction floor price, there are important scenarios, even in the absence of banking, where prices could rise quite rapidly in 2017 or in CP3.⁹ In scenarios where the price does not remain near the floor, the Market Simulation Group projects that the CCA price could rise quickly to approach or exceed the first-tier price of the APCR, which started at \$40/tonne in 2012 and escalates each year at the same annual rate as the auction floor price.¹⁰ Moreover, if AB 32’s Complementary programs do not deliver their projected reductions or market events happen that cause a scarcity of allowances or if normal banking of CCAs occurs or if perfect trading does not occur, the price rise could be rapid and sustained. If the APCR is exhausted, prices would exceed the Tier 3 APCR price, because the APCR provides only a limited buffer supply of allowances and does not employ a hard price cap.

Clearly, there are many uncertain factors that affect the demand for allowances. Hydro and renewables generation, emission rates for “asset-controlling suppliers,” safe-harbor resource re-alignment (aka “resource shuffling”), and the availability of approved offsets (ARBOCs) will each affect future CO₂e emissions, CCA demand and CCA supply. These and other factors could lead to price shocks, most likely in the years past 2017, when additional CO₂e reductions are most likely to have increasing marginal costs.



An earlier study by William Shobe, Thad Huetteman, et. al.,^{11,12,13} consisted of a series of controlled experiments with students and real-time auction simulations carried out with market participants, energy and emissions market experts, regulators and academics. This study indicated that California’s APCR can act effectively to influence allowance purchase decisions. The simulations showed that the APCR 3-tiered sale mechanism influences how traders respond to the perceived risk of future allowance scarcity. Traders who worried that a given price-tier of APCR allowances might be exhausted in the future may buy from that tier in advance, rather than risk not having CCAs available at that price or rather than risk non-compliance. Despite its effectiveness in auction simulations, the APCR can only contain prices, if the APCR allowances aren’t all sold in prior auctions. The number of allowances that can be borrowed from future vintages is limited by rule. So, once the volume of allowances allowed into the APCR is exhausted, the price of CCAs could continue to rise without limit. In another study, Perkis et al., (2014)¹⁴ show that price containment reserves are not as robust as a hard limit on prices would be at limiting excess price variability.

These two studies, among others, indicate that a hard price cap would be the simplest and most reliable means of preventing prices from flying up above the tier 3 APCR price. Given the inelastic nature of the supply curve and the fixed total supply of allowances, adding a hard price cap to the APCR would keep the lid on prices more reliably than the 3-tier APCR. Such a cap would be relatively easy to design and implement, in contrast to developing even more sophisticated ways to stock the APCR with future vintage allowances. Hence, this paper’s recommendation is that a hard price cap should be added to the current APCR mechanism.

2. HOLDING LIMITS, LIMITED EXEMPTIONS AND THE COMPLIANCE ACCOUNT¹⁵

a. Regulatory Background

While the APCR is intended to contain prices, several market design elements in the existing cap-and-trade program were devised to prevent market manipulation. Despite this intent, two of these elements, Holding Limits in combination with Limited Exemptions and the operation of the Compliance Account, could make hair-trigger CCA price swings, up and down, quite possible. By preventing major market participants from trading allowances, these market rules could actually increase the likelihood of market manipulation and the likelihood that surplus supplies will be available to dampen price swings. This section describes the Holding Limits and the Limited Exemption rules now in effect. The next section quantifies them and calculates potential compliance scenarios for several hypothetical high-emitting market participants with annual emissions above the fixed annual Holding Limits.

Maintaining a fair, competitive and liquid market for CCAs is essential for the ultimate success of AB 32.¹⁶ Because there is a relatively small number of very high-emitting firms that must participate in the AB 32 allowance market, including Electric Distribution Utilities (EDUs), electric power plants, factories, refineries and fuel distributors, there is concern that some affected firms or registered financial entities (i.e., firms without a compliance



obligation), might be able to manipulate the market for CCAs and, thus, affect the availability and prices of CCAs and approved Air Resources Board Offset Credits (ARBOCs).

In order to minimize opportunities for firms to engage in market manipulation, the ARB has limited the quantities of allowances that may be held at any time by any firm. The aim was to prevent one or more firms from acquiring enough CCAs to be able to manipulate the market price. The regulations governing the California Cap on Greenhouse Emissions and Market-Based Compliance Mechanisms are found in Subchapter 10 Climate Change, Article 5, Sections 95800 to 96023, Title 17, California Code of Regulations. In particular, Subarticle 11: Trading and Banking, §95920. Trading defines and deals with Holding Limits:

The holding limit is the maximum number of California GHG allowances that may be held by an entity or jointly held by a group of entities with a direct corporate association, as defined in section 95833 at any point in time.

The holding limit is independent of the size of a covered firm’s allowance needs. Hence, a few firms (aka “covered entities”) with large allowance requirements will be more affected by the Holding Limits than will those firms whose annual allowance needs are well below the Holding Limits. Recognizing this, certain allowances that are acquired by a covered entity and placed into its Compliance Account, rather than its General Holding Account, will receive a Limited Exemption (LE) from being counted under the Holding Limit formula. The maximum LE is based on verified prior-year emissions for that entity and may include several prior years of emissions, depending on the year in question. However, to qualify for the LE, allowances must be placed irrevocably into the firm’s Compliance Account.

While the LE allows high-emitting firms to comply, market liquidity will be reduced, because allowances placed into the Compliance Account cannot be removed and are thus not available for trading. Knowing this is the case, other market participants would have a higher likelihood of affecting market prices by acquiring and withholding allowances than if the allowances trapped in Compliance Accounts were available for trading that could keep prices down.

Companies with the highest emissions in 2012 are shown in Table 4. The total emissions in 2013 from these companies were much the same as in 2012 and are expected to be lower in 2015 and subsequent years as the CO₂e emissions cap declines.



Table 4. 2012 CO₂e Emissions from California’s Largest Emitters¹⁷

Firm	Approximate 2012 (MMT)		
	Narrow Scope Emissions	Broad Scope Emissions	Total
Chevron U.S.A. Inc.	9.74	32.16	41.90
Tesoro Refining & Marketing Co.	8.10	26.71	34.81
BP West Coast Products		23.88	23.88
Phillips 66 Company	4.52	18.91	23.42
Southern California Gas Co.	0.17	22.55	22.71
Pacific Gas and Electric Co.	3.36	18.90	22.26
Valero Marketing and Supply Co.	3.73	14.00	17.73
Shell Energy North America	4.24	10.71	14.95
LADWP	12.91	0.00	12.91
Exxon Mobil Co.	3.39	8.61	12.00
Southern California Edison Co.	9.96	0.00	9.96
Calpine Energy Services	9.41	0.00	9.41

Given the combined annual “broad scope” emissions of these firms covered by cap-and-trade requirements in 2015, prudent banking of allowances by each of these firms would also remove a quantity of allowances from the market, subject to each firm’s Holding Limits + Limited Exemptions.

Investor-owned utilities (IOUs) are also subject to the California Public Utilities Commission’s (CPUC) annual allowance purchase limits. This study indicates will be less binding than the Holding Limit + LE for the largest IOU, PG&E, which is the IOU with annual broad-scope emissions above the current annual holding limits. Although the CPUC purchase limits are less binding than the effects of ARB’s Holding Limits, there is concern that the CPUC’s restrictions regarding brokers and exchanges used for trading and the risk bearing/liability requirements for carbon offsets will inhibit trading, as well as discourage the development of future offsets. As a result of these various limits, affected companies must develop appropriate allowance acquisition strategies, as well as strategies to manage their allowance Holding Account, the Compliance Account and Limited Exemptions, subject to all applicable regulatory rules.

b. The 2010 WCI Report on Holding Limits

How were the current Holding Limits devised? In February 2007, California and four other western states, Oregon, Washington, New Mexico and Arizona formed the Western Climate Initiative (WCI). WCI, Inc. is “a collaboration of independent jurisdictions working together to identify, evaluate, and implement emissions trading policies to tackle climate change at a regional level.”¹⁸ In March 2010, the WCI Markets Committee distributed a report on holding limits. This report assisted ARB in its development of the AB 32 Holding Limit regulations.¹⁹ The WCI report recommendations were principally intended to mitigate market manipulation in the secondary allowance market,²⁰ which involves transactions between market participants after the initial distribution of CCAs.



Key observations quoted from the WCI report are:

- “Market manipulation should be a concern for cash-settled contracts such as allowance and offset credit trading markets.
- Market manipulation reduces participation in the market, inhibiting trading volume, reducing market depth and adding to market volatility.
- The size of an individual trader position relative to the size of the market or to the size of the market float are appropriate metrics for monitoring/inhibiting market manipulation.
- Excessive trading can also be used to manipulate allowance and offset markets.
- Since trading behavior changes even with the threat of market manipulations, regulators in the allowance and offset credit markets should employ proactive market surveillance policies.
- Allowances and offset credits issued via primary market auctions and traded in a secondary market are susceptible to manipulation in both the auction and secondary markets.
- Auction design and secondary market trading are linked. Frequent auctions with broad-based access (and participation) can help to minimize manipulation in the secondary market.
- Extant theory on position limits requires an estimate of the price change tolerance of the regulator and a measure of illiquidity in the secondary market for trading of allowances. In this regard, theory is of little practical use to the nascent (prospective) market.
- Nevertheless, most derivative markets apply a form of position limits in deference to the real and active manipulation from various market participants.”

“In this light, and in consideration of the myriad components that contribute to the application of holdings limits, this [WCI] report recommends that the WCI Market Committee apply position limits in the allowance and credit trading market be set as 10 percent of the lagged open interest in contracts up to 25,000 contracts and 2.5 percent of open interest thereafter (the same metrics as applied to futures markets by the U.S. Commodity Futures Trading Commission).”²¹

The report for WCI points out that, “Although disclosure and action-based manipulations should concern market regulators, these forms are only tangentially related to holdings limits. They link to holdings limits only in the sense that large positions largely benefit the most from manipulative strategies, so that smaller allowance holdings limits will necessarily reduce the prospective gains from manipulation. Market power is the primary concern of holdings limits.”²²

Several observable characteristics of a particular market may enable participants to exercise excessive market power. Markets that approach the ideal of “perfect competition” will have an infinite number of buyers and sellers for homogenous products, no barriers to entry, transparent market pricing and information known to all participants, no transaction costs, and participants that act in their own self-interest as profit maximizers.”²³ Deep and wide competitive markets, such as many commodity markets, are heavily traded and relatively more



difficult to manipulate than markets with fewer competitors. In contrast, specific trading restrictions applied to markets with a limited number of competitors that prevent trading of supplies held by market participants, who would otherwise trade those supplies, can make thin markets even less competitive. Such restrictions can make a thin market more vulnerable to manipulation than if those restrictions were not in place. As this study discusses below, several rules that govern firms in California’s cap-and-trade market are likely to make that market less competitive and more vulnerable to manipulation, rather than more competitive and less vulnerable to manipulation.

c. California Air Resources Board Cap-and-Trade Holding Limits

1. Basis for the ARB Holding Limit Formula

The Holding Limit formula applied by ARB was taken from a similar formula used by the Commodity Futures Trading Commission (CFTC) for agricultural products. In its formula the CFTC applies a two-tier structure to set federal limits on agricultural products: 10 percent of the lagged open interest in contracts up to 25,000 contracts and 2.5 percent of the open interest²⁴ thereafter. The CFTC re-evaluates the formula’s limits each year by reviewing market size and liquidity. Although the ARB Holding Limits formula is consistent with the CFTC framework, which allows for higher market share in less liquid markets, because of the relatively small size of the California allowance market, fewer participants, and the lack of experience with this market, it is not evident that this formula will work as intended. So far, no public review of these limits has been conducted. When compared to well-developed commodity markets, a number of the participants in the AB 32 cap-and-trade market do not have financial incentives to manipulate the market or even to trade actively. Regulated entities, like Electric Distribution Utilities, would not be allowed to reap significant profits in this market. There are further differences between the California allowance market and widely-traded commodity markets. For example, when an agricultural product is in short supply, the same product might be imported or more of that product can be produced or a substitute might be purchased. This is not the case with the fixed total quantity of CCAs required for compliance.

As discussed earlier, California’s GHG allowances are given a vintage for a particular emission Budget Year. Current year allowances can be surrendered to satisfy GHG emission compliance obligations for any year in a current or future compliance period. Advance allowances, however, cannot be applied to cover any emissions that occur prior to the vintage year specified for that particular allowance. In an allowance’s designated vintage year an Advance/Future allowance becomes a Current allowance. California’s two-tier Holding Limits formula is applied separately to two categories of allowances distinguished by vintage: Current year/prior year and Advance/future year allowances.

The ARB formula defines “lagged open interest” as the Base = 25,000,000 allowances and “open interest thereafter” as (Annual Allowance Budget – Base). In each year the formula is applied to all the combined allowances held in a firm’s accounts that are of current and prior year vintages, along with allowances from any vintage purchased from the Allowance Price



Containment Reserve and Advance Allowances that have become Current after purchase. That is to say, an Advance Allowance for 2016, V2016, purchased in 2013, will become a Current Allowance in 2016, subject to the applicable Holding Limit for Current Allowances. The Annual Allowance Budget in the formula is the Budget for the current year given in Table 5, which shows the limits for the combined California and Quebec markets.

Table 5. California & Quebec’s Annual Allowance Budget

	Budget Year	California Allowance Budget (Million Tonnes of CA-Quebec Carbon Allowances)	Quebec Allowance Budget (Million Emission Units of Carbon Allowances)	Total Annual Allowance Budget (Million Tonnes)
First Compliance Period	2013	162.8	---	162.8
	2014	159.7	23.2	182.9
Second Compliance Period	2015	394.5	65.3	459.8
	2016	382.4	63.19	445.59
	2017	370.4	61.08	431.48
Third Compliance Period	2018	358.3	58.96	417.26
	2019	346.3	56.85	403.15
	2020	334.2	54.74	388.94

The allowance budget jumps up significantly in 2015, when the scope of emissions covered by cap-and-trade increases. The “cap” then declines each year, as the Annual Allowance Budget is reduced.

For all Advance Allowances the same formula is applied, but the formula applies to each single future year’s vintage of allowances using each year’s Annual Allowance Budget from Table 5. An entity may not hold more than the formula’s specified amount of Advance allowances for each future year’s vintage. When an Advance allowance becomes a Current Allowance, it is included in the Holding Limit calculation for Current vintages.

The final ARB formula, based on discussions with Western Climate Initiative states, is:

$$\text{Holding Limit} = 0.1 * \text{Base} + 0.025 * (\text{Annual Allowance Budget} - \text{Base})$$

in which:

“Base” equals 25 million metric tonnes of CO₂e.

“Annual Allowance Budget” is the number of allowances issued for the current budget year.²⁵



Table 6. Combined California-Quebec Annual Holding Limits

Year	Holding Limit (tonnes)
2013	5,945,000
2014	6,447,500
2015	13,370,000
2016	13,014,750
2017	12,662,000
2018	12,306,500
2019	11,953,750
2020	11,598,500

The Holding Limits apply to all allowances combined in the General Holding Account, the Compliance Account and the Exchange Account, except for allowances held temporarily by trading intermediaries, such as brokers and trading firms. Penalties may be assessed when the holding limit is exceeded.

2. ARB Limited Exemption Rules

As was shown above in Table 4, certain high-emitting firms will have annual compliance obligations after 2014 that are significantly in excess of the specified Holding Limits shown in Table 6. For example, Chevron has total expected CP2 emissions of about 42 million tonnes/year, and SoCalGas is responsible for about 23 million tonnes/year. These companies along with the other firms listed in Table 4 with annual emissions above the Holding Limits are the firms that will be most affected. These are also firms that should be trading competitively in order for the allowance market to function efficiently. In order to acquire and bank sufficient allowances each year and comply at the end of each compliance period, these firms must create Limited Exemptions by putting CCAs into their Compliance Accounts. At present, the allowances placed into the Compliance Account are not removable, except when they are surrendered to meet the compliance deadlines by or before November 1, 2015, 2018 and 2021. Thus, while the Limited Exemption is essential for larger emitters to prudently bank allowances over time, each allowance that contributes to the LE must be sequestered and made unavailable for trading in the allowance market.

The Limited Exemption is calculated based on Article 5 of the regulations.²⁶ On July 1, 2014 the maximum limited exemption was the sum of the annual emissions data reports received by ARB from the firm in 2012 (most likely 2011 emissions) and 2013 (most likely 2012 emissions) that received a positive or qualified positive emissions data verification statement for those emissions that generate a compliance obligation. On November 2, 2014 the maximum limited exemption was increased by the amount of emissions contained in the emissions data report received in 2014. Each subsequent November 2, the maximum LE will be increased by the prior year’s qualified emissions, but on November 2, 2015, covered emissions from 2013 and 2014 will be removed from the LE calculation. In the year following CP2 and CP3 the limited exemption will also be reduced on November 2 by the sum of each entity’s compliance obligation over the just-completed compliance period.



Notably, verified emissions from both 2011 and 2012 can continue to contribute to the maximum LE throughout all three compliance periods. Nevertheless, sufficient allowances must remain in the Compliance Account to maintain the actual Limited Exemption at a particular time. Thus, the LE will fluctuate in size as allowances are transferred in to increase the LE and out for compliance, as the analysis in the following section demonstrates. The important transactions on November 1 and 2 each year are likely to cause additional variations in allowance market liquidity and prices as market participants adjust their accounts.

Moreover, purchasing a quantity of allowances to establish an allowance bank/compliance cushion equal to two year’s emissions may not be economically or administratively feasible, given the large quantities of allowances needed by large emitters. Given that covered entities other than EDUs may only purchase 15% of the allowances in each auction until 2015, when the auction purchase limit is no longer in effect, it could be difficult for industrial firms with large post-2015 needs to acquire an immediate bank via auction purchases. Until the LE is created and grown by adding allowances to the Compliance Account up to the allowable maximum LE, the Holding Limits (HL) shown in Table 6 apply.²⁷ (As described earlier, the HL + LE limit (the Current Limit) applies to all current year and prior year allowances, aka “current allowances,” while the Advance Limits apply to “advance allowances” of each vintage, as described above.)

Even though the Investor-owned utilities (IOUs) could purchase up to 40% of the allowances in auctions held before 2015, when the purchase limit is no longer in effect, the CPUC annual Purchase Limits restricts the rate at which allowances and offsets can be acquired. In general, utilities will try to procure allowances to create a least-cost, least-risk bank that will ensure compliance under a variety of future scenarios.

In 2015, the AB 32 cap-and-trade market scope and allowance budget expands to cover suppliers and users of natural gas, RBOB,²⁸ distillate fuel oils, LPG & transportation fuel distributors. Although Chevron’s Richmond oil refinery is covered in CP-1, emitting about 4 MMT GHG annually, in 2015 Chevron and other refiner’s transportation fuel products will become subject to the cap. Because the GHG emissions associated with fuel distribution are not covered in CP-1, large fuel distributors and other CP-2 entities will not be able to take advantage of a Limited Exemption associated with CP-2 obligations during CP-1.²⁹

However, the maximum Limited Exemption will be increased on January 1, 2015 to include 2013 emissions associated with the expanded scope of coverage in CP-2 for all covered entities with compliance obligations in CP-2. On November 2, another prior year’s emissions can be added to the LE. So, on November 2, 2015 the maximum limited exemption can include qualified expanded scope emissions from both 2013 and 2014. Here again, CP-2 covered entities will only be able to take advantage of their own Limited Exemptions by placing allowances into their Compliance Accounts.



3. EXAMPLE COMPLIANCE STRATEGIES AND EFFECTS OF THE HOLDING LIMIT AND LIMITED EXEMPTION RULES

a. Hypothetical Compliance Strategies for High-emitting Companies

In the first compliance period, CP1, about 360 companies need to acquire and manage CCAs and ARBOCs to comply with the cap-and-trade requirements of AB 32. Firms with annual emissions near to or above the ARB Holding Limits must pay close attention to managing their Holding and Compliance Accounts, in order to create a Limited Exemption (LE) large enough, so that the allowances held in these accounts don’t violate the Current Limit. The Current Limit for each firm is defined as equal to this year’s Current Allowance Holding Limit shown in Table 6 + each firm’s Limited Exemptions at a particular time. Figure 3 below is a compliance strategy for a hypothetical electric utility. It shows the annual Holding Limit (HL), which is the same for all firms. It also shows the sum of HL + LE in each year, as allowances are acquired and transferred from the electric utility’s Holding Account into its Compliance Account to create the LE. Some allowances remain in the Holding Account and could, in principle, be traded. The Current Limit applies to the sum of all Current allowances in both the Holding Account and the Compliance Account. (These are allowances with a vintage in the current year or in a prior year.) In addition, Advance Allowance Holding Limits (referred to here as the Advance Limits) apply to each vintage of Advance allowances.

Managing the transfer of allowances into the Compliance Account, while building an allowance bank to keep some Current allowances available to accommodate uncertainties and to allow some trading from the Holding Account, will be a complicated exercise for companies with emissions above the ARB Holding Limits. These high emitting companies will necessarily be high volume participants in the CCA market, and their collective behavior will affect transaction volumes and prices. Hence, their trading activity will affect the overall supply and demand balance and liquidity in the market at any given time.

To understand the effects of the ARB Holding Limits (Current and Advance) and the CPUC’s annual purchase limits, as well as to examine potential allowance acquisition and transfer strategies, the California Allowance Strategy Calculator was developed in an Excel spreadsheet. Potential allowance acquisition and compliance strategies were examined for hypothetical companies and emission scenarios.³⁰ The CA Allowance Strategy Calculator calculates, checks and updates the Current Holding Limit + Limited Exemption (the Current Limit) and the Advance/Future Holding Limits (the Advance Limits) each year against user-selected allowance acquisitions into the Holding Account and transfers to the Compliance Account. In practice, each transaction throughout a year must comply with the accounting rules and be checked against the relevant limits.

In general, the ARB holding limits and the CPUC purchase limits are not likely to significantly alter or affect the allowance buying and selling strategies employed by companies with emissions well below the Holding Limits. However, for companies with substantial CCA obligations, the ARB holding limits will have a decided constraining effect on allowance acquisition, banking, and trading strategies. For large firms the [Holding Limit



plus concurrent Limited Exemptions], referred to here as the Current Limit, will require most of their current and prior year allowances to be placed into their Compliance Accounts, preventing a significant number of allowances from trading. The “one-way” nature of the Compliance Account will, thereby, diminish the flexibility of large companies to access the C&T market, reduce allowance market liquidity, increase volatility and potentially increase prices.³¹

The results described below for a large hypothetical investor-owned utility firm, Gold River, and for a large hypothetical “Refiner/Fuel Distributor,” indicate that similar firms in California, such as those listed in Table 4, will encounter constraints in implementing their allowance purchase, trading and management strategies. These constraints may not serve their intended purpose, such as to prevent market manipulation. In fact, these rules may act in a counterproductive fashion, since a potential manipulator will know that surplus supplies of allowances are trapped in Compliance Accounts, magnifying attempts to withhold allowances in a market with already inelastic supply.

Figure 3 shows a compliance strategy for the hypothetical Gold River Electric Utility Company. The dashed blue line shows its projected declining emissions obligation between 2013 and 2020. In this case Gold River’s GHG emissions are reduced from 14.7 million tonnes in 2013 to 11.9 million tonnes in 2020. The solid orange line reflects the jump up in the annual Holding Limit in effect in California, before Quebec joined, when the scope of California’s cap-and-trade market was to expand in 2015, and then decline to 2020. (See Table 6 for the somewhat higher limits now in effect.) The purple dotted line shows the total of all Current (current year and prior year) allowances held in each year, which must lie below the applicable Current Limit, indicated by the solid blue line. The Current Limit moves up and down as allowances are added to or surrendered from the Compliance Account. The year-end balances shown here reflect the increase in the maximum Limited Exemption each November 2 to add qualified emissions from the most recent emissions report submitted by that firm. The LE also decreases on November 2, 2015 and 2018, reflecting the allowances surrendered for compliance on or before the day before, November 1.

Figure 4 shows the quantities of CCAs held in Gold River’s Holding Account and its Compliance Account at year-end. In this calculation, the Compliance Account contains only Current allowances, while the Holding Account contains both Current and Advance allowances. A separate HL applies each year to Current and Advance allowances, although the same HL applies to all market participants, regardless of their emissions. The maximum Limited Exemption is unique for each firm and depends on prior year emissions. Although the maximum Limited Exemption is a straightforward calculation that changes each November 2, the actual exemption from the HL that applies at any given time is determined by the number of allowances present in the firm’s Compliance Account.



Figure 3. California Cap-and-Trade Limited Exemptions, GHG Emissions and Allowance Dynamics for the Gold River Electric Company (2013 to 2020)

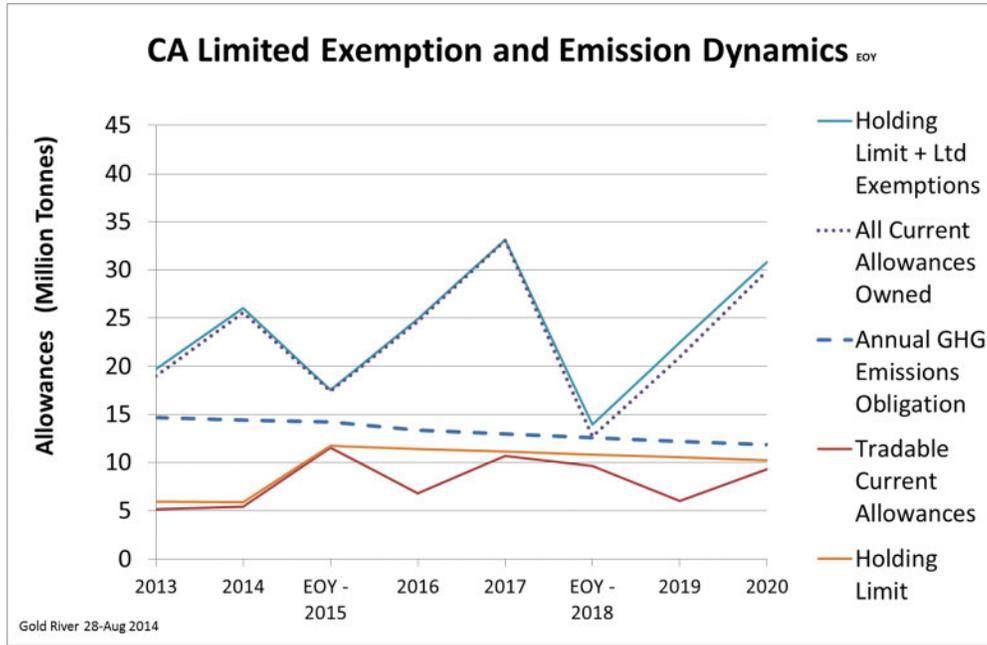
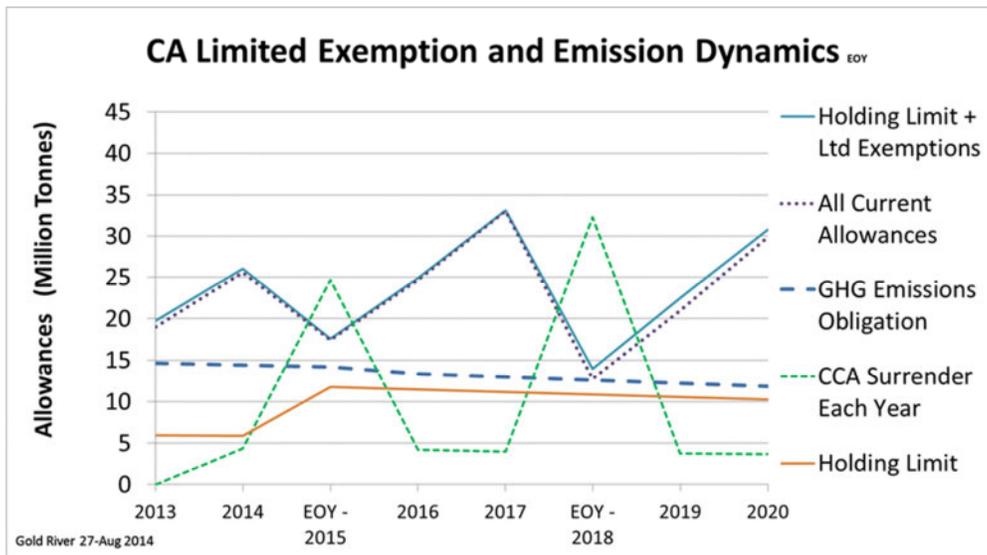


Figure 4. Gold River’s California Carbon Allowance Account Balances – 2% Surplus at the Ends of CP2 and CP3



In general, firms in allowance markets will acquire a bank of allowances sufficient to cover future uncertainties in emissions, while minimizing the costs of compliance. In the hypothetical case illustrated in Figures 3 and 4 Gold River acquired 96 % of its 29.1 million tonne CP1 need by December 31, 2014, the rest in 2015. (4.4 million tonnes were retired on November 1, 2014, the rest in 2015.) In CP2 it acquired 102% of its CP2 need by the end of



2017, carrying over a bank of 2% of its total CP2 need into CP3. Similarly, by December 31, 2020, Gold River is projected to have a 2% surplus over its CP2 need. Annual fluctuations in utility emissions can exceed 20 percent, so a 2% surplus does not really provide an adequate bank to hedge future compliance obligations and prices. It should be noted that in the U.S. SO₂ allowance market many electric utility companies carried large banks, developed primarily to serve their own future allowance needs and to minimize the risks of non-compliance. Similarly, it is likely that cap-and-trade firms in California will buy and hold allowances with a primary objective to meet their own emissions obligations and to accommodate uncertainties by maintaining a bank of CCAs. With rising prices driven by the mandated escalation of the auction price floor, acquiring a reasonable bank of allowances early in the program should be part of many firm’s least-cost, low risk strategy.³²

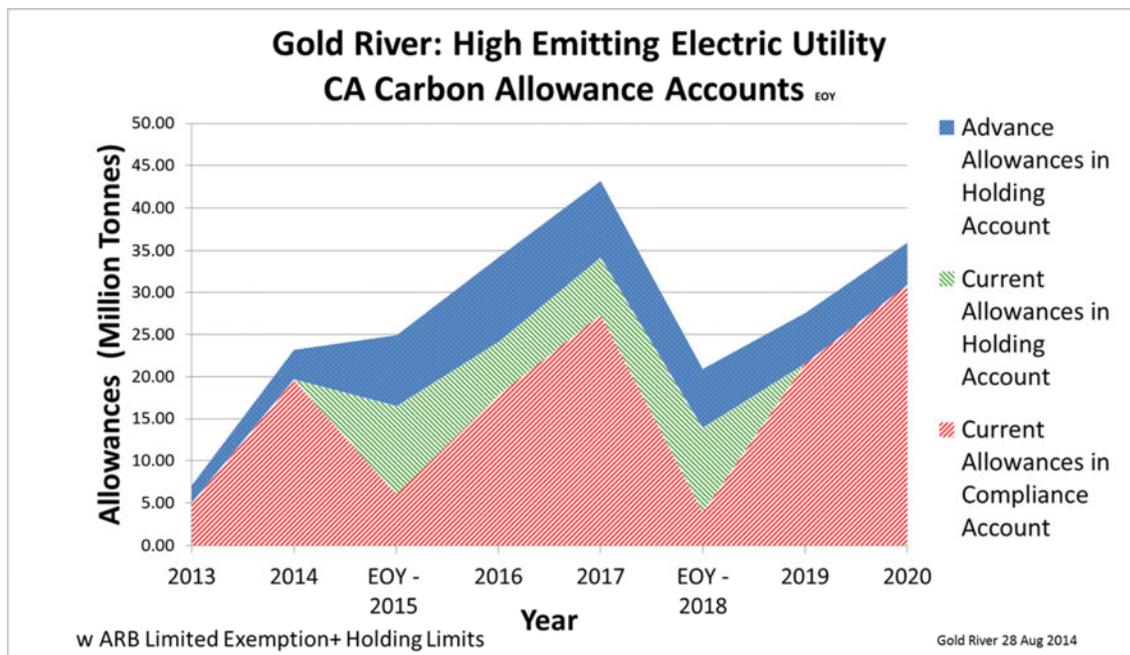
The up and down movement of the account balances shown in of Figure 4 is driven by a) each year’s requirement to surrender enough CCAs to cover at least 30% of last year’s emissions, b) by the need to transfer allowances to the Compliance Account in order to capture and keep the Limited Exemption for a growing number of allowances, and c) to comply in 2015 and 2018, after the end of the prior compliance period. During each compliance period the Gold River Company plans its allowance bank to ensure compliance with the Holding Limit + LE. On November 2, 2015 (and 2018) the maximum available LE is increased by verified emissions from 2014 (2017) and reduced by the number of allowances surrendered to cover the emissions obligation from the prior compliance period. The number of allowances held in the Compliance Account during October 2015 (2018) increases the Current Limit to its largest value, which is reached by November 1, 2015 (2018), and then drops on November 2, to reflect the allowances surrendered on November 1.

It should be noted that Figures 3 and 4 result from perfect foresight and smoothly declining emissions in each future year, as well as perfect knowledge of allowance prices. For large emitters, maintaining an appropriate number of Limited Exemptions by transferring allowances to the Compliance Account may not be easy, particularly if the paths of emissions and allowance prices fluctuate up and down, and if surpluses in allowance accounts occur in some years with deficits in others.

Figure 5 illustrates what imperfect foresight could bring to the Gold River compliance plan. In this case, annual emissions are the same as in the previous example, but Gold River gets a later start in acquiring emission allowances. By December 31, 2014, 83% of its first compliance period allowance need had been purchased. As a result, Gold River was a buyer throughout 2013 and 2014 with a limited ability to create sufficient Limited Exemptions to be able or desire to sell allowances in 2015. By the end of CP2, 2017, it acquires a surplus of 5% above its CP2 need, which enables CCA trading in 2018. But by 2019, Gold River has to put all its purchases into the Compliance Account, in order to satisfy its 2019 retirement obligation and in 2021, the remainder of its CP3 emission obligations, which are 36.7 million tonnes.



Figure 5. Gold River Allowance Account Balances with Imperfect Foresight



Similar behaviors exhibited by the firms in Table 4 can significantly affect market prices and market volatility, due to their magnitude relative to the overall market size and the number of transactions at a given time. Indeed, the acquisition of reasonably sized banks, perhaps over 15% of one year’s compliance obligation, would be reasonable for many firms, depending on future uncertainties in forecast emissions and future CCA price escalation. Prudent banking by many firms, large and small, will affect the availability and price of allowances illustrated in Figure 2, which includes no banking. (Even if it is economically attractive, it might be difficult for high-emitting firms to maintain prudently sized banks and still satisfy the complex Holding Limit + Limited Exemption rules.)

In another simulated case, Gold River’s emissions grew during CP2 above the CP1 level. To cover the increased emissions, Gold River placed more allowances into the Compliance Account, reducing its ability to trade during CP2. Gold River could have petitioned to increase its maximum Limited Exemption to partially alleviate the acquisition of its increased need for CCAs. Nevertheless, as Gold River did in this example, it is unlikely that all firms in California’s cap-and-trade market will execute the complex rules with perfect foresight. The result for those firms will be a paucity of allowances for sale.

The effects of Holding Limits and Limited Exemptions on large fuel distributors that enter the market in 2015 can be more pronounced. The allowance account balances for one compliance strategy are shown in Figure 6 for a hypothetical refiner/fuel distributor with emissions obligations that increase from 9.2 million tonnes per year in CP1 to about 39.2 million tonnes in CP2. These emissions and allowance dynamics are illustrated in Figure 7. In 2013 through 2015, this company must acquire substantial allowances to cover its emissions and then to



place most of them in the Compliance Account to create Limited Exemptions large enough to cover the firm’s allowance requirements. As can be seen, this firm’s annual allowance needs are substantially above the fixed Holding Limits, used in this California-only analysis, which were around 11 million tonnes/year.

Figure 6. Hypothetical Allowance Accounts for a Large Refiner/Fuel Distributor

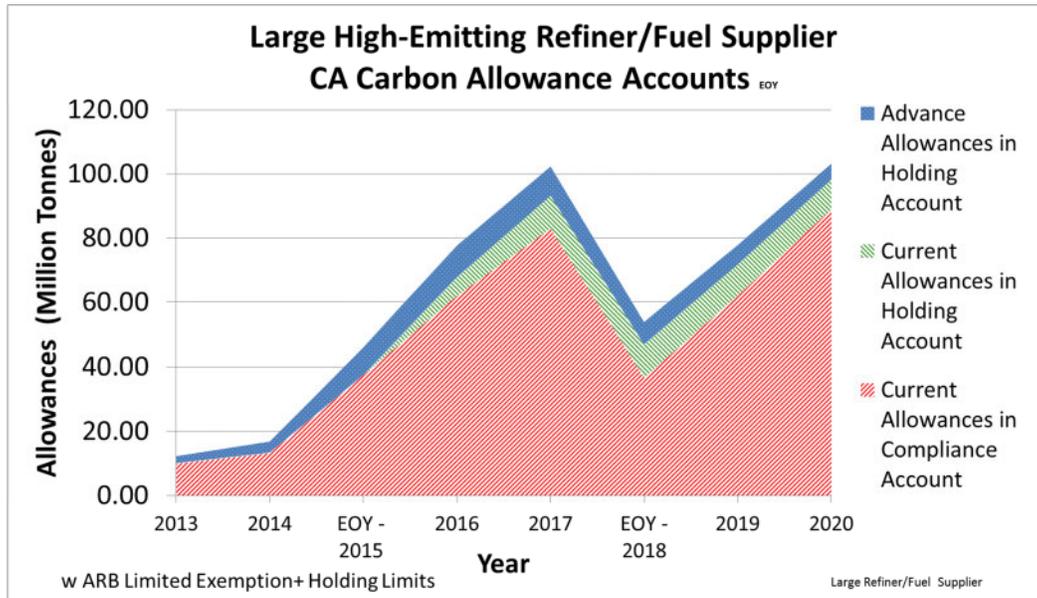
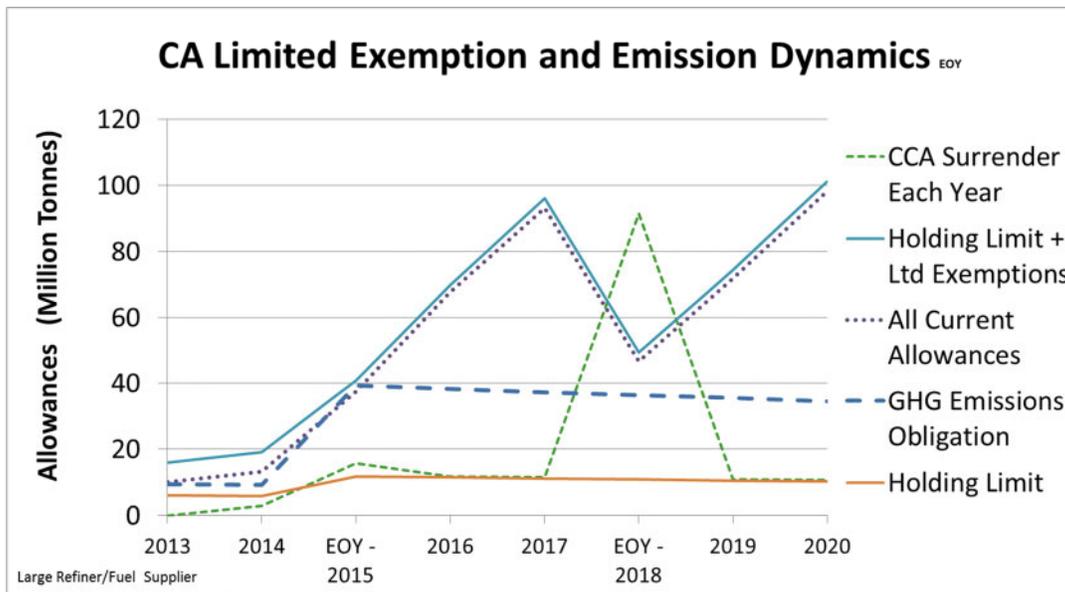


Figure 7. California Cap-and-Trade Limited Exemptions, GHG Emissions and Allowance Dynamics for a Large Refiner/Fuel Distributor (2013 to 2020)





For the first time in 2016, a small fraction of this firm’s CCAs can be kept in its Holding Account and, thus, be made available for sale in the secondary market. Similar effects occur under today’s combined California-Quebec limits, which were derived using a formula that has been applied to other commodity markets with more participants and differing incentives.

In general, well-managed allowance accounts and good timing of allowance purchases will enable most high-emitting firms to keep allowances available for trading up to or near to the Holding Limit in each year, i.e., up to 6 million tonnes in CP1 and about 11 million tonnes in CP2 and CP3. Given that the hypothetical firm illustrated in Figure 7 must obtain in excess of 35 million allowances each year, there is a large asymmetry in its ability to acquire allowances and its ability to sell allowances.³³ Nevertheless, firms with annual emissions above the Holding Limit will have to sequester the majority of their Current allowances in non-tradable Compliance Accounts, thus, significantly reducing potential trades of possible allowance surpluses (for example, if a refinery is shut down for a year) and, hence, restricting supplies that should be available to all market participants.

b. Impacts of the ARB Holding Limit + Limited Exemption Rules

Overall, ARB’s holding limits mean that large emitters can always be allowance buyers, subject to creating and maintaining the correct balance of Limited Exemption allowances in their Compliance Accounts. However, as the complex rule is written, a significant quantity of potential surplus CCAs will be kept away from the market, even if market prices or the firm’s emissions dictate that a firm should sell its surplus allowances. In most scenarios, where allowance prices remain near the price floor, the constraints imposed by existing Holding Limit and LE rules on the behavior of large emitters should have only a small impact on market liquidity and prices. However, in scenarios with rising prices during CP3, the significant supply restriction on high-emitting companies could have deleterious effects on allowance market prices and on the resulting western U.S. electricity prices.

Another implication of the existing Holding Limits relates directly to the primary purpose of having holding limits in the first place: to prevent market manipulation. In fact, reducing the ability of high-emitting firms to sell surplus allowances increases the likelihood that other firms could successfully manipulate the market. Because of the rules, a firm wishing to manipulate the market by withholding allowances would know in advance that potential surpluses from high-emitters cannot be returned to the market. Moreover, prudent banking of allowances by many firms in combination with the mandatory sequestration of some allowance supply for all high-emitting allowance holders will put the market supply/demand balance nearer to or even well-up the steep portion of the allowance supply curve shown in Figure 2. In this case, CCA prices could increase rapidly. Knowing that holders of large inventories of allowances are restricted from selling freely could increase the incentive for others to deliberately withhold allowances from the market.³⁴

Overly complex rules and regulations can inhibit the efficient operation of any market, but particularly when supply is fixed and the number of consumers and total market participants is relatively small. My own rule of thumb is: “A market becomes overly complex, less efficient



and over-regulated, when the number of market rules and restrictions exceeds the number of market participants.” Unfortunately, this is the case with California’s AB 32 cap-and-trade market.

In summary, the studies described in this paper demonstrate that:

- 1) Managing Limited Exemptions and complying with the Holding Limit + Limited Exemption rules will be an essential, but complex, consideration in allowance purchase and sale decisions by all large emitters.
- 2) As now designed, the Limited Exemption rules in combination with current annual Holding Limits will reduce market liquidity by requiring allowances to be placed into the Compliance Account from which they cannot be removed.
- 3) Given the steep marginal costs of allowances illustrated by the Market Simulation Group’s curve in Figure 2, it is plausible that potential reductions in trading volumes caused by the existing Holding Limit + Limited Exemption rules in combination with “one-way” Compliance Accounts will have adverse impacts on prices.
- 4) In addition, the existing Holding Limit + Limited Exemption rules will unnecessarily increase market volatility and could impair an otherwise efficient market from being able to dampen rapid, “hair-trigger” movements in allowance trading volumes and prices.

The large emitters that are most affected by the existing Holding Limit and Limited Exemption rules are well-known, highly visible firms. The allowance transactions of these companies will be closely monitored, even if there are less restrictive Holding Limits + Limited Exemption rules.

The existing Compliance Account rules will permanently remove surplus CCA supplies that should be available in a well-functioning cap-and-trade market. The “one-way” nature of this account places asymmetric restrictions on large-emitters with annual emissions above the Holding Limit and renders most of their Current Allowances unsaleable. High-emitting firms should be among the active traders needed to ensure a well-functioning allowance market. Hence, one of this study’s recommendations is that the Compliance Account rules should, at least, be changed to allow the removal and sale of allowances from the Compliance Account.

4. CPUC PURCHASE LIMITS

a. CPUC Purchase Limit Formulas

In addition to ARB regulations, California Investor-owned Utilities must comply with regulations promulgated by the California Public Utilities Commission (CPUC). In 2012, the CPUC put forward its Direct Compliance Obligation Formula, which calculates the maximum quantity of compliance instruments that an IOU is allowed to purchase in each current year, including carbon allowances (CCAs) and approved offsets (ARBOCs).³⁵ The formula applies to all vintages of allowances combined. The purchase limit formula is estimated for each year by each IOU assuming perfect forecasting of emissions out to 2020. It incorporates a



forecasting approach that increases base case expected emissions forecasts by using a higher than expected market heat rate for production simulations. The CPUC approach is intended to allow some cushion for procuring allowances above the anticipated need. Although the higher emission forecasts under the CPUC’s methodology are probably about 20% to 30% higher than base case forecasts, low hydro-year scenarios, nuclear plant outage scenarios and high electric demand growth scenarios could all contribute to even higher future emissions. An IOU’s forecast can be changed, if the IOU provides updated analysis and submits an Advice Letter to the Commission.

Under the CPUC framework, IOUs would not be allowed to purchase allowances or offsets with vintages more than 3 years from the current year.³⁶

The formula is as follows:

“ $L_{cy} = A + (100\% * FD_{cy}) + (60\% * FD_{cy+1}) + (40\% * FD_{cy+2}) + (20\% * FD_{cy+3})$, where

“L” is the maximum number of GHG compliance instruments an IOU can purchase for purposes of meeting its direct compliance obligation.

“A” is the utility’s net remaining compliance obligation to date,” calculated as the sum of the actual emissions for which the utility is responsible for retiring allowances (or purchasing on behalf of a third party) up to the Current Year, minus the total allowances or offsets the utility has purchased up to the Current Year that could be retired against those obligations. This term in the calculation ensures the IOUs are always able to buy sufficient allowances to cover any prior years’ shortfalls, given that actual emissions may end up being less than forecast and/or prior decisions about how much procurement to do.

“FD” is the utility’s forecasted compliance obligation”, the projected amount of emissions for which the utility is responsible for retiring allowances, or responsible for purchasing on behalf of a third party, calculated using an implied market heat rate (IMHR) that is two-standard deviations above the expected IMHR consistent with an approach described by PG&E.

“cy” is the current year, i.e., the year in which the utility is transacting in the market.

Should the above equation result in a negative number in a given year, the utility’s Direct Compliance Obligation Purchase Limit for that year should be set at zero.”

The CPUC also promulgated a Financial Exposure Purchase Limit to limit the quantity of GHG compliance instruments that can be purchased to hedge financial exposure. This formula requires an estimate of the utility’s financial exposure to GHG costs expected to be embedded in the price of energy over and above the costs of meeting the Direct Compliance Obligation. As such, the allowable purchases under this formula are expected to be less than under the Direct Compliance Obligation formula. The sum of both formulae constitutes the CPUC annual purchase limit. Since these formulae limit the rate and quantity of allowances

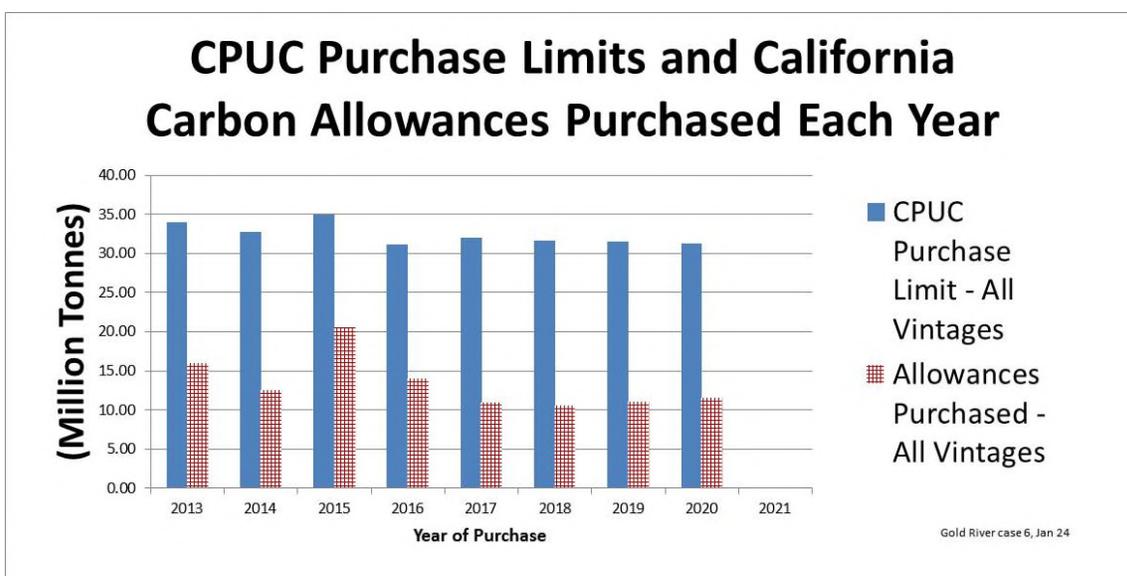


that can be purchased, the CPUC purchase limits could also act as a de facto holding limit for IOUs with annual emission obligations less than the annual Holding Limit.³⁷

b. Analysis of the CPUC Purchase Limits for a High-emitting Utility

The CPUC purchase limits for a hypothetical, high emitting Investor-Owned Utility were analyzed as part of the example compliance strategies previously described. The selected compliance strategies did not conflict with CPUC purchase limits in any of the cases that were examined. Figure 8 illustrates one of the cases for the Gold River Electric Utility Company.

Figure 8. California Public Utilities Commission CCA Purchase Limits



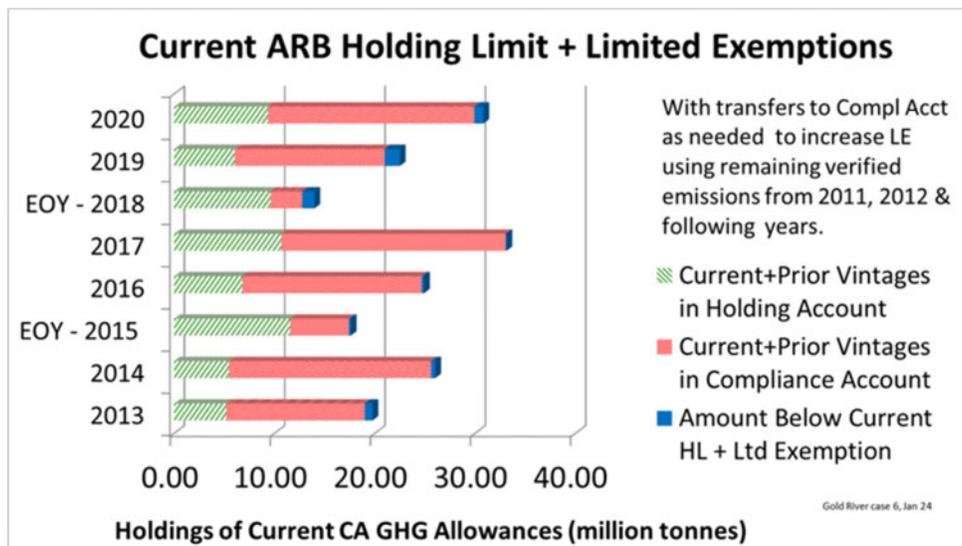
The CPUC’s annual purchase limit formula includes a term that reduces the quantity of allowance purchases permitted in a given year. This term depends on the current and prior year allowances banked up to the current year and the forecasted emissions that must be covered. From examining a number of possible compliance strategies, potential CPUC limitations to the quantity of allowances purchased are more likely to occur in the first year of each compliance period, when allowance banks are being built or replenished. Whether or not the CPUC purchase limit will ever be binding depends on the size of each IOU’s emission obligation, its allowance bank and the cushion needed to minimize the risks of non-compliance, while procuring allowances at least-cost.

This analysis suggests that the CPUC purchase limits will not be as binding as the ARB Holding Limits on the highest emitting investor-owned utility, PG&E. A principal reason for this is that the CPUC’s methodology for setting purchase limits, as described above, uses IOU emission forecasts that are 20 to 30% above the forecasted base case, i.e., the “expected,” most likely emissions. The CPUC’s recognition of future uncertainties enables its purchase limits to permit a greater degree of allowance banking than the ARB’s Holding Limits + Limited Exemptions will allow. Figure 9 shows the more limited headroom available under the ARB’s



holding limits. Thus, in normal circumstances, the CPUC purchase limits should provide adequate headroom to permit IOUs to purchase a reasonable quantity of allowances to satisfy their compliance obligations and accommodate some uncertainties. However, to the extent that a utility’s annual emissions exceed the ARB Holding Limits, the economics of banking allowances (rather than making spot market purchases), and other considerations will affect allowance purchase strategies.

Figure 9. Headroom Under the ARB Holding Limit + Limited Exemptions



Hypothetical Gold River Electric Company - IOU

5. POLICY RECOMMENDATIONS

When the Global Warming Solutions Act was passed in 2006, California recognized that it could not provide the CO₂e emission reductions needed to slow global warming by itself. Now, in late 2014, the cap-and-trade market for California Carbon Allowances (CCAs) is successfully up and running. However, in 2015 the market will more than double in size. California’s market design is evolving, in order to keep the market operating smoothly and to achieve the targeted emission reductions in a manner consistent with other state policies.

California has pursued linkages with other jurisdictions, notably the states in the Western Climate Initiative and several provinces in Canada. As of January 1, 2014, Quebec and California formally linked their programs, and the first joint allowance auction was held on November 25, 2014.³⁸ California also has agreements for varying degrees of cooperation with Australia, China, Peru, Israel and Mexico. In a major announcement in June 2014, the U.S. EPA proposed its Clean Power Plan for existing electric power plants. The proposal encourages states to develop regional “Best Systems of Emissions Reduction,” which can include multi-state cap-and-trade programs.



Since its inception, a primary objective of the AB 32 program has been to develop a market design that could be extended to multiple states and, potentially, to the entire U.S. The timing of EPA’s Clean Power Plan and the 2015 jump in scope in California’s program offer a timely opportunity for California to simplify some of its complex regulations and cap-and-trade rules, in order to make these rules more workable and to allow California’s market design to be more easily adapted for a multi-state program.³⁹

This paper has discussed the potential effects of three important elements of California’s cap-and-trade rules:

- 1.) The Allowance Price Containment Reserve,
- 2.) The Compliance Account, and
- 3.) Holding Limits and Limited Exemptions.

Reasonable modifications to these rules will

- Enable the cap-and-trade market operate more smoothly with fewer complications,
- Help avoid future price run-ups and volatile behavior,
- Reduce the likelihood of market manipulation, and
- Make these rules more attractive as the basis for a regional market design that could satisfy EPA’s Clean Power Plan.

This paper recommends that the Air Resources Board:

- 1) Add a hard price cap to the Allowance Price Containment Reserve, in order to prevent possible unlimited price increases. Such uncapped price run-ups could happen, if the APCR reserve of allowances is exhausted. A consequence of the inelastic supply and fixed total quantity of allowances is the potential for rapid price increases. These factors all suggest that a hard price cap would be a helpful backstop to the APCR.
- 2) Remove the “one-way” restriction on the Compliance Account, in order to allow removal and trading of allowances that are otherwise trapped in these accounts. This will enable more effective and efficient trading, especially when the CCA supply/demand balance tightens.
- 3) Modify the overly-complicated rules governing Holding Limits and Limited Exemptions. Perhaps, simply raise the current annual Holding Limits or adjust the limit for the very few, already highly monitored firms with annual emissions above the current fixed annual holding limits. Examining pivotal supplier tests and concentration ratios under potential future market conditions may assist the Air Resources Board in making appropriate revisions to the holding limits that will enable the market to function properly, after 2018 and again after 2020, when the annual emissions cap will decline more rapidly to reach the 2030 emissions goal. Although the Holding Limit rules won’t directly affect most market participants, the restrictions imposed on the largest emitters will reduce CCA market liquidity, lower the transparency of market prices and increase market volatility. As the market tightens, removing the ability of large emitters to trade their surplus CCAs



could lead to rapid, hair-trigger excursions in CCA prices and might even encourage the very market manipulation that the holding limits are intended to prevent.

By changing the rules to make the AB 32 cap-and-trade market less complex, California’s market design will become more efficient and workable on a multi-state scale. Given the interest in regional markets sparked by EPA’s Clean Power Plan, California’s GHG reduction program is on the cusp of achieving one of its intended goals, which is to become a model for a regional cap-and-trade program. A successful program that encompasses a broader geographic area will be able to reduce more CO₂e emissions than are now covered by the California-Quebec program and to achieve expanded reductions at a lower cost per tonne of CO₂e reduced.

REFERENCES AND ENDNOTES

¹ Air Resources Board. “First Update to the Climate Change Scoping Plan, May 2014. Every five years the AB 32 Scoping Plan is updated, in order to “continue to consider future achievement of maximum technologically feasible and cost-effective GHG emission reductions,” and present the “priorities and recommendations for achieving the State’s longer-term emission reduction objectives.”

² EPA’s Clean Power Plan, Federal Register, June 18, 2014.

³ http://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm

⁴ The Market Simulation Group consists of academic researchers under contract to the Air Resources Board. The agreement with ARB ran through March 2014. The updated MSG report: Severin Borenstein, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins. “Report of the Market Simulation Group on Competitive Supply/Demand Balance in the California Allowance Market and the Potential for Market Manipulation.” Energy Institute at Haas, Working Paper 251. Haas School of Business, University of California, Berkeley. July 2014. The report is also available on ARB’s website:

http://www.arb.ca.gov/cc/capandtrade/simulationgroup/msg_final_v25.pdf

⁵ The floor price is the annual auction reserve price for auctioned allowances. (The floor price started at \$10/tonne in 2012 and escalates at [5%+ CPI inflation] each year.) 2013 and 2014 floor prices are given in Tables 2 and 3.

⁶ See reference 4, page 60 and pages 65-66: “These are the prices one would expect assuming that no allowances are banked for later use. Implicitly, this analysis assumes that all available allowances would be used for the compliance period if the price were above the floor” ...p.67: “In fact, because the price floor rises at 5% above the inflation rate, the withheld allowances themselves, if purchased at or near the price floor, could potentially be attractive, low-risk, long-term investments even absent a manipulation motive.”

⁷ California Executive Order S-3-05, June 1, 2005. See also reference 1.

⁸ Although the MSG assumed no banking in its analysis, the MSG report (see reference 4) acknowledges the market efficiency and price benefits of banking in footnote 67 on page 67: “Of course, allowance banking also has enormous positive impacts on the market, allowing intertemporal arbitrage that encourages cost-efficient abatement. Our discussion of the impact of banking on market manipulation strategies in no way suggests that banking should not be permitted.”

⁹ See reference 4.

¹⁰ The Allowance Price Containment Reserve (APCR) can provide additional allowances at auction, six weeks after regular quarterly auctions, when a request is made. Qualified bids will be satisfied at one of three price tiers, escalated from \$40, \$45, and \$50/tonne in 2012 at (5%+inflation) per year. To make the APCR more viable, ARB implemented changes in 2013. However, in 2014 the Market Simulation Group recommended further changes to expand the APCR. No APCR auctions have been held to date.

¹¹ Shobe, W., Holt, C., and Huetteman, T. “Elements of Emission Market Design: An Experimental Analysis of California’s Market for Greenhouse Gas Allowances.” Journal of Behavioral Economics. JEBO-3346, in press, 2014.

¹² University of Virginia/PEAR, Inc. Report: “Investigation of the Effects of Emission Market Design on the Market-Based Compliance Mechanism of the California Cap on Greenhouse Gas Emissions,” February 12, 2013.



This report is available for download on the University of Virginia Frank Batten School of Leadership and Public Policy website:

http://www.batten.virginia.edu/sites/default/files/FINAL_REPORT_CA_Cap_and_Trade_Market%20imulation_Results_021813_0.pdf

¹³ Van Horn, A. “The PEAR/UVA Study: Testing AB 32’s Market Design – Allowance Holding Limits, the APCR, CPUC Purchase Limits and the CA Allowance Strategy Calculator. Van Horn Consulting, Orinda, CA. March 2013. www.vhcenergy.com

¹⁴ Perkis, D.F., Cason, T.N., Tyner, W.E. “An Experimental Investigation of Hard and Soft Price Ceilings in Emissions Permit Markets. Krannert School of Management, Purdue University (Unpublished manuscript).

¹⁵ The author wishes to acknowledge Kristine Chase, Ed Remedios, Mike Katz, Bill Shobe and Thad Huetteman for helpful comments during the course of this study.

¹⁶ AB 32 will be considered a success, when: 1) CCAs are traded across other linked carbon markets, such as the allowance market in Quebec, 2) California achieves its GHG reduction goals at reasonable cost, 3) California’s cap-and-trade market design is used as a model for regional compliance with the EPA’s recently proposed Clean Power Plan or other regional approaches to reduce carbon emissions.

¹⁷ Reference 4, p. 76.

¹⁸ Western Climate Initiative website, <http://www.westernclimateinitiative.org/history>, January 2, 2013.

¹⁹ Jeffrey H. Harris, Western Climate Initiative Markets Committee Report on Holding Limits, March 2010.

²⁰ The quarterly allowance auctions conducted by the ARB constitute the primary allowance market. The ARB Holding Limits apply to all California carbon allowances (CCAs) and allowances issued by an approved GHG emissions trading program, like Quebec, whether allocated for free or purchased in primary or secondary markets.

²¹ Jeffrey H. Harris, Western Climate Initiative Markets Committee Report on Holding Limits, March 2010. p. ii.

²² Ibid, p. 3.

²³ Ibid, p. 3.

²⁴ Open Interest is the total number of outstanding contracts held by market participants at the end of each day. Open interest measures the flow of money into the futures market for a commodity, like CCAs. For each seller of a futures contract there must be a buyer of that contract. Hence, a buyer and seller in a futures market combine to create only one contract.

²⁵ Article 5: California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms, Subarticle 11: Trading and Banking, §95920 (d) (1) and (e).

²⁶ Article 5, Subarticle 11: Trading and Banking, §95920 (d) (2).

²⁷ During 2013 and 2014, EDUs could purchase up to 40% of the Current allowances offered in an auction, while non-covered entities, such as financial and investment firms, may only buy up to 4% of the Current allowances in an auction, relying on the secondary market for larger transactions. The ARB purchase limit for the Advance auction is 25% of the allowances offered for auction.

²⁸ Reformulated blendstock for oxygenate blending.

²⁹ In an August 28, 2012 teleconference with ARB, ARB explained that “a CP-2 entity should not be registered as a covered entity in CP-1 unless they also have a CP-1 obligation. If a CP-2 entity is registered in CP-1, their CP-2 covered emissions are not considered part of the limited exemption in CP-1. For example, a company may own a refinery which has an obligation under CP-1. They may also be considered the fuel distributor in CP-2. The CP-2 fuel obligation is not allowed as part of the limited exemption until CP-2, unless this facility has chosen to opt-in, in which case they would have an obligation in CP-1.”

³⁰ See reference 11.

³¹ Holding Limits are a secondary factor contributing to allowance market liquidity and volatility. The California allowance market is currently a constrained market with a shrinking supply of product available. When the weather is dry in the Northwest and to a lesser extent in California, then allowance prices will jump. For example, allowance prices might be more volatile than the prices of grain futures, since both of these products are weather-sensitive. However, grains have the advantage that as prices increase, more supply will be produced, while the supply of allowances shrinks over time. Judging the magnitude of the effects that Holding Limits and other constraints will have on the overall California allowance market is a complicated exercise that, to our knowledge, has not been carried out.



³² There is a possibility that California’s future allowance market won’t be able to support the auction price floor, i.e., the minimum reserve price that started in 2012 at \$10.00/tonne and rises at 5% per year plus inflation. With the floor price rising fast in a slack market, it is possible that the secondary market price could fall below the auction floor price. However, since surplus allowances can be kept for future compliance, it may not make sense for companies to sell from their allowance banks at low prices, until the future supply/demand balance becomes clearer at the end of CP2 or in CP3.

³³ Most of the industrial allowances have been allocated for free, which means that large industrial firms will not need to purchase most of their allowances in the market. Of course, this introduces an asymmetry into the potential for active trading. Supposing a large refinery were to be shut down for a year, lowering its CCA need, how easily could the surplus CCAs be returned to the market?

³⁴ The analysis conducted by the Market Simulation Group concluded that, even if deliberate manipulation was successful, market manipulation occurring at the ends of CP1 and CP2 “would have little or no impact on retail prices.” (Reference 4, p. 80.) MSG also states that “the limited impact of a price spike due to manipulation is in contrast to the potential impact we estimate from a real supply/demand imbalance that – even without manipulation – leads to high allowance prices.” (Reference 4, p. 83.) In fact, prudent banking of CCAs, which is likely to be a part of most market participant’s compliance strategies under normal market circumstances, could contribute to a scarcity of tradable supply, leading to rapidly rising allowance prices, unless surplus supplies trapped in Compliance Accounts are made available for trading.

³⁵ The CPUC defines “purchase” as taking title to the instrument when it is delivered.

³⁶ CPUC Decision D.12-04-046, Appendix 1. April 2012.

³⁷ The emission compliance obligations of California utilities can include GHG emissions from electric generators under tolling or other agreements, where the utility assumes an obligation to procure the CCAs needed to cover the supplier’s emissions.

³⁸ On August 7, 2014, California and Quebec carried out a joint practice auction. After a six-day unscheduled delay, the first actual joint auction was conducted successfully on November 25, 2014.

³⁹ For example, much effort has gone into reducing the likelihood that California industries will move to other states and continue to emit in those locations, aka “leakage.” These continuing efforts would be considerably less important to implement, if a western regional cap-and-trade program were in place.