APPENDIX G.
ALLOWANCE PRICE CONTAINMENT RESERVE ANALYSIS

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Appendix G
Allowance Price Containment Reserve Analysis

A. Role of a Cost Containment Mechanism

As described in the AB 32's Climate Change Scoping Plan,[1] the cap-and-trade program is one component of a portfolio of programs and policies to achieve AB 32's objectives reliably and cost effectively. Multiple features of the cap-and-trade program provide compliance flexibility while ensuring that emission goals are achieved, including:

- Scope: A broad scope for the cap-and-trade program improves efficiency and reduces compliance costs by covering a diverse set of sources with a range of emission reduction opportunities.

- Unlimited allowance banking: Unlimited allowance banking enables compliance entities to decide how best to use emission allowances over time. This flexibility can substantially reduce compliance costs across compliance periods.

- Multi-year compliance periods: Multi-year compliance periods provide flexibility for compliance entities, and recognize that emission reduction efforts may take time to phase in, particularly in the early years of the program.

- Offsets: Allowing high-quality offsets and other approved instruments for compliance can reduce program costs. The limit on the use of offsets and other approved compliance instruments ensures that a majority of the required emission reductions are achieved at the covered sources.

Other policies and programs in the Scoping Plan, such as the California Clean Cars Program, the Renewable Electricity Standard, the Low Carbon Fuel Standard, and energy efficiency programs, motivate or require emissions reductions that—due to market barriers—would not otherwise be undertaken solely in response to price considerations. These policies can help reduce overall program compliance costs.

As presented in the Updated Economic Analysis of California's Climate Change Scoping Plan,[2] ARB's analysis finds that the compliance flexibility incorporated into the cap-and-trade program design helps ensure that the overall program is supportive of economic growth and job creation under anticipated conditions.

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[1] Climate Change Scoping Plan: A Framework for Change. Air Resources Board, December 2008. Found at: http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

[2] Updated Economic Analysis of California's Climate Change Scoping Plan: California Air Resources Board, March 24, 2010 http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf (accessed September 23, 2010).

The allowance budget presented in Appendix E—Setting the Program Emissions Cap, is set at a level that enables the necessary emission reductions to be achieved cost effectively.

However, ARB's Updated Economic Analysis of the Scoping Plan, as well as the economic analysis presented in Appendix N—Supporting Documentation for the Economic Analysis, recognizes that future conditions are uncertain. As described below, conditions could develop individually and in combination that could create a risk that program costs are higher than anticipated. Consequently, it is appropriate to examine whether additional features can enable the program to adapt to changing conditions in a way that reduces this risk.

While considering how the program may adapt to changing conditions, it is recognized that program requirements can be adjusted by changing the program regulations themselves. Regulatory adjustments are often undertaken as programs mature and technology evolves. However, in a cap-and-trade program, conditions could change quickly in response to unexpected changes in the demand for emission allowances. While some price volatility may be expected, it will likely take time to assess whether market conditions have changed permanently so that regulatory changes are required, or whether price volatility is temporary. As a result, there is a risk that higher than anticipated costs could be incurred faster than regulatory changes are executed.

Based on these considerations, the role of a cost containment mechanism, therefore, is to reduce the risk that substantially higher than anticipated compliance costs are incurred. To be effective, the mechanism must react fast enough to respond to changing market conditions. Additionally, the mechanism must not interfere with efficient trading of emission allowances or otherwise compromise the program's environmental goals.

B. An Allowance Reserve as a Cost Containment Mechanism

The concept of an "allowance reserve" has been developed as part of federal legislative proposals as a mechanism for providing cost containment in a cap-and-trade program.[3] Based on a review of the literature and input from stakeholders, including during workshops, ARB staff finds that an allowance reserve can reduce the risk of higher than anticipated costs while maintaining the environmental integrity of the program:

- The risk of higher than anticipated costs can be reduced by making available allowances from a reserve when conditions warrant. By

[3] See, for example, Maniloff, P. & B. Murray, "Allowance Price Containment Options for Cap-and-Trade Legislation," Nicholas Institute Discussion Memo on H.R. 2454, Nicholas Institute for Environmental Policy Solutions, October 5, 2009. Available at: http://nicholasinstitute.duke.edu/climate/costsandpolicy/allowance-price-containment-options-for-cap-and-trade-legislation (accessed September 24, 2010).

providing additional allowances, the allowance price will be moderated, reducing the risk of higher costs being incurred.

- The environmental integrity of the program can be maintained by ensuring that the use of a reserve does not relax the emission reductions that will be achieved by the program.

A variety of configurations may be defined to create and use an allowance reserve for cost containment purposes. Based on a review of the literature and discussions with stakeholders, ARB staff refined the allowance reserve concept to fit within the framework of the proposed cap-and-trade program, including the following primary features:

- The Allowance Price Containment Reserve (Reserve): The Reserve is created by taking a number of allowances from the program's allowance budget across all three compliance periods. These allowances in the Reserve are available for use as the cost containment mechanism from the start of the program.

- Offsets: By taking allowances from the program's allowance budget to fill the Reserve, the remaining allowance budget is smaller. The smaller allowance budget would increase the stringency of the program if no other adjustments were made. Unless this increased stringency is addressed, the allowance reserve could increase costs under anticipated conditions, rather than help control costs. To address this stringency issue, the limit on the use of offsets is increased by the number needed to compensate for the removal of allowances from the allowance budget. By allowing more offsets to be used for compliance purposes in this quantity, the stringency of the program remains unchanged—the same amount of emission reductions is required by the compliance entities under the program.

- Use of the Reserve: To provide cost containment, the allowances in the Reserve are made available for sale at a pre-established price or prices: once each quarter, compliance entities could purchase allowances from the Reserve at the price. Knowing that the Reserve is available quarterly at an established price provides an alternative to purchasing allowances in the market at prices above the established price. Only when market conditions warrant, will compliance entities purchase the allowances in the Reserve.

ARB staff finds that this format for an allowance reserve is effective in reducing the risk that costs will be substantially higher than anticipated. By offering to sell allowances in the Reserve at an established price or prices, the Reserve provides protection against prices being higher than the established price or prices. If the demand for allowances is higher than expected so that allowance prices are also higher than expected, the ability to purchase allowances from the

Reserve will moderate the upward pressure on the market price as it approaches the established reserve sales price. The actual purchase of allowances from the Reserve will increase the supply in the market, thereby moderating the price. This influence of the Reserve on allowance prices is present at all times (so long as allowances remain in the Reserve). Consequently, the Reserve provides cost containment even under rapidly changing market conditions. Additionally, the decision to use the Reserve is made by compliance entities, which have the opportunity to purchase allowances from the Reserve. Program administrators do not need to make a determination that market conditions require an intervention. This certainty of the allowances in the Reserve being available at established prices is in important aspect of the design.

This protection against high prices is limited, however, because the number of allowances in the Reserve is limited. Once the allowances in the Reserve are all purchased, there is no additional buffer against higher than expected prices. The size of the Reserve, therefore, is an important design parameter that will determine the extent to which the Reserve will reduce the risk of unexpectedly high costs.

If allowance prices remain within the anticipated range (as described in the ARB's Updated Economic Analysis of the Scoping Plan and Appendix N—Supporting Documentation for the Economic Analysis), no allowances will be purchased from the Reserve because the established sales price or prices would be higher than the market price of allowances. Consequently, when no allowances are purchased from the Reserve, the total number of instruments that can be used for compliance (allowances plus the offset limit) is unchanged by the creation of the Reserve. Under these conditions, the environmental integrity of the program is maintained, and the emission reductions required by covered sources remains unchanged.

Alternatively, if allowances are purchased from the Reserve, the number of instruments that can be used for compliance increases compared to a program without a reserve. The increase is equal to the number of allowances purchased from the Reserve. Under these conditions, the environmental integrity of the program can be maintained because the additional allowances are compensated by the emission reductions achieved by the offsets that were added to the program as part of creating the Reserve. Consequently, the environmental integrity of the offsets is fundamental to maintaining the environmental integrity of the program.

The proposed interrelationship between the Reserve and the offset limit is similar to creating a cost containment mechanism that increases the offset limit under high cost conditions. The Regional Greenhouse Gas Initiative (RGGI) included an allowance price trigger that would increase the offset limit in that program. ARB staff believes that the approach presented here is preferable given these features:

- Offset project developers have indicated that it takes at least several years to bring projects to fruition and reduce emissions. Consequently, there is a risk of a lag between an increase in the offset limit and a corresponding increase in offset supply. The proposed reserve mechanism eliminates this aspect of uncertainty in the overall program demand for offsets and provides an incentive for offset providers to invest and develop projects from the start of the program.

- If a trigger price is used to increase the offset limit, there would be an incentive for market participants to manipulate prices to achieve the trigger level. The proposed allowance reserve does not require a trigger price, and consequently does not provide an incentive to manipulate market conditions.

- Making allowances available for purchase at an established price or prices limits the potential gain associated with manipulating the allowance market toward higher prices. The price moderating effect of the reserve limits the ability to profit from even short-term manipulations. Given the lag time in the development of offset projects, increasing the offset limit in response to high prices may be less effective at mitigating the potential gains from short-term manipulations.

The limited nature of the proposed reserve distinguishes it from a hard allowance price cap. Under a hard price cap, a maximum allowance price is established, and an unlimited number of additional allowances is made available at the cap price. Under such conditions, the environmental integrity of the program is not maintained if additional allowances are sold at the price cap. The allowance reserve discussed here does not share these features with a hard price cap.

C. Analysis of an Allowance Reserve

This section analyzes three aspects of an allowance reserve. First, how large of a reserve is needed to reduce substantially the risk of unexpected high costs? Second, is the offset supply likely to be sufficient to support the creation of a reserve? Third, what are the potential cost implications of incorporating a reserve into the program?

Reserve Size

The size of a reserve needed to reduce substantially the risk of unexpected high compliance cost depends on the conditions that could lead to high costs. Given the uncertainty about the future, conditions may evolve that increase or decrease compliance costs. Because this analysis focuses on cost containment, conditions that have the potential to increase costs are examined.

High costs could come about through several mechanisms:

- Some conditions may cause emissions to be higher than expected, so that more emission reductions are required. For example, an increased incidence or duration of droughts may reduce the availability of hydroelectric power, requiring increased reliance on fossil fuel generating sources. Similarly, the availability of low-carbon generating resources may be delayed or temporarily reduced, so that additional fossil generation is required.

- Some conditions may increase the portion of emission reductions that must be motivated by the cap-and-trade market incentives. If some complementary policies and programs deliver fewer emission reductions than planned, the allowance price may need to increase in order to motivate additional emission reductions.

- Some conditions may cause technology costs to be higher than expected, so that the emission reductions are more costly than anticipated.

ARB's Updated Economic Analysis of the Scoping Plan provides some insight into one of these potential conditions: the potential impacts of less effective complementary policies. Table 23 in the study (p. 51) shows that:

- if transportation measures are less effective than planned, they could realize fewer reductions than anticipated, about 85 million metric tons (MMT) from 2012 to 2020 (Case 3);

- if electricity and natural gas measures are less effective than planned, they could realize about 115 MMT less in reductions from 2012 to 2020 (Case 4); and

- if all the measures are less effective, their reductions could be about 180 (MMT) less than anticipated from 2012 to 2020.

Each of these three cases was estimated to result in allowance prices that are substantially above the $21 per metric ton estimated under the main policy case for 2020 (Case 1). An allowance reserve could potentially prevent the higher allowance prices in these circumstances if it is large enough to accommodate the estimated shortfalls in emission reductions from the complementary measures.

Estimating the required size of the reserve under these conditions requires an estimate of the emission reductions achieved by raising the allowance price from the $21 per ton estimated for the main policy case to the sales price for the reserve. For example, the sales price from the allowance reserve could be set at $40 per ton in 2012 and escalate to $60 per ton in 2020. As described in the ARB's Updated Economic Analysis of the Scoping Plan, raising the allowance price trajectory from $21 to $60 achieves an additional emission reduction of about 30 MMT over the cap-and-trade program's nine years. Incorporating these reductions into the estimate of the size of the reserve, the allowance reserve

would need to be about 55 MMT (85 MMT minus 30 MMT) to accommodate the less effective transportation measures, 85 MMT to accommodate the less effective electricity and natural gas measures, and 150 MMT to accommodate all the measures being less effective. The size of the reserve would need to be larger if the sales price from the reserve were lower (e.g., at $50 per metric ton in 2020).

The total allowance budget in the main policy case of ARB's Updated Economic Analysis of the Scoping Plan is approximately 2,950 MMT over the nine years of the program. Therefore, the allowance reserve needed to accommodate the less effective complementary policies would be in the order of two percent to five percent of the total allowance budget.

The analysis conducted by the Partner jurisdictions of the Western Climate Initiative (WCI) examined a case in which much faster than expected economic growth yielded higher than expected emissions.[4] In this case, emissions increase in all 11 WCI Partner jurisdictions over the nine years of the program compared to the main policy case (WCI, p. 40). As a result, emission reductions from the cap-and-trade program were projected to increase by 333 MMT. To accommodate these additional emission reductions, an allowance reserve of about 260 MMT would be required[5] which is about 3.5 percent of the total allowance budget across all 11 partner jurisdictions. The California portion of this total is about 100 MMT, which is in the same range of additional reductions required if complementary policies are less effective.

Examination of these cases suggests that an allowance reserve on the order of two percent to five percent of the total allowance budget would provide protection from the risk of high prices from these conditions. Based on the proposed allowance budget of about 2,675 MMT (see Appendix E—Setting the Program Emissions Cap), an allowance reserve in the range of 50 MMT to 135 MMT may be appropriate. Additional combinations of conditions could be considered, potentially increasing the upper end of this range.

Offset Supply

The effectiveness of the allowance reserve for cost containment depends in part on the availability of offsets for compliance entities. As described above, the reserve is created by taking allowances from the allowance budget. To retain the

[4] Updated Economic Analysis of the WCI Regional Cap-and-Trade Program. July 2010. Available at (accessed September 26, 2010): http://www.westernclimateinitiative.org/component/remository/Economic-Modeling-Team-Documents/Updated-Economic-Analysis-of-the-WCI-Regional-Cap-and-Trade-Program/

[5] This estimate of the size of the allowance reserve is based on: 333 MMT minus an estimate of about 75 MMT of emission reductions would occur as a result of the allowance price being $60 per ton in 2020 (the reserve sales price). The reserve size is therefore estimated as: 333 minus 75, or about 260 MMT.

original stringency of the program (prior to creating the reserve), the amount of offsets that can be used for compliance is increased by the same quantity as the number of allowances put into the reserve. If the supply of offsets is insufficient to meet this demand, the creation of the allowance reserve has the potential to increase compliance costs. Consequently, this section examines potential offset supply.

The supply of offsets for compliance purposes in California will depend on several factors, including:

- the types of projects eligible to be issued offsets;
- the requirements in the offset protocols and other regulatory processes that affect the cost, timing, and quantity of offsets;
- the geographic area eligible for conducting offset projects that can be issued offsets for compliance purposes;
- the time period eligible for offset projects to be issued offsets for compliance purposes;
- the characteristics of the market for compliance-eligible offsets, including both the quantity of offsets that could be used for compliance and the price that compliance entities may be willing to pay; and
- the opportunities for offset project developers to develop and sell offsets to other programs, such as the European system.

The initial set of project types and protocols under consideration is presented in Parts II through V of the Staff Report. Additional project types and protocols may be developed and added to the program, which has the potential to enhance offset supply. Also, as part of collaborative discussions among the WCI Partner jurisdictions, there is interest in broadening the geographic applicability of the protocols to all of North America.[6]

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[6] The WCI Partner jurisdictions have tasked the WCI Offset Committee to review existing and protocols and develop recommendations for how to broaden their geographic applicability. The Offsets Committee 2009-2010 Work Plan is available on the WCI website at: http://www.westernclimateinitiative.org/component/remository/general/workplans/2009-2010-WCI-Work-Plan/ (accessed September 26, 2010). The WCI Review of Existing Protocols and associated appendices and documents are available on the WCI website at: www.westernclimateinitiative.org/component/remository/offsets-committee-documents/ and (accessed September 26, 2010)

There is relatively little empirical evidence for informing a forecast of the offset supply. The number of offsets developed through the Clean Development Mechanism (CDM) under the Kyoto Protocol is one indication of the potential offset supply for a compliance market. However, the project types, protocols, and geographic area discussed in Parts II through V of the Staff Report are substantially different from the CDM program. The large quantities of offsets developed by certain project types in the CDM program are not contemplated to be eligible for compliance in this program.[7] Consequently, while the CDM program has generated a substantial supply of offsets, the experience of that program is not indicative of the likely supply for this program.

The voluntary offset market may be another indicator of potential offset supply. The program run by the Climate Action Reserve (CAR) is one of several ongoing programs[8] and may be a useful indicator because it is using protocols that are similar to those being considered for this program and is covering a similar geography. CAR has experienced substantial growth in the last several years, having issued a cumulative total of more than seven million metric tons of offsets as of September 2010.[9] CAR's experience provides an example of the time needed to create and execute an offset program. Since CAR first issued credits the volume has grown from fewer than 500,000 metric tons issued in 2008 to nearly two million metric tons issued in 2009 to more than five million metric tons issued in 2010 through September. This offset supply for the voluntary market was generated at prices below $10 per metric ton, and in some cases substantially below.

CAR's experience shows that project developers require time to: understand the program requirements and identify qualifying project opportunities; raise funds to support projects; execute projects; and verify emission reductions or sequestration. Because the protocols presented in Parts II through V of the Staff Report are based in part on CAR protocols, some of the ramp up time for projects may be shortened.

Also of note is that the protocols used in CAR's program have evolved as the program experienced rapid growth. Input from project developers at ARB

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[7] For example, HFC-23 destruction projects under the CDM are undergoing increased scrutiny. Such projects are not contemplated for this program.

[8] Examples of other ongoing offset programs that serve the voluntary offset market include: The Voluntary Carbon Standard (http://www.v-c-s.org/); American Carbon Registry (http://www.americancarbonregistry.org/); The Gold Standard (http://cdmgoldstandard.org/); and The Chicago Climate Exchange Offset Program (http://www.chicagoclimatex.com/).

[9] The more than 7 million metric tons includes all the CAR protocols, including protocols not included in Parts II through V. Landfill gas projects, not included in Parts II through V, account for nearly 50% of CAR's total to date. The status of projects and offsets in the CAR program are available at: https://thereserve1.apx.com/myModule/rpt/myrpt.asp?r=111

workshops indicates that project development has slowed pending finalization of protocols by CAR. Additionally, project developers have been waiting for the adoption of protocols by ARB so that projects could conform to ARB's requirements and be eligible for the compliance market as well as the voluntary market. These conditions may have limited the rate of growth in CAR's program.

As discussed above, RGGI includes an offset program. To date, no offset projects have been listed in the RGGI tracking system, and no certificates have been issued.[10] This experience in the RGGI program indicates the importance of the expected price at which offsets could be sold. The RGGI allowance price has been in the range of $2.00 per short ton. At this price there appears to be little interest among project developers in creating offset supply for the RGGI market.

In addition to these observations of the compliance and voluntary offset markets, studies have been conducted to estimate the potential supply of offsets in the U.S. and from other countries. A 2005 study by the US EPA is among the most comprehensive studies conducted regarding the U.S. offset supply in the areas of agriculture and forestry.[11] This study presents a broad range of annual offset supply potential, from about 116 million metric tons (MMT) of CO_2e at a price of $1 per ton to more than 2,000 MMT CO_2e at a price of $50 per ton. Of this total, approximately 50 percent is associated with forest carbon sequestration and avoided deforestation and the remainder is associated with agricultural practices.

The WCI Partner jurisdictions developed offset supply estimates based on the US EPA study. Reflecting anticipated project types and quality criteria[12] for offset protocols that may be considered by the WCI Partner jurisdictions, the WCI study used approximately nine percent of the estimates in the US EPA study, and increased the price necessary to motivate supply by $2 per ton to reflect project administration costs. The estimates from the WCI study are shown in Table G-1.

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[10] The public reports on offset projects in the RGGI tracking system may be accessed at: http://www.rggi.org/market/offsets/project_tracking. (accessed September 26, 2010)

[11] U.S. EPA, Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture, 2005, EPA 430-R-05-006 available at: http://www.epa.gov/sequestration/pdf/greenhousegas2005.pdf (accessed September 26, 2010)

[12] The WCI Partner jurisdictions released offset criteria outlining the manner in which offset attributes would be assured, including: real, permanent, additional, verifiable, and enforceable. The WCI report "Offset Systems Essential Elements Final Recommendations" is available on the WCI website: http://www.westernclimateinitiative.org/component/remository/Offsets-Committee-Documents/Offsets-System-Essential-Elements-Final-Recommendations/ (accessed September 26, 2010)

Table G-1: Estimates of Potential Annual Offset Supply at a Range of Allowance Prices (Million Metric Tons Per Year)

Allowance Price ($ per metric ton)	WCI Economic Study (MMT/year)	Appendix N (MMT/year)
$5	18	0
$10	37	3
$15	55	9
$20	72	16
$25	87	23
$30	100	29
$35	112	36
$40	122	43
$45	131	49
$50	140	56
Estimates from the WCI Economic Study are based on supply conditions for 2015. The U.S. EPA study indicates that supply conditions will evolve over time. The Appendix N supply curve does not change over the period 2012 to 2020.		

The WCI study's application of the U.S. estimates found that the offset supply was substantially more than what would be needed to satisfy the projected demand for offsets for a combined program of WCI Partner jurisdictions. At the estimated allowance prices, the offset supply was more than sufficient to produce enough offsets to fulfill the offset limit recommended in the program design.

As a contrast, ARB staff used a more restrictive estimate of offset supply in Appendix N—Supporting Documentation for the Economic Analysis. As shown in the Table G-1, the offset supply is a fraction of the WCI study estimates, indicating that substantial uncertainty remains in projections of potential offset supply. The more restrictive supply assumptions may be more indicative of conditions during program start up. Also, uncertainty regarding the market for offsets in the long-term would tend to reduce supply. The limited duration of the proposed program (2012 to 2020) contributes to uncertainty regarding post-2020 market conditions.

Table G-2 shows the portion of the estimated offset supply that would be required to satisfy the demand for offsets in the program. Because the offset supply varies with price, the estimates are shown for a range of 2020 allowance prices, from $25 per metric ton to $50 per metric ton. The estimates also reflect a range of sizes for the allowance reserve, from no reserve (0 MMT) to a reserve of 150 MMT.

As shown in the table, in the absence of an allowance reserve (0 MMT), both supply estimates show that the offset supply is expect to be sufficient to satisfy offset demand at a 2020 allowance price of $25 per metric ton. However, if an allowance reserve of 100 million metric tons is created, at a 2020 allowance price of $25 the demand for offsets may exceed supply by 54 percent under the Appendix N supply assumptions. Alternatively, under the WCI study assumptions, offset supply is sufficient to meet demand, so that only 33 percent of the anticipated offset supply is needed. These differences in supply assumptions indicate different potential outcomes associated with creating an allowance reserve. Under the Appendix N supply assumptions, the 2020 allowance price may need to increase from the expected $25 per metric ton to motivate sufficient offset supply to satisfy demand associated with creating a 100 MMT allowance reserve. Under the WCI Study assumptions, the allowance price in 2020 need not increase above $25 in order to satisfy demand.

The decisions regarding whether to create an allowance reserve and the size of the reserve should consider the potential opportunities to ensure that offset supply is adequate to meet demand. The pace at which project types and project protocols become eligible for use for compliance, as well as the geographic applicability of the protocols, are important factors affecting supply that are driven primarily by ARB activities.

Among sources of potential additional supply are sector-based offset credits from Reductions in Emissions from Deforestation and Degradation (REDD). Considerable international efforts are ongoing to develop this area of sector-based forestry offsets. California is participating in discussions with potential suppliers of REDD sector-based offset credits to develop the requirements and procedures needed to develop compliance quality instruments.[13] The time required to achieve compliance eligible REDD sector-based offset credits remains uncertain.

The program design also provides for compliance instruments from other recognized programs to be used for compliance in the same manner as offsets. Both the European Union and RGGI programs have been discussed as potential candidates for linking. A unilateral link that makes instruments in those programs eligible for compliance in California's program could enhance the supply of instruments. If a unilateral link is established, covered sources in the California program will decide whether to purchase instruments from other programs and use them for compliance. The price of those instruments relative to the price of offsets and emission allowances issued under the California program will likely be an important factor affecting the extent to which the instruments from other

[13] See the Governors' Climate and Forests Task Force Joint Action Plan 2009-2010, August 2009; and the GCF Options Paper-Regulatory Design Options for Subnational REDD Mechanisms, February 2010, http://www.gcftaskforce.org/documents.html (accessed September 26, 2010)

programs are used for compliance. This potential supply is not included in the supply estimates.

Table G-2: Portion of 2012-2020 Offset Supply at a Range of Allowance Prices Required to Satisfy Offset Demand

Allowance Reserve (million metric tons)	2020 Allowance Price (dollars per metric ton)			
	$25	**$30**	**$40**	**$50**
Appendix N Offset Supply Assumptions				
0 MMT	81%	60%	40%	30%
50 MMT	117%	88%	58%	43%
100 MMT	154%	115%	76%	57%
150 MMT	191%	142%	94%	71%
WCI Study Offset Supply Assumptions				
0 MMT	17%	15%	12%	10%
50 MMT	25%	21%	17%	14%
100 MMT	33%	28%	22%	19%
150 MMT	40%	34%	27%	23%

Estimates that are larger than 100 percent indicate that the offset supply is smaller than the potential offset demand. Estimates that are smaller than 100 percent indicate that the offset supply is larger than the potential offset demand.

Estimates of offset demand from 2012 to 2020 include 110 MMT for the four percent offset limit plus the size of the Reserve. The allowance price is assumed to increase at seven percent per year from 2012 to 2020 to reach the 2020 allowance price. The offset supply available each year is based on the allowance price estimate for each year.

Finally, the impact of the creation of an allowance reserve on the supply of offsets should also be considered. Creating an allowance reserve of 100 MMT approximately doubles the offset limit, thereby potentially doubling the market for offsets. This increase in market size would draw attention to the offset market, potentially increasing supply as a result.

Cost Implications

An allowance reserve is expected to have an impact on the following types of costs:

- Emission abatement costs: Abatement costs are real resource costs to society.

    o Unexpectedly high cost conditions: By moderating unexpectedly high costs, the allowance reserve can reduce emission abatement

costs relative to what would have occurred without an allowance reserve.

o Anticipated moderate or low price conditions: By reducing the allowance budget to create the allowance reserve, the reserve has the potential to increase abatement costs relative to what would have occurred without an allowance reserve. If allowance prices are not increased by the reserve, then abatement costs do not increase.

- Allowance value: Allowance value is the allowance price times the allowance budget. The selling and buying of allowances are transfer payments and are not real resource costs to society. Nevertheless, the need to acquire allowance represents a compliance cost for sources covered by the program. Although a substantial portion of the allowances is anticipated to be distributed for free, of particular interest may be the value of allowances purchased from the State.

  o Unexpectedly high cost conditions: By moderating unexpectedly high costs, the allowance reserve can reduce the allowance value and consequently transfer payments. Also reduced is the value of allowances purchased from the State.

  o Anticipated moderate or low price conditions: By reducing the allowance budget to create the allowance reserve, the reserve has the potential to increase allowance prices and consequently transfer payments. If allowance prices are not increased by the reserve, then transfer payments do not increase.

- Offset costs: The cost of producing offsets is a real resource cost to society. If the offset limit is binding and the price at which offsets are purchased exceeds the cost of producing the offsets, a portion of the expenditures on offsets may be a transfer payment. By increasing the offset limit to accommodate the creation of the allowance reserve, the quantity of offsets produced is expected to increase. Consequently, offset costs will likely increase. If program costs are lower than anticipated, covered sources may find that they do not need offsets to comply. Consequently, under low price conditions, offset costs may not increase relative to conditions without the allowance reserve.

To examine the impact of an allowance reserve on these costs, this analysis examined three scenarios:

1. Scenario 1: Unexpectedly high costs that would result in the allowance price reaching $90 per metric ton in 2020 in the absence of an allowance reserve. These Scenario 1 allowance price assumptions are used to facilitate analysis of the potential impacts

of an allowance reserve. The allowance prices are not forecasts of anticipated conditions.

2. Scenario 2: Expected moderate costs that would result in the allowance price reaching $25 per metric ton in 2020 both in the absence of an allowance reserve and with an allowance reserve.

3. Scenario 3: Expected moderate costs that would result in the allowance price reaching $25 per metric ton in 2020 in the absence of an allowance reserve but because of insufficient offset supply the allowance price would reach at $30 per metric ton with an allowance reserve.

Scenario 1 represents the conditions against which the allowance reserve is meant to provide cost containment. Scenario 3 represents the potential risk that costs could increase as a result of creating an allowance reserve that is not actually needed.

To evaluate these scenarios, the allowance reserve is assumed to have the following features:

- Size: 100 million metric tons (MMT).

- Sales price: start at $40 per metric ton in 2020, increasing to $60 per metric ton in 2020.

This size is selected for evaluating the reserve because it is in the mid-range of the sizes discussed above in relation to potential conditions that could lead to high costs. This sales price trajectory is selected because it is sufficiently above expected allowance prices to avoid interfering with price discovery and price volatility under moderate cost conditions and lower than allowance price levels that would be associated with unexpectedly high compliance costs.

Table G-3 presents Scenario 1 allowance price estimates and abatement cost reductions due to the allowance reserve. As shown in the table, the allowance price starts at $15 per metric ton in 2012. In the second compliance period, the market adjusts to a higher than expected cost trajectory,[14] so that in the absence of an allowance reserve, allowance prices would be consistent with a 2020 allowance price of $90 per metric ton price by the third compliance period. Starting in 2017, the allowance reserve sales price is less than what would have been the allowance price. With the allowance reserve, the allowance price is

[14] Staff considered whether to analyze the adjustment as a one-time adjustment or as a series of adjustments. For this analysis, staff chose the latter approach. In this approach market participants gain an increasing amount of information each year during the second compliance period that the cap-and-trade program will cost more than market participants had previously realized.

moderated starting in 2017. This scenario assumes that only 75 percent of the 100 MMT in the reserve is used. Consequently, the allowance price is moderated to be equal to the sales price from the reserve.[15] The avoided abatement due to the reserve saves about $5 billion. The savings due to the avoided abatement would be larger or smaller depending on the portion of the allowance reserve that is used.

By reducing the allowance price from 2017 to 2020 in this scenario, the allowance reserve reduces allowance value by about $33 billion. As discussed above, a portion of this allowance value would have been purchased from the State and a portion would have been given to covered sources. About $15 billion of this allowance value would have been purchased from the State, so that the allowance reserve also reduces this component of compliance costs by about $15 billion. The combined savings in compliance costs due to reduced allowance value and reduced abatement costs are about $20 billion.

Balanced against these savings are the costs of producing and acquiring the 100 MMT of offsets that are added to the program to create the Reserve. Assuming that this offset supply can be produced at expected prices of under $25 per metric ton, the real resource cost to produce the offsets is less than $2.1 billion.[16] These additional offset costs need not increase compliance costs for covered sources. The proposed allowance reserve does not reduce the number of allowances freely distributed. Rather, the allowances placed into the reserve are taken from the portion of allowances that would otherwise be auctioned. As a result, purchases from the State decline. In this scenario, the reduction in expenditures to purchase allowances from the State is valued at about $5 billion (in addition to the $15 billion described above). This reduction in compliance expenditures compensates for the increased costs of purchasing offsets.

[15] If all the allowances in the reserve were purchased, the allowance price could rise above the reserve sales price or prices.

[16] The estimate of offset costs reflects the trajectory of allowance prices from 2012 to 2020, with the price reaching $25 per metric ton in 2020.

Based on these considerations, the overall impact of the allowance reserve in Scenario 1 is:

- reduced real resource costs of abatement by about $5 billion
- increased expenditures to purchase offsets by less than $2.1 billion, which reflects increased real resource costs of producing offsets (also less than $2.1 billion)
- reduced auction expenditures by $20 billion.

These factors reduce compliance costs for covered sources by at total of $22.9 billion ($5 billion minus $2.1 billion plus $20 billion)

Table G-4 presents Scenario 2 estimates. In this scenario, the allowance reserve is not used because the allowance price remains below the reserve sales price. Consequently, there are no abatement cost savings. Assuming that the additional $100 MMT of offsets is produced and purchased, the costs of offsets will increase by less than $2.1 billion as discussed under Scenario 1. Also as discussed under Scenario 1, these increased expenditures for offsets can be compensated by reduced auction expenditures. As a consequence, the overall impact of the allowance reserve in Scenario 2 is no impact on compliance costs.

Scenario 3 examines the implications of the allowance reserve causing an increase in allowance prices. As discussed above, creating a 100 MMT allowance reserve reduces the allowance budget by 100 MMT and increases the offset limit by the same 100 MMT over the period 2012 to 2020. The lack of adequate offset supply to satisfy this increase at a 2020 allowance price of $25 per metric ton leads to the increase in allowance prices. As a result of the price increase, additional abatement will occur and additional offset supply will become available.

To develop the scenario, the extent of the offset supply shortfall must be defined. In this scenario the offset supply is assumed to be sufficient to satisfy only 35 MMT of the 100 MMT taken from the allowance budget to create the reserve. The shortfall of 65 MMT induces the increase in allowance prices, which motivates the additional emissions abatement and additional offset supply. This estimate of available supply at $25 per metric ton is based on the Appendix N supply assumptions and the WCI study estimates. Because this scenario is examining inadequate offset supply conditions, this estimate of 35 MMT is closer to the values based on the Appendix N assumptions.

Based on the analysis of the potential responsiveness of offset supply and emissions to allowance prices in the range of $25 per metric ton, a response to an increase in price on the order of $5 per metric ton would be dominated by increased supply of offsets. ARB's Updated Economic Analysis of the Scoping Plan indicates that an allowance price increase of $5 per metric ton in 2020

would motivate an increase in abatement of about 5 MMT from 2012 to 2020. The additional offset supply motivated by the allowance price is expected to be substantially larger. The Appendix N offset supply assumptions indicate a response of about 45 to 50 MMT for the $5 per metric ton increase. The offset supply estimates from the WCI study indicate a substantially larger supply response, more than double the Appendix N assumptions. Again, because this scenario is examining conditions of inadequate offset supply, the offset supply response is assumed to be closer to the Appendix N estimate, at 60 MMT.

Using these estimates and assumptions, Scenario 3 is defined as:

- Creating the reserve reduces the allowance budget by 100 MMT, but only 35 MMT of offset supply is available at the allowance price that would have occurred in the absence of the reserve ($25 per metric in 2020).

- The allowance price increases as a result of the shortfall in offset supply, so that the 2020 allowance price is $30 per metric ton.

- The increase in allowance price motivates 5 MMT of additional emissions abatement and 60 MMT of additional offset supply.

Using these figures, in this scenario the compliance cost impacts of creating the allowance reserve include (see Table G-5):

- Increased compliance costs of about $0.1 billion reflecting the real resource costs for 5 MMT of additional abatement.

- Additional compliance costs to acquire 95 MMT of offsets (35 MMT plus 60 MMT). Although 35 MMT of offsets would have been available at the original allowances prices, all offsets are assumed to be acquired at an increased compliance cost reflecting the increased allowance price. The compliance costs for these offsets are estimated to be less than $2.3 billion. The real resource costs of producing the offsets would also be less than $2.3 billion.

- The increase in allowance prices increases the expenditures to purchase allowances at auction from the State by about $3.1 billion.

The additional abatement and offset costs, plus the increase in auction expenditures under Scenario 3, highlight the importance of ensuring an adequate offset supply given the size of the allowance reserve. The larger the reserve that is created, the more pressure there may be on allowance prices if offset supply is insufficient. Given the uncertainty in the offset supply, the size of the allowance reserve should be considered carefully.

As described above, the allowance reserve provides limited protection from unexpected conditions because of the finite number of allowance in the reserve. Extreme conditions could occur that cause the allowance reserve to be exhausted. Even under these conditions, the allowance reserve would provide cost containment. Although allowance prices could exceed the reserve sales prices, the additional allowances provided by the reserve would reduce abatement costs and expenditures for allowance purchases from the State.

D. Other Considerations

The objective of the cost containment mechanism defined above is to reduce compliance costs under unexpectedly high cost conditions. Consequently, it is appropriate to consider whether additional allowance reserve features could help further this objective.

Restricting access to the allowance reserve to covered sources may be appropriate to ensure that those entities can access the reserve at the established prices when needed for compliance purposes. Generally, it has been viewed as preferable to allow purchase and ownership of allowances without restriction as to type of entity. Unrestricted participation in the allowance market can support market liquidity and efficient price discovery. However, given the specific objective of containing compliance costs for covered sources, limiting access to the reserve can help ensure that the reserve accomplishes its objective.

Similarly, restrictions on the use of allowances purchased from the reserve may be appropriate to consider. Given the focus on containing compliance costs, the reserve allowances should not be available for use in market speculation and trading. Rather, the use of allowances purchased from the reserve could be restricted to compliance purposes only. This restriction could be implemented by requiring that allowances purchased from the reserve are put directly into compliance accounts of covered sources.

Finally, the allowance reserve could be structured in several tiers. For example, the reserve could be divided into three equal tiers, each with its established sales price. Covered sources would be eligible to purchase allowances from all three tiers, and would presumably purchase from the lowest priced tier first. Segmenting the reserve into tiers provides a mechanism for observing the degree of imbalance in the supply and demand for allowances. If only the first tier is accessed, then the maximum size of the imbalance is known more precisely. If the first tier is exhausted quickly and purchases are made from the higher tiers, then a more significant imbalance is occurring, and more substantial adjustments to the program may be required, or may be required more quickly.

Table G-3: Analysis of Scenario 1 – Unexpectedly High Costs

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Scenario 1 Allowance Price Without a Reserve	$15	$16	$17	$26	$43	$65	$79	$84	$90	
Allowance Reserve Sale Price	$40	$42	$44	$47	$49	$52	$54	$57	$60	
Scenario 1 Allowance Price With a Reserve	$15	$16	$17	$26	$43	$52	$54	$57	$60	
Avoided Abatement Due to Reserve (MMT)	0.0	0.0	0.0	0.0	0.0	11.3	19.8	21.2	22.7	75.0
Reduced Abatement Cost Due to Reserve (billions)	$0	$0	$0	$0	$0	$0.7	$1.3	$1.5	$1.7	$5.2

Allowance prices in dollars per metric ton.

Scenario 1 allowance prices without a reserve are assumed to be higher than anticipated to facilitate analysis of the potential impacts of an allowance reserve. The allowance prices presented are not forecasts of anticipated conditions.

Avoided abatement assumed to be 75% of the size of the allowance reserve, or 75 million metric tons (MMT) in total.

Reduced abatement costs estimated as the avoided abatement (MMT) times the mid-point between the allowance reserve sale price and the Scenario 1 allowance price without a reserve (dollars per metric ton).

Purchases from the reserve are equal to the avoided abatement.

Table G-4: Analysis of Scenario 2 – Moderate Costs

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Scenario 2 Allowance Price Without a Reserve	$15	$16	$17	$18	$19	$20	$22	$23	$25	
Allowance Reserve Sale Price	$40	$42	$44	$47	$49	$52	$54	$57	$60	
Scenario 2 Allowance Price With a Reserve	$15	$16	$17	$18	$19	$20	$22	$23	$25	
Avoided Abatement Due to Reserve (MMT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reduced Abatement Cost Due to Reserve (millions)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Allowance prices in dollars per metric ton. No avoided abatement is estimated because allowance prices remain below the allowance reserve sale price.										

Table G-5: Analysis of Scenario 3 – Moderate Costs with Insufficient Offset Supply

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Scenario 3 Allowance Price Without a Reserve	$15	$16	$17	$18	$19	$20	$22	$23	$25	
Allowance Reserve Sale Price	$40	$42	$44	$47	$49	$52	$54	$57	$60	
Scenario 3 Allowance Price With a Reserve	$17	$19	$20	$21	$23	$24	$26	$28	$30	
Increased Abatement Due to Reserve (MMT)	0.2	0.2	0.3	0.7	0.7	0.7	0.7	0.7	0.8	5.0
Increased Abatement Cost Due to Reserve (billions)	<$0.01	<$0.01	<$0.01	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.1
Increased Offsets Due to Higher Prices (MMT)	2.8	2.9	3.1	7.9	8.2	8.5	8.6	8.9	9.2	60.0
Increased Offset Costs Due to Higher Prices (billions)	<$0.1	$0.1	$0.1	$0.2	$0.2	$0.2	$0.2	$0.2	$0.3	$1.5
Increased Offsets Due to Reserve (MMT)	2.2	2.1	2.1	5.2	5.0	4.8	4.7	4.5	4.4	35.0
Increased Offset Costs Due to Reserve (billions)	<$0.1	<$0.1	<$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.8

Allowance prices in dollars per metric ton.

Allowance price increases with a reserve due to an assumed insufficient offset supply for this Scenario.

Increased abatement assumed to be 5 MMT given the $5 per metric ton increase in the 2020 allowance price.

Increased offsets used assumed to be 60 MMT given the $5 per metric ton increase in the 2020 allowance price.

Increased offsets used assumed to be 35 MMT at a 2020 allowance price of $25 metric ton due to the creation of the reserve and the increase in the offset limit.

Increased abatement costs estimated as the increased abatement times the mid-point between the allowance price without a reserve and the allowance price with a reserve (dollars per metric ton).

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