

# Exploring the Interaction between California’s Greenhouse Gas Emissions Cap-and-Trade Program and Complementary Emissions Reduction Policies

## *Background Paper<sup>1</sup> for the EPRI-IETA Joint Symposium on Complementary Policies*

April 2013

### I. BACKGROUND

This paper has been prepared for a symposium co-hosted by the Electric Power Research Institute ([www.EPRI.com](http://www.EPRI.com))<sup>2</sup> and the International Emissions Trading Association ([www.IETA.org](http://www.IETA.org))<sup>3</sup> to be held on April 16, 2013 in San Francisco, CA. It is the 14<sup>th</sup> EPRI-sponsored workshop since 2008 related to greenhouse gas (GHG) emissions offsets and climate policies.<sup>4</sup>

This paper summarizes information contained in a recent EPRI report<sup>5</sup> that concludes that the performance of “complementary policies” (CPs) in achieving emission reductions will have a significant impact on the level of abatement that covered sources will need to achieve to meet the fixed emissions cap in the new California GHG cap-and-trade program, and on expected GHG emission allowance prices. In addition, the potential variance in the performance of CPs and other variables, and recent regulatory decisions that have been made regarding program implementation, will complicate the efforts of electric companies and other regulated firms to develop an effective risk management strategy to comply with the program. Conclusions regarding the directional impacts of varying levels of CP performance on emission reduction requirements and allowance prices in California’s cap-and-trade program likely will be applicable to other jurisdictions employing similar policy models to address climate change.

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<sup>2</sup> EPRI is a U.S. based non-profit 501(c)(3) organization created in 1973. EPRI brings together its scientists and engineers, as well as experts from academia and industry, to help address societal challenges in electricity, including reliability, efficiency, health, safety and the environment.

<sup>3</sup> The International Emissions Trading Association (IETA) is a nonprofit business organization created in June 1999 to establish a functional international framework for trading in GHG emission reductions. IETA members seek to develop an emissions trading regime that results in real and verifiable GHG emission reductions, while balancing economic efficiency with environmental integrity and social equity.

<sup>4</sup> Agendas, background papers and expert presentations from all of the EPRI GHG emissions offsets workshops are available online at [http://globalclimate.epri.com/annual\\_events\\_ghg\\_offset\\_policy\\_dialogue.html](http://globalclimate.epri.com/annual_events_ghg_offset_policy_dialogue.html).

<sup>5</sup> This background paper was prepared by Adam Diamant of EPRI and Ethan Ravage of IETA, and is based on a 2013 EPRI technical update report “*Exploring the Interaction between California’s Greenhouse Gas Cap-and-Trade Program and Complementary Emissions Reduction Policies.*” EPRI, Palo Alto, CA: 2013. 3002000298. This EPRI report was prepared by Rich Rosenzweig and Robert Youngman of Natsource, LLC.

## **Assembly Bill 32 (AB-32)**

In 2006, California enacted Assembly Bill 32 (AB-32) – also known as the *Global Warming Solutions Act* – to address climate change. AB-32 required the California Air Resources Board (ARB) to develop a plan to reduce the State’s GHG emissions to 1990 levels by 2020.

In general, AB 32 provided ARB with broad authority to develop market-based compliance mechanisms, such as a GHG emissions cap-and-trade program, and any other policies that it determined were necessary to achieve the emissions reduction requirements included in the legislation. The SP that was adopted included a GHG cap-and-trade program and many other *complementary policies*. The cap-and-trade program and the CPs were designed to achieve GHG reductions from all sectors of the State’s economy. The interactions between CPs and the GHG cap-and-trade program are the focus of this paper.

The ARB incorporated 17 categories of CPs in the SP. These policies were designed to reduce GHG emissions from the State’s key emitting economic sectors by: (i) requiring more renewable energy; (ii) imposing GHG emissions standards on vehicles and reducing the carbon intensity of transportation fuels; and, (iii) increasing the energy efficiency of the State’s economy.

California’s strategy of combining a cap-and-trade program with multiple CPs is not unique. Other jurisdictions, including the European Union, Australia, and the states that make up the Regional Greenhouse Gas Initiative (RGGI), have developed a similar hybrid policy approach to achieve climate policy objectives. However, CA appears to rely on CPs to a greater extent than other jurisdictions to meet its GHG emissions target. Although this approach has been widely used to address climate change, little analysis has been undertaken on the interactions between CPs and GHG cap-and-trade programs and their impacts on program costs and covered entities.

## **ARB Scoping Plan and Complementary Policies**

AB-32 provided the ARB with broad regulatory authority to develop policies to achieve the specified GHG emissions limitations. Specifically, the legislation required ARB to:

- Adopt regulations by January 1, 2010 to implement “discrete early action” GHG emission reduction measures<sup>6</sup> prior to the adoption of GHG emission limits and emission reduction measures; and,
- Develop and approve a Scoping Plan (SP) by January 1, 2009 that would achieve the maximum technologically feasible and cost-effective reductions in GHG emissions. “The plan shall identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms...”<sup>7</sup> The policies included in the plan were to be adopted on or before January 1, 2011.<sup>8</sup>
- The original SP is a five year plan, and is scheduled to be reviewed and updated in 2013.
- The legislation included language indicating the intent of the Legislature that the statewide emission limit would continue past 2020.<sup>9</sup> In addition to AB 32, Governor Schwarzenegger

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<sup>6</sup> California Global Warming Solutions Act of 2006 (AB-32), Section 38560.5(a).

<sup>7</sup> Ibid, Section 38561(b).

<sup>8</sup> Ibid, Section 38562(a).

<sup>9</sup> Ibid, Section 38550.

issued Executive Order S-3-05 in 2005, which sets a goal for CA to reduce its GHG emissions 80% below 1990 levels by 2050.<sup>10</sup>

The ARB developed a SP made up of a GHG emissions cap-and-trade program and direct regulatory measures (aka “complementary policies”) to achieve the 2020 target. The CPs, which were designed to achieve climate policy and other important policy objectives, target emissions from sectors covered by the GHG cap-and-trade program and those not covered by the program. ARB estimated that the CPs would achieve approximately 80% of the emissions reductions required to achieve the 2020 emissions target. In public meetings, ARB staff consistently has said the cap-and-trade program is designed to function as a backstop in case the emissions reductions associated with the CPs are not achieved.

The climate change program developed by CA represents the most comprehensive effort to date by any jurisdiction in the United States to address climate change. Given that CA is the largest state in the U.S. and the 14th largest emitter of GHG emissions in the world,<sup>11</sup> the program requires careful consideration and analysis based upon its potential to affect the development of future climate mitigation policies in other jurisdictions.

### **The GHG Emissions Target and Emissions Sources**

California’s emissions sources are diverse. ARB’s initial analysis, based on GHG emissions in 2002-04, forecasted that the leading contributors to the State’s emissions in 2020, by sector, would be transportation (38%), the electric power sector (23%) and industry (17%), as shown in Figure 1.<sup>12,13</sup> Given the diverse sources of the State’s emissions, the cap-and-trade program covers emissions from the power and industrial sectors, and fuel from the transportation and other sectors. Similarly, the CPs were designed to reduce emissions from these key emitting sectors as well.

The ARB has undertaken several analyses to quantify the GHG emission reductions required to achieve the 2020 emissions target included in AB-32. At the time the SP was published in December 2008, the State had developed an initial forecast that estimated 2020 BAU emissions of 596 million tonnes of carbon dioxide equivalent (MtCO<sub>2e</sub>).<sup>14</sup> In March 2010, the ARB issued its updated economic analysis,<sup>15</sup> which included a revised BAU estimate of 525 Mt<sup>15</sup>, as shown in Figure 1. In October 2010, ARB further revised the BAU estimate, down to 507 Mt.<sup>16</sup>

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<sup>10</sup> Executive Order S-3-05, June 1, 2005, <http://www.dot.ca.gov/hq/energy/ExecOrderS-3-05.htm> .

<sup>11</sup> Air Resources Board, “California Greenhouse Gas Emissions Inventory: 2000-2009,” December 2011, p. 3, [http://www.arb.ca.gov/cc/inventory/pubs/reports/ghg\\_inventory\\_00-09\\_report.pdf](http://www.arb.ca.gov/cc/inventory/pubs/reports/ghg_inventory_00-09_report.pdf) .

<sup>12</sup> Air Resources Board, December 2008, op. cit., p. 11.

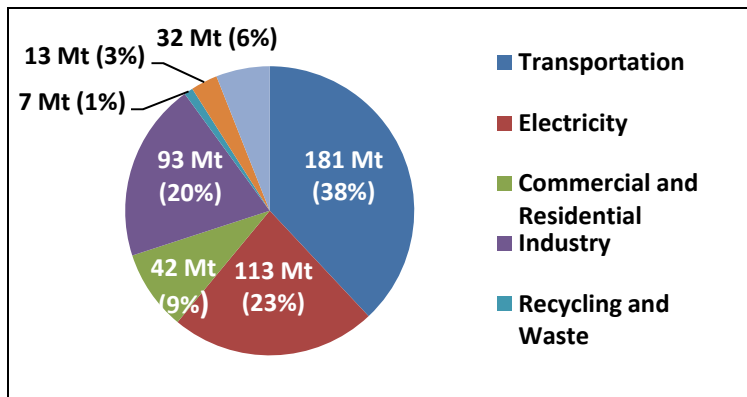
<sup>13</sup> Emissions from the commercial sector, high-GWP gases and agricultural activities were estimated to account for the large majority of remaining emissions. See Air Resources Board, “Climate Change Scoping Plan: A Framework for Change,” December 2008, p. 17, [http://www.arb.ca.gov/cc/scopingplan/document/adopted\\_scoping\\_plan.pdf](http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf).

<sup>14</sup> ARB, 2008, op. cit., p. 12.

<sup>15</sup> Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan, Staff Report to the Air Resources Board,” March 24, 2010, [http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated\\_sp\\_analysis.pdf](http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf). Air Resources Board, p. ES-3.

<sup>16</sup> Air Resources Board, “California GHG Emissions – Forecast (2008-20), October 28, 2010, [http://www.arb.ca.gov/cc/inventory/data/tables/2020\\_ghg\\_emissions\\_forecast\\_2010-10-28.pdf](http://www.arb.ca.gov/cc/inventory/data/tables/2020_ghg_emissions_forecast_2010-10-28.pdf) .

These changes mainly reflected the effects of the severe recession between 2007 to 2009, and the inclusion of two key CPs in the baseline (the “Pavley I” GHG performance standards for light-duty vehicles, and the 20% Renewable Portfolio Standard (RPS) target for 2010).



**Figure 1**  
**California Average Annual GHG Emissions by Sector (2002-04)**

The ARB also determined that the State’s 1990 GHG emissions equaled 427 Mt. Thus, achieving the AB-32 emission target would have required GHG emission reductions of 169 Mt (i.e., 596Mt – 427Mt = 169 Mt) – approximately 30% below the 2020 BAU estimate.<sup>17</sup> The revisions in the 2020 emissions forecast had the effect of reducing needed emission reductions to comply with the 2020 target from 169 Mt (based on the 596 Mt BAU estimate) to 98 Mt (based on the 525 Mt estimate) to 80 Mt (based on the 507 Mt estimate). Figure 2 illustrates these changes. **Based on this, only 80 Mt of GHG emission reductions would be required to achieve the 2020 GHG emissions target.**<sup>18</sup>

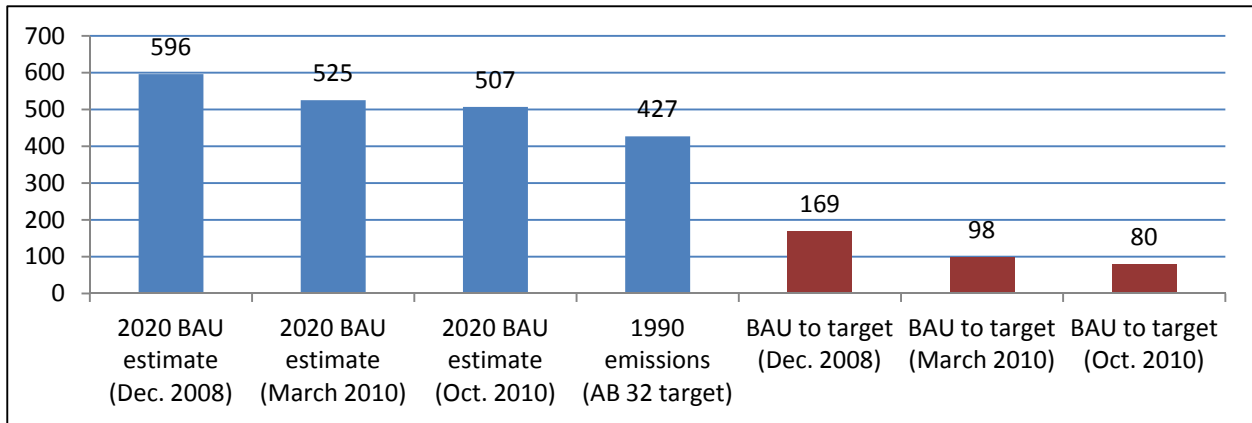
Significantly, the revisions to 2020 BAU emissions mean that CPs will play a more important role in achieving the fixed statewide target. As shown in Figure 3, the most current ARB analysis of the SP assumes the CPs will achieve 62 Mt, or 78% of the 80 Mt of emission reductions required to achieve the target.<sup>19</sup>

CPs designed to achieve reductions from sectors covered by the cap-and-trade program are estimated to achieve 49 Mt of reductions. CPs designed to achieve reductions from sectors not covered by the cap-and-trade program are estimated to achieve 13 Mt of reductions. This implies **the cap-and-trade program would account for just 22.5% of the GHG emissions reductions required to close the gap between 2020 BAU emissions and the AB-32 emissions target.** A more precise estimate of emission reductions, taking multiple factors into account, follows.

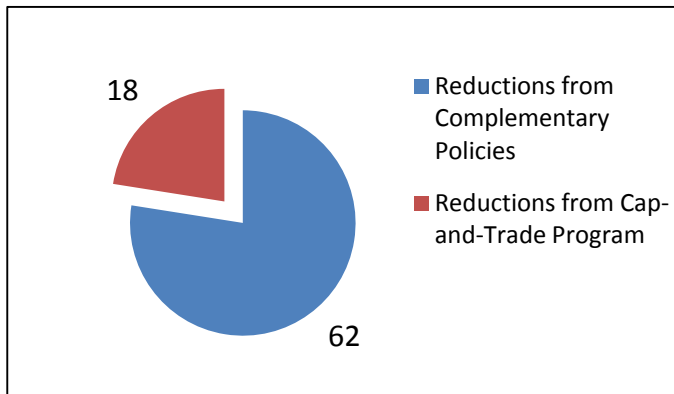
<sup>17</sup> ARB, December 2008, op. cit., p. 12..

<sup>18</sup> Air Resources Board, “Status of SP Recommended Measures,” July 2011, [http://www.arb.ca.gov/cc/scopingplan/status\\_of\\_scoping\\_plan\\_measures.pdf](http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf).

<sup>19</sup> Air Resources Board, July 2011, op. cit.



**Figure 2**  
**Evolution of ARB's Estimates of 2020 BAU emissions and Emission Reductions (MtCO<sub>2</sub>e)**



**Figure 3**  
**Estimated Emission Reductions in 2020 by CPs and by Sectors Covered by Cap-and-Trade Program (MtCO<sub>2</sub>e)**

## II. OVERVIEW OF CALIFORNIA'S CAP-AND-TRADE PROGRAM

The GHG emissions cap-and-trade program is one of the key programs included in the SP. The SP estimated that the cap-and-trade program would achieve 34.4 Mt of reductions in 2020.<sup>20</sup> By July 2011, ARB had adjusted this figure down to 18 Mt reductions in 2020, based on a significantly lower emissions baseline, and revisions in estimated reductions from CPs.<sup>21</sup>

The overall levels of abatement necessary to achieve the fixed emissions cap in the cap-and-trade program will depend on the performance of the CPs in achieving estimated emissions reductions, whether allowances used to fund an Allowance Price Containment Reserve (APCR) are used,

<sup>20</sup> Air Resources Board, December, 2008, op. cit., p. 22.

<sup>21</sup> Air Resources Board, "Attachment D, Final Supplement to the AB 32 Scoping Plan, Functional Equivalent Document, released August 19, 2011, considered at the August 24, 2011 Board Hearing, Modified Text (Clean Copy)," p. 21, [http://www.arb.ca.gov/cc/scopingplan/document/final\\_supplement\\_to\\_sp\\_fed.pdf](http://www.arb.ca.gov/cc/scopingplan/document/final_supplement_to_sp_fed.pdf).

and the level of offset supply and other factors. A very brief description of key elements of CA's GHG cap-and-trade program follows.

### Coverage and Point of Regulation

The CA cap-and-trade program is "economy-wide," and when it is fully implemented in 2015 it will cover 85% of the State's emissions, including direct emissions from 600 facilities operated by 350 businesses<sup>22</sup> in the power and industrial sectors, and emissions from the combustion of fuels in the industrial, commercial, residential and transportation sectors. The emissions of in-state electric generation facilities and industrial facilities emitting more than 25,000 Mt per year are covered downstream beginning on January 1, 2013.<sup>23</sup>

The program also has adopted an approach to regulate so-called *First Jurisdictional Deliverers* of electricity, which means that imports of electricity from power plants located outside of the State that contribute more than 25,000 Mt also will be covered at that time.<sup>24</sup>

In addition, the program regulates emissions from fuel combustion. Emissions from industrial, commercial and residential fuel combustion and transportation fuels (e.g., propane, heating oil, natural gas) will be regulated starting January 1, 2015. Commercial and residential fuel combustion and transportation fuels will be regulated where the fuel enters into commerce.<sup>25</sup> Industrial fuel combustion will be regulated upstream.

### The Emissions Cap and Compliance Periods

The cap-and-trade program includes three compliance periods: CP1 (2013-2014); CP2 (2015-2017); and, CP3 (2018-2020), as shown in Figure 4.

The BAU GHG emissions in 2020 for sectors covered by the trading program are estimated to be approximately 409 Mt in 2020. The *gross cap* – i.e., the total amount of allowances issued – for the covered sectors will be 334 Mt in 2020.<sup>26</sup> The 2020 *net cap* is approximately 311 Mt. This results from subtracting 23 Mt of allowances in 2020 to fund the APCR.<sup>27</sup> **Thus, covered sectors would need to reduce emissions in 2020 by 75 Mt to meet the gross cap and 98 Mt to meet the net cap.**

### Allowance Allocation

Allowances generally are allocated for free at the beginning of the program, with an increased proportion to be auctioned as implementation of the program progresses. The allocation of

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<sup>22</sup> Air Resources Board, "Overview of ARB Emissions Trading Program," revised October 20, 2011, [http://www.arb.ca.gov/newsrel/2011/cap\\_trade\\_overview.pdf](http://www.arb.ca.gov/newsrel/2011/cap_trade_overview.pdf); Air Resources Board, "Climate Change SP Appendices, Volume I: Supporting Documents and Measure Detail, Appendix C: Sector Overviews and Emission Reduction Strategies," December 2008, p. C-16, [http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).

<sup>23</sup> Air Resources Board, "Climate Change SP Appendices, Volume I, Appendix C," December 2008, op. cit., p. C-15.

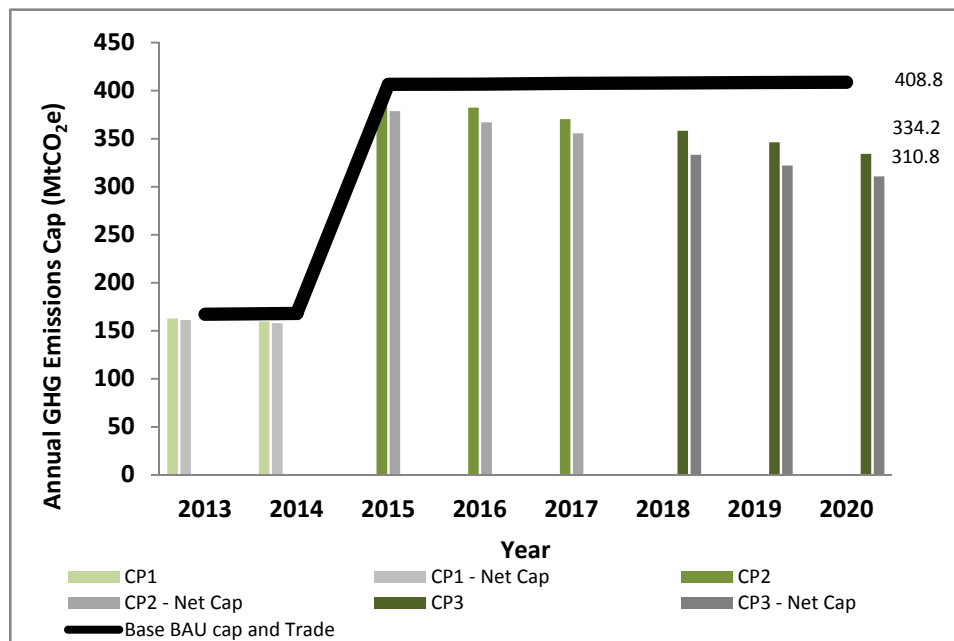
<sup>24</sup> Ibid, p. 2.

<sup>25</sup> Ibid, p. C-15.

<sup>26</sup> Air Resources Board, "California GHG Emissions – Forecast (2008-20), October 28, 2010, [http://www.arb.ca.gov/cc/inventory/data/tables/2020\\_ghg\\_emissions\\_forecast\\_2010-10-28.pdf](http://www.arb.ca.gov/cc/inventory/data/tables/2020_ghg_emissions_forecast_2010-10-28.pdf).

<sup>27</sup> Subchapter 10 Climate Change, Article 5, Section 95913, <http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf>.

emissions allowances to the electric utility, industrial, and refinery participants are calculated differently as described briefly below.



**Figure 4**  
**California CO<sub>2</sub> Gross and Net Emission Caps for Compliance Period (CP) 1, 2 and 3 (2013-20).**

Electricity distribution utilities (EDUs) are provided 90% of their expected allowance needs for free in 2012 for the benefit of their customers,<sup>28</sup> declining to 85% in 2020.<sup>29</sup> These allowances will be sold in quarterly auctions along with other allowances being auctioned by the State. In contrast, free allocations to Publicly Owned Utilities (POUs) may be used for compliance, and are not required to be auctioned. Independent Power Providers (IPPs) are allocated zero free allowances in the program, and must purchase all needed allowances at auction or in the market.

Each industrial facility’s allowance allocation is calculated based on three variables: (i) facility-specific product output or energy consumption; (ii) a cap adjustment factor based upon the sector to which the facility belongs; and (iii) an assessment of the sector’s “leakage risk.” The leakage risk factor is designed to protect industries whose competitors outside of the State do not face similar requirements to reduce their GHG emissions.

Oil refiners’ allocations for the first compliance period are based on one of two methods. The two methods are based upon whether or not the facility has an energy intensity index. For the most part, allowances are provided for free at the beginning of the program, with a higher percentage being auctioned as the program moves forward.

<sup>28</sup> Ibid, pp. 119-120; Air Resources Board, “Appendix A: Staff Proposal for Allocating Allowances to the Electric Sector,” 2011, op. cit., p. 5.

<sup>29</sup> Air Resources Board, “Appendix A: Staff Proposal for Allocating Allowances to the Electric Sector,” 2011, p. 1, <http://www.arb.ca.gov/regact/2010/capandtrade10/candtappa2.pdf>.



## Allowance Trading

Emissions allowances can be freely traded by both covered entities and non-covered entities subject to rules and various limits, including holding limits.

## Banking, Borrowing and Holding Limits

Covered entities in the cap-and-trade program are permitted to bank excess allowances and use them for future years' compliance. However, the ability to bank allowances is subject to various restrictions, and is likely to be severely limited by allowance *holding limits*. These limits apply to companies and "corporate associations," not to individual facilities. Moreover, the quantitative holding limits are the same for all companies regardless of their size or compliance obligation.

## Linking

Currently, California is in the process of linking its program with Quebec's recently adopted GHG cap-and-trade program, and there have been preliminary discussions about linking the CA program with Australia's recently adopted GHG cap-and-trade program.

## Allowance Auctions

Allowances that are not allocated to electric companies and industrial emitters are to be auctioned by the State in quarterly auctions. Allowances from previous, current and future compliance years may be sold in each auction. There is an administratively established floor price of \$10 for 2013 allowances purchased at auction in 2012, increasing 5% plus the rate of inflation annually thereafter.<sup>30</sup>

To date, the ARB has held two GHG allowance auctions. On November 14, 2012, the ARB sold approximately 23 million 2013 vintage allowances at a market price of \$10.09 per allowance and approximately 5.5 million 2015 allowances at the administrative price floor of \$10/tCO<sub>2</sub>e.<sup>31</sup> On February 19, 2013, the ARB sold approximately 13 million 2013 vintage allowances at a market price of \$13.62 per allowance, and approximately 4.4 million 2015 allowances at the administrative price floor of \$10.71/tCO<sub>2</sub>e.<sup>32</sup>

## Allowance / Compliance Instrument Surrender

Each covered entity is required to surrender compliance instruments (allowances and/or offsets) annually equal to 30% of its previous year's emissions, and to submit compliance instruments equal to their total emissions for each compliance period by November 1 of the year following the end of the compliance period.<sup>33</sup> For CP1, covered entities must surrender compliance instruments equal to their 2013 and 2014 emissions by November 1, 2015. For CP2, covered

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<sup>30</sup> Subchapter 10 Climate Change, Article 5, Subarticle 10, op. cit.

<sup>31</sup> California Air Resources Board, California Environmental Protection Agency, "Quarterly Auction 1," [http://www.arb.ca.gov/cc/capandtrade/auction/november\\_2012/auction1\\_results\\_2012q4nov.pdf](http://www.arb.ca.gov/cc/capandtrade/auction/november_2012/auction1_results_2012q4nov.pdf).

<sup>32</sup> California Air Resources Board, California Environmental Protection Agency, "Quarterly Auction 2," [http://www.arb.ca.gov/cc/capandtrade/auction/february\\_2013/auction2\\_feb2013\\_summary\\_results\\_report.pdf](http://www.arb.ca.gov/cc/capandtrade/auction/february_2013/auction2_feb2013_summary_results_report.pdf).

<sup>33</sup> Air Resources Board, "Cap-and Trade Regulation Instructional Guidance: Chapter 1: How Does The Cap-and-Trade Program Work?" September, 2012, p. 17, <http://www.arb.ca.gov/cc/capandtrade/guidance/chapter1.pdf>; Subchapter 10 Climate Change, Article 5, Section 95856 subsections (a) to (g), op. cit.



entities must surrender compliance instruments equal to its emissions in the 2015-2017 period by November 1, 2018. And, for CP3, covered entities must surrender compliance instruments to cover the 2018-2020 period by November 1, 2021. Offsets submitted cannot exceed 8% of total compliance in any compliance period.

### **Non-compliance**

If there is a shortfall in the amount of compliance instruments that regulated firms surrender to ARB, or if they are late in providing the allowances or offsets to ARB, compliance entities must surrender four allowances for every ton of emissions that was not covered in time.<sup>34</sup>

Subsequently, ARB will retire one of these allowances for compliance purposes and transfer three allowances to the APCR.

### **Offsets**

Covered entities are permitted to use offsets to comply with 8% of their compliance obligation.<sup>35</sup> Based on this, a total of 218 MtCO<sub>2e</sub> of offsets are allowed to be used for compliance between 2013 and 2020. Currently, the use of offsets is restricted to offset projects that utilize four ARB approved offset protocols: forestry, urban forestry, animal waste (aka dairy) digesters, and projects which destroy ozone depleting substances (ODS). Recently, the ARB has undertaken development of two new protocols, coal mine methane (CMM) destruction and methane destruction in rice production, and ARB has indicated it intends to consider development of a nutrient management protocol to reduce nitrous oxide emissions in crop production in the future.

### **Allowance Price Containment Reserve (APCR)**

In an effort to contain potential spikes in future allowance prices, the program includes an APCR. The APCR is “funded” by withholding 1% of allowances from auctions in 2013-2014, 4% in the years 2015-2017, and 7% in the years 2018-2020.<sup>36</sup> In addition, any current year allowances that fail to sell in the annual auctions can be added to the APCR.

Allowances contained in the APCR only can be purchased by entities with compliance obligations. Beginning in 2013, these entities can purchase allowances from the APCR at three predetermined price levels – \$40, \$45, and \$50 – for three equal-sized tranches of allowances. These sales will take place six weeks after each quarterly auction, and APCR allowances offered for sale will increase in price by 5% annually plus the rate of inflation thereafter.

### **Emissions cap and compliance periods**

In the SP, ARB originally projected the State’s total 2020 BAU emissions would be 596 Mt. The BAU emissions for the covered sectors were estimated to be 512 Mt, and the 2020 emissions cap was set at 365 Mt.<sup>37</sup> This would have required 147 Mt of emissions reductions, or approximately 15% below BAU estimates.

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<sup>34</sup> Air Resources Board, October 20, 2011, op. cit.

<sup>35</sup> Air Resources Board, October 20, 2011, op. cit.

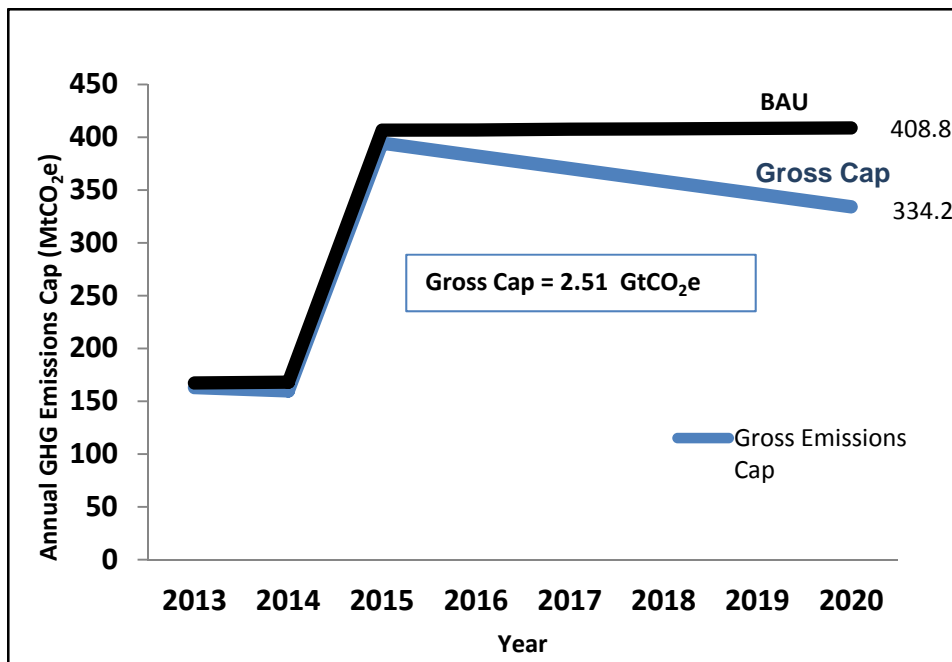
<sup>36</sup> Subchapter 10 Climate Change, Article 5, Section 95913, op. cit.

<sup>37</sup> Ibid, p. C-17.

In October 2010, ARB reduced its estimated 2020 emissions baseline to 507 Mt, and its BAU estimate for the covered sectors to 409 Mt.<sup>38</sup> These figures have been cited in subsequent ARB documents, and have not been revised in any public documents since October 2010. Importantly, the 409 Mt estimate does not include estimated emission reductions from CPs.

The program includes a declining cap in three compliance periods from 2013 to 2020. The program initially planned to start in 2012, but was delayed until 2013. As such, the first compliance period began on January 1, 2013 and will end on December 31, 2014. Emissions will be reduced 2% per year from a 2012 baseline. The CP2 and CP3 are each three years long, and will run from 2015-2017 and 2018-2020 respectively. The cap will decline by approximately 3% per year from 2015 to 2020 from the 2012 baseline.<sup>39</sup> In the first period, the program covers emissions from the power and industrial sectors (“narrow scope” emissions). Starting in 2015, the program expands to include transportation emissions (“broad scope” emissions).

As shown in Figure 5, the emissions cap for covered sectors in 2020 is 334 Mt, and the *cumulative* emissions cap for the period 2013-20 is 2.51 gigatonnes (Gt) CO<sub>2</sub>e. This cap may be referred to as the “*gross cap*,” to distinguish it from the “*net cap*,” which is more stringent, and refers to the gross cap minus the allowances placed into the APCR. **To meet the gross cap, covered sectors must reduce their emissions from 409 Mt to 334 Mt in 2020, or 75 Mt.** This is the level of emission reductions that must be achieved – through a combination of reductions under the cap-and-trade program and from CPs – if the allowances in the APCR are fully used.

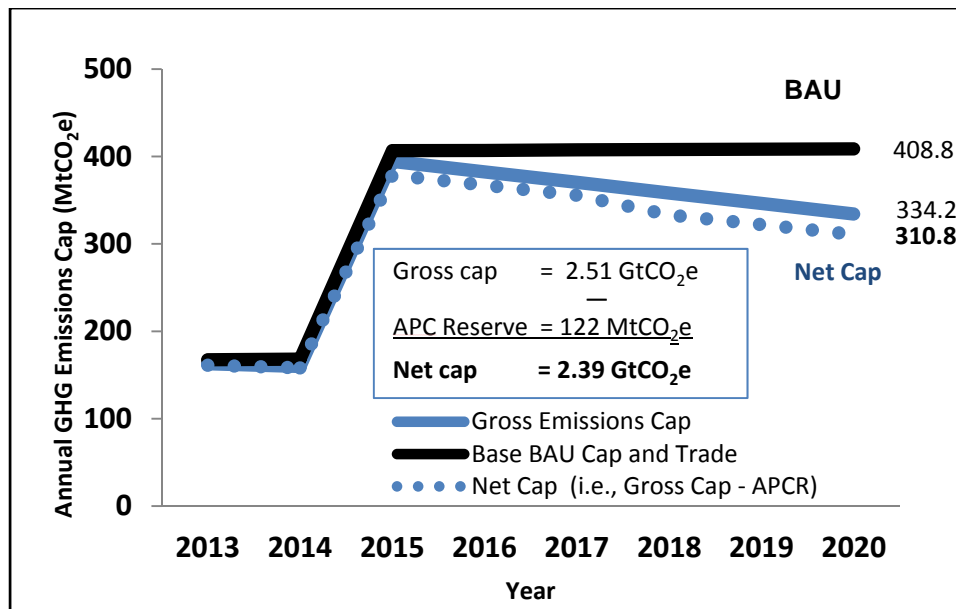


**Figure 5**  
California CO<sub>2</sub> Emissions BAU and Emissions-to-Gross Cap 2013-20

<sup>38</sup> Air Resources Board, “California GHG Emissions – Forecast (2008-20), October 28, 2010, op. cit.

<sup>39</sup> Air Resources Board, October 20, 2011, op. cit.

As illustrated in Figure 6, the APCR has the effect of reducing the GHG emissions cap for each year 2013-2020. For example, in 2020 the *gross* amount of emissions allowances available for compliance is 334 MtCO<sub>2</sub>e, and 23 Mt of allowances will be placed in the APCR. Once the allowances used to fund the APCR have been removed, the *net* emissions allowance budget for 2020 is reduced by 23 MtCO<sub>2</sub>e to 311 MtCO<sub>2</sub>e. If prices do not trigger the use of the APCR, covered sectors must meet the net cap, and reduce their emissions by 98 Mt, from 409 Mt to 311 Mt. Over the entire term of the program from 2013-2020, the gross emissions budget is 2,509 MtCO<sub>2</sub>e. The net cap after removing 122 Mt of allowances is 2.39 GtCO<sub>2</sub>e, assuming no additional unsold allowances are added to it.



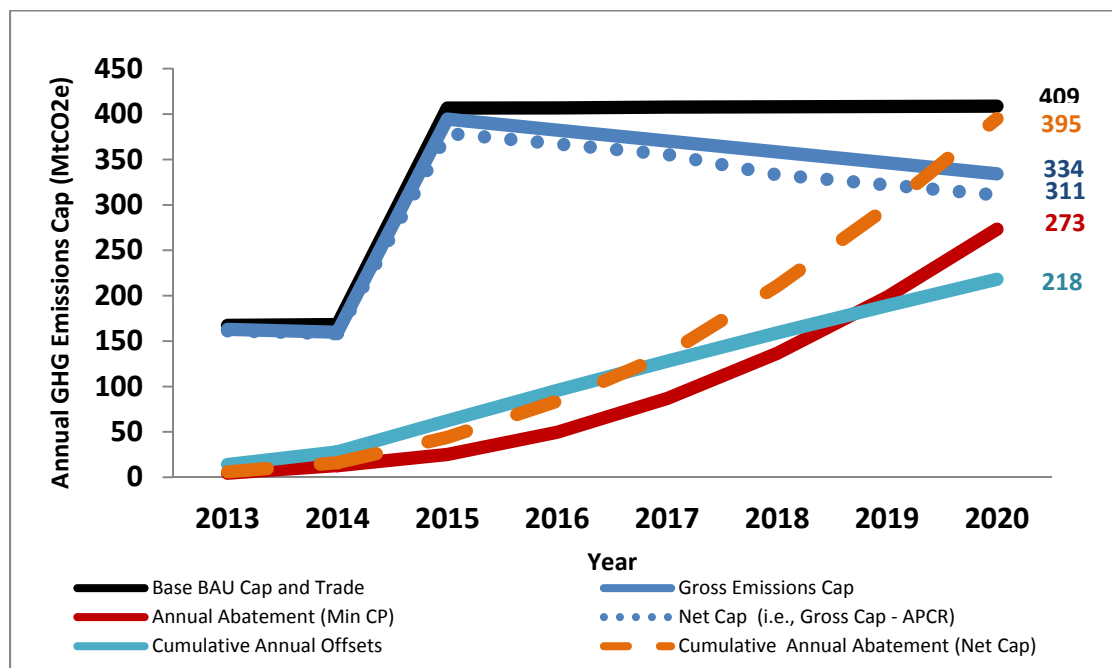
**Figure 6**  
**California CO<sub>2</sub> Emissions BAU and Emissions-to-Net Cap 2013-20**

If all allowances in the APCR are released into the market (i.e., the APCR is completely used) as a result of high allowance prices, the level of cumulative abatement covered sectors must achieve is 273 Mt – i.e., the cumulative gap in 2013-20 between BAU emissions and the gross cap, as shown in Figure 6.

Alternatively, if allowances prices remain below the APCR prices levels and the APCR is never used during the 2013-20 period, the amount of cumulative abatement in 2013-20 required to meet the net cap would grow to a total of 395 Mt, equal to 273 Mt to close the gap from BAU to the gross cap plus another 122 Mt to reduce the number of allowances to the level of the net cap, as shown in Figure 6.

As described above, a total of 218 Mt of offsets are allowed to be used for compliance purposes over the 2013-2020 time period. Assuming the total amount of allowable offsets are used for compliance during these years, offsets can be expected to comprise 55-80% of total abatement achieved under the cap-and-trade program as shown in Figure 7. If the APCR is never utilized and total abatement reaches 395 Mt as shown, than 218 Mt of offsets would comprise 55% of

overall abatement. Alternatively, if all of the APCR allowances are used for compliance, total abatement will be 273 Mt of which offsets could comprise 80% of this total.



**Figure 7**  
Cumulative Abatement in Covered Sectors and Role of GHG Offsets

### III. CALIFORNIA’S CAP-AND-TRADE PROGRAM AND COMPLEMENTARY POLICIES

California’s long experience developing and implementing environmental regulations and aggressive energy policies has shaped its views on the need for CPs, which can be seen in its policy rationales in the SP. It adopted building and appliance efficiency standards in the 1970’s, and legislation creating an RPS in 2002. California’s passage of legislation in 2002 to address GHG emissions from personal transport (i.e., light-duty cars and trucks) was the first such policy adopted in the United States. Fourteen other states followed CA’s lead, and the program influenced the national effort to target GHG emissions from personal transport.

The SP includes a discussion of the policy rationales and economic, environmental and public health benefits of the CPs. In addition, with respect to GHG emissions, language in the SP emphasizes not just the 2020 GHG emission reduction target included in AB 32, but also Executive Order 3-05’s long-term goal of reducing GHG emissions 80% below 1990 levels by 2050.<sup>40</sup> Achieving the 2050 target will require a comprehensive, sustained effort that transforms key emitting sectors of the economy, such as power generation and transportation. Policies will need to be adopted that enable the development and commercialization of technologies that are not yet in widespread use. In an attempt to do so, policies included in the SP set far-reaching

<sup>40</sup> Air Resources Board, December, 2008, op. cit., pp. ES-8 - ES-14.

goals for energy efficiency, renewable energy and the development and deployment of non-emitting vehicles for personal transportation. As such, it is clear that the State's goal was not solely to create a climate change program capable of achieving its near-term targets at the lowest possible societal costs, but also to specific policy measures to be achieved in key sectors of the economy.

Some observers support a cap-and-trade program to limit GHG emissions because they believe it will address the market failure, or externality of the free venting of GHG emissions into the atmosphere by allowing the market to set a price on them. Some also support a cap-and-trade program over other policy approaches because they believe it will achieve climate policy objectives in the most economically efficient manner and at the lowest possible economic cost. Those with these views argue that once regulated firms' emissions are constrained by an emissions cap, they will seek out the lowest cost approaches to complying with the cap, whether it be buying emissions rights in the market place, or investing in activities such as energy efficiency or renewable energy which will reduce emissions within their own assets while achieving other important public policy objectives. Those supportive of cap-and-trade as the best approach to limiting emissions may believe that adding complementary policies to a cap-and-trade system will increase costs of by limiting the flexibility in the program.<sup>41</sup>

Others believe that CPs are needed along-side of a cap-and-trade-program to stimulate greater levels of energy efficiency, increase development of renewable energy and induce higher levels of fuel economy in the transportation sector to achieve climate policy and other objectives such as energy security, lower criteria pollutants and other co-benefits.

Although the discussion over cap-and trade programs and CPs tends to be characterized as "either-or" in the climate policy debate, most governmental programs around the world that have been developed to limit GHG emissions to achieve climate policy objectives typically employ a hybrid of both approaches.

## **Overview of Key Complementary Policies**

The CPs included in the SP are designed to achieve emission reduction in sectors covered by the cap-and-trade program (e.g., power, transportation and industrial sectors), and uncapped sectors (e.g., high-GWP gases). The CPs targeting emissions in *covered* sectors are estimated to achieve 49 Mt of reductions, and those targeting emissions in uncapped sectors are designed to achieve 13 Mt.<sup>42</sup> The performance of CPs targeting covered sector emissions is one of the key variables that will determine the level of emission reductions that covered sectors must achieve to comply with the fixed cap, and price of allowances in the program. Under-performance of these policies will result in higher emissions in covered sectors, requiring greater emission reductions to meet

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<sup>41</sup> See Ann E. Carlson, "Designing Effective Climate Policy: Cap-and-Trade and Complementary Policies," Harvard Journal on Legislation, volume 49, 2012, [http://www.harvardjoi.com/wp-content/uploads/2012/08/Carlson\\_Article.pdf](http://www.harvardjoi.com/wp-content/uploads/2012/08/Carlson_Article.pdf) ; Charles River Associates, "Analysis of the California ARB's SP and Related Policy Insights, March 2010, pp. 10-12, <http://crai.com/uploadedFiles/analysis-of-ab32-scoping-plan.pdf> ; and, Todd Schatzki (Analysis Group, Inc.), Robert N. Stavins (Harvard University), "Using the Value of Allowances from California's Cap-and-Trade System," Analysis Group Inc., August 27, 2012, p. 14, <http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Value-Allowances-California-GHG-Cap-Trade-System.pdf> .

<sup>42</sup> Air Resources Board, July 2011, op. cit.

the fixed cap under the cap-and-trade program. This will result in higher allowance prices. Below is a brief description of some of the key CPs included in the SP.

- **Renewable Portfolio Standard** – An RPS requires retail sellers of electricity to source a specified percentage of their generation portfolios from qualified renewable sources. California first passed an RPS in 2002. The current RPS is 33%, and ARB estimates it will achieve 11 Mt of GHG reductions in 2020, beyond the reductions to be achieved by the 20% RPS mandate previously in force.
- **Transportation Sector Programs** – The programs targeting transportation emissions include two phases of vehicle GHG emission standards (i.e., Pavley standards), and a Low Carbon Fuel Standard (LCFS). The Phase 1 Pavley standards, which were signed into law in 2002, target GHG emissions for model years 2009-2016, and are estimated to achieve approximately 26 Mt of reductions. These reductions are incorporated in the 2020 emissions baseline. Phase 2 of the Standards target GHG emissions from model years 2017-2025, and are estimated to achieve 3.8 Mt of reductions in 2020. The LCFS is designed to reduce the carbon intensity of CA's transportation fuels by at least ten percent by 2020. It applies to all transportation fuel providers in CA, and establishes two separate standards for gasoline and diesel fuel.<sup>43</sup> The LCFS is estimated to achieve 15 Mt of annual reductions by 2020.
- **Energy Efficiency Programs** – California has utilized energy efficiency programs since the 1970's to achieve environmental and energy policy objectives. The CPs in the plan are estimated to achieve 12 Mt of reductions annually by 2020. They attempt to: (i) achieve zero net energy in new buildings; (ii) improve the energy efficiency of existing buildings; (iii) strengthen building codes and broaden appliance efficiency standards; (iv) improve the performance of IOU and POU efficiency programs; and (v) increase the use of combined heat and power (CHP).

### **Complementary Measures – Estimated Costs and GHG Emissions Reductions**

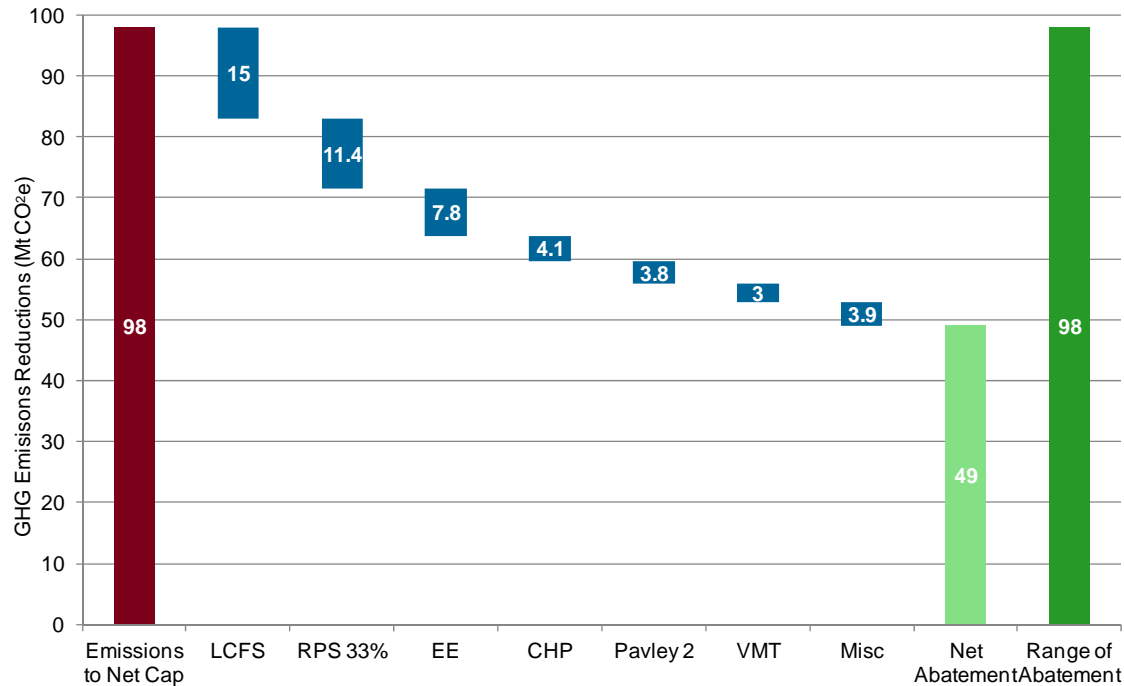
Based on the ARB's analysis, the CPs included in the SP can be expected to achieve 49 Mt of the 98 Mt needed to close the gap between the 2020 BAU emissions for the covered sectors and the 2020 net emissions cap, as shown in Figure 8. This means that if the CPs succeed in achieving emissions reductions as envisioned by the ARB, covered entities will only need to achieve 40 Mt of *net* abatement in the covered sectors or by using qualifying GHG emissions offsets.

Table 1 summarizes ARB's estimates of the costs and emission reductions associated with key complementary measures contained in the March 2010 economic analysis. In addition, Table 1 shows the estimated costs (\$/tCO<sub>2</sub>e) of reducing emissions based on each of the CPs. Based on these results, the largest sources of expected emission reductions among the CPs in 2020 are the 33% RPS (20 Mt)<sup>44</sup>, the LCFS (14 Mt), and energy efficiency programs (12 Mt).

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<sup>43</sup> Information in this paragraph derives from Air Resources Board, "California's Low Carbon Fuel Standard: Final Statement of Reasons," December 2009, p. 5, <http://www.arb.ca.gov/regact/2009/lcfs09/lcfsfor.pdf>.

<sup>44</sup> The 20 Mt estimate for the 33% RPS in the updated economic analysis considers only incremental reductions from increasing the RPS from 20% to 33%; this estimate later was further revised down to 11.4 Mt in ARB's July 2011 status update document.



**Figure 8**  
**Required GHG Emissions Reductions and Key Role of Complementary Policies in 2020**

Other emission reduction estimates also were revised in ARB’s July 2011 update, as discussed below. The estimated costs of these programs vary significantly. The RPS is the most expensive policy, costing an estimated \$5.5 billion in 2020. It is also the least cost-effective policy, with an estimated cost of \$277/tCO<sub>2</sub>e. Measures to increase the use of CHP are almost as expensive on a per-tonne basis, at \$274/tCO<sub>2</sub>e. Importantly, the \$277/tCO<sub>2</sub>e estimate for the RPS does not include the costs for any new transmission systems needed to meet a 33% RPS. The analysis cites a \$1.8 billion cost estimate made by the consulting firm E3 and the CPUC for new transmission facilities necessary to meet the 33% RPS.<sup>45</sup> Including this additional cost would increase the total estimated cost of the RPS.

ARB estimates that the economic costs associated with three key CPs – energy efficiency, Pavley II, and regional VMT reduction measures – are *negative*, as shown in Table 1. This implies that ARB expects these policies overall to provide economic *benefits* to the State. The estimated net cost for the VMT reduction program (-\$8.7 billion) is particularly striking, as it is sufficient to outweigh the positive economic costs of the RPS, the LCFS and CHP programs *combined*, resulting in a combined negative cost estimate of -\$1.7 billion, and an overall cost effectiveness of -\$106/tCO<sub>2</sub>e for the key CPs. Based on ARB’s analysis, this implies that these CPs provide \$1.7 billion in net benefits to the State and that the average cost of reducing a tonne of emissions is -\$106/tCO<sub>2</sub>e.

<sup>45</sup> See Air Resources Board, March 2010, op. cit., footnote 1 to Table 13, p. 37.



**Table 1**  
**ARB's Estimated Costs and Emission Reductions Associated with CPs in 2020** <sup>46</sup>

|  | 33% RPS <sup>1</sup> | Energy Efficiency <sup>2</sup> | Combined Heat and Power | Pavley II | Low Carbon Fuel Standard | Regional VMT Reduction Measures | Totals       |
|--|----------------------|--------------------------------|-------------------------|-----------|--------------------------|---------------------------------|--------------|
| Total GHG emissions Reduction (MtCO <sub>2</sub> e)                  | 20                   | 12                             | 5                       | 4         | 14                       | 5                               | <b>60</b>    |
| Fuel Expenditures (2007 M\$/Yr)                                      | 994                  | -4720                          | -864                    | -1722     | 1316                     | -1945                           |              |
| Annualized Investment and Operating Costs (2007 M\$/Yr) <sup>3</sup> | 4545                 | 1073                           | 2233                    | 279       | 512                      | -6736                           |              |
| Annual Economic Cost <sup>4</sup> (2007 M\$/Yr)                      | 5539                 | -3647                          | 1369                    | -1443     | 523                      | -8681                           | <b>-6340</b> |
| Total Cost/tCO <sub>2</sub> e (\$/tCO <sub>2</sub> e)                | 277                  | -304                           | 274                     | -361      | 131                      | -1736                           | <b>-106</b>  |

1. Costs do not include the cost of new transmission, estimated to be on the order of \$1.8 billion (\$2008) in 2020.
2. Costs include actual equipment upgrades associated with these efficiency gains, but not utility program and administration costs.
3. Capital costs are annualized over the lifetime of the investment using a 5 percent real-capital-recovery factor.
4. Totals are derived by the authors from estimates in Table 13 of ARB's March 2010 economic analysis, and did not take into account any rounding that ARB may have applied to those estimates.

ARB cautions that the economic analysis “does not compute an exact measure of economic impact” and that individual CPs that will require new regulations will be evaluated in separate economic analyses.<sup>47</sup>

### **Scenarios Which Will Affect California's Cap-and-Trade Program**

As noted above, if the 23 Mt of allowances set aside in the APCR are not used in 2020, covered sectors must reduce emissions by 98 Mt, from 409 Mt to 311 Mt, to meet the cap in the cap-and-trade system. What follows are a few scenarios that illustrate how the program will be affected by CP performance and levels of offset supply.

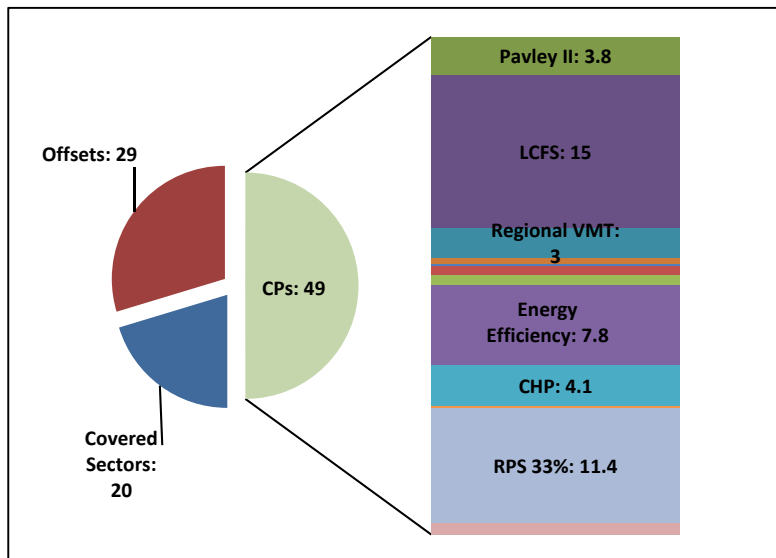
- **Scenario 1** – The program operates as intended;
- **Scenario 2** – CPs *under-perform* by 16 Mt, or 33%;
- **Scenario 3** – CPs *over achieve* by 7 Mt, or 115%; and,
- **Scenario 4** – CPs *under-perform* by 16 Mt and *offset supply is limited*.

Figure 9 illustrates how emission reductions from covered sectors in response to the program working as intended as described in Scenario 1. In Figure 9, it is assumed that covered sectors must reduce emissions from the BAU level of 409 Mt to the net cap of 311 Mt, or by 98 Mt

<sup>46</sup> Air Resources Board, March 2010, op. cit., Table 13, p. 37.

<sup>47</sup> Ibid, p. 5.

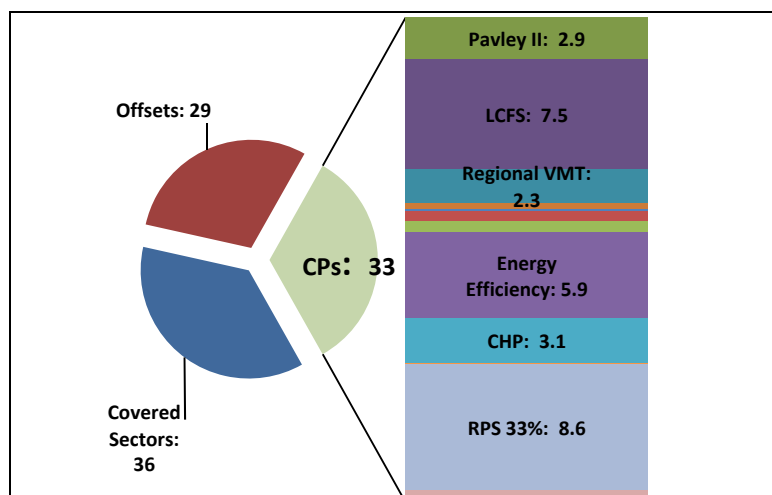
(i.e., it is assumed that the APCR is not used). In Scenario 1, CPs targeting covered sector emissions achieve their estimated level of emission reductions in 2020 – 49 Mt – and account for 50% of emission reductions by covered sectors. The maximum allowable volume of offsets consistent with the 8% offset usage limit – 29 Mt – is assumed to be available. **As shown, covered sectors under the cap-and-trade program then must achieve emissions reductions of 20 Mt, equal to approximately 20% of compliance.**



**Figure 9**  
**CPs Achieve Estimated Emission Reductions and Maximum Volume of Offsets Available (MtCO<sub>2</sub>e)**

Figure 10 illustrates how abatement in the cap-and-trade program may be impacted by the failure of CPs to achieve their estimated emission reductions, as described in Scenario 2. In this scenario, it is assumed that: (i) CPs targeting covered sector emissions achieve only 33 Mt of reductions, or two-thirds of ARB’s 49 Mt estimate; and, (ii) the maximum allowance volume of offsets (29 Mt) is available. In this circumstance, covered sectors must compensate for the shortfall in emission reductions from CPs, and increase their emission reductions from 20 Mt in the base case to 36 Mt, or by 80%.

The sharp increase in abatement in the cap-and-trade program could be expected to result in a potentially significant increase in allowance prices. As shown, the cap-and-trade program acts basically as a backstop, ensuring that the program’s hard cap is reached, even if CPs underperform. Here, CPs’ share of emission reductions declines to 34% from 50% in the base case, and covered sectors’ share increases from 20% in the base case to 37%. As discussed below, if available offset supply is lower than 29 Mt, covered sectors must further increase their level of emission reductions.



**Figure 10**  
**CPs Under-achieve, and Maximum Volume of Offsets is Available (MtCO<sub>2</sub>e)**

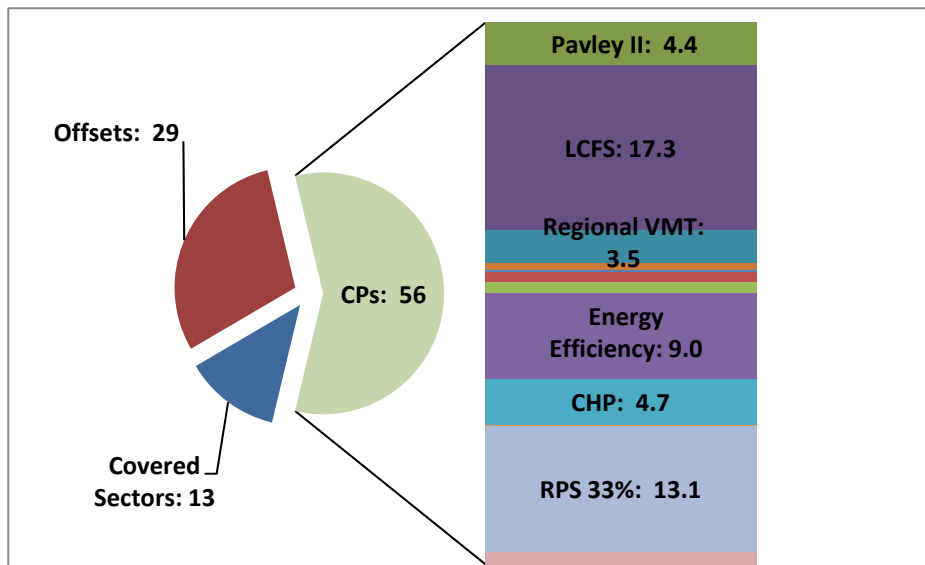
If complementary policies achieve emission reductions that *exceed* ARB’s estimates, the cap-and-trade program’s emission reduction requirements will decline. In Figure 11, CPs targeting covered sector emissions achieve 56 Mt of abatement, or 15% more than the 49 Mt estimated by ARB. If the maximum level (29 Mt) of offsets is available, covered sectors only would be required to reduce emissions by 13 Mt, which is 35% lower than the 20 Mt of abatement in the base case. The lower level of abatement likely would result in lower allowance prices. These trends would be further reinforced if economic and emissions growth were lower than forecast, or nuclear and hydroelectricity generation were higher than forecast. This would result in significant downward pressure on allowance prices, which may approach the auction price floor.

***Offset supply is significantly lower than the maximum allowed use limit***

**Existing analyses of expected cumulative offset supply from 2013-20 range from 66 Mt to 140 Mt, which is far below the 218 Mt maximum use limit for the period.** For example, the American Carbon Registry (ACR) estimates that there will be a 67% (134 Mt) shortage of offsets by 2020 if demand reaches the offset use limit. The ACR estimates the maximum allowable usage limit at just over 200 Mt. The 67% shortage estimate is based only on the four existing offset protocols, and implies a cumulative supply of approximately 66 Mt (i.e., 200 Mt – 134 Mt). Other estimates of supply include Barclay’s<sup>48</sup> (140 Mt, based on existing protocols) and Point Carbon Thomson Reuters<sup>49</sup> (89.5 Mt, based on existing protocols, to 121 Mt, assuming the addition of CMM, rice management, and nutrient management in agriculture).

<sup>48</sup> Winrock International/American Carbon Registry, “Compliance Offset Supply Forecast for California’s Cap-and-Trade Program (2013-2020),” September 2012, <http://americancarbonregistry.org/acr-compliance-offset-supply-forecast-for-the-ca-cap-and-trade-program>.

<sup>49</sup> Barclay’s Capital, “Carbon Flash, California: Still dreaming,” October 21, 2011, and Point Carbon Thomson Reuters, “Carbon price forecast: Still need more offsets,” Olga Chistyakova, presentation at IETA’s Carbon Forum North America, October 2, 2012, <http://ietacarbonforum.org/2012/wp-content/uploads/2012/10/Chistyakova-CFNA2012.pdf>.



**Figure 11**  
**CPs Over-achieve, and the Maximum Volume of Offsets is Available (MtCO<sub>2</sub>e)**

Based on these estimates, offset supply could be far lower than the usage limit if ARB does not approve new protocols that can generate significant additional supply, and if allowance prices are not high enough to bring large volumes of forestry and other offsets into the market. According to ARB’s modeling, the availability of offsets is a key determinant of allowance prices. For example, ARB’s Case 1 and Case 2 (see below) both assume that CPs achieve their emission reduction targets, but Case 1 assumes full use of offsets and Case 2 assumes no offsets are used for compliance. In Case 2, allowance prices increase to \$106/tCO<sub>2</sub>e from \$21 in Case 1.

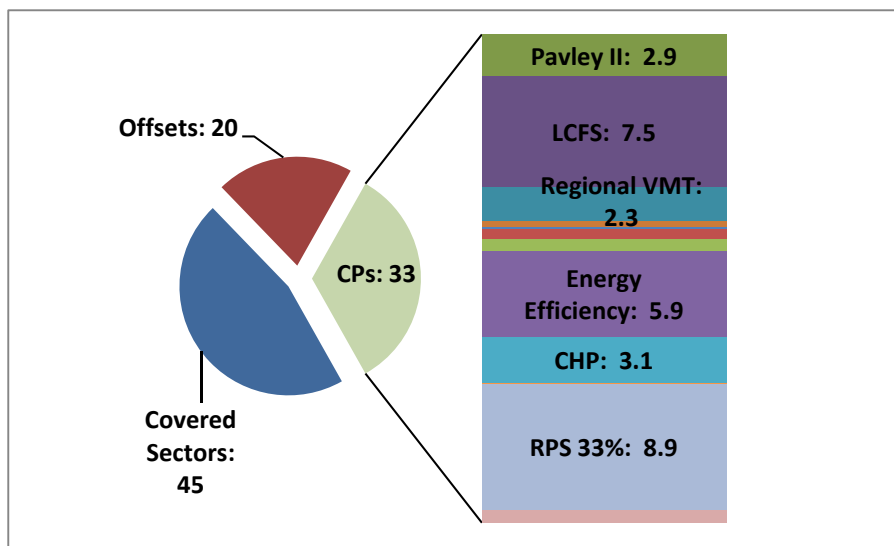
Figure 12 illustrates how a combination of lower-than-expected emission reductions from CPs and limited offset supply would impact the level of emission reductions that the cap-and-trade program must achieve. In this scenario, CPs deliver 33 Mt of abatement, as assumed in Scenario 2 (Figure 9), but only 20 Mt of offsets are available, rather the maximum of 29 Mt. This would force covered sectors to increase abatement from 20 Mt in Scenario 1 to 45 Mt, or 126%. This sharp increase in covered sector emission reductions likely would put significant upward pressure on allowance prices. If prices reached levels triggering the use of the APCR, the release of allowances into the market could mitigate the price increase.

***Offset supply is sufficient to meet the offset use limit***

If allowance prices are sufficiently high to attract large forestry offset projects to the market, supply could increase significantly. In addition, if ARB approves other offset protocols for project types with significant supply potential and with less dependence on higher allowance prices to incentivize investment, this will change market expectations.

***Economic and emissions growth is higher than forecasted***

This scenario could arise because the pace of the economic recovery is difficult to accurately predict, and future economic growth could be higher than estimated. Higher economic and emissions growth would result in higher allowance prices.



**Figure 12**  
**CPs Under-perform, and Offset Supply is Limited (MtCO<sub>2</sub>e)**

***Economic and emissions growth is lower than forecasted***

Some believe that even ARB’s revised 2020 BAU baseline of 507 Mt is too high because it was based on a report (the 2009 IEPR), which was said to have underestimated the duration of the recession. If BAU emissions prove to be lower than ARB’s forecast, fewer emission reductions will be required to meet the cap, and allowance prices will be lower than forecasted.

**Review of Economic Analyses of Complementary Policies in CA and their Impacts**

The ARB conducted an economic analysis on the impacts of the CPs included in the SP in March of 2010 (ARB, March 2010).<sup>50</sup> Charles River Associates (CRA) provided input to ARB on its economic analysis, prepared its own analysis, and concluded that the overall costs of implementing the SP would be higher than those estimated by ARB. The analyses conducted by ARB and CRA are described briefly below.

***Analysis by the California Air Resources Board (ARB)***

The ARB’s analysis concluded that implementation of measures in the SP, including the cap-and-trade program and the various CPs, will not adversely affect CA’s economic growth over the next decade, and would result in lower allowance prices than those estimated by CRA. The projected growth rate under BAU is expected to remain unchanged when SP measures are in place, mainly due to estimated savings in fuel expenditures.<sup>51</sup>

The ARB’s analysis concludes that the RPS, energy efficiency policies, CHP, Pavley II standards, the LCFS, and regional vehicle miles traveled (VMT) reduction measures collectively

<sup>50</sup> Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan, Staff Report to the Air Resources Board,” March 24, 2010, [http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated\\_sp\\_analysis.pdf](http://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf).

<sup>51</sup> Air Resources Board, March 2010, op. cit., p. ES-2.

achieve annual net savings of over \$6 billion in 2020.<sup>52</sup> These savings are derived primarily from large negative costs resulting from the implementation of regional VMT reduction measures, Pavley II standards and energy efficiency programs. The analysis concludes that the VMT reduction program is estimated to result in annual savings of more than \$8 billion.

The results from ARB's March 2010 analysis, while important, were based on assumptions that have since been revised. ARB has made further changes to its emissions baseline (from 525 Mt in the analysis to 507 Mt, as noted already), and increased the offset usage limit in the cap-and-trade program from the 4% limit assumed in the analysis to 8%.

The ARB also undertook a sensitivity analysis to explore how expected GHG allowance prices in the cap-and-trade program, and overall economic costs, might be impacted if CPs deliver fewer emission reductions than expected. ARB considered five different cases describe below, ranging from the CPs achieving 100% of estimated reductions to achieving 30% of estimated reductions.<sup>53</sup> When the CPs achieved estimated levels of reductions, allowance prices were far lower than in cases when they did not.

- **Case 1: *Cap-and-Trade with Offsets*** – Base case. All CPs shown in Table 1 achieve their emission reduction target by 2020);
- **Case 2: *Cap-and-Trade without Offsets*** – identical to Case 1, but with no use of offsets;
- **Case 3: *Transportation Policy Sensitivity with Offsets*** – the LCFS and Pavley II achieve 50% of their expected emission reductions, regional VMT reductions are excluded (i.e., they are absent from the analysis, and achieve zero reductions), and other CPs achieve their expected emission reduction targets;
- **Case 4: *Electricity and Natural Gas Sensitivity with Offsets*** – energy efficiency and CHP achieve 50% of their expected emission reductions, 33% RPS is excluded, and other measures achieve their targets; and,
- **Case 5: *Combined Sensitivity with Offsets*** – 33% RPS and regional VMT reduction are excluded, and other measures achieve one-half of their expected emission reductions.

ARB's analysis provides estimated allowance prices for each of these scenarios, and estimated cumulative emissions abatement from the CPs, the cap-and-trade program, and offsets from 2012-2020, as shown in Table 2.

### Cumulative GHG abatement

In Cases 1 and 2, CPs achieve their expected emission reductions, and account for 63% of cumulative abatement. In the other three cases, complementary measures do not achieve expected levels of emission reductions. In Case 3, in which policies targeting transportation sector emissions do not achieve their estimated level of reductions, the percentage of cumulative abatement associated with the CPs declines to 49%. This percentage decreases even further, to 42%, in Case 4, in which energy efficiency and CHP deliver only one-half of expected reductions, and the RPS delivers zero reductions.

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<sup>52</sup> Ibid, Table 13, p. 37.

<sup>53</sup> Ibid, pp. 35, 51.

**Table 2**  
**ARB's Estimates of Allowance Prices, Impact on Gross State Product, and Cumulative Abatement under Different Scenarios<sup>54</sup>**

|  | Case 1         | Case 2         | Case 3         | Case 4         | Case 5         |
|--|----------------|----------------|----------------|----------------|----------------|
| Allowance price in 2020 (\$/tCO <sub>2</sub> e)  | 21             | 106            | 40             | 87             | 102            |
| Gross State Product (% change from 2020 reference case)                                | -0.2%          | -0.9%          | -1.0%          | -0.8%          | -1.4%          |
| <b>Cumulative abatement, 2012-20 (MtCO<sub>2</sub>e) and % of cumulative abatement</b> |                |                |                |                |                |
| From CPs   | 319.2<br>(63%) | 319.2<br>(63%) | 234.1<br>(49%) | 202.3<br>(42%) | 136.8<br>(30%) |
| From reduced economic growth   | 4.1<br>(1%)    | 20.3<br>(4%)   | 23.9<br>(5%)   | 18.0<br>(4%)   | 32.3<br>(7%)   |
| From covered sources due to cap-and-trade  | 99.9<br>(20%)  | 170.0<br>(33%) | 118.0<br>(25%) | 166.7<br>(34%) | 180.1<br>(39%) |
| From offsets due to cap-and-trade  | 86.8<br>(17%)  | 0<br>(0%)      | 102.2<br>(21%) | 98.6<br>(20%)  | 111.0<br>(24%) |

In Case 5, transportation and electricity/natural gas-related policies both fail to perform as estimated in the Base Case, and the percentage of abatement associated with the CPs declines to 30% in this case. **In short, cumulative abatement from CPs declines from approximately 319 Mt in Case 1 to approximately 137 Mt in Case 5 – a decline of more than 180 Mt.** The abatement attributed to cap-and-trade ranges from 20% in Scenario 1 to 39% in Scenario 5. It increases from approximately 100 Mt in Case 1 to approximately 180 Mt in case 5.

Figure 13 illustrates how emission reductions from the cap-and-trade program and offsets adjust to changes in the performance of CPs targeting emissions in covered sectors. In Case 2, the prohibition on offset use results in a higher level of abatement from covered sectors than in Case 1. In Case 5, emission reductions from CPs decrease significantly, requiring covered sectors to increase their emission reductions under the cap-and-trade program. This additional burden, however, is shared with offsets. Emission reductions from offsets increase relative to Case 1, and are able to do so because offset use is not at the maximum level in Case 1.

### GHG emissions offsets

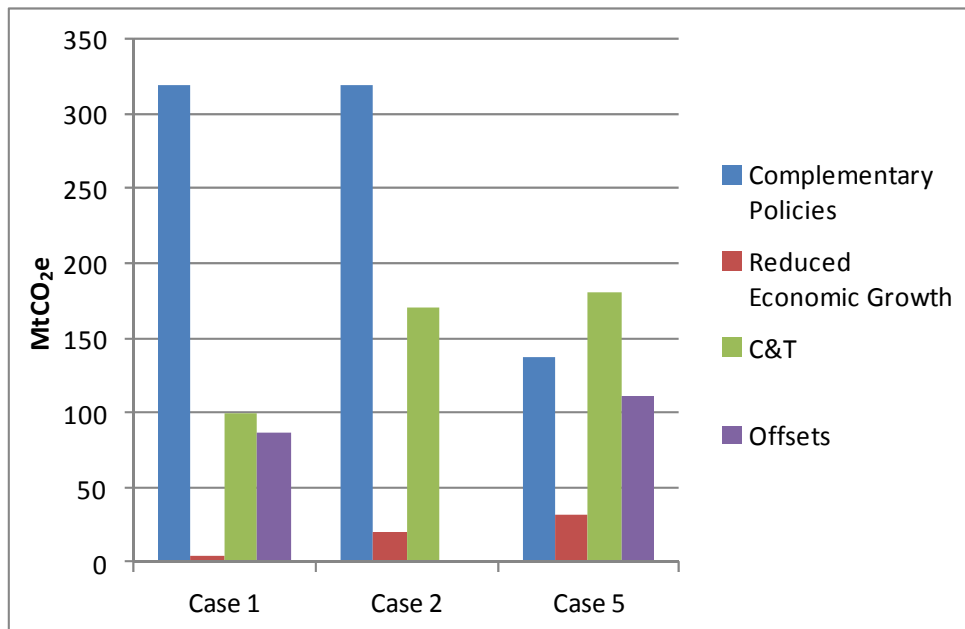
The estimates of offset use in ARB's March 2010 analysis are far lower than the 218 Mt offset use limit in the final cap-and-trade regulation because the analysis limited offset use to 49% of emission reductions below initial cap levels, as assumed in the December 2008 SP. ARB calculated that this limit theoretically could range from about 80 Mt to 120 Mt.<sup>55</sup> The offset use limit in the cap-and-trade program was later increased to *8% of each entity's compliance obligation*, or the equivalent of 218 Mt on a cumulative basis from 2013-20. As a result, the

<sup>54</sup> See Air Resources Board, March 2010, op. cit., Table 23, p. 51, and Table ES-2, p. ES-7.

<sup>55</sup> Ibid, p. 29.



ARB March 2010 analysis' estimates of offset use (in scenarios in which offset use is allowed) range from 86 Mt to 111 Mt.



**Figure 13**  
**Cumulative GHG Emission Reductions from CPs, Cap-and-Trade and Offsets,**  
**as shown in ARB's March 2010 Analysis**

In scenarios in which CPs fail to deliver their expected level of emission reductions, ARB estimates that offset use will increase. In Case 5, offset use rises to 24% of cumulative abatement, from 17% in Case 1. Offsets therefore are assumed to fill the void left by CPs that fail to achieve their estimated emission reductions, subject to the maximum offset use limit, and to the extent they are cost-effective and available. Regarding offset availability, ARB assumes that offsets will not be available at prices of \$8 or less in 2020. If offsets are not able to fill the void left by CPs that fail to achieve their estimated emission reductions, covered sources in the cap-and-trade would necessarily achieve more of the reductions required to meet the targets.

**In Case 2, which is identical to Case 1 with respect to performance of CPs but assumes no use of offsets, allowance prices increase to \$106 from \$21/tCO<sub>2</sub>e in Case 1 – a five-fold increase.** As noted above, ARB's analysis assumes an offset usage limit equal to 49% of the reductions from the cap, as originally proposed for the cap-and-trade program.<sup>56</sup> This limit translates to approximately 4% of a covered entity's compliance that can be addressed using offsets, or one-half of the 8% limit adopted in the final cap-and-trade regulation.<sup>57</sup> The incorporation of the (lower) 4% offset use limit in the updated economic analysis could produce an upward bias in its allowance price estimates – all else being equal – because the (higher) 8% offset use limit likely would have reduced the marginal cost of abatement in the cap-and-trade

<sup>56</sup> Ibid.

<sup>57</sup> Air Resources Board, "The Role of Offsets in Cap-and-Trade: Consideration of a Process for the Adoption of Offset Accounting Protocols for Compliance Purposes," presentation, February 25, 2010, p. 9, <http://www.arb.ca.gov/cc/capandtrade/meetings/022510/pres.pdf>.

program. However, as discussed in below, a number of analyses project that offset supply will fall far short of the 8% offset use limit. As a result, ARB's March 2010 assumptions on offset use could be relatively close to actual offset use, based on available supply estimates.

### GHG emissions allowance prices

**Table 2 illustrates that estimated allowance prices are likely to increase significantly if complementary measures do not deliver their expected levels of emission reductions, and the covered sources in the cap-and-trade program must achieve additional emissions reductions.** To illustrate this situation further, we can consider Case 5, in which the CPs achieve their lowest levels of emission reductions. Case 5 assumes that CPs achieve only 30% of cumulative emission reductions, compared to 63% in Case 1. In this case, the cap-and-trade program acts as the intended backstop for the overall program, and is required to effectively compensate for the shortfall in emissions reductions achieved by the complementary policies. This increases the cumulative emission reductions to be achieved from the cap-and-trade program from 100 Mt in Case 1 to 180 Mt in Case 5, resulting in an increase of the percentage of overall emissions reductions attributable to the cap-and-trade program from 20% to 39%. As a consequence of the additional emission reductions needed to be achieved in Case 5 under the cap-and-trade program, 2020 allowance prices are estimated to increase to \$102/tCO<sub>2e</sub> – approximately 5 times the \$21 allowance price estimated for Case 1.

As ARB noted in March 2010, “Successful implementation of the complementary measures has the effect of reducing emissions for sources covered by the cap-and-trade program, meaning that fewer emissions reductions need to be found through the cap-and-trade mechanism than would otherwise be the case. Less effective implementation of these measures results in a small negative effect on the economy both through increased allowance prices and through the lack of cost savings that derive from many of the complementary measures in the main policy case.”<sup>58</sup>

### **Analysis by Charles River Associates (CRA)**

Charles River Associates (CRA) also undertook a detailed analysis of various scenarios of CA's program,<sup>59</sup> although the scenarios they utilized are different than those used by ARB. As such, direct comparisons of ARB's and CRA's modeling results generally are not possible, with one exception. CRA did model a scenario in which the CPs achieved estimated levels of emission reductions, and offsets may be used for compliance. The analysis concluded that allowance prices would be \$52/tCO<sub>2e</sub>, or 148% higher than the \$21 price estimated by ARB for a similar scenario.<sup>60</sup> The estimated “social cost” of this scenario (i.e., the total economic cost of the scenario) from 2012-20 would be approximately \$95 billion.<sup>61</sup>

CRA also modeled a scenario (CRA scenario 8c) that did not include any CPs, in which reductions to comply with the AB 32 target would need to be achieved solely by the cap-and-

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<sup>203</sup> Air Resources Board, March 24, 2010, op. cit., pp. ES-6, ES-7.

<sup>59</sup> CRA used its integrated MRN-NEEM model to analyze the SP measures. The MRN (Multi-Regional National) model is a “forward-looking dynamic CGE [computable general equilibrium] model of the U.S.,” and the NEEM (North American Electricity and Environment Model) is a “partial equilibrium model of the continent's electricity market that can simultaneously model system expansion and environmental compliance.”

<sup>60</sup> Charles River Associates, March, 2010, op. cit., pp. 10-12.

<sup>61</sup> Ibid, p. 13.

trade system.<sup>62</sup> It estimated that allowance prices would be approximately \$78/tCO<sub>2</sub>e, versus ARB's estimate of \$102 for Case 5 (Case 5 assumes 57% less emission reductions from complementary measures than Case 1, and is the closest approximation to scenario CRA 8c).<sup>63</sup> Social cost resulting from the program would be approximately \$47 billion, or approximately 50% of the cost of Case 1, which includes a full set of complementary measures.<sup>64</sup> However, allowance prices would be 50% higher in this scenario than in Scenario 1.

**These findings illustrated CRA's view that complementary measures would significantly increase the overall cost of the program compared to a pure cap-and-trade program even though they would result in lower allowance prices.** This is because the CPs reduce emissions in covered sectors, and therefore demand for allowances. ARB's earlier study concludes the opposite. Its estimated losses in gross state product were far lower in the scenario in which the CPs achieve estimated levels of reductions than in the scenario in which they only achieve 30% of estimated reductions.<sup>65</sup>

In contrast, the effect of adding in complementary measures in ARB's analysis was to reduce the costs of the program. For example, as shown in Table 2, the estimated change in gross state product in Case 5 (which assumes 136.8 Mt of emission reductions from complementary measures) is -1.4%. This loss is significantly greater than the -0.2% estimated for Case 1, in which complementary policies achieve 319.2 Mt of reductions. CRA also concludes that complementary measures result in increased costs also has implications for the effectiveness of offsets. Based on its different scenarios, CRA concluded that offsets are less effective in reducing costs when CPs are implemented, "because offsets cannot undo the effect of costly regulatory requirements and mandates."<sup>66</sup>

### **Complementary Policies and Offset Supply Impact the Cap-and-Trade Program**

The cap-and-trade program incorporates a fixed emissions cap that serves as a backstop for CPs. If CPs under-perform, the effect will be to increase emissions in covered sectors and the level of emission reductions that covered sources must achieve to comply with the cap. In turn, the higher level of emission reductions can be expected to create upward pressure on allowance prices. In contrast, if CPs achieve their expected level of emission reductions, covered sector emissions will be reduced from BAU levels, and the level of emission reductions required to meet the fixed cap will decrease, resulting in lower allowance prices.

With respect to the electricity sector, if CPs targeting emissions from the sector – i.e., energy efficiency programs, CHP and the 33% RPS – fail to achieve their emission reduction targets, this will result in higher-than-projected emissions in the sector overall. In this scenario, the sector would confront increased emission reduction obligations under the fixed cap, higher allowance prices, and increased compliance costs. In a different scenario, CPs addressing electricity sector emissions could meet their emission reduction targets, but policies addressing

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<sup>62</sup> Ibid, pp. 10-11.

<sup>63</sup> If CRA had assumed the inclusion of complementary policies from Air Resources Board's Case 5, presumably its estimated social cost would be higher and its estimated allowance price would be lower than in CRA 8c.

<sup>64</sup> Ibid, p. 13.

<sup>65</sup> Air Resources Board, March 2010, op. cit., Table ES-2, p. ES-7.

<sup>66</sup> Charles River Associates, March 2010, op. cit., p. 14.

transportation emissions could fall short of their emission reduction targets. Because covered emissions in the transportation sector would increase, allowance prices also would increase, thereby increasing compliance costs for the electric power sector, despite their meeting their emission reduction targets for RPS, energy efficiency and CHP.

### **Uncertainties make it Challenging for Firms to Develop Compliance Strategy**

Electric power companies have significant experience developing strategies to manage the risks associated with costs to comply with environmental requirements. However, developing and implementing a strategy to mitigate risk related to AB-32 compliance may present some unique challenges. This is due to the potential variance in outcomes with respect to several key variables that will affect the required volume of emission reductions in the cap-and-trade program, allowance prices, and overall compliance costs. It may be particularly difficult to predict the combined effect of different variables on allowance prices. As discussed above, **required emission reductions in the cap-and-trade program could vary by a factor of four -- from 97-395 Mt** – depending on the level of emission reductions achieved by CPs and the extent to which the APCR is used.

In addition to the performance of CPs and the use or non-use of allowances held in the APCR, other variables will affect the level of required emission reductions, and allowance prices. These include offset supply, the performance of the CA economy, the level of nuclear and hydroelectric generation relative to expected levels, and the performance, and of CPs in jurisdictions with cap-and-trade programs that will be linked to CA's program, such as Quebec.