Protecting the Most Vulnerable

A Financial Analysis of Cap-and-Trade's Impact on Households in Disadvantaged Communities Across California

UCLA Luskin School *of* Public Affairs
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Disclaimer

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1. Executive Summary

California has adopted and implemented a Cap-and-Trade Program, which places the world's first economy-wide cap on greenhouse gas (GHG) emissions and establishes market mechanisms to price carbon allowances. The regulated entities are large emitters of GHGs, including electric utilities, natural gas utilities, and fuel distributors. This report analyzes Cap-and-Trade compliance costs, which result from the regulated entities' purchase of carbon allowances. The costs of these allowances create price signals that communicate to consumers the amount of GHG emissions associated with electricity, natural gas and gasoline consumption.

While allowing price signals to encourage lower GHG consumption choices, policymakers also want to ensure that the cost burden does not fall disproportionately on low-income Californians. To address this, mitigation strategies or protective measures include: 1) the provision of climate credits directly to households; 2) climate investments[1] and other efficiency, fuel switching, and vehicle mile reducing programs and policies that help households lower their expenditures on electricity, natural gas and gasoline; and 3) low-income rate assistance programs, which although unrelated to the Cap-and-Trade Program, can reduce households' budgetary burden associated with electricity and natural gas consumption. Because the latter two types of measures can lower energy and gasoline bills, they indirectly help to lower any Cap-and-Trade compliance cost passed on to customers.

The UCLA Luskin Center for Innovation finds that the state is effectively protecting low-income Californians from Cap-and-Trade compliance costs passed through from electric, natural gas, and gasoline providers. The key results of our findings include:

- We calculate that as electric utility customers, our representative low-income households could potentially receive an estimated positive financial impact of between $215 and $246 cumulatively, from 2016 through 2020, associated with the Cap-and-Trade Program. The net savings are due to our estimation that these particular households would receive more in climate credits than they would pay in Cap-and-Trade associated costs as electricity consumers. We estimate that the financial impact of Cap-and-Trade in 2016 on our representative households' electricity bills could on average be approximately $15, while these households would also receive approximately $65 in climate credits, for a net positive financial impact of $50.
- As natural gas utility customers, our representative low-income households could potentially receive a positive financial impact of between $44 and $83 cumulatively, from 2015 through 2020, under the Cap-and-Trade Program. Specifically, we estimate that these particular households

1 Revenues from the sale of Cap-and-Trade allowances at auction are deposited into the Greenhouse Gas Reduction Fund and these climate investments support various programs that reduce GHG emissions in California and provide financial co-benefits. For instance, millions of dollars each year are now going to the Affordable Housing and Sustainable Communities Program, the Low Carbon Transit Operations Program, and the Transit and Intercity Rail Capital Program to give Californians transportation alternatives to driving and thus help reduce gasoline expenditures.

would receive more in climate credits than they will pay in Cap-and-Trade associated costs. We estimate that the financial impact of Cap-and-Trade in 2016 on our representative households' natural gas bills could on average be approximately $7, while we predict that these households could receive approximately $10 to $20 in climate credits per year in the future, for a net positive financial impact of $10 to $18 annually.

- As gasoline customers, we estimate that our representative households could potentially receive a cumulated, indirect net benefit of approximately $350 to $700 during the Cap-and-Trade Program period from 2015 through 2020. Gasoline customers do not receive climate credits nor have any other mechanism to directly offset Cap-and-Trade related costs. However, government policies and standards, climate investments and other factors are significantly impacting vehicle-miles traveled and vehicle efficiency over time. This reduces gasoline consumption and thereby indirectly reduces gasoline consumer exposure to Cap-and-Trade related costs, which we estimate could be $65 to $98 for our representative low-income households in 2016.

For our estimations, this report uses government and industry forecasted trends in electricity and natural gas consumption as well as trends associated with gasoline consumption. These trends are cumulatively affected by a multitude of efficiency, fuel switching and vehicle-miles reducing policies and programs as well as other factors. This report does not quantify the effect of individual measures such as the many specific programs under Assembly Bill 32, the Global Warming Solutions Act of 2006. Instead, this report focuses on Cap-and-Trade compliance costs and how these costs are likely being offset for low-income Californians—directly by climate credits and indirectly by cumulative factors that could include climate investments. It is important to note that climate investments are just one part of a much larger suite of policies and programs that seek to improve energy and vehicle efficiency, reduce vehicle-miles traveled, enhance transit options, improve conditions for bicyclists and pedestrians and other strategies to reduce GHGs and help Californians save money.

1.1. Introduction

California is an international leader in climate change policy. The foundation of this leadership is Assembly Bill 32 (AB 32, Núñez and Pavley), the Global Warming Solutions Act of 2006. AB 32 requires the state to reduce greenhouse gas (GHG) emissions to 1990 levels by the year 2020. The legislature largely delegated the job of establishing programs to achieve this goal to the California Air Resources Board (ARB). In response, ARB identified and began implementing a number of programs to reduce GHGs from a variety of sources.

Among the measures that ARB adopted is a Cap-and-Trade Program, which places the world's first economy-wide cap on carbon emissions and establishes market mechanisms to price carbon emissions. California's Cap-and-Trade Program covers the vast majority of the state's economic sectors and almost 85 percent of California's GHG emissions. The regulated entities are large emitters of GHGs, including electric utilities, natural gas utilities and fuel distributors. These utilities and firms purchase compliance instruments based on the amount of GHGs associated with the electricity, natural gas or transportation fuels they sell to consumers. The compliance costs create a price signal that over time is passed on to consumers, leading to relatively higher prices for energy and fuels with higher GHG content and relatively lower prices for electricity and fuels with lower or no GHG content.

In this study, we focus explicitly on one of two types of compliance associated with the Cap-and-Trade Program. We calculate ***Cap-and-Trade compliance costs***, which represent the costs resulting from utilities' and firms' purchase of GHG allowances and offsets. There is a second type of cost that may also be passed on to consumers: ***GHG mitigation costs***. These represent the costs that utilities and firms incur to lower their own GHG emissions, thus avoiding the need to purchase allowances. Common mitigation costs include installing technologies that reduce GHGs and/or use renewable energy. A portion of both compliance and mitigation costs may be passed on to consumers.

Our research strategy. This study explores whether/how Cap-and-Trade compliance costs in three industries— electricity, natural gas and gasoline—may be passed on to consumers. Our research strategy was to calculate the impact of Cap-and-Trade compliance costs on low-income Californians as electricity, natural gas and gasoline consumers. We then compared these household-level costs with the financial savings accrued from climate credits and cost-saving protective measures for low-income Californians in order to calculate the net impacts on a household.

For two reasons we focus on calculating compliance costs, rather than the mitigation costs, that may be passed on to low-income consumers. First, it is not clear that commonly observed mitigation strategies used by utilities and firms can be entirely attributed to the Cap-and-Trade Program as opposed to other regulations and market forces. Second, we do not have access to the data needed for such cost estimation. However, our approach enables us to create a framework for assessing the impacts of mitigation costs for electricity and natural gas.

Why focus on low-income Californians? The State of California has identified that over nine million people, representing nearly a quarter of the total state population, live in a disadvantaged community burdened by environmental and socioeconomic issues such as poverty.[2] From the inception of AB 32 through recent regulatory implementation decisions, state policymakers have sought to balance two competing goals. First, they seek to protect low-income households from bearing a disproportionate burden of Cap-and-Trade related costs as a percentage of their income. At the same time, they want to preserve the price signals that communicate the GHG implications of energy consumption decisions for all households in California. In this study, we evaluate—for the first time—how well state policymakers have accomplished these two goals.

We focus on the potential impact on families in disadvantaged communities because low- income households would be particularly vulnerable to any cost pass-through given that paying their gasoline, electricity and natural gas utility bills make up a larger percentage of their incomes compared to affluent households. Family size, climate zones, utility providers and many other conditions could also affect how households might be financially impacted by the Cap-and-Trade Program.

Methodologically, this study takes a case study approach, focusing on four disadvantaged communities across California that collectively represent a range of different climate zones, utility providers, land use and transportation patterns and other factors that affect household-level energy

2 California Environmental Protection Agency and the Office of Environmental Health Hazard Assessment (2014). The California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0). http://oehha.ca.gov/ej/ces2.html

and transportation expenditures. Within each community, we construct two household consumption profiles (based on the most prevalent local housing and transportation options) for a total of eight representative households for which we conduct our financial analysis.

State policymakers have long sought to protect low-income Californians from high energy and fuel prices. Some of these programs existed well before the Cap-and-Trade Program (and others are tied to it). The cost protections most relevant to this study fall into three main categories:

1. **Policies and programs that help Californians reduce their electricity, natural gas and gasoline consumption, and thus expenditures.** This covers a wide range of policies and programs, many associated with AB 32. The policies and programs are designed to do three main things: 1) to increase efficiency of everything from home appliances to personal vehicles, 2) to incentivize fuel or power switching, through for example rebates for solar panels and electric vehicles, or 3) to support the reduction of vehicle-miles traveled through sustainable land use and by supporting transit, biking and walking options.

   Many such programs are receiving significant funding from the Greenhouse Gas Reduction Fund (GGRF). The state's portion of the Cap-and-Trade auction proceeds are deposited in the GGRF, and used to further the objectives of AB 32 to reduce GHGs. These climate investments are also designed to bring local economic, public health, and environmental benefits to California's disadvantaged communities and low-income residents. Senate Bill 535 (De León) requires that a minimum of 25 percent of the monies in the GGRG go to projects that benefit disadvantaged communities in California, and a minimum of 10 percent go to projects located in these communities.

   The California State Legislative Office estimates that the Cap-and-Trade Program will raise $12 - 45 billion dollars in funding between 2012 and 2020. Between March 2014 and December 2015, over $2.6 billion has been appropriated to state agencies to for such programs, projects and activities. Of the nearly $1 billion implemented thus far, over half of the funds are reported to be benefiting disadvantaged communities.[3] Refer to A Guide to Greenhouse Gas Reduction Fund Program Designs, Expenditures and Benefits for further information.[4]

2. **Climate credits.** In addition to the GGRF, another part of the Cap-and-Trade auction revenue is being directly returned to the millions of Californians who are residential customers of an electric investor-owned utility (IOU), such as Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE). This money is returned as a dividend or "climate credit" line item on electricity bills twice a year. Climate credits will begin this year for residential customers of a natural gas IOU. Climate credits were approximately $25 to $30, dispersed twice a year in 2015, for PG&E and SCE residential customers. For the purpose of this case study, we focus on PG&E and SCE service territories.

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3 California Air Resources Board (March, 2016). Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds (Greenhouse Gas Reduction Fund Monies). http://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2016_final.pdf

4 UCLA Luskin Center for Innovation (2015). A Guide to Greenhouse Gas Reduction Fund Program Designs, Expenditures and Benefits. http://innovation.luskin.ucla.edu/content/guide-greenhouse-gas-reduction-fund-program-designs-expenditures-and-benefits-disadvantaged-

3. **Low-income energy discount programs.** Programs such as the California Alternate Rates for Energy (CARE) and Family Electric Rate Assistance (FERA) programs help low-income customers of electricity and natural gas utilities afford their bills. CARE and FERA provide a monthly discount on utility rates for low-income household relief. While these programs were established prior to and unconnected to the Cap-and-Trade Program, participation will affect energy bills in this current period in which Cap-and-Trade exists. Thus, researchers of this study incorporated energy discount program participation into our calculations.

This study evaluates how well these strategies have collectively worked for low-income households in case study communities. As such, we qualitatively estimate electricity, natural gas and gasoline consumption for representative households both in a baseline year (2015) and during the Cap-and-Trade Program through 2020.

Chapter 2 of this report describes our methodology for selecting case study communities and eight representative households. It also shows our estimations for baseline electricity, natural gas and gasoline consumption for each household.

Chapter 3 provides background information on the Cap-and-Trade Program and energy prices that is important for understanding our financial analysis of the program's potential impact on our representative households as electricity, natural gas and gasoline consumers.

Finally, Chapters 4, 5 and 6 show the results of our financial analysis for our representative households as electricity, natural gas and gasoline consumers, respectively.

2. Methodology

In order to calculate the Cap-and-Trade Program's potential financial impact on representative households in case study disadvantaged communities, UCLA Luskin Center researchers first completed two research steps:

1. We selected four case study communities classified by the state as disadvantaged.[5] We utilized data from the American Community Survey to ensure that the selected communities collectively provide diversity of geography and climate as well as a range of average household size, income, employment status, transportation mode, length of travel time and housing characteristics. We next constructed two hypothetical albeit representative household profiles for each of the four case study communities, for a total of eight representative households. We used American Community Survey data to determine the average and most common characteristics of households in each of the communities.

2. We then calculated the baseline energy and fuel consumption profiles for these eight representative households in the four case study disadvantaged communities. For inputs into the energy profile model, we used data from the 2009 California Appliance Saturation Survey.[6] For inputs into the transportation profile model, we used data from the California Household Travel Survey.[7] The model outputs provide estimated annual electricity, natural gas and gasoline consumption of the representative households.

2.1. Selecting Case Study Disadvantaged Communities and Representative Households

We selected four case study communities at the census tract level that are classified by the California Communities Environmental Health Screening Tool (CalEnviroScreen) as disadvantaged communities.[8] Our criterion for selecting the specific communities was to collectively represent a range of the following:

- Geographic areas across the state with differing climates as well as differing electricity and natural gas utility providers, that provide service to concentrations of disadvantaged communities;

5 California Environmental Protection Agency and the Office of Environmental Health Hazard Assessment (2014). California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0). It generates, at the census tract level, environmental health risk rankings regarding pollution burden and other environmental indicators as well as population characteristics and socioeconomic indicators. The census tracts that receive a score grouping them in a quintile within the top 25 percent are classified as disadvantaged communities.

6 California Energy Commission (2015). 2009 Residential Appliance Saturation Survey. http://www.energy.ca.gov/appliances/rass/

7 California Department of Transportation (2015). 2010-2012 California Household Travel Survey. http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_travel_analysis/chts.html

8 Ibid.

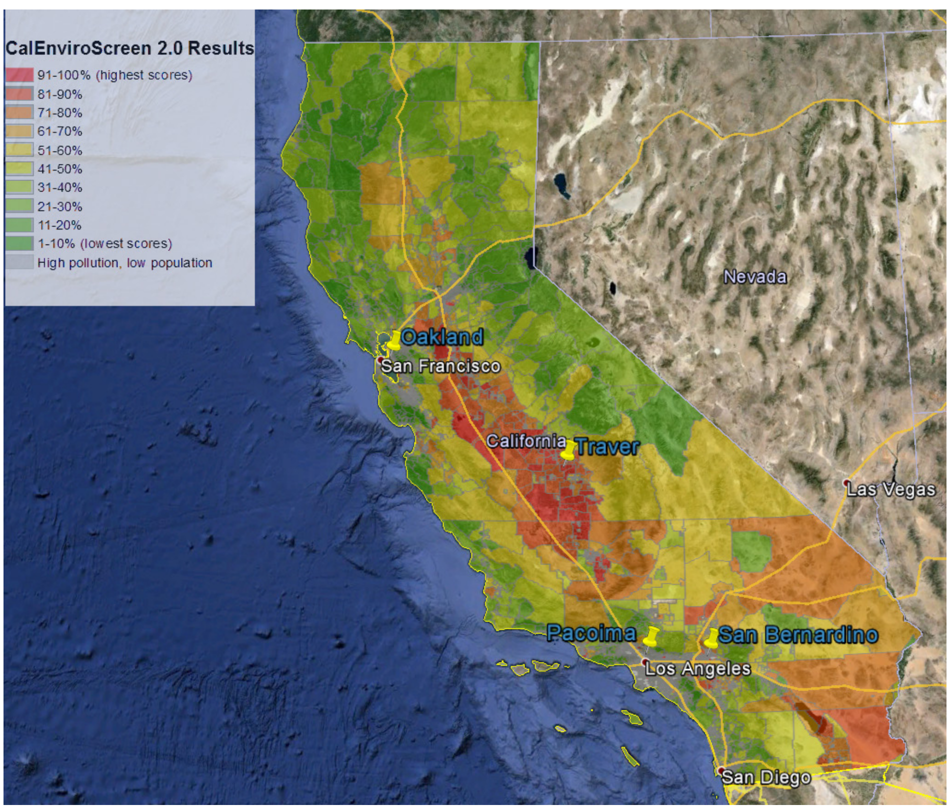
- Household sizes;
- Transportation patterns that could affect gasoline consumption;
- Housing stocks (multi-family, single-family and mobile homes) and housing square footage that could affect electricity and natural gas consumption; and
- Community demographics (population, race and unemployment status).

With these criteria in mind, we selected a census tract in each of the following cities/towns (listed in alphabetical order):

- City of Los Angeles (specifically the community of Pacoima in the San Fernando Valley) in Los Angeles County;
- City of Oakland in Alameda County;
- City of San Bernardino in San Bernardino County (suburban Inland Empire); and
- The small town of Traver in Tulare County (rural San Joaquin Valley).

See the following map for the location of the communities listed above (illustrated by four yellow markers).

Figure 1: Location of Case Study Communities



We used American Community Survey data to identify average characteristics of households in each of the four case study disadvantaged communities. See Table 1 for an overview and the Appendix for more data about the selected communities.

Table 1: Key Characteristics of Case Study Communities

Location	Utility Providers: Electricity/Gas *	CalEnviro Screen Rank[9]	Average House-hold Income	Average House-hold Size	Below Poverty Level	% Hispanic or Latino	% Black or Afr. Am.
Los Angeles	LADWP/ SoCalGas	91-95%	$49,711	3.98	24%	84%	9%
Oakland	PG&E/PG&E	81-85%	$38,219	2.87	40%	23%	44%
San Bernardino	SCE/SoCalGas	96-100%	$39,514	3.82	31%	66%	2%
Traver	PG&E/ SoCalGas	96-100%	$42,530	4.32	44%	87%	0%

*Table note: Abbreviations stand for Los Angeles Department of Water and Power (LADWP); Southern California Gas Company (SoCalGas); Pacific Gas and Electric Company (PG&E); and Southern California Edison (SCE).

Next, we identified average or most common characteristics of households in these communities, again using American Community Survey data. This included identifying the average or most common housing composition, transportation mode to work, length of travel time and housing characteristics (see the Appendix for more details). We assembled profiles for two households in each census tract (eight households total) based on the average or top two most common characteristics for each census tract. This allows us to study the impact on two common household structures, dwelling types and modes of transportation for each location. See Table 2 for details about the representative households.

9 The California Communities Environmental Health Screening Tool (CalEnviroScreen 2.0): census tracts that receive a score grouping them in a quintile within the top 25 percent of all tracts (75 – 100% ranking) are classified as disadvantaged communities by California for purpose of implementing SB 535.

Table 2: Representative Households in Each Case Study Community

	Los Angeles	Oakland	San Bernardino	Traver
Climate Zone[10]	9	3	10	16
Representative Household #1				
Household Composition	4 people, 2 workers	3 people, 1 worker	4 people, 2 workers	4 people, 2 workers
Housing Type	Single-family structure	Multi-family dwelling	Single-family structure	Single-family structure
Most Prevalent* Modes of Transportation to Work	Driving alone by car and carpooling	Public transportation and driving alone by car	Driving alone by car*	Driving alone by car and carpooling
Representative Household #2				
Household Composition	4 people, 2 workers	2 people, 1 worker	4 people, 1 worker	4 people, 1 worker
Housing Type	Multi-family dwelling	Multi-family dwelling	Single-family structure	Mobile home
Most Prevalent Modes of Transportation to Work	Driving alone by car and carpooling	Public transportation and walking/biking	Driving alone by car*	Driving alone by car and carpooling

*Table note: We only show one mode of transportation for the San Bernardino households because, according to data from the American Community Survey, the vast majority (approximately 3/4) of the population in the San Bernardino census tract reports driving alone to work and the other transportation modes reported are spread out very thinly relative to our three other census tracts.

2.2. Calculating Baseline Energy and Gasoline Consumption for Case Study Households

In order to assess the financial impact that the Cap-and-Trade Program could have on lower income households, we first had to establish the annual baseline consumption of electricity, natural gas and gasoline by our representative households, before the impacts of the Cap-and-Trade Program went into effect. In order to do so, the Luskin Center constructed energy (electricity and natural gas) and fuel (gasoline) consumption profiles for each of the aforementioned representative households.

10 California Energy Commission (2015). California Energy Maps. http://www.energy.ca.gov/maps/renewable/building_climate_zones.html The California Energy Commission established 16 climate zones that represent a geographic area for which a maximum amount of energy that a building or portion of a building can consume per year. Those climate zones are also based on temperature, weather and other factors.

For inputs into the energy profile, we used data from the 2009 California Appliance Saturation Survey.[11] The key objective was to obtain specific consumption patterns depending on housing types and climate zones. For inputs into the transportation profile model, we used data from the 2010-2012 California Household Travel Survey[12] and from the EMFAC 2014 Web Database.[13] While the California Household Travel Survey is the most detailed study on travel patterns for California residents, a principal challenge of using it is the fact that the number of data points in each census tract is limited. In the Appendix we describe how we overcame methodological challenges, and explain in more in detail the various assumptions and factors that impact our findings.

Table 3 summarizes the results of our energy and transportation models. It shows estimated baseline consumption for electricity, natural gas and gasoline for each of the eight representative households. All numbers indicate total estimated consumption in 2015, the year selected as our baseline.

Table 3: Annual Estimated Energy and Transportation Consumption for Representative Households in Baseline Year 2015

	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1				
Vehicle-mile traveled (VMT)	15,068	13,724	20,573	19,207
Gasoline consumption (gallon)	729	613	917	857
Electric consumption (kWh)	6,355	3,414	6,768	6,715
Natural gas consumption (therm)	346	332	456	446
Representative Household #2				
Vehicle-mile traveled (VMT)	15,068	0	20,573	19,207
Gasoline consumption (gallon)	729	0	917	857
Electric consumption (kWh)	3,682	3,360	6,768	4,673
Natural gas consumption (therm)	261	259	456	382

Table note: Refer back to Table 2 for information about each household's characteristics that affect Table 3's energy and fuel consumption profiles. The Luskin Center purposely chose to study eight households with different dwelling types, dwelling sizes, household compositions and modes of transportation, resulting in different energy and fuel consumption profiles.

Table note 2: See the Appendix for a full description of our methodology. As Table 3 illustrates, the estimated consumption of gasoline, electricity and natural gas differs amongst the various locations, each of which is in a different climate zone and has distinct land use, transportation patterns, and

11 California Energy Commission (2015). 2009 Residential Appliance Saturation Survey. http://www.energy.ca.gov/appliances/rass/

12 California Department of Transportation (2015). 2010-2012 California Household Travel Survey. http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_travel_analysis/chts.html

13 California Air Resources Board (2015). EMFAC 2014 Web Database.

household and housing characteristics. For example, San Bernardino experiences a hotter climate compared to Oakland. Thus, a typical family in San Bernardino will use more electricity to cool their home, which also is on average significantly larger than a home in the case study community in Oakland. Also statistically speaking, vehicle-miles traveled will be higher for a family that lives in the outer ring of Los Angeles (i.e. the community of Pacoima) compared to the heart of more transit-friendly Oakland.

3. Background

California's Cap-and-Trade Program is a market-based regulation designed by the California Air Resources Board (ARB) to reduce greenhouse gases (GHGs) from multiple sources while minimizing compliance costs on regulated entities and their customers.[14] ARB measures emissions by metric ton of carbon dioxide equivalent (MtCO2e). (Carbon dioxide, methane and nitrous oxide are taken into account in the calculation of CO2 equivalent.) Entities covered under the program (those that emit a certain amount of GHGs annually) are required to have an emissions allowance or offset (see the following page for details) for every MtCO2e emitted.

In order to assess how the Cap-and-Trade Program could financially impact our representative households' energy and fuel profiles, it is important to understand the price evolution of a MtCO2e as well as the mechanisms influencing this specific trading market, how GHG allowance amounts impact energy prices and what might be the mid-term trend of energy consumption in low-income households.

3.1. The Cap-and-Trade Program

The GHG "allowances" are a tradable authorization, like a permit, to emit one metric ton of MtCO2e. ARB established different mechanisms in order to regulate the carbon market and avoid dangerous market manipulation or extreme carbon price movement.

The Cap. First, ARB sets a cap, defined as the amount of allowed emissions, for each covered entity based on their 2012 GHG emissions level. The cap declined by two percent in 2014, declined by three percent in 2015, and will keep declining by three percent annually through 2020. This puts pressure on covered entities to reduce their GHG emissions over time. The mechanism provides covered entities with enough long-term visibility to invest in strategies, such as green technology, that will lower their emissions over the long term.

Free Allocation of Allowances. Second, every year ARB allocates free allowances to entities, such as electrical distribution utilities and natural gas suppliers, for the benefit of ratepayers. This strategy is meant to provide transition assistance for newly covered entities, to help prevent businesses from leaving California and to protect energy end-users against steep energy price increases or shocks.

Offsets. An offset is "a credit for a verified emission reduction from a source outside the Cap-and-Trade program...[that] can be used by covered entities to meet their cap-and-trade obligations instead of using emission allowances or reducing on-site emissions."[15] This report does not take into account the effect of offsets because it is highly unlikely that they are impacting Cap-and-Trade compliance costs under current conditions. The amount of offsets—used by covered utilities to

14 California Air Resources Board (2015). "Cap-and-Trade Program." www.arb.ca.gov/cc/capandtrade/capandtrade.htm

15 California Air Resources Board (2010). Presentation on the Role of Offsets. Slide 4. http://www.arb.ca.gov/cc/capandtrade/meetings/022510/pres.pdf.

comply with their Cap-and-Trade obligations in 2013 and 2014—was very low (below one percent, according to ARB Compliance Report).[16] While covered entities are allowed to cover up to eight percent of their Cap-and-Trade compliance obligations with offsets, offsets have been trading with a discount that is minimal compared to allowance prices, and offsets may involve legal risks that allowances do not.[17]

Auction Reserve Price. Lastly, ARB set a bottom floor price limit (i.e. the Auction Reserve Price) and a soft price ceiling (i.e. the Allowance Price Containment Reserve). The auctions have price floors to prevent the auction price from going too low.[18] ARB set the Auction Reserve Price at $10 in 2012 and increases it each year at a rate of five percent plus inflation to help assure a stable and growing market for future years, resulting in financial incentives for companies to invest in cleaner energies now before allowance prices increase. (For our study estimating future rates, we assume the inflation rate will be two percent).

Allowance Price Containment Reserve (APCR). To avoid drastic spikes in allowance prices and prevent market manipulation, ARB can hold quarterly sales of allowances from what is called the Allowance Price Containment Reserve (reserve sales or APCR). "Reserve sales" from the APCR are available in three fixed-price tiers: $40, $45 and $50 starting in 2013. These prices increase by five percent plus an inflation rate every year. (For our study we assume the inflation rate will be two percent). None of the covered entities, however, have decided to participate in an APCR auction given that allowance prices have been far below the APCR levels.[19]

Future Price Projections. There are three main compliance phases of the Cap-and-Trade Program: between 2013-2014, 2015-2017 and 2018-2020. According to a macroeconomic study conducted by Borenstein et al. (2014),[20] there is a 31 percent or less chance of the carbon price reaching the lowest step of the Auction Price Containment Reserve during the third compliance phase, and an even smaller probability during the first two compliance periods: a two to 17 percent chance during the second compliance phase and only a two to four percent chance of reaching the lowest step of the APCR during the first compliance phase.

Borenstein's projections are playing out in reality. Since the end of 2012 and through the time this report was written in 2015, the price of a metric ton of CO2 has been mainly trading around its bottom

16 California Air resources Board (2016). 2014-2015 Compliance Obligation Report. www.arb.ca.gov/cc/capandtrade/2013-2014compliancereport.xlsx)

17 California Carbon website (March 16, 2016). CCA and Offset daily price. http://californiacarbon.info/. According to this source, COO offsets trade with a 11% discount and Golden offsets trade with a 4% discount, compared to the allowance spot market.

18 Association of Corporate Counsel (2011). "Understanding California's Cap-and-Trade". www.acc.com/legalresources/quickcounsel/UCCTR.cfm

19 California Air Resources Board (2016). Greenhouse Gas Allowance Price Containment Reserve. http://www.arb.ca.gov/cc/capandtrade/auction/auction.htm

20 Severin Borenstein, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins (2014). "Report of the Market Simulation Group on Competitive Supply/Demand Balance in the California Allowance Market and the Potential for Market Manipulation. Supported by the California Air Resources Board."

floor price (the Auction Reserve Price). Graphic 1 illustrates the price variation between $10 and $14, but $14 is an outliner at the beginning of the program (a quick spike when trading volumes were at their lowest[21]) and more recently the price has settled near the bottom floor price.

Graphic 1: Settlement Price of Current Vintage MtCO2e Allowances

Source: Graph created by the UCLA Luskin Center for Innovation, using the ARB's Cap-and-Trade auction results data since November 2012. (http://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf)

The State of California has the obligation to sell all allowances in the market every year, which pushes it to sell near the bottom floor price. As an example, during the last auction, on February 17, 2016, 95 percent of current vintage allowances were sold at the minimum floor price of $12.73 and 93 percent of the 2019 vintage allowances sold at the floor price of $12.73. While a higher percentage of future prices could certainly be above the bottom floor price, factoring this into our calculations would require us to make specific numerical assumptions. To maintain objectivity, we will use a future proxy price scenario where a MtCO2e trades at the bottom floor price. The Appendix presents a scenario in which the price of a MtCO2e would jump from the bottom floor price to the first step of Allowance Price Containment Reserve. Together, these two scenarios present a range of potential possibilities. However, it is most likely that the actual price will remain closer to the bottom floor price instead of jumping up to an Allowance Price Containment Reserve level. This is why in Chapters 4, 5 and 6 we use the bottom floor price scenario.

21 California Air Resource Board (May, 2015). "Summary of Cap-and-Trade Program Auction Settlement Prices and Results". http://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf

3.2. Cap-and-Trade Compliance Costs on Energy and Fuel Prices

Covered entities that emit a certain amount of GHGs every year are required to have an emissions instrument (e.g. allowance or offset) for every MtCO2e emitted. These annual costs represent the Cap-and-Trade compliance costs. The fewer GHGs emitted by an entity, the fewer allowances it has to purchase, and thus the smaller its compliance costs. Additionally, the continuous increase of the bottom floor price puts upward pressure on carbon prices while reducing the amount of allowances allocated puts downward pressure on supply. Thus, there is growing incentive for covered entities to move toward cleaner energy or otherwise reduce their emissions.

As previously stated, this study focuses on the financial impact of the Cap-and-Trade Program on representative households as electricity, natural gas and gasoline consumers. For each of these energy sources, the compliance costs are calculated the same way: multiplying the allowance price (i.e. the price of one metric ton of carbon dioxide) by the emission factors provided by ARB, for each energy sector (i.e. the amount of carbon dioxide, methane and nitrous oxide emitted per unit of electricity, natural gas and gasoline sold to customers). ARB regulates how electricity providers can pass on these costs to customers differently than natural gas providers and fuel distributors.

Electricity. For the electric utilities, Cap-and-Trade compliance costs can be calculated by multiplying the price of one metric ton of carbon dioxide (MtCO2) for each ton of carbon dioxide equivalent (MtCO2e) emitted. Each utility has to calculate its emissions resulting from its electricity generation and purchases. Thus, compliance costs will be affected by the mix of energy resources. Producing electricity from natural gas versus solar energy, for example, results in different amounts of MtCO2e/kWh. Investing in renewable energy and energy efficiency will help utilities to reduce their compliance costs over time and will comply with other state mandates such as the Renewable Portfolio Standard.

Natural Gas. For the natural gas providers, Cap-and-Trade compliance costs can be calculated by multiplying the allowance price by the emission factors for natural gas provided by ARB (i.e. the price of one MtCO2e is multiplied by the amount of GHGs emitted by each utility over the year). As explained in more detail in the Appendix, those costs are only partially passed through to customers, since natural gas providers, unlike electricity providers, can use some of the free allowances given by the state to offset a part of their compliance costs by reducing the amount of allowance they have to buy in the market.

Those utilities can also decrease their compliance costs by investing in energy efficiency and utilizing cleaner forms of energy, such as by increasing the amount of renewable natural gas (RNG), which is produced from landfills, livestock operations and other biological residues.

Gasoline. For the gasoline sector, Cap-and-Trade compliance costs can be calculated by multiplying the allowance price by the emission factors for gasoline provided by ARB (i.e. multiplying the price of one MtCO2 by the amount of GHGs emitted by the distribution of a gallon of gasoline). A gasoline distributor could reduce its compliance costs by selling less polluting fuels such as E85 (83 percent of ethanol and 17 percent of gasoline).

4. Electricity:

Assessing the Financial Impact of Cap-and-Trade on Case Study Households in Disadvantaged Communities Across California

This chapter quantitatively estimates how the Cap-and-Trade Program could affect our representative households as electricity ratepayers in disadvantaged communities across California. To do so, this chapter addresses the following questions:

- What are the compliance costs of the Cap-and-Trade Program on electricity providers/utilities?
- What are the strategies to mitigate those costs?
- What is the cost pass-through from the electric utilities to ratepayers/consumers?
- As such, what do we estimate will be the financial impact on our representative households in disadvantaged communities as electricity ratepayers?

This report focuses on the period from 2016 through 2020 because we estimate that no Cap-and-Trade related costs were passed through to residential customers of electric utilities from 2013 to 2015. See the Appendix for details about the 2013 to 2015 period and the cost mitigation strategies that were in place during that time, which differ from current strategies.

4.1. Background and Data used in our Study

What are the Cap-and-Trade compliance costs on electricity providers/utilities?

Electricity distribution utilities were covered by the Cap-and-Trade Program beginning in 2013. Since then, every year these utilities have to cover their greenhouse gas (GHG) emissions by buying allowances on the market through quarterly auctions, or through state[22] approved exchanges and brokers. The costs associated with doing so are referred to as the Cap-and-Trade compliance costs and depend on the price of a metric ton of carbon dioxide equivalent (MtCO2e) and the amount of GHGs for which they have a compliance obligation. Each year, utilities are required to publish information regarding the amount of allowances bought in the market, the amount of energy (MWh in this case) distributed over the past year and other information that helped us estimate potential Cap-and-Trade compliance costs per unit of electricity. Refer to the Appendix for further details on methodology, factors and assumptions used in our study.

We calculate that with an allowance price around $12.5 in 2015, the Cap-and-Trade related costs on electricity per kWh consumed in 2015 would be 0.3 and 0.5 cents for Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE), respectively. Our findings are in line with the utilities' reported GHG costs for that year.[23]

22 Specifically, the California Public Utilities Commission.

23 Pacific Gas and Electric (November 30, 2015). Energy Resource Recovery Account 2016 Forecast of Operations. Table 13-2 for illustrative rate impact.

What is directly mitigating those costs?

As discussed in Chapter 3, the California Air Resources Board (ARB) has been allocating carbon allowances for free to electrical distribution utilities on behalf of ratepayers in order to mitigate bill impacts due to Cap-and-Trade compliance costs. Cap-and-Trade regulation requires that electric investor-owned utilities (IOUs) must consign all allowances to auction, and must use the value generated from the sale of these allowances for the benefit of ratepayers only.[24] This decision gave birth to climate credits for residential ratepayers. According to the state, the climate credit approach has the advantage of preserving the carbon price signal, providing a greater return as a share of income to lower-income households[25] and preserving the "incentives the Cap-and-Trade Program is intended to provide."[26]

As of April of 2014, residential customers of IOUs have received a "climate credit" line item on their utility bill twice a year.[27] Californians whom are a residential customer of an electric IOU have received approximately $25 to $40 each April and November, regardless of consumption or income. More specifically, residential customers of PG&E received $60 in climate credits on their electricity bill in 2014 and $50 in 2015. SCE customers received $40 in 2014 and $29 in 2015.[28]

With the elimination of the volumetric rate offset (see the Appendix for details on volumetric rate offset and other mitigation strategies in place from 2013 through 2015), climate credits (non-volumetric rate offset) will likely increase in amount over time. (California Public Utilities Commission ruling states that if the state "discontinues permitting the utilities to use allowance proceeds for the residential volumetric credit, the size of the Climate Credit will be correspondingly larger – residential customers will still receive the same total amount of allowance revenue; they will simply receive it all as the California Climate Credit, which will not affect rates or mute the carbon price signal"[29]). Consequently, and if everything remains constant, we estimate that future bi-annual climate credits could increase by 2020 to approximately $35 and $45 for residential customers in PG&E and SCE territories, respectively. We obtained these numbers by multiplying the amount of free allowances that these two utilities will receive, with the forecasted Auction Reserve Price, and then distributing the revenues equally among residential customers.

Southern California Edison (May 1, 2015). Energy Resource Recovery Account 2016 Forecast of Operations. Table VII-28 for rate impacts. http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/0C8747C098762A3488257E430071D1D3/$FILE/A1505007%202016%20ERRA%20Forecast%20-%20SCE-1%202016%20ERRA%20Forecast%20Testimony_PUBLIC.pdf

24 California Air Resource Board (2011). Subchapter 10 Climate Change, Article 5, Section 95892. http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf

25 California Public Utilities Commission (2012). Proceeding R.11-03-012. p.181. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M040/K631/40631611.PDF

26 California Public Utilities Commission (2015). Proceeding R.12-06-013. p.248.http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M153/K023/153023530.PDF

27 California Public Utilities Commission (2014). "California Climate Credit" http://www.cpuc.ca.gov/PUC/energy/capandtrade/climatecreditfaq.htm

28 Ibid

29 California Public Utilities Commission (2015). Proceeding R.12-06-013. p.247.http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M153/K023/153023530.PDF

What is the cost pass-through from the electric utilities to ratepayers/consumers?

The California Public Utilities Commission (CPUC) mandates that electric IOUs fully pass on Cap-and-Trade compliance costs to their residential customers and thus the carbon price signal should be fully reflected in residential rates.[30] The revenue generated by the sale of allowances that the utilities receive for free has to be used for the benefit of ratepayers, which takes the form of the aforementioned climate credits.

An exception made for Publicly-owned Utilities (POUs)

State regulation[31] requires that IOUs must consign all allocated allowances to auction. Publicly-owned utilities (POUs) and electrical cooperatives (co-ops), however, can determine how to distribute their allowances among their compliance accounts. Those entities, such as the Los Angeles Department of Water and Power (LADWP), do not have the obligation to consign 100 percent of their allowances. In fact, LADWP has fully covered its compliance obligation with the free allowances received.[32] Consequently, it can be assumed that LADWP has avoided passing on any Cap-and-Trade compliance cost to its ratepayers. In other words, LADWP customers are unlikely to be subject to a carbon signal or any climate credit in the near future. This assumption will be extended to the rest of the time period of our analysis because the ARB will provide LADWP with more free allowances than LADWP would need to cover its compliance obligations, according to the utility's projected emissions[33] from 2016 to 2020.

What strategies indirectly mitigate Cap-and-Trade related costs and what other data are taken into account in our study?

We used the following four sets of information to inform our analysis:

1. We incorporate into our study the California Energy Commission's recent middle scenario forecast that implies a decrease in electricity consumption per household from 2015 to 2020 at a rate of 1.7 percent, 2.1 percent, and 2.6 percent for SCE, PG&E and LADWP, respectively.[34] Improved energy efficiency is the main factor driving decreased electricity consumption. In addition, the forecasted numbers take into consideration the following other balancing factors:
    - Increased state population;
    - Increased adoption of electric vehicles, increased multi-media use and plug load, and other factors that put upward pressure on electricity demand; and

30 California Air Resource Board (2011). Subchapter 10 Climate Change, Article 5, Section 95892. http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf

31 California Air Resource Board (2011). Subchapter 10 Climate Change, Article 5, Section 95892. http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf

32 California Air Resource Board (2015). Cap-and-Trade Program Summary of Vintage 2013 Electrical Distribution Utility Allocated Allowance Value Reports. pp.9-14. http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/edu-v2013-allowance-value-report.pdf

33 LADWP (2013). LA's clean energy future. http://www.ladwpnews.com/external/content/document/1475/1727403/1/Navajo%20+%20IPP%20Coal%20Elimination%20Presentation%20031913.pdf

34 California Energy Commission (2016). California Energy Demand 2016-2026 Adopted Forecast. http://www.energy.ca.gov/2015_energypolicy/documents/index.html#adoptedforecast.

- Increased energy savings from building and appliance standards and other energy efficiency efforts;
- Market and technology trends as well as other factors that lower demand for electricity.

2. Additionally, programs such as the California Alternate Rates for Energy (CARE) and Family Electric Rate Assistance (FERA) help low-income customers of electricity and natural gas utilities afford their bills. Because this discount applies to the entire bill, it automatically helps to lower any Cap-and-Trade compliance costs passed on to customers. The eight hypothetical, representative households in our case studies communities are eligible for and enrolled in a low-income energy discount program, such as CARE. Political support for the CARE program is unlikely to change because it has been in place for a long time and benefits over 4.5 million Californians (with about an 84 percent penetration rate of total estimated eligible households).[35]

3. The allowance price is most likely going to trade at the bottom floor price, during the time period of our study. We made this forecast for several reasons. According to Severin Borenstein's analysis, there is only a four to 17 percent chance that the carbon price would raise above the bottom floor price and reach the lowest step of the Auction Price Containment Reserve (APCR) during the 2015 to 2017 period. There is a 31 percent or less chance of reaching the APCR from 2018 to 2020. Our forecast is also informed by the past auction results since 2014.[36] (Refer to Chapter 3, Graphic 1). In general, the price has hovered just slightly above the bottom floor price. The State of California has the obligation to sell all allowances in the market every year, which pushes it to sell near or at the bottom floor price. As an example, during the last auction on February 17, 2016, 95 percent of current vintage allowances were sold at the minimum floor price of $12.73 and 93 percent of the 2019 vintage allowances sold at the floor price of $12.73.

   It is likely that a higher percentage of allowances could sell above the bottom floor price in the future, but factoring this into our calculations would require use to make specific numerical assumptions. To maintain objectivity, we use the bottom floor price in this chapter while in the Appendix we present a scenario in which the carbon price trades are much higher, at the first step of the APCR. Together, these two scenarios present a range of possibilities.

35 California Public Utilities Commission (2015). CARE Fact Sheet. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=7795

36 California Air Resources Board (2015). Summary of Auction Settlement Prices and Results. http://www.arb.ca.gov/cc/capandtrade/auction/nov-2015/ca_proceeds_report.pdf

4.2. Findings

Table 4 below presents our estimated financial impact of the Cap-and-Trade Program for each of our eight case study households as electricity customers, between 2016 and 2020. We estimate that there will be no financial impact for Los Angeles residents and a net positive impact for the households in Oakland, San Bernardino and Traver. For those households in Oakland, San Bernardino and Traver, we estimate that they could receive more financial support from climate credits than the Cap-and-Trade compliance cost pass-through they would pay. Specifically from 2016 through 2020, we estimate that the representative low-income households could receive approximately $215 to $246 from the state more than they would pay related to Cap-and-Trade compliance costs. Our findings on Cap-and-Trade impacts on utility rates are in line with forecasts prepared by the IOUs.[37]

Table 4: Estimated Cumulative Financial Impact of the Cap-and-Trade Program for our Electricity Ratepayers,* from 2016 through 2020

Estimations	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1	**4 people** **Single-family structure**	**3 people** **Multi-family dwelling**	**4 people** **Single-family structure**	**4 people** **Single-family structure**
Compliance costs passed through	-	($31)	($103)	($61)
Climate credits received	-	$276	$341	$276
Net financial impact related to C&T	-	$245	$238	$215
Representative Household #2	**4 people** **Multi-family dwelling**	**2 people** **Multi-family dwelling**	**4 people** **Single-family structure**	**4 people** **Mobile home**
Compliance costs passed through	-	($31)	($103)	($42)
Climate credits received	-	$276	$341	$276
Net financial impact related to C&T	-	$246	$238	$234

*Table note: Climate credits should not be considered as an electricity bill reduction per say because although they are administered by the utilities, they are mandated by the state.

In order to present a broader analysis, two other scenarios can be found in the Appendix. Scenario 2 presents a broader range of price impacts, where all aforementioned assumptions remain the same except that the allowance price jumps from the bottom floor price to the first step of the APCR in 2018 (from around $14 to $56). This analysis demonstrates that the higher the allowance price is, the more the low-income households are protected by climate credits.

Scenario 3 presents an analysis where none of the representative households are eligible for the CARE discount, in order to highlight how this program assists low-income Californians.

37 Pacific Gas and Electric (November 30, 2015). Energy Resource Recovery Account 2016 Forecast of Operations. Table 13-2 for illustrative rate impact. Southern California Edison (May 1, 2015). Energy Resource Recovery Account 2016 Forecast of Operations. Table VII-28 for rate impacts. http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/0C8747C098762A3488257E430071D1D3/$FILE/A1505007%202016%20ERRA%20Forecast%20-%20SCE-1%202016%20ERRA%20Forecast%20Testimony_PUBLIC.pdf

5. Natural Gas:

Assessing the Financial Impact of Cap-and-Trade on Case Study Households in Disadvantaged Communities across California

This chapter quantitatively estimates how the Cap-and-Trade Program could affect our case study households as natural gas ratepayers in disadvantaged communities across California. To do so, this chapter addresses the following questions:

- What are the compliance costs of the Cap-and-Trade Program on natural gas providers/utilities?
- What is the cost pass-through from the natural gas utilities to ratepayers/consumers?
- What are the strategies to mitigate those costs?
- How will these impacts change over time?
- As such, what do we estimate will be the financial impact on our representative households in disadvantaged communities as natural gas ratepayers?

5.1. Background and Data used in our Study

What are the Cap-and-Trade compliance costs on natural gas providers/utilities?

Since 2015, every year natural gas utilities have to cover their greenhouse gas (GHG) emissions by buying allowances on the market, through four auctions held quarterly. The cost of doing so is referred to as the Cap-and-Trade compliance costs, and they depend on the price of a metric ton of carbon dioxide equivalent (MtCO2e) and the amount of GHGs emitted. Each year, utilities have to publish information regarding the amount of allowances bought in the market, the amount of energy (therms in this case) distributed over the past year, and other information that helped us estimate potential Cap-and-Trade compliance costs per therm.

We calculate that with an allowance price around $12.5 in 2015, the Cap-and-Trade related costs on natural gas per therm consumed in 2015 would be 7 cents. However, unlike the electricity distributor utilities, natural gas providers do not have to consign 100 percent of the free allowances they received from the State, resulting in a diminished Cap-and-Trade cost pass-through.

What is directly mitigating those costs?

Every year, the state assigns natural gas suppliers a specific amount of allowances, based on their baseline 2011 emissions, in order to ensure that their ratepayers do not experience sudden increases in their bills due to the Cap-and-Trade Program. State regulation requires that natural gas suppliers must consign at least 25 percent of their allowances for the benefit of their ratepayers in the first year of compliance (2015).[39] This minimum requirement started at 25 percent in 2015 and increases every year by five percent until it reaches 50 percent in 2020. This means that at least 25 percent of the monetized allowance value will be directly given back to residential ratepayers, which recently was decided to be distributed in the form of climate credits. As such, natural gas residential customers will begin receiving annual climate credits starting in 2016, which could be approximately $10 to $20 per year. This would benefit our representative households that are customers of Pacific Gas and Electric (PG&E) and Southern California Gas Company (SoCalGas).

What is the cost pass-through from the natural gas utilities to ratepayers/consumers?

The annual Cap-and-Trade compliance costs passed through for natural gas utilities are equal to the number of allowances needed to cover compliance obligations, minus the amount of free allowances received, in addition to the number of allowances consigned:

Compliance costs = End-users needs – Free Allowances + Consigned Allowances

We calculated that with an allowance price around $12.5 in 2015, Cap-and-Trade compliance costs on natural gas would be around 2 cents per therm consumed in 2015, for Pacific Gas and Electric (PG&E) and the Southern California Gas Company (SoCalGas). Our findings are in line with what natural gas utilities reported as GHG costs for 2015.[40]

The California Public Utilities Commission (CPUC) ordered natural gas utilities to hold on to their Cap-and-Trade compliance costs and revenues for the first year and "amortize their 2015 forecast costs and allowance proceeds equally between 2016 and 2017."[41] Thus, although our analysis covers the period from 2015 to 2020, in reality, natural gas customers most likely did not start to experience a bill impact from Cap-and-Trade until 2016.

What strategies indirectly mitigate those costs and what other data are taken into account in our study?

We used the following three sets of information to inform our analysis:

1. Based on historical data and trends retrieved from the California Energy Commission Demand Analysis Office, we incorporated into our analysis a decrease in natural gas consumption per household at a rate of 1.76 percent per year for PG&E customers, and 1.64 percent per year for SoCalGas customers, from 2015 through 2020.[42] Our results are within the industry's own forecast range[43] as well as consistent with data from the U.S. Energy Information Administration (EIA).[44]

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39 California Air Resource Board (2011). Subchapter 10 Climate Change, Article 5, Section 95892. http://www.arb.ca.gov/regact/2010/capandtrade10/ctfro.pdf

40 Pacific Gas and Electric (November 30, 2015). Advice Letter 3647-G-A, Table A. SoCalGas (November 12, 2015). Advice Letter 4877-A, Appendix A, table A.

41 California Public Utilities (2015). Proceeding R14-03-003 on Natural Gas and Cap-and-Trade. p.63. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M155/K330/155330024.PDF

42 California Energy Commission (2015). California Residential Natural Gas Consumption. http://energyalmanac.ca.gov/naturalgas/residential_natural_gas_consumption.html

43 California Gas and Electric Utilities (2014). 2014 Natural Gas Report. p.36 for residential northern California forecasts and p.64 southern California forecasts. www.pge.com/pipeline/library/regulatory/downloads/cgr14.pdf

44 U.S. Energy Information Administration (2015). Annual Energy Outlook 2015 with Projections to 2040. p.16. https://

2. Programs such as the California Alternate Rates for Energy (CARE) and Family Electric Rate Assistance (FERA) help low-income customers of electricity and natural gas utilities afford their bills. Because this discount applies to the entire bill, it automatically helps to lower any Cap-and-Trade compliance costs passed on to customers. The eight hypothetical, representative households in our case studies communities are eligible for and enrolled in a low-income energy discount program, such as CARE. Political support for the CARE program is unlikely to change because it has been in place for a long time and benefits over 4.5 million Californians (with about an 84 percent penetration rate of total estimated eligible households).[45]

3. The allowance price is most likely going to trade at the bottom floor price, during the time period of our study. We made this forecast for several reasons. According to Severin Borenstein's analysis, there is only a four to 17 percent chance that the carbon price would raise above the bottom floor price and reach the lowest step of the Auction Price Containment Reserve (APCR) during the 2015 to 2017 period. There is a 31 percent or less chance of reaching the APCR from 2018 to 2020. Our forecast is also informed by the past auction results since 2014.[46] (Refer to Chapter 3, Graphic 1). In general, the price has hovered just slightly above the bottom floor price. The State of California has the obligation to sell all allowances in the market every year, which pushes it to sell near or at the bottom floor price. As an example, during the last auction on February 17, 2016, 95 percent of current vintage allowances were sold at the minimum floor price of $12.73 and 93 percent of the 2019 vintage allowances sold at the floor price of $12.73.

   It is likely that a higher percentage of allowances could sell above the bottom floor price in the future, but factoring this into our calculations would require use to make specific numerical assumptions. To maintain objectivity, we use the bottom floor price in this chapter while in the Appendix we present a scenario in which the carbon price trades much higher, at the first step of the APCR. Together, these two scenarios present a range of possibilities.

5.2. Findings

Table 5 below presents our estimated financial impact of the Cap-and-Trade Program for each of our eight case study households as natural gas customers, between 2015 and 2020. Our results find a net positive financial impact for our representative households living in disadvantaged communities across California. We estimate that from 2015 through 2020 these households could receive approximately $44 to $83 from the state more than they would pay in total related to Cap-and-Trade compliance costs. Our findings on Cap-and-Trade impacts on utility rate impacts are in line with IOUs reported impacts.[47]

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www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf

45 California Public Utilities Commission (2015). CARE Fact Sheet. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=7795

46 California Air Resources board (2015). Summary of Auction Settlement Prices and Results. http://www.arb.ca.gov/cc/capandtrade/auction/nov-2015/ca_proceeds_report.pdf

47 Pacific Gas and Electric (November 30, 2015). Advice Letter 3647-G-A, Table A. SoCalGas (November 12, 2015). Advice Letter 4877-A, Appendix A, table A.

Table 5: Estimated Cumulative Financial Impact of the Cap-and-Trade Program on our Natural Gas Ratepayers,* from 2015 through 2020

Estimations	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1	**4 people** **Single-family structure**	**3 people** **Multi-family dwelling**	**4 people** **Single-family structure**	**4 people** **Single-family structure**
Compliance costs passed through	($46)	($42)	($60)	($59)
Climate credits received	$104	$116	$104	$104
Net financial impact related to C&T	$58	$74	$44	$45
Representative Household #2	**4 people** **Multi-family dwelling**	**2 people** **Multi-family dwelling**	**4 people** **Single-family structure**	**4 people** **Mobile home**
Compliance costs passed through	($35)	($33)	($60)	($56)
Climate credits to be received	$104	$116	$104	$104
Net financial impact related to C&T	$70	$83	$44	$48

*Table note: Climate credits should not be considered as a natural gas bill reduction per say because although they are administered by the utilities, they are mandated by the state.

In order to present an expanded analysis, two other scenarios can be found in the Appendix. Scenario 2 presents a broader range of price impacts, where all of the aforementioned assumptions remain the same, except that the allowance price jumps from the bottom floor price to the first step of the APCR in 2018 (from around $14 to $56). This analysis demonstrates that the higher the allowance price is, the more low-income households might be protected by climate credits.

Scenario 3 presents an analysis where by none of the representative households are eligible to the CARE discount, in order to highlight the importance of this program in protecting low-income Californians.

6. Gasoline:

Assessing the Financial Impact of Cap-and-Trade on Case Study Households in Disadvantaged Communities across California

This chapter quantitatively estimates how the Cap-and-Trade Program could affect our case study households as gasoline consumers in disadvantaged communities across California. To do so, this chapter addresses the following questions:

1. What are the compliance costs of the Cap-and-Trade Program per gallon of gasoline?
2. What is the cost pass-through to consumers?
3. What are the strategies in place to indirectly mitigate those costs?
4. What do we estimate will be the financial impact on our representative households in disadvantaged communities as gasoline consumers?

6.1. Background and Data used in our Study

What are the compliance costs of the Cap-and-Trade Program per gallon of gasoline?

For the gasoline sector, Cap-and-Trade compliance costs can be calculated by multiplying the price of one metric ton of carbon dioxide equivalent (MtCO2e) by the amount of MtCO2e emitted per gallon combusted. See Chapter 3 and the Appendix for details. According to the California Air Resource Board (ARB), California has had 10 percent ethanol in its gasoline since the beginning of 2010,[48] which is also referred to as E10. The combustion of a gallon of E10 produces 0.0085 MtCO2e (CO2, CH4 and N2O).[49]

Consequently, with an allowance price trading at $12.52 in August 2015, this would increase the cost of a gallon of gasoline by 11 cents[50] and will likely go up to 15 cents per gallon in 2020, if the allowance price keeps trading at the bottom floor price. Based on the average number of miles that our case study households drive, we estimate that this could translate into an additional $65 to $98 cost for each household in 2016. It is important to note that 11 cents of a $3.8 gallon of gasoline (the 2015 average price)[51] represents only a 3 percent fuel price increase. This becomes an important factor

48 California Air Resources Board (2010). FAQ. http://www.arb.ca.gov/fuels/gasoline/faq.htm

49 California Air Resources Board (2012). Regulation – 40 CFR Part 98 Subpart C. Default CO2, CH4 and N2O Emission Factors and High Heat Values for Various Types of Fuel. pp.40-42. http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf

50 Aug 2015 Allowance price @ $12.52 * 0.0085 MtCO2e per Gallon of Gasoline = $0.11/gallon. This estimation is in line with Severin Borenstein's study (2014) "Report of the Market Simulation Group on Competitive Supply/Demand Balance in the California Allowance Market and the Potential for Market Manipulation" p.56, table 5. http://www.ourenergypolicy.org/wp-content/uploads/2014/07/HAAS.pdf

51 U.S. Energy Information Administration (2016). Annual Retail Gasoline Price in California for 2015. https://www.eia.gov/

when multiplied by thousands of miles travelled each year, but it should be kept in mind that this cost increase could be offset by using less air conditioning or by driving two or three miles per hour slower on highways (for the average car).[52,53]

What is the cost pass-through to consumers?

The ARB does not allocate free allowances to gasoline providers, unlike for electricity and natural gas providers, in part because the state would not able to ensure that gas providers use the free allowances for the benefit of customers. Thus, gasoline consumers will experience a full Cap-and-Trade cost pass-through in the form of higher gasoline prices.[54]

What strategies indirectly mitigate those costs and what other data are taken into account in our study?

Gasoline customers do not receive climate credits or any other mechanism to directly mitigate Cap-and-Trade compliance costs passed through. However, state policies and standards, climate investments, other programs as well as other factors are significantly impacting vehicle-miles traveled and vehicle efficiency over time. This reduces gasoline consumption, which indirectly reduces gasoline consumer exposure to Cap-and-Trade related costs. Specifically, the following impacts our analysis:

1. California data from the Federal Highway Administration indicates that household vehicle-miles traveled (VMT) have decreased by 1.1 percent each year since 2000.[55,56] The decreasing VMT trend is likely to continue given policies—most notably Senate Bill 375 that requires metropolitan planning organizations to reduce VMT over time—and because of behavioural factors such as the increase of teleworkers and the change in transportation preferences among the younger generation.

2. Using data from the Nationwide Personal Transportation Survey, Murakami and Young (1997)[57] found that the average car in low-income families is 10 years old, compared to 7.3 years for other households. This three-year lag is taken into account in our gasoline consumption model.

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dnav/pet/pet_pri_gnd_dcus_sca_a.htm

52 Severin Borenstein (2014). Californians Can Handle the Truth About Gas Prices. https://energyathaas.wordpress.com/2014/08/11/californians-can-handle-the-truth-about-gas-prices/

53 John F. Thomas, Brian H. West and Shean P. Huff (2013). Predicting Light-Duty Vehicle Fuel Economy as a Function of Highway Speed. http://www.greencarcongress.com/2013/01/thomas-20130117.html

54 Department of Energy - Energy Information Administration (2003). Gasoline Price Pass-through. http://www.eia.gov/pub/oil_gas/petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm. For the gasoline sector, it is estimated that "the price pass-through from the spot to the retail market is complete within two-and-one-half months, with about 50 percent of the change occurring within 2 weeks and 80 percent within 4 weeks.

55 Kent M. Hymel (2014). Factors Influencing Vehicle Miles Traveled in California: Measurement and Analysis. http://www.csus.edu/calst/FRFP/VMT%20Trends%20-%20Hymel%20-%20Final%20Report.pdf. This study uses data retrieved from the Highway Statistics Annual Publication published by the Federal Highway Administration.

56 U.S. Department of Transportation, Federal Highway Administration (2011). Highway Statistics Annual Publication. https://www.fhwa.dot.gov/policyinformation/statistics.cfm

57 E. Murakami and J. Young (1997). Daily Travel by Persons with Low Income. http://nhts.ornl.gov/1995/Doc/lowinc.pdf

3. ARB's EMissions FACtors (EMFAC) Web Database[58] presents emissions and emission rates data for vehicle fleets in California. From this we were able to calculate past, current and forecasted fuel efficiency of vehicle fleets in each county of our case study communities. Using those data for each of our census tracts, we estimate that the average on-road, vehicle fuel economy for our representative low-income households is 22 miles per gallon (MPG) in 2015 and will increase to 24.5 MPG by 2020, resulting in an overall efficiency improvement of 11 percent during our study period. Given this fuel efficiency increase and the aforementioned VMT trend, we forecast that there will be a 15 percent decrease in gasoline consumption for our case study households, from 2015 through 2020.

4. As we do in the previous chapters, we again assume that a MtCO2e will trade at the bottom floor price. See the previously stated justification, located immediately before the Findings sections in Chapters 4 and 5. Another price scenario and its impact on gasoline expenditure is presented in the Appendix.

6.2. Findings and Discussion

Table 6 shows that we estimate that our representative households as gasoline customers could potentially receive a cumulated, indirect net benefit of approximately $350 to $700 during the Cap-and-Trade program period by 2020. Gasoline customers do not receive climate credits or another other mechanism to directly offset Cap-and-Trade compliance costs passed through from gasoline providers. However, state policies and standards, climate investments, other programs as well as other factors are significantly impacting vehicle-miles traveled and vehicle efficiency over time. This reduces gasoline consumption and thereby indirectly reduces gasoline consumer exposure to Cap-and-Trade related costs, which we estimate could be $65 to $98 for our representative low-income households in 2016.

The variances between each household are due to differences in the number of miles travelled each year, affected by local land use and transportation characteristics and transportation. For example, a typical household in the Oakland community on average drives fewer miles than a typical household in San Bernardino.

58 California Air Resources Board (2015). EMissions FACtors (EMFAC) Model Web Database. http://www.arb.ca.gov/emfac/

Table 6: Estimated Net Financial Impact of the Cap-and-Trade Program on our Gasoline Consumers, from 2015 through 2020

Estimations	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1	**Driving alone** **Carpooling**	**Public transit** **Driving alone**	**Driving alone** **Driving alone**	**Driving alone** **Carpooling**
Compliance costs passed through	($419)	($353)	($525)	($487)
Savings from fuel efficiency + VMT reduction	$858	$722	$1,123	$1,169
Net financial impact	$439	$369	$597	$682
Representative Household #2	**Driving alone** **Carpooling**	**Public transit** **Walking/biking**	**Driving alone** **Driving alone**	**Driving alone** **Carpooling**
Compliance costs passed through	($419)		($525)	($487)
Savings from fuel efficiency + VMT reduction	$858		$1,123	$1,169
Net financial impact	$439		$597	$682

In order to present a broader analysis, another scenario can be found in the Appendix. This Scenario 2 presents the reader with a broader range of price impact, where all assumptions remain the same except that the allowance price jumps from the bottom floor price to the first step of the APCR in 2018 (from around $14 to $56). This analysis demonstrates that even with a higher allowance price, the increased fuel efficiency gained from the vehicle upgrade still offsets the potential Cap-and-Trade Program related costs.

While our study focused on gasoline customers because they can be directly impacted by Cap-and-Trade compliance cost pass-throughs, it is important to note that many low-income Californians do not drive and therefore do not consume gasoline. It is also important to note that climate investments are designed to help make it easier for Californians to get around without a car. Each year, millions of dollars from the Greenhouse Gas Reduction Fund (GGRF) go towards the Affordable Housing and Sustainable Communities Program, the Low Carbon Transit Operations Program and the Transit and Intercity Rail Capital Program to give Californians alternatives to driving. The state Legislature is considering other strategies to help low-income Californians afford and use public transportation.

7. Conclusion: Importance of Mitigation Strategies

This report analyzed Cap-and-Trade compliance costs on electric utilities, natural gas utilities, and gasoline distributors. We also assessed their cost pass-through to customers; what might be directly or indirectly mitigating Cap-and-Trade related costs for low-income Californians; and the net impact. We find that the state is effectively protecting low-income Californians from Cap-and-Trade compliance costs passed through from electricity, natural gas, and gasoline providers.

While allowing carbon price signals to encourage lower greenhouse gas (GHG) consumption choices, policymakers also want to ensure that the Cap-and-Trade related costs do not disproportionately impact low-income Californians. We analyzed three types of mitigating strategies: 1) the provision of climate credits directly to households; 2) climate investments and other efficiency, fuel switching and vehicle-mile reducing programs and policies that help households lower their consumption of electricity, natural gas and gasoline; and 3) low-income rate assistance programs, which although unrelated to the Cap-and-Trade Program, can also reduce a household's budgetary burden associated with electricity and natural gas consumption. Because the latter two types of measures can lower energy and gasoline bills, they can indirectly help to lower any Cap-and-Trade compliance cost passed on to customers.

We estimate that during our study period, low-income Californians will likely receive more in climate credits than they will pay in Cap-and-Trade compliance costs passed through to them as electricity and natural gas ratepayers. We also estimate that gasoline customers could receive net savings during the Cap-and-Trade Program period through 2020. Gasoline customers do not receive climate credits or another mechanism to directly offset Cap-and-Trade related costs. However, state policies and standards, climate investments, and other factors are putting downward pressure on vehicle-miles traveled and upward pressure on vehicle efficiency over time in California as a whole. This reduces gasoline consumption and thereby could indirectly offset Cap-and-Trade related costs.

The results underscore the importance of climate credits, low-income energy assistance programs, and policies and programs that reduce vehicle-miles traveled and facilitate improved energy and vehicle efficiency. Many of these programs are now receiving funding from Cap-and-Trade auction revenues that go into the Greenhouse Gas Reduction Fund (GGRF). These climate investments are helping Californians to reduce their electricity, natural gas and gasoline consumption.

For example, the Low-income Weatherization Program (LIWP), supported by state climate investments from the GGRF, is making low-income housing units more energy efficient through weatherization.[59] This includes refrigerator replacement, water heater repair or replacement, heating and cooling system repair or replacement, weather stripping, insulation, caulking, window repair or replacement, and other measures that can affect electricity and natural gas consumption. We did not quantify the predicted impact of the LIWP and instead highlight its existence as an example of the types of programs that can affect mid- and long-term electricity and natural gas consumption trends.

59 California Department of Community Services and Development (2015). Low-Income Weatherization Program (LIWP) Program Guidelines, Effective Date: January 13, 2015. p.7.

Vehicle emissions and efficiency trends are also affected by government policies and programs, such as the state's GHG tailpipe standards under the Advanced Clean Cars Program and the federal GHG tailpipe and fuel economy standards. There is a gradual but growing percentage of cleaner, more fuel-efficient vehicles over time. The GGRF funded Low Carbon Transportation (LCTP) Program is helping low-income Californians afford to upgrade their vehicles to newer and more fuel-efficient models. Administered by the ARB, the LCTP has many sub-programs and projects, including the Clean Vehicle Rebate Project (CVRP). Thanks to the CVRP, the following rebates are available to Californians who purchase or lease a "clean" vehicle: $5,000 for a new fuel-cell vehicle, $2,500 for a new electric vehicle and $1,500 for a hybrid vehicle. This is in addition to the $7,500 federal tax credit (which is not useful to all low-income households because of tax liability reasons). Although historically the CVRP had very limited participation from low-income Californians, the ARB has recently moved to provide additional funding incentives for lower- and moderate-income consumers.

Another major clean vehicle incentive exists for low-income Californians who live in certain parts of the state. The ARB announced in June 2015 that a pilot project[60] in the South Coast Air Quality Management District and the San Joaquin Valley Air Pollution Control District regions will help low-income Californians replace their old, polluting vehicles with cleaner, more fuel-efficient cars. Under this Enhanced Fleet Modernization Program & Plus-Up Pilot Project, it is possible for a family that meets the income guidelines to receive up to $9,500 for a cleaner car, to what CVRP adds an extra $2,500 if the car is new.[61] (It is important to note that if a low-income Californian decides to scrap their old, dirty car but chooses not to replace it, they could be eligible for vouchers for public transit passes, between $2,500 and $4,500 in value, depending on their income level.) This means that our case study households in Los Angeles, San Bernardino and Traver could get up to $9,500 for the purchase of a secondhand electric car, or $7,000 for the purchase of a hybrid vehicle with a 35+ miles per gallon (MPG) fuel efficiency. This could potentially completely cover the cost to purchase a second hand hybrid vehicle.

As an added financial benefit, the improved vehicle efficiency of these replacement vehicles will reduce households' gasoline expenditures drastically. We estimate that fuel efficiency improvements could allow the new owners to save an average of 43 percent in gasoline expenditures. This would result in significant financial savings. As an example, with a gallon of gasoline at $3.8 (2015 average) and a car with an average of 35 MPG, a household in Los Angeles would save approximately $5,000 during the six years studied by our analysis.

This is just one example of how the state's climate investments might help low-income Californians save money while reducing emissions. An extensive suite of policies and programs, along with other factors, are putting downward pressure on energy and fuel consumption over time. This then affects what we predict will be net financial benefits for low-income Californians during the Cap-and-Trade Program through 2020.

As policymakers consider the next phases for the state's climate programs, including Cap-and-Trade, it would behoove them to understand the financial impact of such programs on low-income Californians. State decision makers may specifically want to consider continuing programs post 2020 and increasing and/or strengthening climate credits, low-income energy assistance programs, and policies that facilitate improved energy and vehicle efficiency and reduced vehicle-miles travelled.

60 California Air Resources Board (2015). Making the Cleanest Cars Affordable. www.arb.ca.gov/newsrel/efmp_plus_up.pdf
61 Ibid

8. Appendix

8.1. Selecting our Eight Case Study Households

As introduced in Chapter 2, researchers at the UCLA Luskin Center for Innovation used the California Communities Environmental Health Screening Tool (CalEnviroScreen Version 2.0) to identify California communities that are disproportionately burdened by environmental risks and social vulnerability indicators such as poverty. Using previously stated criteria for geographic and other forms of diversity, we selected four communities identified by CalEnviroScreen as disadvantaged communities. We used the American Community Survey data to identify average socioeconomic characteristics of households in each of the four case study disadvantaged communities. See Table 1 in Chapter 2 for the key characteristics of our selected communities.

For example, the census tract in Oakland has a high percentage of residents living in multi-family dwellings, the highest percentage of African American residents and the lowest average income per household. The census tract selected for Los Angeles (Pacoima) has an even distribution of residents living in multi- and single-family dwellings, and this census tract shows a high percentage of Hispanic or Latino residents. Traver, however, has an even higher percentage of Latinos than Los Angeles and is unique because of its relatively high amount of mobile homes in the census tract (30 percent of all households live in a mobile home or recreational vehicle). San Bernardino's census tract is characterized by single-family houses and low public transit use.

8.2. Construction of an Energy Consumption Profile for Each Case Study Household

In order to assess the financial impact that the Cap-and-Trade Program could have on lower-income households, it was necessary to first calculate the estimated annual baseline consumption of electricity, natural gas and gasoline for our representative households, before the impacts of Cap-and-Trade went into effect. In order to do so, we constructed electricity and natural gas and gasoline consumption profiles for each of the aforementioned case study households.

For inputs into the energy profile, we used data from the 2009 California Residential Appliance Saturation Survey.[63] The key objective was to obtain specific consumption patterns depending on housing types and climate zones. For inputs into the transportation profile model, we used data from the 2010-2012 California Household Travel Survey,[64] and the EMFAC 2014 Web Database.[65]

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63 California Energy Commission (2015). 2009 Residential Appliance Saturation Survey. http://www.energy.ca.gov/appliances/rass/

64 California Department of Transportation (2015). 2010-2012 California Household Travel Survey. http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_travel_analysis/chts.html

65 California Air Resources Board (2015). EMFAC 2014 Web Database. http://www.arb.ca.gov/emfac/2014/

Electricity

The 2009 California Residential Appliance Saturation Survey (CRASS)[66] provides information on appliances, equipment and general consumption patterns for five different dwelling types: single-family, 2-4 unit apartment, 5+ unit apartment, town house and mobile home. Those distinctions are important because electricity consumption is affected by the size of the house. As an example, a household living in a single-family home with an average of 1,882 square feet consumes an average of 894 kWh per year for central air conditioning while a multi-family unit apartment with an average dwelling size of 1,038 consumes on average 401 kWh per year.

In order to focus on disadvantaged communities, only some of the appliances listed in Table A were selected (circled in red). This is based on saturation rates provided by the CRASS and other studies conducted on behalf of the California Public Utilites Commission (CPUC).[67] As it can be noticed in the below table, the appliances not circled in red are either those with a very small saturation rate, or those excluded by the Luskin Center for the purposes of this study because they are correlated with the lifestyle of wealthier households (i.e. pool pump, spa, second refrigerator, etc.).

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66 California Energy Commission (2015). 2009 Residential Appliance Saturation Survey. http://www.energy.ca.gov/appliances/rass/

67 EverGreen Economics (2013). Needs Assessment for the Energy Savings Assistance and the California Alternate Rates for Energy Programs. http://www.energydataweb.com/cpucFiles/pdaDocs/1016/ESA%20CARE%20LI%20Needs%20Assessment%20Final%20Report%20-%20Volume%201%20-%2012-16-13.pdf

Table A: Electricity Consumption and Appliance Saturation Summaries, by Dwelling Type

	Single Family		Town Home		2-4 Unit Apt		5+ Unit Apt		Mobile Home	
	UEC	**Sat.**	**UEC**	**Sat.**	**UEC**	**Sat.**	**UEC**	**Sat.**	**UEC**	**Sat.**
All Household	7,605	15354 homes	4,561	1990 homes	3,821	2018 homes	3,709	4236 homes	5,580	858 homes
Conv. Heat	1,171	0.01	501	0.04	552	0.06	570	0.11	739	0.07
Heat Pump	994	0.01	320	0.01	324	0.01	522	0.03	504	0.02
Aux. Heat	382	0.01	86	0.00	62	0.02	99	0.02	342	0.01
Furnace Fan	216	0.73	91	0.61	80	0.42	64	0.40	157	0.66
Attic Ceiling Fan	96	0.19	217	0.08	286	0.08	304	0.06	280	0.11
Central Air Conditioning	894	0.56	483	0.41	494	0.33	324	0.36	876	0.48
Room AC	293	0.13	126	0.11	104	0.19	81	0.24	423	0.16
Evap. Cooler	650	0.06	359	0.02	383	0.04	266	0.02	552	0.28
Water Heat	3169	0.05	2190	0.06	1301	0.09	1543	0.11	2575	0.16
Solar Water Heat	1877	0.00	2075	0.00	.	0.00	.	0.00	.	0.00
Dryer	719	0.33	508	0.36	540	0.21	480	0.21	489	0.37
Clothes Washer	121	0.96	66	0.79	60	0.46	26	0.36	7	0.81
Dishwasher	83	0.74	62	0.68	60	0.49	50	0.58	52	0.56
First Refrigerator	827	1.00	731	1.00	643	1.00	660	1.00	740	1.00
Second Refrigerator	1286	0.33	665	0.14	695	0.10	635	0.05	1123	0.18
Freezer	968	0.23	877	0.14	846	0.10	742	0.06	802	0.27
Pool Pump	3,502	0.16	.	0.00	.	0.00	.	0.00	.	0.00
Spa	293	0.14	134	0.02	.	0.00	.	0.00	264	0.03
Outdoor Lighting	388	0.78	210	0.65	168	0.42	196	0.29	204	0.65
Range/Oven	310	0.42	234	0.43	218	0.43	165	0.55	224	0.30
TV	738	1.00	646	1.00	574	1.00	611	1.00	697	1.00
Spa Electric Heat	1,013	0.07	764	0.02	.	0.00	.	0.00	981	0.03
Microwave	133	0.94	111	0.93	109	0.88	99	0.89	109	0.88
Home Office	89	0.23	71	0.20	51	0.17	62	0.16	132	0.08
PC	673	0.88	495	0.84	479	0.77	498	0.80	437	0.72
Well Pump	562	0.06	511	0.02	614	0.01	561	0.01	447	0.20
Miscellaneous	2,177		1,441		1,233		1,141		1,510	

Table note: UEC stands for unit energy consumption. Sat. stands for saturation.

Table A highlights that some appliance consumption is affected by dwelling size or structure. However, as illustrated in Table B below, appliance consumption can also be affected by location/forecasted climate zone. As an example, a typical two- to four-unit apartment in San Bernardino (forecast zone 10) consumes 1,204 kWh per year for central air conditioning, while the same size apartment in Pacoima (forecast zone 12) consumes only 276 kWh per year.

Table B: Electricity Consumption for HVAC in 2-4 Unit Apartments in Different Forecast Zones

	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
2-4 Unit Apt	**UEC**	**Sat.**	**UEC**	**Sat**	**UEC**	**Sat**	**UEC**	**Sat**	**UEC**	**Sat**	**UEC**	**Sat**
All Household	4,069	431 homes	3,802	192 homes	5,146	251 homes	2,800	173 homes	3,270	47 homes	3,448	244 homes
Conv. Heat	304	0.03	408	0.07	406	0.01	259	0.05	116	0.10	496	0.14
Heat Pump	185	0.04	478	0.00	467	0.00	.	0.00	.	0.00	447	0.01
Aux. Heat	37	0.03	92	0.00	28	0.00	.	0.00	.	0.00	42	0.12
Central Air Conditioning	196	0.32	323	0.40	1,204	0.69	295	0.10	276	0.38	147	0.33
Room AC	60	0.26	218	0.25	290	0.16	67	0.26	89	0.31	50	0.31

We use the aforementioned information to create electricity consumption profiles for the eight representative households in each of the four climate zones of our four case study communities. It is important to note that both space and water heating were not taken into account in our electricity consumption calculations because the vast majority of low-income households do not use electricity for space and water heating, and instead use natural gas.[68] Thus, space and water heating needs are reflected in the natural gas consumption profiles, which are described in the following section. The following section uses the same general methodology as this section to create a natural gas consumption profile for each of the representative households.

Natural Gas

Accordingly to the California Residential Appliance Saturation Appliance Survey,[69] 85 percent of the population studied has a natural gas line to their home, with an annual average consumption of 354 therms per household. Nearly half (49 percent) of this energy was used for water heating and 37 percent for space heating. However, compared to electricity data, the survey does not provide the same level of depth when it comes to natural gas consumption. The information provided focuses on consumption of natural gas per dwelling type, or the consumption of natural gas per climate zone. Each was separated into two distinct tables as shown below by Tables C and D. Both distinctions are important.

68 EverGreen Economics (2013). Needs Assessment for the Energy Savings Assistance and the California Alternate Rates for Energy Programs. http://www.energydataweb.com/cpucFiles/pdaDocs/1016/ESA%20CARE%20LI%20Needs%20Assessment%20Final%20Report%20-%20Volume%201%20-%2012-16-13.pdf

69 California Energy Commission (2015). 2009 Residential Appliance Saturation Survey. http://www.energy.ca.gov/appliances/rass/

Table C below shows the appliances taken into account in our natural gas consumption model, which are circled in red. It also shows that water and space heating are affected by the size of the house and the number of people living in it. As an example, a household with an average of three residents living in a single-family home consumes an average of 183 therms per year for space heating, while a household of fewer than three residents living in a multi-family unit apartment consumes an average of 66 therms per year for space heating.

Table C: Natural Gas UECs per Year, by Dwelling Type

	Single Family		Townhome		2-4 Unit Apt		5+ Unit Apt		Mobile Home	
	All Homes		All Homes		All Homes		All Homes		All Homes	
	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.
All Household UEC	421	15357	245	1993	229	2018	149	4238	339	858
Primary Heat	183	0.85	58	0.80	66	0.70	32	0.61	143	0.56
Auxiliary Heat	93	0.01	39	0.01	50	0.01	38	0.01	90	0.00
Conv. Gas Water Heat	195	0.86	189	0.77	186	0.62	183	0.39	193	0.54
Solar Water Heat w/Gas Backup	162	0.00	145	0.00	143	0.00	165	0.00	153	0.00
Dryer	26	0.52	23	0.31	20	0.20	22	0.11	21	0.29
Range/Oven	36	0.69	32	0.61	33	0.57	28	0.46	24	0.52
Pool Heat	220	0.06	180	0.00	56	0.01	39	0.01	44	0.00
Spa Heat	52	0.07	66	0.01	.	0.00	.	0.00	34	0.00
Miscellaneous	23	0.13	22	0.10	23	0.07	31	0.03	41	0.06

Table note: UEC stands for unit energy consumption. Sat. stands for saturation.

Table D below shows that space heating needs are also affected by climate zone. For example, a typical household in San Bernardino consumes an average of 173 therms per year for space heating, while a similar household in Los Angeles consumes only 85 therms per year.

Table D: Natural Gas UECs per Year, by Climate Zone

	Zone 10		Zone 11		Zone 12		Zone 13		
	All Homes		All Homes		All Homes		All Homes		
	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household UEC	2456 homes	390	3206 homes	273	1576 homes	303	1098 homes	295	3886 homes
Primary Heat	0.80	173	0.83	62	0.75	85	0.87	98	0.73
Auxiliary Heat	0.01	64	0.02	30	0.01	31	0.00	44	0.00
Conv. Gas Water Heat	0.81	179	0.83	228	0.63	205	0.73	178	0.69
Solar Water Heat w/Gas Backup	0.00	143	0.00	203	0.00	200	0.00	141	0.00
Dryer	0.57	26	0.57	28	0.29	25	0.51	24	0.41
Range/Oven	0.78	34	0.77	40	0.74	35	0.82	31	0.58
Pool Heat	0.05	212	0.06	227	0.03	246	0.06	185	0.04
Spa Heat	0.06	48	0.07	96	0.02	60	0.06	49	0.07
Miscellaneous	0.09	23	0.14	31	0.06	25	0.12	21	0.15

Consequently, we computed a "dwelling size adjustment factor" depending on each dwelling type, which we applied to each of our selected appliance:

Size adjustment factor "k"=(average therms consumed per appliance x in dwelling type n)/(average therms consumed per appliance x in California)

As an example, for space heating needs, the average consumption of therms each year in the State of California is 144. According to Table C above, average consumption is 66 therms per year, for each apartment in a two- to four-unit apartment building. Thus, our adjustment factor for space heating for a two- to four-unit apartment is:

k=66/144= 0.46

This factor helped to obtain the amount of consumption depending on the dwelling type and the climate zone. For example, we know that on average a household in San Bernardino consumes 173 therms per year for "primary heating" (Table D). Consequently, we assume that an apartment in a two- to four-unit building in San Bernardino would consume 173*0.46 = 80 therms per year.

Gasoline

Vehicle-miles Travelled (VMT) and Mode of Transportation

For each census tract, a travel gasoline consumption profile was created using data retrieved from the 2010-2012 California Household Travel Survey Final Report.[70] Due to data limitations, the California Travel Survey is best used at a county level instead of a census tract level in order to have sufficiently large sample sizes. By expanding our analysis to the county level, we increased the number of households to analyse, in order to identify typical travel patterns depending on location, household size and the number of workers per household. As an example, the dataset indicated that a household living in a suburban area such as San Bernardino is likely to travel more and use less public transit than the same household in Oakland.

One of the main risks when enlarging the radius of analysis is that we are diluting some of the characteristics of our four specific disadvantaged communities. To help maintain fidelity, households with an income above $100,000 per year were deleted from our database for the purpose of this study. This allowed us to obtain the same annual income average per household between our model and the actual number within the census tracts selected.

The final results obtained were backed by the data retrieved from the American Census Tract Survey, summarized in Table E below. As illustrated, the census tract in San Bernardino has the highest percentage of people commuting in their own car to work. In both the Traver and Los Angeles census tracts, more than 20 percent of workers carpool. And in the Oakland census tract more people take public transportation, walk, bike or telecommute than commute by car.

Table E: Mode of Transportation for Work Related Trips

Work Related trips and mode of transportation to work	Los Angeles	Oakland	San Bernardino	Traver
Mean travel time to work (minutes)	23.9	27.5	26	21.2
Car, truck or van -- drove alone	59.10%	47.10%	72.80%	60.80%
Car, truck or van -- carpooled	21.40%	2.10%	18.30%	30.50%
Public transportation (excluding taxicab)	5.30%	25.60%	4.90%	0.00%
Walked	6.10%	10.20%	1.20%	2.40%
Other means	6.20%	11.70%	0.00%	1.60%
Worked at home	1.90%	3.30%	2.80%	4.80%

Based on common transportation modes for each of the four case study communities, we attributed a mode to each of the eight households. For example, it was decided when assembling hypothetical but representative households, that one household in Oakland would only travel using public or active transportation, such as walking or biking, per the data.

70 California Department of Transportation (2015). 2010-2012 California Household Travel Survey. http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_travel_analysis/chts.html

Gasoline Consumption and Fuel Efficiency

In order to estimate the number of gallons of gasoline consumed per year for each household, we analysed fuel efficiency trends. We use data retrieved from the California Air Resources Board's EMFAC 2014 Web Database[71] to calculate on-road fuel efficiency per county, per year. An advantage of using this database is that it projects fuel efficiency increases overtime.

Our study included results provided by the California Air Resources Board (ARB) regarding each of the following categories: passenger cars, light-duty trucks (GVWR < 6000 lbs, with ETW up to 5750 lbs) and motorcycles. Medium-duty, light-heavy-duty and medium-heavy-duty diesel trucks were excluded from our calculation because we focus on households rather than commercial or industrial sectors. Table F below presents our findings.

Table F: Average Fuel Efficiency for On-Road Passenger Vehicles per County

Year	Los Angeles County	San Bernardino County	Alameda County	Tulare County
2012	20.7	22.4	22.4	22.4
2013	20.9	22.7	22.7	22.8
2014	21.3	23.1	23	23.2
2015	21.7	23.6	23.5	24
2016	22.2	24.2	24	24.6
2017	22.8	24.9	24.7	25.3

Table note: Dates go from 2012 to 2017 instead of 2015 to 2020 because we assume that low-income households drive a vehicle that is three years older than the Californian average. Using data from the Nationwide Personal Transportation Survey, Murakami and Young (1997)[72] found that the average car in low-income families is 10 years old, compared to 7.3 years for other households.

Baseline Energy and Fuel Consumption Estimations

Table 3 in the body of the report presents our baseline energy and fuel consumption estimations for each of the eight representative households. All numbers are estimated for 2015, the year selected as our baseline, according to the following assumptions:

- Electricity consumption per household remains the same over the time, as explained in the body of the report;
- Average natural gas consumption per household decreases each year, depending on the location of the household, as explained in the body of the report. Thus, the annual average consumption of natural gas per household used in 2015 is less than the data retrieved from the 2012 California Residential Appliance Saturation Survey;

71 California Air Resources Board (2015). EMFAC 2014 Web Database. http://www.arb.ca.gov/emfac/2014/

72 E. Murakami and J. Young (1997). Daily Travel by Persons with Low Income. http://nhts.ornl.gov/1995/Doc/lowinc.pdf

- Average vehicle-miles travelled decreases each year, as explained in the body of the report; and
- Average fuel efficiency used for each county increases every year, as illustrated in Table F.

The estimated consumption of electricity, natural gas and gasoline differs amongst the various locations, each in a different climate zone with distinct land use and transportation patterns, and also due to differing household and housing characteristics. For example, San Bernardino will experience more extreme hot days compared to Oakland and thus a typical family there will use more electricity to cool their house, which is on average significantly larger than the home (statistically speaking, the apartment) of a household living in the Oakland case study community. Also, gasoline consumption will be higher for a family that lives in the outer ring of Los Angeles (i.e. the community of Pacoima) compared to the heart of more transit-friendly Oakland.

8.3. Cap-and-Trade Compliance Costs and Climate Credits Estimation

Most of the important information and assumptions made in our study are explained in the main report. Here, we supplement this information with the following details that informed our methodology for estimating financial impact on electricity, natural gas and gasoline consumers.

Gasoline

According to the U.S. Energy Information and Administration, "about 19.64 pounds of carbon dioxide (CO2) are produced from burning a gallon of gasoline that does not contain ethanol. California has had 10 percent ethanol (or E10) in its gasoline since the beginning of 2010.[73] Burning a gallon of E10 produces about 17.68 pounds of CO2 from the fossil fuel content. If the CO2 emissions from ethanol combustion are considered, then about 18.95 pounds of CO2 are produced when a gallon of E10 is combusted."[74] Since other greenhouse gases (GHG) are also covered by the Cap-and-Trade regulation, we accounted for other gases and their greenhouse effect weight as per the ARB Greenhouse Gas Reporting Regulation Document.[75] It was calculated that the combustion of a gallon of E10 (90 percent of gasoline and 10 percent of ethanol) produces 0.0085 metric ton of carbon dioxide equivalent (MtCO2e) (CO2, CH4 and N2O). Consequently, the GHG costs of gasoline is expected to be $12.52 (the allowance price in August, 2015)*0.0085 = $0.11 per gallon in 2015.

For our analysis on gasoline, we assume that all Cap-and-Trade compliance costs will be passed on from fuel distributors to consumers. This means that under all of our study's scenarios, 100 percent of the costs related to the purchase of allowances on the market will be systematically passed on to final customers. According to a large part of the literature, and the latest study realized by the Energy Information Administration (EIA), "estimates show that the price pass-through from the spot (of gasoline) to the retail market is complete within two-and-one-half months, with about 50 percent of the change occurring within 2 weeks and 80 percent within 4 weeks."[76]

73 California Air Resources Board (2015). Gasoline and greenhouse gas emission FAQ. http://www.arb.ca.gov/fuels/gasoline/faq.htm

74 U.S. Energy Information Agency (2015). FAQ on CO2 emissions. http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11

75 California Air Resources Board (2015). Greenhouse Gas Reporting Regulation. http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf

76 U.S. Energy Information Agency (2003). Gasoline Price Pass-Through. http://www.eia.gov/pub/oil_gas/petroleum/

Electricity and Natural Gas

Estimating the exact amount of carbon dioxide, methane and nitrous oxide emissions for each utility is a complicated task. The Luskin Center simplified the research by looking at published information disclosed by the CPUC regarding GHG emissions resulting from energy generation, its distribution, the infrastructures and distribution losses, the potential leaks and import/export trading balance. The Luskin Center decided to focus on the following variables in order to estimate the possible future evolution of Cap-and-Trade related costs per unit of energy:

- Cap-and-Trade compliance costs, defined as being the cost related to the purchase of allowances in the market in order to cover the utility's direct and indirect GHG emissions and comply with Cap-and-Trade regulations;
- Free allowances received by each utility, each year, on behalf of ratepayers (also called allowance proceeds);
- Amount or portion of allowances that will be consigned in order to be redistributed directly to final ratepayers;
- Amount or portion of allowances that will be used to invest in cleaner energy or other strategies not directly dedicated to climate credits;
- Amount of unit of energy (therms or kWh) distributed each year, and their potential evolution over time, for each utility;
- Amount of customers (accounts) per utility; and
- Any potential evolution over time.

Estimation of climate credits for electricity customers:

$$\frac{(\text{\# of Free Allowances Received * Price of MtCO2e * \% of Revenues Allocated to CC})}{\text{\# of Customer Accounts}}$$

Estimation of Cap-and-Trade related costs passed through to electricity customers:

$$\frac{(\text{Reported \# of Allowances Purchased to Cover End-Users Needs * Price of MtCO2e})}{\text{\# of kWh Distributed per Year}}$$

Estimation of climate credits for natural gas customers:

$$\frac{(\text{\# of Free Allowances Received * Price of MtCO2e * Consignment Rate})}{\text{\# of Customer Accounts}}$$

Estimation of Cap-and-Trade related costs passed through to natural gas customers:

$$\frac{\begin{array}{c}(\text{Reported \# of Allowances Purchased to Cover End-Users Needs +}\\ \text{Consigned Allowances – Free Allowances Received) * Price of MtCO2e)}\end{array}}{\text{\# of Therms Distributed per Year}}$$

feature_articles/2003/gasolinepass/gasolinepass.htm

The assumptions that we had to take into account when forecasting the future evolution of Cap-and-Trade related costs and climate credits, are listed below:

- Price of a ton of CO2 increases by five percent plus an inflation rate, as required by ARB regulation. We chose an inflation rate of two percent according to historical inflation in the U.S.
- Consignment rate increase by five percent, as required by ARB regulation, from 25 percent in 2015 to 50 percent in 2020.
- In this scenario, 100 percent of the revenues consigned from the sale of free allowances are distributed toward price mitigation, known as climate credits.
- According to the 2014 California Gas Report, the demand for natural gas will reduce by 0.2 percent every year, which impact our columns "End-Users Needs" and "# Therms Distributed per Year".

8.4. Alternative Scenarios for Assessing the Financial Impact of Cap-and-Trade on Electricity Ratepayers

Chapter 4 presented a scenario (Scenario 1) for assessing the financial impact of Cap-and-Trade on electricity customers in which the carbon price stays at the bottom floor Auction Reserve Price through 2020. Here, we present alternative Scenarios 2 and 3, and the period from 2013 to 2015.

Scenario 2

We present a scenario in which the price of one metric ton of carbon dioxide would more than double in 2018, from the bottom floor price to the first step of the Allowance Price Containment Reserve. (See chapter 3, section 3.1 for details about the Allowance Price Containment Reserve). This price increase would trigger a surge in Cap-and-Trade compliance costs passed through to customers. But it could also increase utilities' allowance proceeds, resulting in more money available for climate credits, if everything else remains constant. As Table G presents, if our assumptions remain the same, electricity ratepayers could benefit financially by receiving more than twice the amount they would receive if the carbon price stayed around the bottom floor price.

However, in this high carbon price scenario, electric utilities would most likely want to invest a larger share of those allowance proceeds into cleaner energy, in order to reduce their emissions. In that event, climate credits would not increase as much as the table below predicts. Any reduction in the climate credit amount predicated below, however, would be limited, because state regulation caps the maximum amount that can be invested in cleaner energy to 15 percent, assuring that the majority of these revenues would still be returned to ratepayers for price mitigation.

Table G: Scenario 2, Financial Impact of the Cap-and-Trade Program on our Electricity Ratepayers, Cumulative from 2016 to 2020

ESTIMATIONS	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1	**4 people Single-family structure**	**3 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Single-family structure**
Compliance costs passed through	-	($81)	($268)	($159)
Climate credits received	-	$715	$865	$715
Net financial impact related to C&T	-	$634	$598	$556
Representative Household #2	**4 people Multi-family dwelling**	**2 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Mobile Home**
Compliance costs passed through	-	($79)	($268)	($111)
Climate credits received	-	$715	$865	$715
Net financial impact related to C&T	-	$635	$598	$604

Scenario 3

In order to highlight the importance of low-income rate assistance programs, we present a scenario in which the case study households are not enrolled in the California Alterative Rates for Energy (CARE) or a similar energy discount program. The compliance costs are higher in this scenario than they are in the scenario presented in the main report. This is due to the 35 percent discount applied on the bills of low-income households enrolled in the CARE program. This discount being applied on the overall utility bill, the Cap-and-Trade related costs are then discounted the same way. The net financial impact remains positive because the amount received through climate credits is higher than the Cap-and-Trade Program related costs.

Table H: Scenario 3, Financial Impact of the Cap-and-Trade Program on our Electricity Ratepayers, Cumulative from 2016 to 2020

ESTIMATIONS	Los Angeles	Oakland	San Bernardino	Traver
Representative Household #1	**4 people Single-family structure**	**3 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Single-family structure**
Compliance costs passed through	-	($48)	($158)	($94)
Climate credits received	-	$276	$341	$276
Net financial impact related to C&T	-	$229	$183	$183
Representative Household #2	**4 people Multi-family dwelling**	**2 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Mobile Home**
Compliance costs passed through	-	($47)	($158)	($65)
Climate credits received	-	$276	$341	$276
Net financial impact related to C&T	-	$229	$183	$211

The Period from 2013 to 2015

Protection for Low-income and Other Residential Ratepayers Who Consume Less Electricity (Senate Bill 695)

During the Cap-and-Trade period from 2013 to 2015, state law (SB 695) restricted the investor-owned utilities (IOUs), such as Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE), from increasing lower-tier electricity rates (Tier 1 and Tier 2). That restriction, which represent the vast majority of kWh consumed, means that residential ratepayers who used less electricity received significant protection from any potential cost pass-through associated with Cap-and-Trade compliance from 2013 to 2015. Specifically, annual increases to Tier 1 and 2 rates were pegged to the consumer price index plus one percent, with an upper limit of five percent.

SB 695 takes an additional step to protect low-income households enrolled in CARE. The law placed further restriction on any CARE Tier 1 and Tier 2 rate increases.[77] In fact, the index upon which any increase would be pegged did not increase, resulting in an effective prohibition on rate increases.

All of our hypothetical, representative households in disadvantaged communities are not likely to consume any significant amount of electricity above the Tier 2 level. They were also likely to qualify for CARE and thus receive the additional protection.

Volumetric Rate Offset

CPUC's decision D.12-12-033 on December 12th 2012 explains that SB 695 restrictions on lower-tier "will be effectively blind to any carbon price signal and will have no incentive to alter electricity consumption as a result of the Cap-and-Trade Program, while customers on upper-tier rates will see a disproportionally strong signal."[78] Therefore, the CPUC decided to temporarily offset any carbon price signal in any tier through volumetric return of GHG allowance revenues, in order to avoid any inequity between residential customers, from 2014 through 2015, for the following IOUs: PG&E, San Diego Gas and Electric and SCE.

Residential Climate Credits (Non-volumetric Rate Offset)

As previously discussed, some of the money from Cap-and-Trade auction proceeds are being directly returned to the millions of residential customers of an IOU. As of April 2014, those Californians have received a "climate credit" line item on their utility bills twice a year.[79] They received approximately $25 to $40 each April and November, regardless of consumption or income. More specifically, the bi-annual climate credit for PG&E residential households was $29.8 in 2014 and $24.76 in 2015, twice a year and for SCE households the bi-annual climate credit was $40 in 2014 and $29 in 2015.[80]

This means that both a volumetric rate offset and a non-volumetric rate offset existed in 2014 and 2015 for residential customers of IOUs.

77 California Public Utilities Commission (2012). Decision 12-12-033. Comments on SB 695. p.22 & p.178. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M040/K631/40631611.PDF

78 California Public Utilities Commission (2012). Decision 12-12-033. Comments on SB 695. p.112. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M040/K631/40631611.PDF

79 California Public Utilities Commission (2014). "California Climate Credit" http://www.cpuc.ca.gov/PUC/energy/capandtrade/climatecreditfaq.htm

80 Ibid

Findings for the 2013 to 2015 Period

Due to the aforementioned cost protections established by the state, we determined that it is most likely that Cap-and-Trade compliance costs were not passed on to our representative households between 2013 and the end of 2015. Instead, thanks to climate credits, our representative households likely received a net positive impact. Table I below presents our estimation of the cumulated financial benefit of Cap-and-Trade on representative households living in disadvantaged communities across California. This table shows that in 2014 and 2015, the volumetric rate offset exactly compensated for the compliance costs in rates, resulting in a financial impact of $0, relative to what would have happened without the Cap-and-Trade Program. Moreover, our case study residential customers also received climate credits of $59.6 in 2014 and $49.5 in 2015 for those living in Oakland and Traver (within PG&E service territory), and $80 in 2014 and $58 in 2015 for those living in San Bernardino (within SCE service territory). (It is important to note that all residential ratepayers will receive the same climate credit.) Given what was previously discussed in the Publicly-owned Utilities section, we assume that our representative households in Los Angeles do not receive a Cap-and-Trade compliance cost pass-through nor do they receive climate credits.

Table I: Estimated Cumulative Financial Impact of the Cap-and-Trade Program for our Electricity Ratepayers, from 2013 through 2015

ESTIMATIONS	LOS ANGELES	OAKLAND	SAN BERNARDINO	TRAVER
Representative Household #1	**4 people Single-family structure**	**3 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Single-family structure**
Compliance costs passed through	-	-	-	-
Climate credits received	-	$109	$138	$109
Net financial impact related to C&T	-	$109	$138	$109
Representative Household #2	**4 people Multi-family dwelling**	**2 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Mobile home**
Compliance costs passed through	-	-	-	-
Climate credits received	-	$109	$138	$109
Netf financial impact related to C&T	-	$109	$138	$109

*Table note: Climate credits should not be considered as an electricity bill reduction per se because they are administered by the state instead of by the utilities.

8.5. Alternative Scenarios for Assessing the Financial Impact of Cap-and-Trade on Natural Gas Ratepayers

Chapter 5 presented a scenario (Scenario 1) for assessing the financial impact of Cap-and-Trade on natural gas customers in which the carbon price stays at the bottom floor Auction Reserve Price through 2020. Here, we present alternative Scenarios 2 and 3.

Scenario 2

In this scenario, the price of one metric ton of carbon dioxide more than doubles in 2018, from the bottom floor price to the first step of the Allowance Price Containment Reserve. (See chapter 3, section 3.1 for information about the Allowance Price Containment Reserve). This price increase triggers a surge in compliance costs passed through to customers. But it would also increase the allowance proceeds for utilities, resulting in more money available for climate credits, if everything remains constant. As Table J presents, if our assumptions remain the same, natural gas customers could benefit financially by receiving more than twice the amount they would receive if the price stays around the bottom floor price.

However, in this high carbon price scenario, natural utilities would most likely want to invest a larger share of those allowance proceeds into cleaner energy, in order to reduce their emissions. In that event, climate credits would not increase as much as the table below predicts. Any reduction in the climate credit amount predicated below, however, would be limited, because state regulation caps the maximum amount that can be invested in cleaner energy to 15 percent, assuring that the majority of these revenues would still be returned to ratepayers for price mitigation.

Table J: Scenario 2, Financial Impact of the Cap-and-Trade Program on our Natural Gas Ratepayers, Cumulative from 2015 to 2020

ESTIMATIONS	LOS ANGELES	OAKLAND	SAN BERNARDINO	TRAVER
Representative Household #1	**4 people Single-family structure**	**3 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Single-family structure**
Compliance costs passed through	($119)	($109)	($157)	($153)
Climate credits received	$268	$298	$268	$268
Net financial impact related to C&T	$149	$189	$111	$115
Representative Household #2	**4 people Multi-family dwelling**	**2 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Mobile Home**
Compliance costs passed through	($90)	($80)	($157)	($144)
Climate credits received	$268	$298	$268	$268
Net financial impact related to C&T	$178	$213	$111	$124

Scenario 3

The following scenario is the same as the scenario presented in the main report except for one factor: the households are not enrolled in a low-income rate assistance program such as CARE. Table K below presents the net financial impact of the Cap-and-Trade Program on natural gas consumers under this non-CARE scenario. We can see that the compliance costs passed through are slightly higher than for the CARE customers. This is due to the 20 percent discount applied to natural gas low-income customers who are eligible to the CARE program.

Table K: Scenario 3, Cumulated Financial Impact of the Cap-and-Trade Program on our Natural Gas Ratepayers, from 2015 to 2020

ESTIMATIONS	LOS ANGELES	OAKLAND	SAN BERNARDINO	TRAVER
Representative Household #1	**4 people Single-family structure**	**3 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Single-family structure**
Compliance costs passed through	($57)	($53)	($76)	($74)
Climate credits received	$104	$116	$104	$104
Net financial impact related to C&T	$47	$63	$29	$30
Representative Household #2	**4 people Multi-family dwelling**	**2 people Multi-family dwelling**	**4 people Single-family structure**	**4 people Mobile Home**
Compliance costs passed through	($43)	($41)	($76)	($43)
Climate credits received	$104	$116	$104	$104
Net financial impact related to C&T	$61	$75	$29	$61

8.6. Alternative Scenario for Assessing Financial Impact of Cap-and-Trade on Gasoline Consumers

To supplement the Scenario 1 in Chapter 6, here we present a scenario in which the price of a metric ton of carbon dioxide jumps from the bottom floor price to the first step of the Allowance Price Containment Reserve. (See chapter 3, section 3.1 for information about the Allowance Price Containment Reserve). This price jumps triggers a surge in compliance costs passed through to gasoline customers. However, as table L presents it, the savings resulting from fuel efficiency improvements and VMT reduction over time almost offset the Cap-and-Trade related costs. It is important to note that those numbers do not take into consideration the price elasticity of demand for gasoline in the long term. It has been proven that the gasoline demand is highly inelastic on the short term basis, but increases on a period longer than a year. Moreover, we do not take into consideration the strong impact resulting from pilot programs put in place by ARB, such as the Enhanced Fleet Modernization Program & Plus-Up Pilot Project (Refer to the Conclusion). We estimate that with a $9,500 voucher, low-income households could purchase a second hand clean car, and save a tremendous amount of money. As an example, with a gallon of gasoline at $3.8 (2015 average) and a fuel efficiency of 35 MPG, a household in Los Angeles, San Bernardino or Traver, would save approximately $5,000 during the six years studied by our analysis. This would completely offset any Cap-and-Trade related costs.

Table L: Scenario 2, Estimated Net Financial Impact of the Cap-and-Trade Program on our Gasoline Consumers, from 2015 through 2020

ESTIMATIONS	LOS ANGELES	OAKLAND	SAN BERNARDINO	TRAVER
Representative HH #1	**Driving alone**	**Public Transit**	**Driving alone**	**Driving alone**
	Carpooling	**Driving alone**	**Driving alone**	**Carpooling**
Compliance costs passed through	($958)	($806)	($1,199)	($1,107)
Savings from fuel efficiency + VMT reduction	$858	$722	$1,123	$1,169
Net Financial Impact	($100)	($84)	($77)	$62
Representative HH #2	**Driving alone**	**Public Transit**	**Driving alone**	**Driving alone**
	Carpooling	**Walking/ biking**	**Driving alone**	**Carpooling**
Compliance costs passed through	($958)	$ -	($1,199)	($1,107)
Savings from fuel efficiency + VMT reduction	$858	$ -	$1,123	$1,169
Net Financial Impact	($100)	$ -	($77)	$62

Table note: We only show one mode of transportation for the San Bernardino households because, according to data from the American Community Survey, the vast majority (approximately 3/4) of the population in the San Bernardino census tract reports driving alone to work and the other transportation modes reported are spread out very thinly relative to our three other census tracts.

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