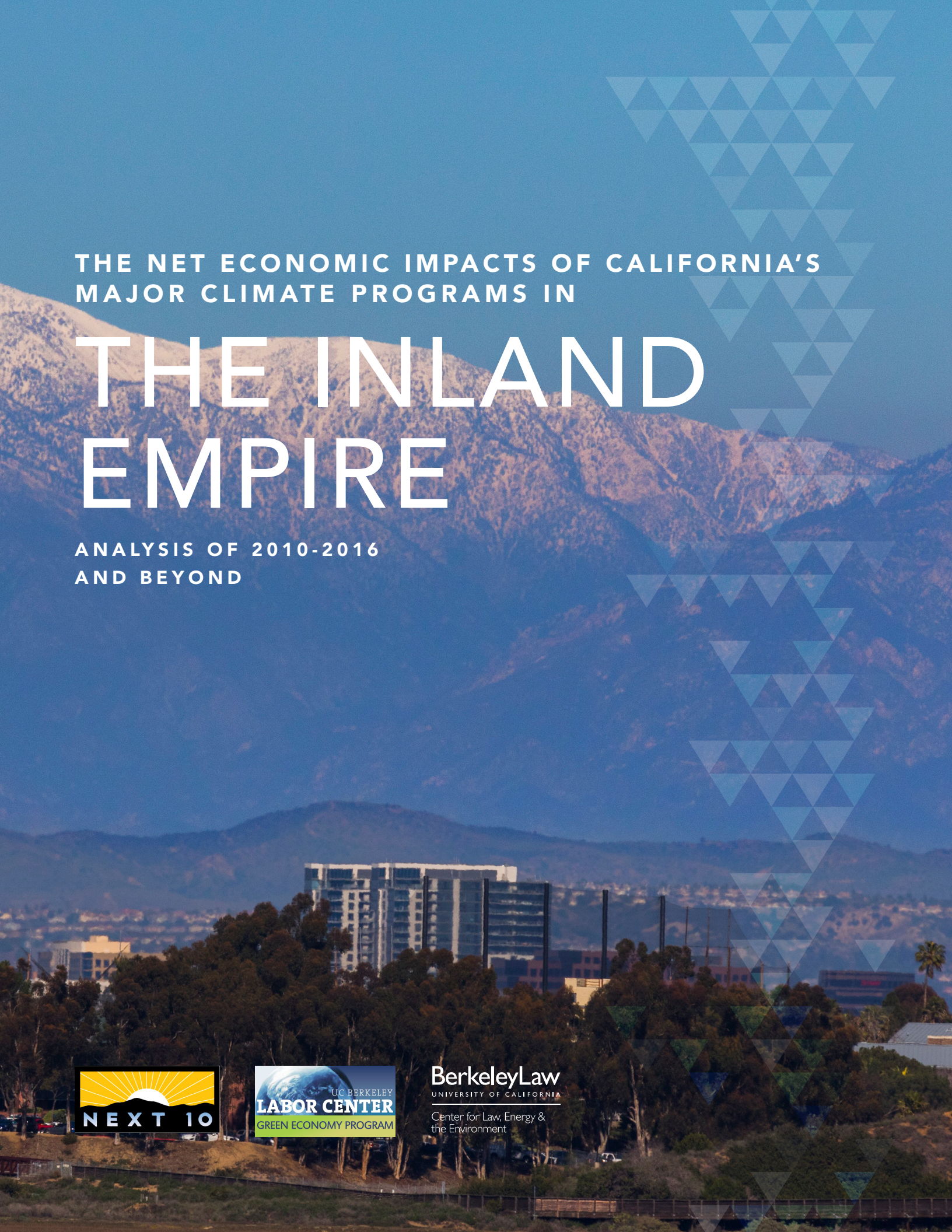

THE NET ECONOMIC IMPACTS OF CALIFORNIA'S MAJOR CLIMATE PROGRAMS IN

THE INLAND EMPIRE

ANALYSIS OF 2010-2016 AND BEYOND

NEXT 10

UC BERKELEY LABOR CENTER
GREEN ECONOMY PROGRAM

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EXECUTIVE SUMMARY

As the metropolis of Los Angeles spread east and Southern California industry shifted after World War II from manufacturing war supplies to a consumer economy, the sweeping groves of the Orange Empire gave way to the sprawling housing developments of the Inland Empire. Located in the valleys and foothills east of Los Angeles and north of San Diego, the Inland Empire is defined here as Riverside and San Bernardino Counties. Situated in a strategically important area inland from the ports of Long Beach and Los Angeles, the Inland Empire has been a hub for the transportation of goods and people since its initial development. After the economic downturn of 2008-09, the region emerged as a powerhouse in the blossoming logistics and warehousing industry;[1] transportation and warehousing employ 7 percent of the region's workers (compared with 5 percent statewide).[2] In addition, the Inland Empire has always included many "bedroom communities" for the Los Angeles area: about 44 percent of Inland Empire workers travel 30 or more minutes each way to work.[3]

But this economic shift has come with an environmental cost. Industrial air pollution has directly affected the lives of Inland Empire residents since World War II, when a steel plant was built in the San Bernardino County town of Fontana. The air quality challenges have become more pressing with the growth in automobile traffic in the Los Angeles area, as prevailing winds bring smog into the region.[4] The Empire's valleys also trap the area's own air pollution from the truck, automobile, and train traffic running through the region, connecting the ports to the west with the major throughways to the east.[5]

In addition to the environment, the economy of the region is also fragile. The Inland Empire makes up over 11 percent of California's population,[6] but incomes and employment lag behind much of the state. Per capita income is about $23,000 compared with a state average of over $30,000, placing it among the lowest earning metropolitan areas in California. More than 17.5 percent of the population was living below the federal poverty line in 2015 ($24,250 for a family of four), compared to 14.7 percent of California's entire population.[7] The environmental and economic challenges facing the Inland Empire make it an important region in which to study the economic impacts of the state's climate programs.

This report offers a quantitative assessment of the net economic impacts between 2010 and 2016 in the Inland Empire of four of California's major climate programs and policies: cap and trade, the renewables portfolio standard (RPS), distributed solar programs (including the California Solar Initiative), and investor-owned utility (IOU) ratepayer-funded energy efficiency programs, overseen by the California Public Utilities Commission (CPUC). It also includes projections and factors affecting the impacts of these programs on the region through 2030.

Results for the four programs and policies investigated are summarized below. The findings indicate that California's major climate policies have had net economic benefits in the Inland Empire.

Economic Impacts

This analysis presents costs and benefits to the Inland Empire economy—including job gain and loss—of cap and trade, the RPS, distributed solar programs, and energy efficiency programs overseen by the CPUC. We used publicly available data to determine the costs and benefits of these programs between 2010–16, and then modeled the regional economic impacts using IMPLAN.

After accounting for the full costs of these programs to industry, the region received $9.1 billion more than was spent, and saw 41,000 more jobs gained than were lost. When accounting for the ripple effects of this influx of capital (the secondary and tertiary spending that occurs), the Inland Empire saw a total of $14.2 billion in economic activity and 73,000 jobs as a results of California's major climate programs. Over 90 percent of the direct impact is due to the proliferation of renewable energy power plants in the region.

While the benefits of California's expanding green economy have been widely reported,[9] this analysis provides a more tempered account by also considering the suite of costs resulting from environmental policy.

For cap and trade, we quantified the cost to the Inland Empire's capped entities of complying with the program. These entities included transportation fuel suppliers, mining operations, and other emission-intensive industries. These estimated compliance costs were based on each entity's reported emissions, minus estimated free allowances, times the settlement price of greenhouse gas allowances auctioned by the California Air Resources Board. We quantified the benefits going to the region from the Greenhouse Gas Reduction Fund (GGRF), which is created with auction proceeds. We adjusted these benefits downward by accounting for the share of these investments in the region that "leak out" of the economy. For example, "leakage" occurs when Greenhouse Gas Reduction Fund investments are spent on locomotives

manufactured outside of the region. Even after weighing the costs and tempering the benefits, the cap-and-trade program has had a net positive impact in the region, meaning that the impact of the money flowing into the region from the investment of auction revenue via GGRF dollars exceeds the impact of money flowing out of the region for allowance purchases.

For the renewables portfolio standard (RPS), which requires that an increasing share of the state's electricity sales must be from renewable sources, we gathered information on all new power plants built in the region since 2010. We then omitted the construction of renewable energy facilities that may have been built to replace older natural gas plants that retired between 2010 and 2016. We reasoned that replacement infrastructure would have been built anyway, and we sought to measure only net impacts attributable to the RPS. We also accounted for the negative impacts of fossil fuel-based electricity generation reductions caused by the increase in renewable generation. The RPS has had a resulting significant net positive impact in the region. The Inland Empire is still a net importer of electricity, but less so due to the region's strong competitive advantage for wind and solar.

For distributed solar and energy efficiency, we gathered the ratepayer and federal incentives to customers in the Inland Empire to catalyze solar and efficiency investments. We did not account for the additional private spending associated with solar installation and energy efficiency. In addition to the public incentives, we accounted for the costs incurred by ratepayers in funding these climate programs. These costs and benefits are shown by line in Table 1 and described in the report with details on our data sources and methodology.

MOST AFFECTED INDUSTRIES

The impacts reported by IMPLAN (summarized in Table 1) can be used to identify local industries that benefit from and are harmed by the state's climate programs (See Table 2). These results indicate that the Inland Empire's building industry benefitted the most from the programs over the 2010 to 2016 period. The segments of this industry most impacted were involved in the construction of solar and wind electric power facilities as well as residential and non-residential solar. Construction establishments experienced an increase of over $9.6 billion in additional business and the addition of over 36,000 jobs. This activity added much needed stimulus to an industry that had not fully recovered from the 2008-2009 Great Recession.

Another positively impacted industry resulted from the operation of new wind and solar power generation facilities. Revenue for these operators increased by over $1.8 billion and increased employment by over 900 jobs. Third, the ripple effects associated with jobs, income, and spending increased revenue for local retailers by over $760 million and increased employment by approximately 9,000 jobs.[9] Fourth, wholesale establishments experienced a revenue increase of over $330 million and an employment increase of over 1,500 jobs. Finally, the increase in economic activity stimulated real estate activity. Sales revenue for real estate establishments increased by about $243 million with the addition of over 1,600 jobs. These top five most impacted industries experienced about 91 percent of the total economic impact and approximately 67 percent of the total employment impact.

TABLE 1 Economic Impacts (Costs and Benefits) of California's Major Climate Programs in the Inland Empire, 2010-16 (reported in 2017 dollars)

Climate Program	Impact	Direct Effects	Direct Employment	Total Impact on Economic Activity	Total Impact on Employment	Impact on State & Local Tax Revenue
		($ million)	(jobs)	($ million)	(jobs)	($ million)
Cap and Trade	Cap-and-Trade Auction Proceeds (Greenhouse Gas Reduction Fund (GGRF) Implemented)	$95	240	$58	409	$2.4
	Cap-and-Trade Compliance (Material Purchases)	-$25		-$15	-117	-$0.7
	Cap-and-Trade Compliance (Labor & Proprietor Compensation)	-$29		-$17	-138	-$0.8
Renewable Energy	Renewable Energy Construction	$8,367	29,255	$12,088	58,498	$360.1
	Increased Grid-Scale Wind Generation	$587	265	$809	2,046	$29.8
	Increased Grid-Scale Solar Generation	$1,307	669	$1,592	2,967	$36.4
	Reduced Natural Gas Generation	-$1,968	-1,167	-$2,021	-3,299	-$175.4
Distributed Solar and Energy Efficiency	Distributed Solar (Federal Tax Credit)	$893	4,836	$1,220	8,195	$40.7
	Distributed Solar (California Solar Initiative)	$210	1,134	$286	1,922	$9.6
	Energy Efficiency Installation Activity	$365	2,080	$489	3,292	$16.1
	Energy Efficiency Program Administration	$247	3,972	$357	4,643	$13.5
	Ratepayer Costs-Household Income	-$749		-$450	-3,568	-$21.7
	Ratepayer Costs-Supplier Industries	-$121		-$142	-1,441	-$4.6
	Ratepayer Costs-Proprietor Income	-$24		-$14	-113	-$0.7
	Net Impact	**$9,155**	**41,284**	**$14,240**	**73,296**	**$304.7**
Net Impact	**Average Annual Impact (2010-16)**	**$1,307.9**	**5,898**	**$2,034.3**	**10,507**	**$43.5**

*Note: Impact on economic activity includes direct effects and impact on employment includes direct jobs.

TABLE 2 Top Five Inland Empire Industries Benefiting From and Harmed by California's Major Climate Programs. Industry-Level Impacts for Industry-Level Revenue and Employment, 2000-16

Top Five Industries Benefitting from Programs	Revenue and Employment	Top Five Industries Harmed by Programs	Revenue and Employment
Construction	$9,690.3 million 36,536 jobs	Electric Power Generation with Fossil	–$1,724.4 million -1,165 jobs
Renewable Power Generation (wind and solar)	$1,894.1 million 934 jobs	Extraction of Natural Gas and Crude Oil	–$11.3 million –36 jobs
Retail	$762.6 million 8,917 jobs	Mining	–$3.6 million –7 jobs
Wholesale Trade	$338.4 million 1,551 jobs	Support Industries for Oil and Gas Operations	–$38,300 –less than 1 job
Real Estate	$242.8 million 1,625 jobs	Drilling Oil and Gas Wells	–$1,000 –less than 1 job
Total	**$12,928.2 million 49,563 jobs**		**–$1,739.3 million –1,210 jobs**

Source: IMPLAN. Results reported in 2017 dollars.

The industries most negatively affected were involved in fossil fuel power generation and extraction. For example, fossil fuel-based electric power generators experienced over $1.7 billion in reduced sales and the loss of over 1,100 jobs. Establishments involved in fossil fuel extraction in the two-county region lost almost $15 million in sales and over 40 jobs. The losses to businesses supporting oil and gas operations and drilling are low because there is little of this activity in the two-county region. The combined sales revenue loss of these five industries totaled over $1.7 billion. The employment loss exceeded 1,200 jobs in the two-county region.

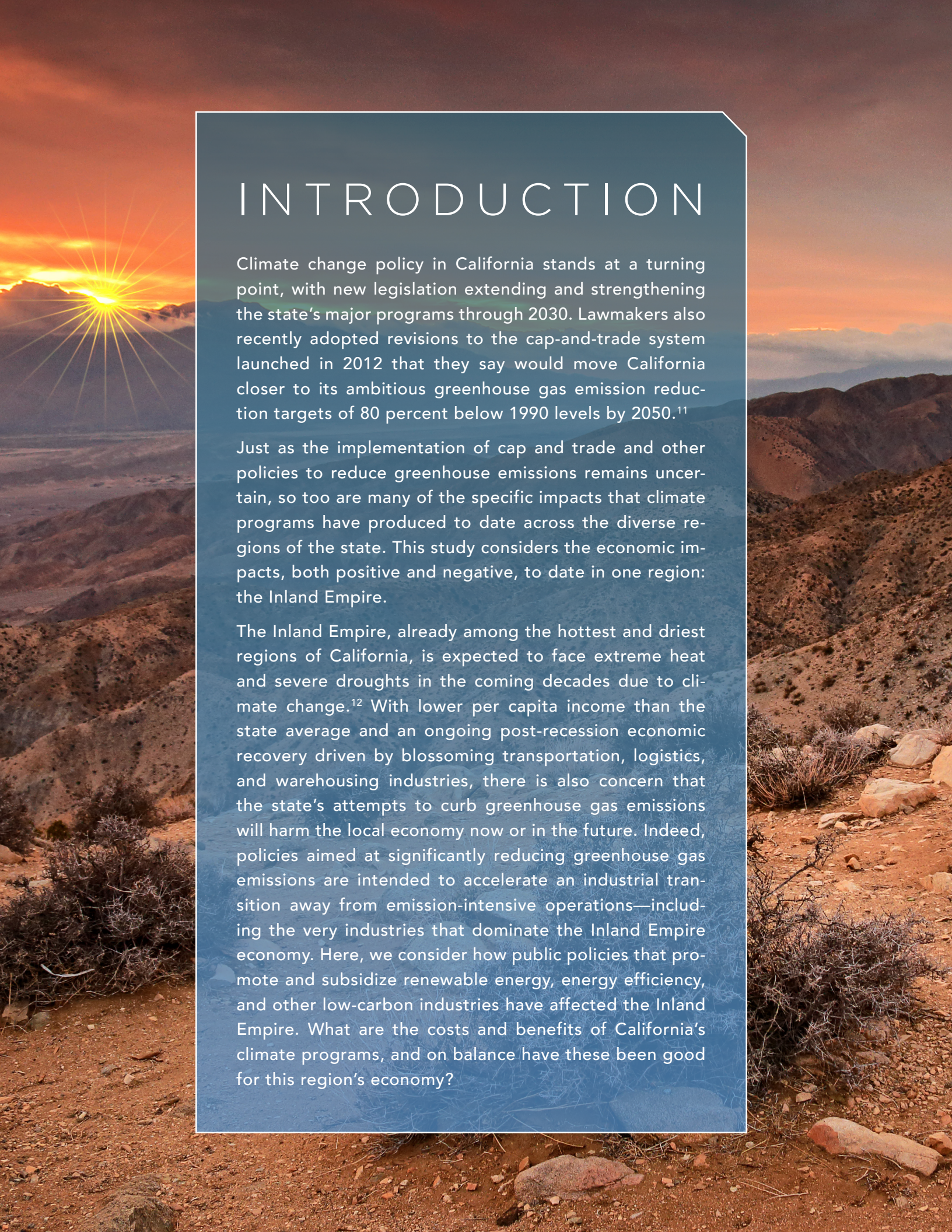
To place the positive net impact of climate programs on the Inland Empire economy in context, the gross regional product for the Inland Empire is $139 billion.[10] As a result, the impact on economic activity averages 1.4 percent of gross regional product each year. With a total workforce of more than 1.3 million in 2016, the average annual addition of about 10,500 jobs accounts for 0.8 percent of annual employment.

Policy Recommendations

Climate programs have had positive impacts overall in the Inland Empire, but there is room for improvement. To maintain and improve the positive effects of climate policy for the region, state leaders should consider the following priority law and policy changes to ensure the state's climate programs continue to benefit the Inland Empire:

- Develop a comprehensive transportation program equal to the renewable energy programs for electricity adopted in the state. A comprehensive strategy could build on the foundation of SB 375, the low carbon fuel standard, and transportation programs such as the California Sustainable Freight Action plan to maximize benefits and minimize harm for local industry and residents. The importance of warehousing and logistics and the distances traveled by residents each day to and from work makes transportation the greatest unknown of California's climate program.
- Improve implementation of the cap-and-trade program through 2030 by considering provision of dividends to consumers in the Inland Empire to account for the higher than average transportation fuel and electricity use in the region.
- Disburse cap-and-trade auction proceeds in a timely and predictable manner and ensure that the Inland Empire receives an appropriate level of statewide spending based on its economic and environmental needs.
- Ensure that a representative share of cap-and-trade auction proceeds are spent on Inland Empire programs (including potential dividends) that create jobs, further greenhouse gas reduction benefits, and reduce co-pollutants, particularly in disadvantaged communities, per SB 535 (de Leon), AB 1550 (Gomez), and AB 398 (Garcia) governing auction revenue spending.
- Expand energy efficiency incentives and expenditures for the Inland Empire where per capita energy use is higher than the state average. This will improve the building and housing stock in the Inland Empire, reduce energy costs for residents, businesses, and industry, create jobs, and increase economic activity in the region. GGRF funding should be used, in addition to ratepayer funds.
- Develop robust transition programs for workers and communities affected by the decline of the Inland Empire's greenhouse gas-emitting industries, including re-training and job placement programs, income supports, bridges to retirement for older workers, and regional economic development and diversification initiatives.
- Improve the economic and job benefits of renewable energy and energy efficiency projects through labor agreements that promote local and career-track jobs.

California has other critical climate programs in addition to the ones studied here, such as the low carbon fuel standard, zero-emissions vehicle incentives, net-metering, plans to reduce short-lived climate pollutants, and programs to encourage cities to adopt land use and transportation plans, thus reducing dependence on automobiles. Future studies should analyze the combined impacts of these programs in addition to those studied here. This report finds overall that policymakers who wish to continue the positive momentum in the Inland Empire should stay the course on existing policies and strengthen them as recommended.



INTRODUCTION

Climate change policy in California stands at a turning point, with new legislation extending and strengthening the state's major programs through 2030. Lawmakers also recently adopted revisions to the cap-and-trade system launched in 2012 that they say would move California closer to its ambitious greenhouse gas emission reduction targets of 80 percent below 1990 levels by 2050.[11]

Just as the implementation of cap and trade and other policies to reduce greenhouse emissions remains uncertain, so too are many of the specific impacts that climate programs have produced to date across the diverse regions of the state. This study considers the economic impacts, both positive and negative, to date in one region: the Inland Empire.

The Inland Empire, already among the hottest and driest regions of California, is expected to face extreme heat and severe droughts in the coming decades due to climate change.[12] With lower per capita income than the state average and an ongoing post-recession economic recovery driven by blossoming transportation, logistics, and warehousing industries, there is also concern that the state's attempts to curb greenhouse gas emissions will harm the local economy now or in the future. Indeed, policies aimed at significantly reducing greenhouse gas emissions are intended to accelerate an industrial transition away from emission-intensive operations—including the very industries that dominate the Inland Empire economy. Here, we consider how public policies that promote and subsidize renewable energy, energy efficiency, and other low-carbon industries have affected the Inland Empire. What are the costs and benefits of California's climate programs, and on balance have these been good for this region's economy?

Overall, this report finds that the net economic impacts of climate programs in the Inland Empire are positive. In part, this is due to the fact that the majority of climate policies implemented in California thus far focus on promoting renewable energy production. Between 2010 and 2016, numerous large-scale solar and wind facilities were built, started, or permitted in this region. The cap-and-trade program, which took effect in 2012 has also had a positive net economic effect in the region.

In addition to the direct economic impacts detailed here, climate programs can have significant positive impacts on public health, which in turn affects the economy. While quantifying these effects is beyond the scope of this paper, it is worth noting that the Inland Empire has a lot at stake. Air quality is far worse in the Inland Empire than in other regions of the state. Between 2006 and 2016, the South Coast Air Quality Monitoring District, which encompasses Los Angeles and Orange Counties in addition to the Inland Empire, experienced 1,392 days that exceeded the 2015 federal ozone standards. This means that for more than one-third of every year, ozone levels were high enough to be damaging to human health.[13]

Inland Empire pollution is even worse than the broader Southern California region. In 2016, locations in the Inland Empire had as many as 108 days exceeding the state ozone standard; the most in Los Angeles County was 55 and the most in Orange County was 13.[14] In 2015, a testing station in Ontario (in San Bernardino County) had the worst air quality in all of Southern California.[15] Smog in the Inland Empire is consistently among the worst in the state, and as a result, more residents are diagnosed with asthma and other pollution-related health conditions.[16] While car and truck traffic is the main culprit of air pollution, heat waves and wildfires exacerbated by climate change can worsen these conditions.

Within this context, California has embarked on an ambitious effort to reduce greenhouse gas emissions. The state seeks to reduce emissions to 1990 levels by 2020, per California's Global Warming Solutions Act of 2006 (AB 32, Nuñez, 2006).[17] SB 32 (Pavley, 2016) set further targets of 40 percent reductions below 1990 levels by 2030. Executive orders issued by Governor Schwarzenegger in 2005 (Executive Order S-3-05) and Governor Brown in 2015 (Executive Order B-30-15) both set the state's long-term goal of an 80 percent reduction below 1990 levels by 2050.[18] Meanwhile, SB 350 (de Leon, 2015), set 2030 targets for increasing renewable energy to 50 percent, accelerating widespread transportation electrification, and doubling the energy savings from efficiency.[19] SB 535 (De Leon, 2012) and AB 1550 (Gomez, 2016) prioritize disadvantaged communities for allocation of proceeds from the cap-and-trade program, which was established by AB 32. AB 398 (Eduardo Garcia, 2017) and the companion AB 617 (Cristina Garcia, 2017) extended the cap-and-trade program through 2030 by a supermajority vote, with the latter allowing for greater measures to monitor and reduce toxic air pollution, particularly in disadvantaged areas.

A number of studies have sought to quantify the job gains and other economic benefits of these state climate efforts, but this report presents the first study that quantifies both the costs and the benefits in the Inland Empire. These results may be useful to policymakers and leaders who seek to better understand how much the region pays for California's climate programs and how much it reaps the economic rewards.

Methodology

To conduct the economic impact analysis, we used the IMPLAN software for the two-county (Riverside and San Bernardino) Inland Empire region.[20] IMPLAN contains an input-output model that measures the market transactions between businesses, and between businesses and consumers, within a specified regional economy. For our analysis of the regional economic impact of climate policies in the Inland Empire, IMPLAN calculates both the benefits resulting from program investments in the region, and the costs of climate programs and regulations to the region's residents and businesses. The input-output model then measures the ripple effects, both positive and negative, of the initial impact of the climate policies. As money flows into or out of households and industries as a direct result of a climate policy, it stimulates or dampens subsequent transactions between other businesses and households. These ripple effects are known as multipliers.

The overall multipliers are based on direct, indirect, and induced effects. The direct effect is the initial impact: a spending or employment change in directly affected industries. In this particular analysis, the direct impacts are both the direct costs of paying for climate programs as well as the direct economic benefits from the investment that takes place under these programs.

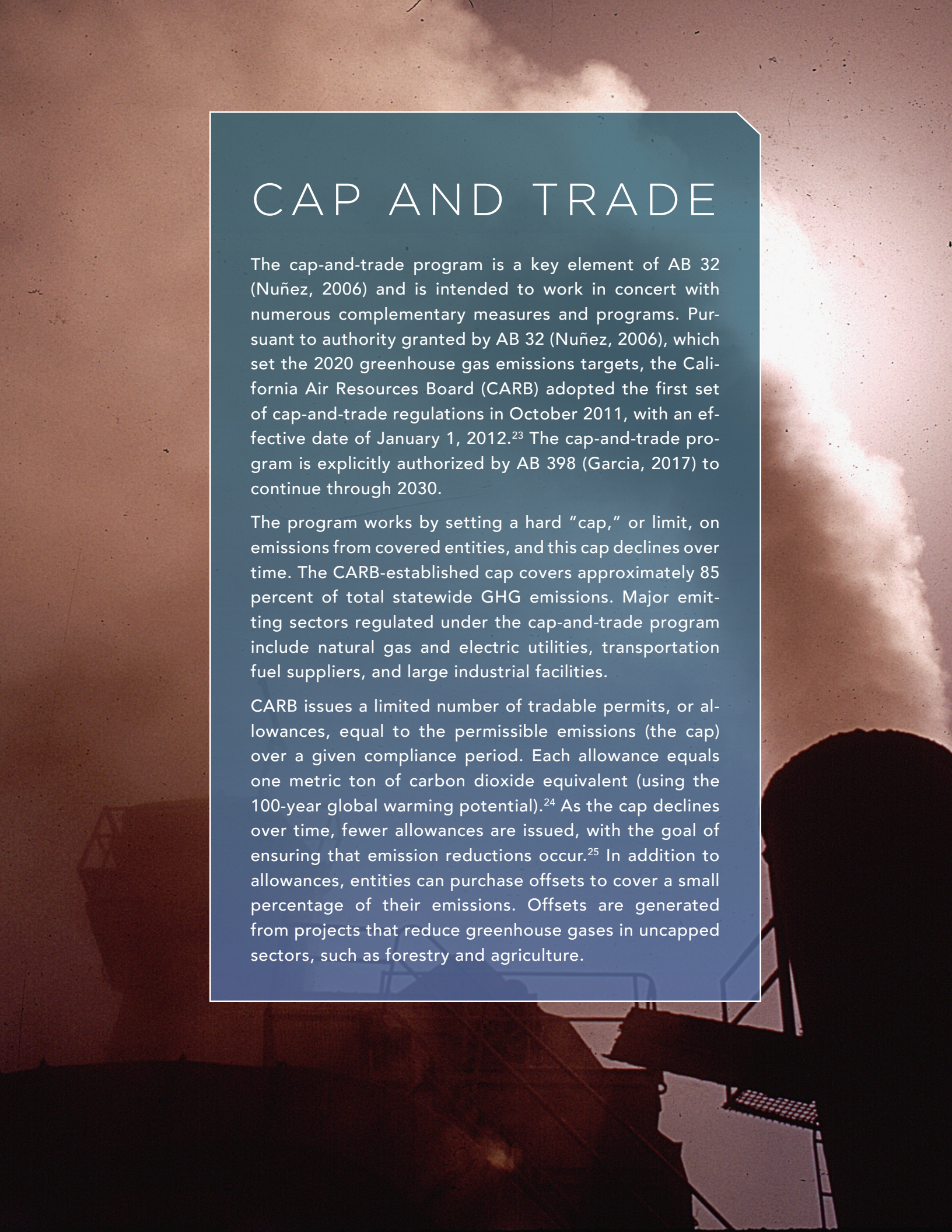
INDIRECT EFFECTS are "supply chain" effects; they measure the jobs and economic activities of industries that supply goods and services to the directly affected industries. The indirect effects capture increases and decreases in demand for supplies, like construction materials, caused by the initial impact.

INDUCED EFFECTS are the outer ripples resulting from changes in the income and spending of households, employees, and proprietors of industries directly or indirectly affected by the policies. These changes in spending re-circulate throughout the economy, into a diversity of sectors such as retail, personal and professional services, restaurants, and more. These effects are measured over the time period needed for all of the ripples to work through the regional economy.

IMPLAN's calculation of job impacts in an industry is based on the annual average of monthly jobs in the industry. This is the same method used by federal employment surveys. Because of this method, a "job" in IMPLAN is not a full-time equivalent (FTE), but it is close. On average, one job in IMPLAN equals 0.96 FTEs for one year.[21]

The use of IMPLAN in this analysis offers several advantages. First, IMPLAN allows for separate measurements of the negative impacts associated with the costs of these programs and the positive impacts associated with the investments in the region. In addition, the software uses data specific to the two-county Inland Empire region.

While the IMPLAN analysis in this paper looks backward at the impacts to date, the spending and employment multipliers can also be used for forecasting purposes. An important caveat, however, is that no methodology can adequately incorporate unrelated contemporaneous trends. For example, from 2014 to 2016, the cap-and-trade program increased costs for fuel suppliers; however, during the same period, the price of crude oil fell dramatically, providing a major boost to consumer incomes via a decrease in retail gasoline prices.[22] Using these multipliers for forecasting therefore cannot account for future unknowns.



CAP AND TRADE

The cap-and-trade program is a key element of AB 32 (Nuñez, 2006) and is intended to work in concert with numerous complementary measures and programs. Pursuant to authority granted by AB 32 (Nuñez, 2006), which set the 2020 greenhouse gas emissions targets, the California Air Resources Board (CARB) adopted the first set of cap-and-trade regulations in October 2011, with an effective date of January 1, 2012.[23] The cap-and-trade program is explicitly authorized by AB 398 (Garcia, 2017) to continue through 2030.

The program works by setting a hard "cap," or limit, on emissions from covered entities, and this cap declines over time. The CARB-established cap covers approximately 85 percent of total statewide GHG emissions. Major emitting sectors regulated under the cap-and-trade program include natural gas and electric utilities, transportation fuel suppliers, and large industrial facilities.

CARB issues a limited number of tradable permits, or allowances, equal to the permissible emissions (the cap) over a given compliance period. Each allowance equals one metric ton of carbon dioxide equivalent (using the 100-year global warming potential).[24] As the cap declines over time, fewer allowances are issued, with the goal of ensuring that emission reductions occur.[25] In addition to allowances, entities can purchase offsets to cover a small percentage of their emissions. Offsets are generated from projects that reduce greenhouse gases in uncapped sectors, such as forestry and agriculture.

The cap is enforced by requiring that each source operating under the cap turn in one allowance or offset credit (which is equivalent emission reductions or sequestered carbon achieved outside of the cap, subject to ARB's compliance protocol) for every ton of carbon dioxide-equivalent emissions it produces. To comply with the program, covered entities can reduce on-site emissions or buy allowances or offsets.[26] They can also trade allowances on a secondary market.[27] A portion of the issued allowances is distributed for free, a portion is placed in a reserve account (primarily as a safeguard to avoid price spikes in case of allowance shortages), and the remainder is auctioned. The allowances allocated to the investor-owned utilities (IOUs) are consigned to auction, with the revenue going back to IOU consumers. The publicly-owned utilities may also choose to auction their allowances.[28]

The state allocates free allowances for several reasons. In the case of electricity and gas utilities, allowances are provided to shield end users from sudden bill increases as a result of cap and trade. Industrial entities are given allowances to prevent leakage (moving activities out of state) and for transition assistance.

The number of free allowances each entity receives depends on the ARB's assessment of their leakage risk and transition assistance factors. In addition, the state has a sector- and entity-specific emissions allocation that is based on production, rather than energy consumption or emissions.[29] This way of distributing allowances ensures that entities with more efficient, lower-emission systems than their industry competitors are not inadvertently penalized for their climate leadership. In other words, if two widget manufacturers produce the exact same number of widgets, they will receive the same allowance allocation, even if one manufacturer has adopted a more efficient manufacturing process and has fewer emissions.

CARB conducts quarterly auctions. State proceeds from cap-and-trade auctions are deposited into the Greenhouse Gas Reduction Fund (GGRF) and then appropriated via legislative actions.

Statutes require that the state portion of the proceeds from the auction be used to further reduce GHG emissions, benefit disadvantaged communities, and, to the extent feasible, further the goals of AB 32, SB 32, and the legislature.[30] Expenditures must also comply with the requirements of SB 862, the 2014 trailer bill that provides continuous appropriations of GGRF monies for high speed rail, affordable housing and sustainable communities, transit capital, and transit operations beginning in FY 2014-15, as well as the aforementioned AB 617 (Garcia, 2017) and SB 535 (De Leon, 2012).[31]

As of December 2016, the auctions have generated more than $4 billion in proceeds for the GGRF.[32] During that time, the agencies developed and began implementing a suite of programs and activities around sustainable communities and clean transportation, clean energy and energy efficiency, and natural resources and waste diversion.[33]

BEYOND 2020

The legislature recently resolved the future of the cap-and-trade program beyond 2020, with the passage by a two-thirds supermajority of AB 398 (Garcia, 2017). This action allows the state to raise revenue from auctioning allowances without the risk of litigation (tax increases in California require two-thirds approval, and a court may have found the auction to constitute a form of taxation).

AB 398 made a number of changes to the current cap-and-trade program for the years 2021 through 2030, including the following:

- Imposed a new price ceiling on the allowance marketplace post 2020, based upon a variety of factors;[34]
- changed allocation of offset credits, limiting them to a total of 4 percent from the current 8 percent of a covered entity's compliance obligation through 2025, and 6 percent of the entity's compliance through 2030;[35] and
- changed rules for banking of allowances.[36]

AB 398 also made important changes to the allocation of proceeds from the auction, which could affect the amount available for a region like the Inland Empire. While existing law appropriates 60 percent of climate fund proceeds for transit, affordable housing, sustainable communities, and high-speed rail, AB 398 added several new priorities for spending proceeds from allowance auctions post-2020, such as mitigating air toxic and criteria air pollutants from stationary and mobile sources.[37] In addition, the legislation directs some of the proceeds to new purposes, such as replacing the state's fire prevention fee to fund fire prevention activities and extending a tax cut for certain assets through cancellation of outstanding and unpaid sales and use tax.[38]

AB 398 was contingent upon the passage of two companion bills, with further implications for how auction proceeds will be spent. First, ACA 1 (Mays, 2017) proposes a state constitutional amendment to go before the voters, which, if approved, would require all appropriations of auction proceeds in 2024 to be subject to a one-time, two-thirds majority vote in the legislature.[39] After the two-thirds approval is secured, appropriations of GGRF funds in future years would resume as usual and could be modified by a majority vote.[40] If the legislature fails to approve new appropriations after January 1, 2024, the funds would be held in the state treasury. Second, AB 617, discussed above, allows GGRF dollars to be used to help fund emissions reduction programs in disadvantaged areas, including grants to support community participation in the programs.

Economic Impacts of Cap and Trade in the Inland Empire

The cap-and-trade program has both positive and negative impacts on the economy of the Inland Empire. The introduction of a carbon price creates advantages for low-carbon businesses, whose growth will be assisted by carbon pricing. On the other hand, the carbon cap increases costs for some emission-intensive industries in the region, such as cement manufacturers, power plants, and fossil fuel producers (see Figure 1 for the stationary sources of GHG emissions in the Inland Empire).

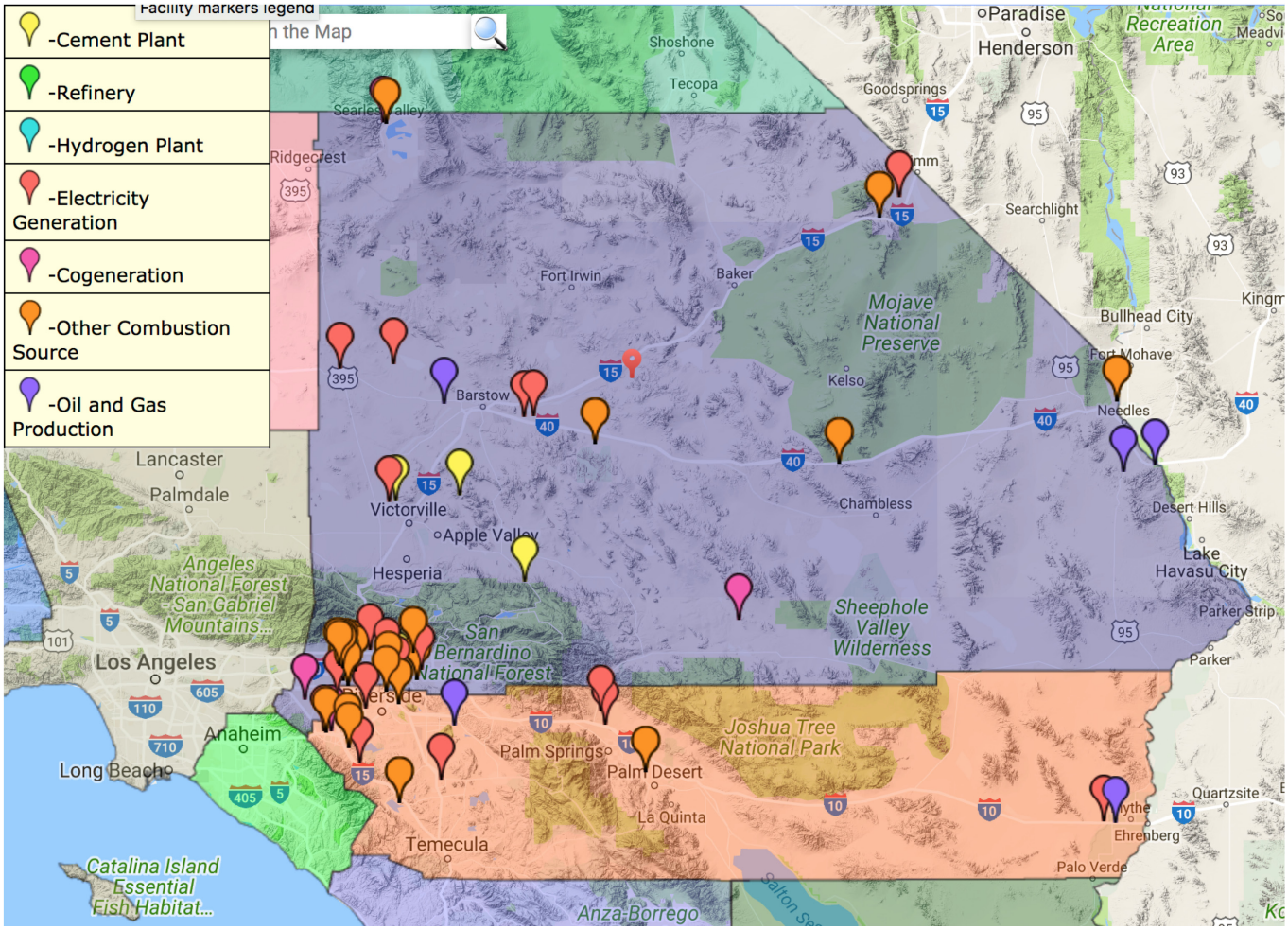
Some of these capped entities take steps to reduce greenhouse gas emissions through investments in renewable energy and energy efficiency, which often yield cost savings as well as emission reductions. Other entities decide to purchase offsets and allowances necessary to cover their cap-and-trade obligations. The costs of these investments and purchases will either be passed on to consumers or absorbed by the affected businesses.

Some of the costs of compliance will recirculate within the region as entities invest in on-site reductions (which create local work), trade allowances with one another, or purchase offsets from projects located in the region.[42] Other costs flow out of the region as they are collected by the state through the quarterly allowance auctions. The proceeds from these auctions are then distributed to projects throughout the state, including the Inland Empire, that further reduce greenhouse gas emissions.

The Inland Empire sees money flowing back into the region as these proceeds are invested in projects including transit and intercity rail construction, incentives for clean vehicle purchases, weatherization improvements, water efficiency, affordable housing, and other spending programs. While the costs of compliance may reduce some economic activity, this flow of money into the region has a stimulating effect on economic activity and employment.

These contrasting negative and positive impacts alter economic activity in ways that ripple throughout the regional economy, affecting consumers and businesses that are not major direct emitters of greenhouse gases.[43] We modeled cap-and-trade's direct and ripple effects on economic activity, employment, and state and local tax revenue in the Inland Empire. Overall, we found net impacts of the cap-and-trade program are positive, but those benefits are also a very small portion of the region's economy.

FIGURE 1 Stationary Sources of GHG Emissions* Covered by Cap-and-Trade Program in the Inland Empire, 2013-15



Source: California Air Resources Board [41]

**excludes electricity importers and fuel suppliers*

NEGATIVE ECONOMIC IMPACTS OF CAP AND TRADE IN THE INLAND EMPIRE

DATA AND METHODS

We calculated the cap-and-trade program's total capped emissions for the period 2013-15, and projected capped 2016 emissions (data on which have not yet been released) using publicly available emissions reports.[44] Emissions covered by the California cap totaled 633 million metric tons (MMT) CO_2e (carbon dioxide equivalent) in the period 2013-15, and we forecast emissions for 2016 at 335 MMT CO_2e by extending the current trend line.

To account for the allocation of free allowances, we used reported allowance allocation for electrical utilities, but the actual allowance allocation for individual industrial entities is not publically available. To model the number of free allowances for individual industrial entities, we proportionally assigned a shares of each sector's reported aggregate allowances to each entity in that sector based on their reported emissions.

The emissions from power plants and electricity importers throughout California fall under the cap. Power plants in the Inland Empire produced about 28 million metric tons of CO_2e between 2013 and 2016, out of about 209 million statewide, but the region consumes more electricity than its power plants produce. Power plants pass the cost of cap-and-trade compliance on to consumers, thus increasing electricity costs. At the same time, however, utility-allocated allowances are consigned to the auction, and revenue is returned to consumers to mitigate these rate increases. For the Inland Empire, we accounted for the allowances allocated to the region's publicly owned utilities as well as a share of Southern California Edison's (SCE) allowances proportional to its share of SCE's electricity load. We could not account for all of SCE's emissions because the emissions themselves are attributed to power plants, and SCE does not own or control all of the generation facilities from whom they purchase power. Reported emissions for the sector as a whole between 2013 and 2015 were 209 million metric tons of CO_2e, although this does not include cogeneration or other electricity generation whose emissions were reported under other industry codes. Statewide, the reported allowances for electrical utilities between 2013 and 2015 totaled about 280 million. Again, the IOUs like SCE sell their allowances in the auction and return the revenue to ratepayers to mitigate cost increases. As a result, the dividends returned to consumers exceeded the costs incurred by consumers. This is reported in the section, "Costs and Benefits of Programs to Ratepayers in the Inland Empire" on page 46.

Table 3 shows the estimates of emissions regulated by cap and trade and the reported free allowances for the non-electricity sector. We accounted for the negative cost impacts on the industries that would have had to purchase allowances. To estimate this cost, we used the auction settlement prices. As Table 3 shows, the compliance cost for the non-electricity sector entities in the Inland Empire totaled about $54 million (adjusted to 2017 dollars). Table 4 shows the breakdown of these costs by industry sector.

The Inland Empire industries with the highest greenhouse gas emissions that were covered by the cap-and-trade program were transportation fuel suppliers, cogeneration, mining, and oil and gas production.[49] Cement manufacturing and mining, and iron, steel, and aluminum production received free allowances that covered many of their emissions. These industries' compliance costs were a small fraction of what they would have been without free allowances.

TABLE 3 Total Capped GHG Emissions and Allowances from Cap-and-Trade-Regulated Entities (Non-Electricity), 2013-16 (in million metric tons CO_2e)

Region	Non-Electricity Capped Emissions (million metric tons CO_2e)	Free Allowance Allocation (Estimated) (million metric tons CO_2e)	Compliance Obligation (million metric tons CO_2e)	Compliance Cost (in $ million)
California	701	376	325	$3,880
Inland Empire	29	24	5	$53.6

Note: The first compliance period (2013 to 2014) covered entities (other than transportation fuels) whose annual emissions equaled or exceeded 25,000 metric tons CO_2e in any year from 2008 to 2011. The second compliance period, beginning January 1, 2015, covers all entities whose annual emissions equaled or exceeded 25,000 metric tons CO_2e in any year from 2011 to 2014 plus transportation fuels. The compliance obligation remains in place until GHG emissions fall to less than 25,000 metric tons of CO_2e per year during one full compliance period, or if the entity shuts down.

Source: Authors' analysis using MRR Report data [note45] and allowance data[46] from the California Air Resources Board

TABLE 4 Distribution of Cap-and-Trade Compliance Costs by Sector (Excluding Electricity), Inland Empire, 2013-16

Sector	Percent of Cost
Cogeneration	28%
Cement Plant	1%
Hydrogen Plant	1%
Oil and Gas Production	9%
Transportation Fuel Supplier	37%
Mining	13%
Paperboard Mills	8%
Iron, Steel, Aluminum Production	1%
Universities	0%

This distribution is modeled based on authors' analysis using MRR Report data[47] and allowance data[48] from the California Air Resources Board. This distribution takes into account published emissions data, but we had to model the allocation of free allowances because this data is not publicly available at the entity level.

TABLE 5 Economic Impact of the Cost of Cap-and-Trade Compliance for Inland Empire, Based on Net Compliance Expenditures, 2013 to 2016

Category	Direct Effect**	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Material Purchases	–$24.6 million	–$14.8 million	–117 jobs	–$0.7 million
Labor & Proprieter Compensation	–$29.0 million	–$17.4 million	–138 jobs	–$0.8 million
Total	**–$53.6 million**	**–$32.2million**	**–255 jobs**	**–$1.5 million**

Source: IMPLAN. Results reported in 2017 dollars.

**Excludes property tax revenue.*

*** Note: Employment multipliers for the cost of compliance cannot be calculated due to insufficient information on employment related to labor and proprietor compensation.*

ECONOMIC IMPACT

The estimated cost of complying with cap-and-trade regulations for entities located in the Inland Empire is approximately $53.6 million (in 2017 dollars).[51] Businesses respond to mandated expenditures on direct emission reduction, offsets, and allowances by passing costs on to consumers and/or spending less on supplies and labor. In this report, we assume that compliance costs reduce business activity directly (i.e., the businesses spend less on supplies and labor). Consequently, the economic impact of cap-and-trade compliance is based on reduced demand for labor and reduced demand for products purchased from entity suppliers in the region.

The economic impact of the cost of compliance is reported in Table 5, which details how the affected industries allocate their expenditures between material purchases and labor (including proprietor compensation).[51] The industries are estimated by our model to reduce by $24.6 million the purchase of materials, and by $29 million labor and proprietor income (for a total of $53.6 million).

Once the effects of reduced demand for labor and services have fully circulated through the regional economy, the final cost of compliance is found to be approximately $32 million. This is less than the direct cost of compliance—$53.6 million—for two reasons. First, many of the supplies used by the directly affected businesses are produced outside the region and are purchased by local wholesalers; in these cases, the impact of reduction in demand is found in wholesalers' profit margins and transportation costs only. The second reason is that much of labor and proprietor income is spent on goods and services outside of the region. This leakage of spending from the area also results in a smaller overall regional economic impact (absolute value). Ultimately, our results indicate that one additional dollar in compliance costs decreases economic activity by $0.60.

Other results reported in Table 5 indicate that the cost of compliance reduces employment in the region by 255 jobs and reduces state and local tax revenue (exclusive of property taxes) by approximately $1.5 million.

TABLE 6 Distribution of Implemented Auction 2013-16 Revenue, by Program within the Inland Empire (all amounts are adjusted for inflation and reported in 2017 dollars)

Category	Industry and IMPLAN code	Implemented spending	Distribution within the Region
Affordable Housing and Sustainable Communities Program	New multi-family construction (60)	$6.3 million	7%
Low Carbon Transit Operations	Locomotive purchase (395), transit (412), and business services (462), transit construction (58)	$8.6 million	9%
Low Carbon Transportation Program	Vehicle purchase (395)	$5.7 million	6%
Transit and Intercity Rail Capital Program	Locomotive and vehicle purchase (395), Rail construction (58)	$61.3 million	65%
Urban and Community	Landscaping (469)	$0.8 million	1%
Forestry			
Waste Diversion	Waste Management (471), Construction waste management (62)	$6.7 million	7%
Water-Energy Efficiency Grant Program	Electrical (62), Construction residential repair (63)	$5.4 million	6%
Total		**$94.8 million**	**Does not sum to 100% due to rounding**

Source: California Air Resources Board 2017 List of Implemented GGRF Projects.[54]

POSITIVE ECONOMIC IMPACTS OF CAP AND TRADE IN THE INLAND EMPIRE

DATA AND METHODS

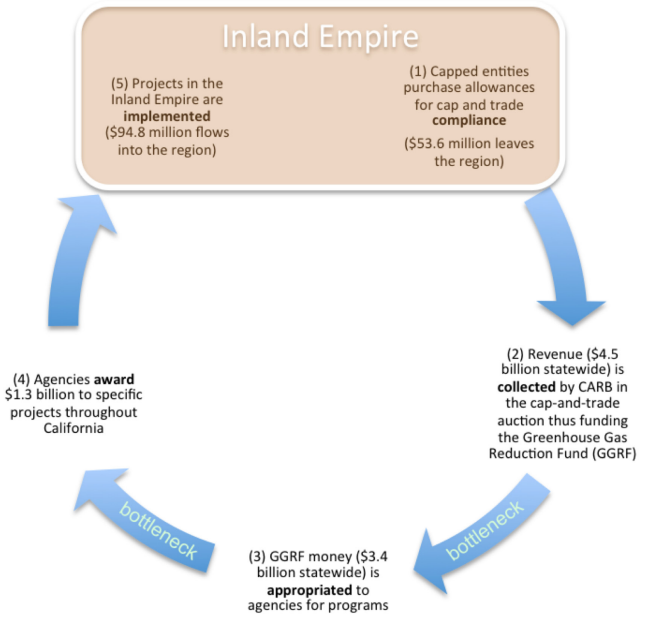
Between 2012 and 2016, the reported state-owned cap-and-trade auction proceeds totaled $4.5 billion (see Figure 2).[52] Some of this revenue was from the sale of allowances to be used for compliance in 2017-19. Of the total proceeds, $3.4 billion has been appropriated to the state's agencies for programs. Once appropriated, the money gets awarded to projects that further reduce greenhouse gas emissions. As of March 2017, over $1.3 billion has been awarded. Of this, $95 million went to projects implemented in the Inland Empire, equaling 7 percent of the spending so far. These projects are distributed by program; see Table 6.[53]

Figure 2 illustrates this process.

The Office of the Governor announced the new cap-and-trade expenditure plan agreement on August 31, 2016.[55] The distribution of future GGRF funds for climate investments under this plan differs from the distribution of implemented funding over the 2013-2015 period.[56] Under the new plan we expect larger shares of funding for clean vehicle and fleet modernization purchase incentives, waste diversion, and ecosystem restoration. With a shift in spending priorities, the Inland Empire's allocation could also shift. Should there be a move toward more construction spending—e.g., for affordable housing, weatherization, and solar installation projects—we would expect to see higher economic impacts because of the larger multipliers associated with the construction industry.

If the distribution does not change dramatically, and if the Inland Empire continues to receive about 7 percent of the GGRF funds, the additional appropriated revenue would increase the economic benefits in the region about 2.7 times. There is over $2 billion of additional GGRF funds that have been appropriated but not yet awarded.

FIGURE 2 Diagram showing money flowing out of and into the region due to cap-and-trade program (2013 to 2016)



In looking at the net benefits of cap and trade, it is important to consider the time lag between when cap-and-trade compliance costs are incurred and when cap-and-trade revenue is redistributed; money flows out of the region for compliance before money flows into the region from the auction revenue (GGRF). This time lag is necessary; the process of collecting funds, appropriating them to the relevant agencies, finding and selecting suitable projects, and then implementing the projects is complex. An annual assessment of cap-and-trade costs that includes the program's benefits for the same year only will significantly underestimate the benefits of cap and trade, particularly in the early years (2013, 2014, 2015) when GGRF spending is just beginning and the funded programs are just being launched. We try to address this issue by examining the benefits that will be produced by the revenues collected into the GGRF even though they have not yet been implemented (see Table 7).

TABLE 7 Economic Impact of Implemented and Appropriated GGRF Investments on the Inland Empire Economy: Changes in Economic Activity, Employment, and State and Local Tax Revenue

GGRF Investments	Direct Impact and Jobs Created	Total Impact on Economic Activity	Total Impact on Employment	Impact on State & Local Tax Revenue*
Implemented as of March 2017	$37.7 million** 240 jobs	$57.9 million	409 jobs	$2.4 million
Proportional Share of Appropriated Funds	$103.1million 620 jobs	$149.6 million	1,060 jobs	$6.2 million
Proportional Share of Funds Collected for Compliance Years 2013-16 but not yet Appropriated***	$110.3 million 702 jobs	$155.0 million	1,200 jobs	$7.0 million

Source: IMPLAN. Results reported in 2017 dollars.

**Excludes property tax revenue.*

*** The direct spending of $94.8 million is adjusted to $37.7 million so only the portion of the spending that remains in the region is included. The same pattern is assumed for future investments, although a higher percentage of spending in the construction industry would allow the region to realize a larger direct impact.*

****This does not include approximately $900 million collected from the auction of allowances for compliance in years 2017-19, nor does it include auction revenue from 2017.*

ECONOMIC IMPACT

The impact of GGRF funds on the Inland Empire economy is reported for three periods (Table 7). First we examine the impact of GGRF funds that were implemented in specific projects by 2017. Next we examine the effect of GGRF funds that have been appropriated, but not yet implemented. Finally, we examine the impact of GGRF funds that were collected for cap-and-trade compliance from 2013 to 2016, but have not yet been appropriated. All figures in Table 7 have been adjusted to 2017 dollars.[57]

A large portion (63 percent) of the GGRF funds were allocated to the purchase of vehicles and locomotives that are not produced in the Inland Empire region. As a consequence, the impacts for these purchases are based on the portion that remains in the region, or the "retail margin" (inclusive of the profit margin and transportation costs of local wholesalers). This adjustment has the effect of reducing the direct impact from $94.8 million to $37.7 million.[58] The indirect and induced impacts are based on this adjusted number. As a result, the economic impact findings are smaller, more conservative, and more accurate economic impact findings.

The total (direct, indirect, and induced) economic impact of implemented GGRF funds in the Inland Empire is approximately $58 million.[59] The spending of GGRF funds directly employs about 240 workers. The expenditures made by these employees, as well as the local purchases of additional supplies, creates and supports 169 additional jobs for a total employment impact of approximately 409 jobs. The increase in economic activity generates approximately $2.4 million in state and local tax revenue.[60] When the

TABLE 8 Net Economic Impact of Cap and Trade for Inland Empire, 2013 to 2016

GGRF Investments	Direct Spending*	Total Impact on Economic Activity	Total Impact on Employment	Impact on State & Local Tax Revenue**
Benefits (Implemented)	$94.8 million 240 jobs	$57.9 million	409 jobs	$2.4 million
Costs	–$53.6 million	–$32.2 million	–255 jobs	–$1.5 million
Net	**$41.2 million**	**$25.7 million**	**154 jobs**	**$0.9 million**

**This figure is before adjustments are made for leakage*
***Excludes property tax revenue.*

appropriated GGRF funds are implemented, and assuming they are implemented in the same pattern as the original implementation, the economic impact is expected to be approximately $150 million in the two-county region. The economic activity generated by this influx of funds will increase local employment by about 1,000 jobs and increase state and local sales tax revenue by approximately $6.2 million. Once all the GGRF funds collected from cap-and-trade compliance through 2016 are implemented, the total impact is slightly higher still.

The spending and employment multipliers are useful in measuring the impacts of future investments or comparing impacts across programs in the region. For example, an additional $1.00 in GGRF funds will increase economic activity in the region by approximately $0.61.[61] This multiplier is less than $1.00 because the impact for vehicle and locomotive purchases is based on wholesaler margins, which is a fraction of the total spending. The employment multiplier is 1.7, indicating that a job supported by GGRF funds will create and support another 0.7 jobs in the region (for a job total of 1.7 jobs).

NET ECONOMIC IMPACT

Table 8 shows a net positive impact of the cap-and-trade policy in the Inland Empire. This finding reflects the methodology in which we modeled impacts based on flows of money into and out of the region. Our findings are conservative because we only included GGRF funds that have already been implemented—about one-third of the total funds collected from 2013 to 2016. About two-thirds of the revenue has been appropriated, but not yet awarded to specific projects in specific locations. Since we can't be sure which industries and projects in the Inland Empire will receive the additional funds, we cannot project total benefits from the first years of the cap-and-trade program. If more funds are invested in construction activities, more of the money will stay in the regional economy and the economic multiplier will be bigger. If a significant portion of the funds continue to be invested in vehicle purchases, the total impact will remain smaller, as reported in this paper.

The cap and trade system rewards companies that take early action to reduce emissions and incentivizes technological innovation. Should a capped entity have allowances in excess of their emissions for a particular year, the allowances can be sold in the private market or reserved for compliance in future years. Our analysis does not account for these positive impacts

and instead only accounts for the costs for entities that would have had to purchase allowances to cover their compliance obligation. In other words, while cap and trade creates a new market for the private trading of allowances, where some companies pay and some companies profit, we only accounted for those who would have had to pay. In the electricity sector, where dividends are returned to consumers to mitigate the increase in electricity costs, we assumed no net impact of cap and trade in the region.

As Table 8 shows, the cap-and-trade program implementation in the Inland Empire from 2013 to 2016 has resulted so far in a net positive economic impact of $25.7million, 154 jobs, and $900,000 in combined state and local tax revenue. Accounting for future implementation of past auction revenue brings the net impact to $122.8 million, 945 jobs, and $5.5 million in tax revenue.

POTENTIAL ECONOMIC IMPACTS OF AN EXTENDED CAP AND TRADE THROUGH 2030

With California lawmakers deciding to extend the cap-and-trade program through 2030, the potential economic impact in the Inland Empire will depend on a number of factors, mostly relating to ongoing law and policy decisions but also technological and market-driven changes. The following section describes the factors that will likely determine both the costs and benefits for the region's businesses and residents from an extended cap-and-trade program.

FUTURE NEGATIVE IMPACTS

Inland Empire sources that continue to emit high levels of greenhouse gases will likely experience ongoing costs to comply with the cap-and-trade program. These costs could result from multiple methods of compliance, such as from on-site emissions reductions, purchase of allowances in the cap-and-trade auctions, purchase of less-expensive offsets, or reduction in or relocation of business activity to avoid compliance obligations. These costs, in turn, may result in higher prices for electricity, manufactured goods, and transportation fuels, and these higher prices will have some negative impact on demand for these products produced in the Inland Empire.

To determine the cost of allowance purchases, we estimate the total number of allowances the California Air Resources Board will issue from 2017 through 2030, based on the California Air Resources Board's existing rules for the program through 2020 and proposed amendments to extend the program through 2030 (with additional modifications now needed to incorporate AB 398 directives on the allowance price ceiling and offset restrictions, among others).[62] We estimate 4,025 billion total allowances will be issued statewide from 2017 through 2030. If we assume that Inland Empire sources will continue emitting about 6 percent of the emissions covered by the statewide cap, Inland Empire entities would have a compliance obligation equal to approximately 241.5 million allowances between 2017 and 2030.

To calculate the cost of this compliance, we assume the auction reserve price is a proxy for the compliance cost. We multiply the auction reserve price (which increases by approximately 5 percent per year) by the total allowances available over the period to get a total statewide compliance cost of $54 billion (in 2017 dollars). (The minimum auction reserve price is based on the $13.43 price in the 2017 auction year.[63]) With Inland Empire sources responsible for 6 percent of the state's capped emissions, these entities would have compliance costs of $3.24 billion (in 2017 dollars) from 2017 to 2030.

A number of factors will influence the actual cost, and the negative economic impact, of complying with cap and trade:

- **The price of allowances**
  As the cap declines, there will be fewer allowances. If supply of allowances decreases more quickly than demand, the cost of allowances should increase, and a wider range of abatement opportunities will become cost effective by comparison. An initial economic study of the proposed auction extension through 2030 indicates the potential for significant variability in the allowance prices. A working paper by the Energy Institute at Haas School of Business, UC Berkeley, found that with a ceiling price of $60 above the floor price, the auction had a 34 percent probability of hitting this ceiling, a 47 percent probability of the price at the floor, and a 19 percent probability of a price in between.[64]

- **Free allowance allocations**
  The California Air Resources Board has allocated free allowances to many covered entities to prevent leakage and assist with transition. These free allowances may decline post 2020, based on criteria proposed by the California Air Resources Board. The result could be that entities receiving them now will need to increase allowance purchases over time.[65]

- **Amount of utility allowances auctioned and corresponding climate credits**
  Under the rules of the cap-and-trade program, investor-owned utilities must auction their free allowances and redistribute the revenue to electricity customers. Municipal, or publicly owned, utilities also receive allowances and have discretion over how to use them. The redistribution of this allowance revenue to customers is intended to mitigate the price increases for sensitive customers.[66]

- **Available offsets**
  California's program rules allow capped entities to meet 8 percent of their compliance obligation through offsets. As discussed, AB 398 now reduces them to 4 percent through 2025 and then 6 percent of their compliance through 2030. This change could potentially increase the total cost of compliance, if regulated entities can no longer access as many less expensive offsets and must reduce emissions on-site or purchase allowances instead.

- **Cost of emissions reduction technologies**
  As the market for emissions-reducing technology grows, the cost of these technologies will likely decrease.

Ultimately, as the numbers to-date indicate, these compliance costs (not including benefits) through 2030 could lead to job loss and reduced economic activity in the fossil fuel-based sector between 2017 and 2030. However, the range of these impacts will depend on the policy and market factors described above, and they will continue to be offset by the benefits of the cap-and-trade program in the Inland Empire, assuming the program continues.

FUTURE POSITIVE IMPACTS

The future benefits to the Inland Empire of the cap-and-trade program will flow from the spending of statewide auction proceeds, via the Greenhouse Gas Reduction Fund (GGRF). This spending will create jobs and boost economic activity, as well as reduce some residents' costs for transportation and utilities, by supporting more transit, low-income solar, and affordable housing near jobs and services. In addition, to the extent that greenhouse gas emissions reductions also mean reductions in other harmful pollutants, the region may experience public health improvements, such as reduced asthma rates.

The amount of auction proceeds through 2030, however, could vary greatly, as could the amount of statewide proceeds that the state may spend in the Inland Empire. The following factors directly influence the potential economic benefits to the Inland Empire of cap and trade:

- **The price of allowances and percentage sold**
  As discussed, the potential range in auction price means a corresponding range in the amount of auction proceeds that the state could spend in the Inland Empire. In addition, the percentage of allowances auctioned versus freely allocated, the amount set aside in the cost-containment reserve, and the price ceiling required by AB 398 could greatly impact the amount of proceeds. The amount of auction proceeds dedicated to investor-owned utilities and publicly owned utilities also determines how much of the proceeds are available to spend in the Inland Empire (although the Inland Empire currently receives more proceeds from utility allowance sales than from the state proceeds). For example, we estimate that total auction proceeds from 2017 through 2030, with 75 percent of the allowances auctioned at a minimum price, could be $55.3 billion, with approximately 24 percent ($13.8 billion) for investor-owned utilities. In this scenario, the state would therefore have over $41 billion in proceeds to spend. If a smaller percentage of the proceeds is directed to investor-owned utilities, the state could have more to spend (although that spending could be offset by the decline in utility proceeds that would have benefitted the Inland Empire). If the allowance price is twice the reserve price, that figure could be over $112 billion (in 2017 dollars).
- **The percentage of greenhouse gas reduction funds spent in the Inland Empire**
  To date, 7 percent of the program's implemented funding has been spent in the Inland Empire. If the region continues to receive approximately 7 percent of the auction proceeds, the Inland Empire could potentially receive between $2.87 billion (minimum auction reserve price and 75 percent auction) and $3.53 billion (90 percent auction) and as much as $7.06 billion (in 2017 dollars), assuming 90 percent of allowances are auctioned and sell for twice the minimum auction reserve price.
- **Amount of utility allowances auctioned**
  As discussed, the amount of auction proceeds available depends on the sale through the auction of their free allowances and the continued dividends and rate adjustments to mitigate the cap-and-trade price impacts for electricity customers. Because the Inland Empire is a net importer of electricity, ratepayers get more in proceeds from the auctioned utility allowances than power plants in the region spend on compliance.

Overall, no matter how high the compliance costs get, the auction mechanism preserves the pool of revenue to invest back into the region, as long as capped entities stay in California. As a result, the Inland Empire could continue to have positive net economic impacts from the extension of cap-and-trade program through 2030. However, given the region's higher than average transportation fuel and electricity use, policymakers should pay attention to the design of dividends for Inland Empire households and small businesses.

RENEWABLES PORTFOLIO STANDARD

California has been increasing the stringency of its renewable energy requirements since 2002. That year, SB 1078 established the state Renewables Portfolio Standard (RPS) to require retail electricity sellers, with the exception of municipal utilities, to procure 20 percent of their electricity from eligible renewable energy resources by 2018, a goal that was later accelerated. In 2011, Governor Brown signed legislation to increase the RPS to 33 percent by 2020.[67] He set clean energy goals as part of a plan to help rebuild California's economy, with an overall goal of adding 20,000 MW of renewable generation by 2020, comprised of 8,000 MW of large-scale renewable generation and 12,000 MW of renewable distributed generation. California is ahead of schedule for meeting the 2020 RPS target.[68] In 2015, SB 350 increased the RPS again, by requiring that 50 percent of the retail electricity come from renewable sources by 2030.

The California RPS is unique in its design. There are three categories of qualifying renewable energy, and as the state progresses toward the goal, a greater share of renewable energy has to be procured from Category 1 and a smaller share from Category 3. Category 1 refers to renewable energy from a facility whose connection to the grid is controlled by a California balancing authority, which means most Category 1 energy is built in California (Category 2 energy is typically from a neighboring state). Category 3 refers to "unbundled" Renewable Energy Credits (RECs), which are certificates of renewable energy that can be purchased separately from the actual renewable energy generated. As a result, Category 3 renewable energy is not restricted geographically. By 2017, 75 percent of RPS-qualifying energy must be from Category 1, while 10 percent can be from Category 3. This design means that most of the employment and related economic benefits from the construction of renewable energy to meet the RPS will be captured in-state.

As a result of these policies and the corresponding decrease in technology and deployment costs, the state has made significant strides on renewable procurement. Statewide, operating capacity of renewable resources is over 26,000 MW. Large-scale renewable capacity (greater than 20 MW) has steadily increased from 6,600 MW in 2010 to an estimated 16,900 MW in 2016. In 2016, construction also started on 1,100 MW of large-scale renewable facilities and an additional 600 MW received environmental permits.[69] As of October 31, 2016, almost 9,400 MW of distributed generation (less than 20 MW in size) capacity was operating or installed in California, with nearly 900 MW of additional capacity pending.[70]

The Inland Empire is a net importer of electricity, meaning that consumers in the region use more electricity than the power plants located in the two counties produce. But the RPS has decreased net imports to the region. According to the California Energy Commission, the Inland Empire accounts for more than 17 percent of the energy renewable projects online as of October 2016 and all of the renewable projects in the state that had received environmental permits and are under construction as of that same date. Since 2010, the Inland Empire has been home to 20 percent of the state's total renewable development. This share totals 3,721 MW of renewable capacity, generating enough electricity to power over 2.6 million homes. Permitted projects could add an additional 2,162 MW of renewable capacity in the region.[71] The region is a much larger contributor to the state's renewable electricity generation system than it is to the overall electricity system. In other words, the region has a strong competitive advantage for renewable energy production, and because of this, significant investment has flowed to the region for solar and wind farms.

BEYOND 2020

In the fall of 2015, SB 350 called for a research study to explore the creation of a regional grid with other western states. Governor Jerry Brown and state regulators say a regional grid would help the state's transition to clean energy by allowing the California to import and export solar and wind energy, which would lower costs and increase generation. The plan would allow the California Independent System Operator (CAISO), which manages electricity markets and transmission for about 80 percent of the California grid, to merge its portion of the grid with PacifiCorp, another grid operator that covers most of Wyoming and Utah as well as small parts of Northern California, Washington, Oregon, and Idaho. Other utilities and states have also expressed interest in integrating into a regional grid. Under such integration, during midday

in California, when solar energy production is at its peak, electricity could be exported to other states, while at night, California could import power from Wyoming wind, which is typically strong at night. As of August 2017, planning for a regional grid was postponed because of concerns that any flaws in the new system could weaken California's RPS or reduce the state's regulatory control, while the states involved grappled with potential shared governance models.[72]

A recent study commissioned by CAISO estimated a regional grid could increase state GDP by as much as $1.7 billion and create as many as 19,300 jobs over and above levels for current state policies.[73] However, all the net new income and new jobs were projected to be created indirectly by lowered electricity rates for consumers and businesses. While lower electricity rates would benefit Inland Empire consumers, who use more electricity than the statewide average, integration could reduce the growth of renewables in the Inland Empire, and the job growth associated with that construction could slow.

As long as renewable energy developers continue to build in California, solar PV will continue to play a vital role in the economy and the energy future of both California and the Inland Empire. The cost of solar technology has decreased dramatically in the past half-decade, and renewables developers view the Inland Empire as an opportunity area due to its abundant sunshine, geographic proximity to demand and existing transmission infrastructure, and large parcels of suitable land.

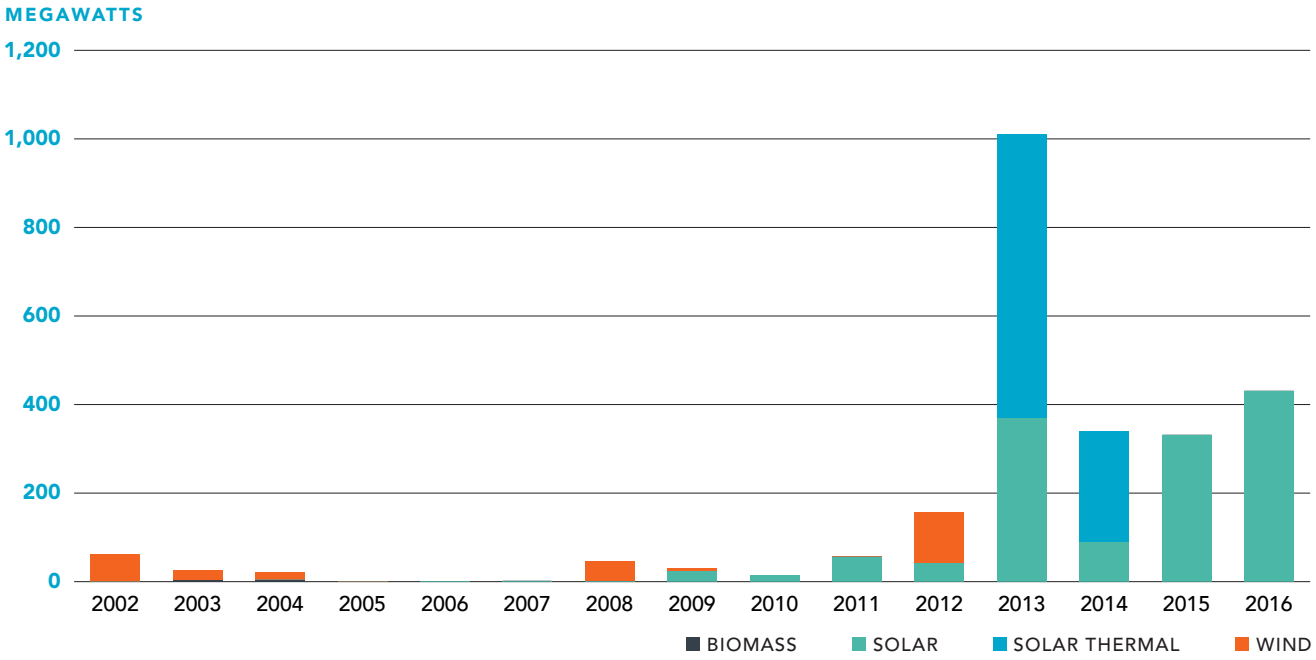
ECONOMIC IMPACTS OF RENEWABLES PORTFOLIO STANDARD IN THE INLAND EMPIRE

To estimate the net economic impacts of the RPS in the Inland Empire, we needed to account for the amount of renewable energy that was additional compared to the amount that was replacing other energy generation in the region. Finding no simple way to do this, we worked around the problem by creating a counterfactual scenario and separately analyzing the construction impacts from the generation impacts.

For the construction analysis, we assume the region had enough natural gas capacity to generate as much electricity as it did in its peak year of 2012 (see Figure 4) and would have replaced the retired plants with new natural gas plants to maintain the 2012 level of generation. The amount of power generation infrastructure beyond this is then considered additional and attributable to the RPS.

Generally, all electricity generation (renewable and non-renewable) in the Inland Empire has increased since 2000, and most of the new generation was from natural gas plants. Only in 2014 did renewable generation diverge from, and essentially replace, natural gas generation. While the RPS triggered a significant net increase in construction of power infrastructure in the Inland Empire, the gross *increase* of renewable energy generation is tempered by the *reduction* in energy generated from natural gas plants, and the net impact is very small.

FIGURE 3 Renewable Construction in the Inland Empire, 2002-2016



Source: California Energy Commission[74]

CONSTRUCTION IMPACTS

The requirements of the Renewables Portfolio Standard (RPS) have spurred the development of renewable power infrastructure in California. The Inland Empire is illustrative of the policy's effect where, between 2010 and 2016, power plants equal to 837 MW of generating capacity retired and 3,245 MW of new electrical generating capacity was built.[75] Of the new generation infrastructure, 801 MW was built as new natural gas power plants, and the rest (2,444 MW) was built with wind, solar PV, and solar thermal technology.

Since it could be argued that at least 37 MW of wind or solar replaced natural gas plants that would have otherwise been built to replace retirements, we net out that amount. This suggests that 2,408 MW of wind and solar development was policy-induced construction, financed by investments from outside of the region, and repaid through electricity rates that are no higher than they would have been absent the RPS.[76] Consequently, the flow of this investment into the region stimulated additional economic activity in the two-county area. The construction activity, beyond business-as-usual, is reported in Table 10. After adjusting to 2017 dollars, the total net investment in renewable construction between 2010 and 2016 was $8.4 billion.[77] The economic impact of this investment into the region is reported in Table 9.[78]

The impact of an additional $8.4 billion in renewable energy power plant construction increased overall economic activity in the region by approximately $12.1 billion. The building of these plants employed about 30,000 construction workers. These plants added much-needed stimulus to the Inland Empire's construction industry that was severely impacted by the Great Recession. For example, construction employment in the two-county region reached a low of 58,289 in 2010.[79] By 2016 employment in this industry increased to 85,674. Growth in renewables has clearly helped revive and stabilize the construction industry in the region.

TABLE 9 Economic Impact of the Construction of Renewable Energy Power Plants in the Inland Empire, 2010 to 2016

Category	Direct Effects ($ and jobs)	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Renewable Energy Power Plant Construction	$8,367 million 29,255 jobs	$12,088.3 million	58,498 jobs	$360.1 million

Source: IMPLAN. Results reported in 2017 dollars. **Excludes property tax revenue.*

The incomes and spending generated by the building activity, plus the purchase of local construction supplies, increased overall employment by more than 58,000 jobs. The additional economic activity increased state and local tax revenue by about $360 million. The implied spending and employment multipliers indicate that every $1.00 in renewable power plant construction increased economic activity in the region by about $1.44. Each additional construction job supported one other job in the region (the employment multiplier is 2.0).

GENERATION IMPACTS

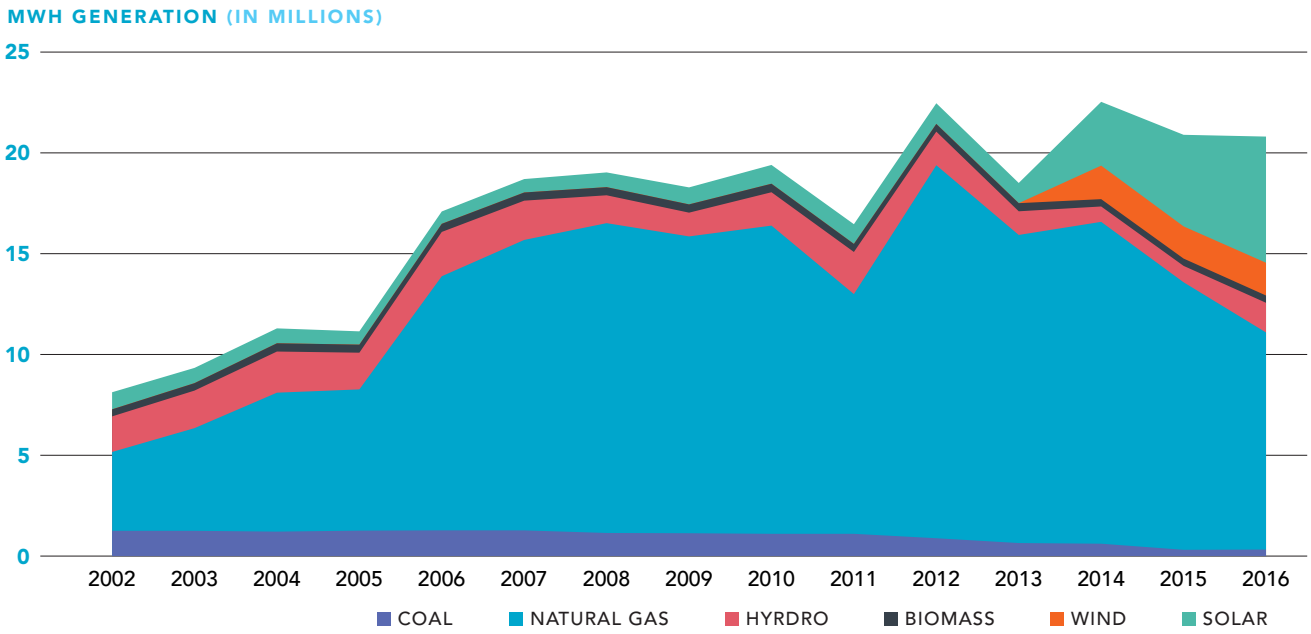
While construction of renewable energy infrastructure in California has been mostly additive, the RPS policy does appear to have reduced power generation in natural gas plants in the Inland Empire faster and more sharply than for the rest of the state. As Figure 4 shows, in the Inland Empire, renewable power began to coincide with a decrease in natural gas power in 2014, whereas Figure 5 shows that in the state as a whole, renewable generation didn't coincide with a decrease in natural gas power generation until 2016.

While renewable generation in the Inland Empire grew more than natural gas generation shrank, the negative economic impact from the decrease in natural gas electricity generation outweighed the positive impact from increased renewable generation. From

TABLE 10 Net New Renewable Energy Power Plant Construction in Inland Empire, 2010-16

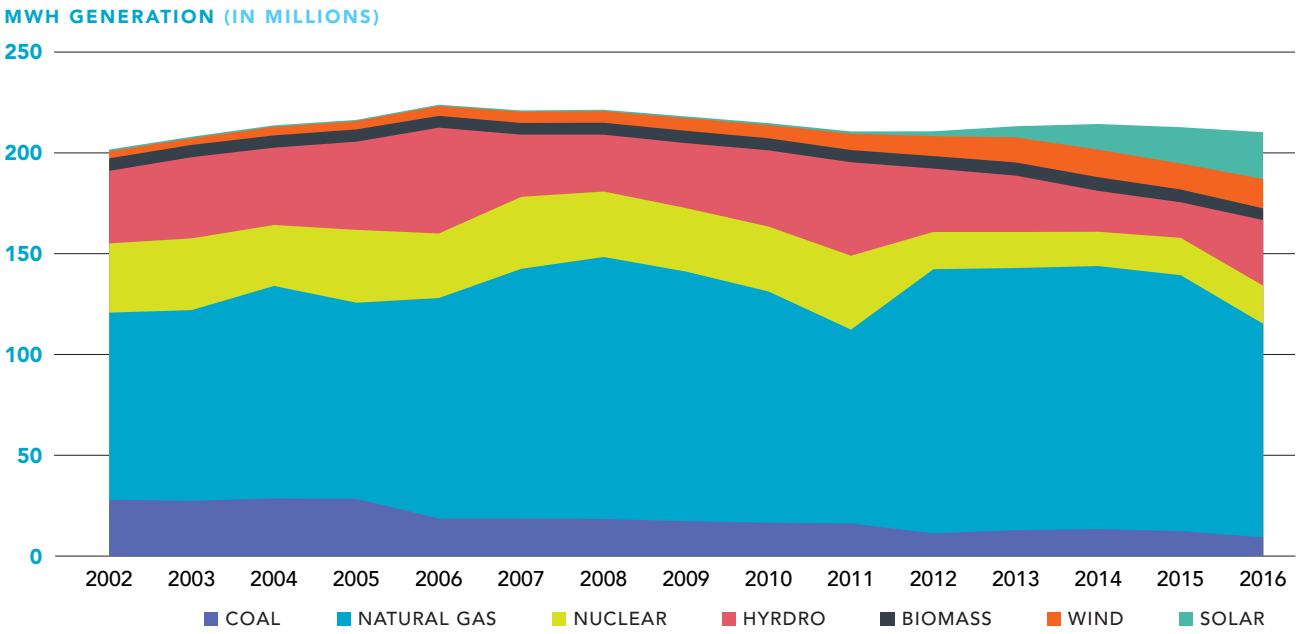
Year	Sum of MW Capacity	Sum of Construction Cost (Estimated) in $ million
2010	29.6	$113.4
2011	105.2	$400.8
2012	183.4	$434.7
2013	986.0	$3,640.0
2014	340.0	$1,378.2
2015	331.9	$843.4
2016	431.0	$1,056.0
Total	**2407.7**	**$7,866.6 (nominal) $8,400 (2017 dollars)**

FIGURE 4 Electricity Generation by Source in the Inland Empire, 2002-2016



Source: California Energy Commission[80]

FIGURE 5 Electricity Generation by Source in California, 2002-2016



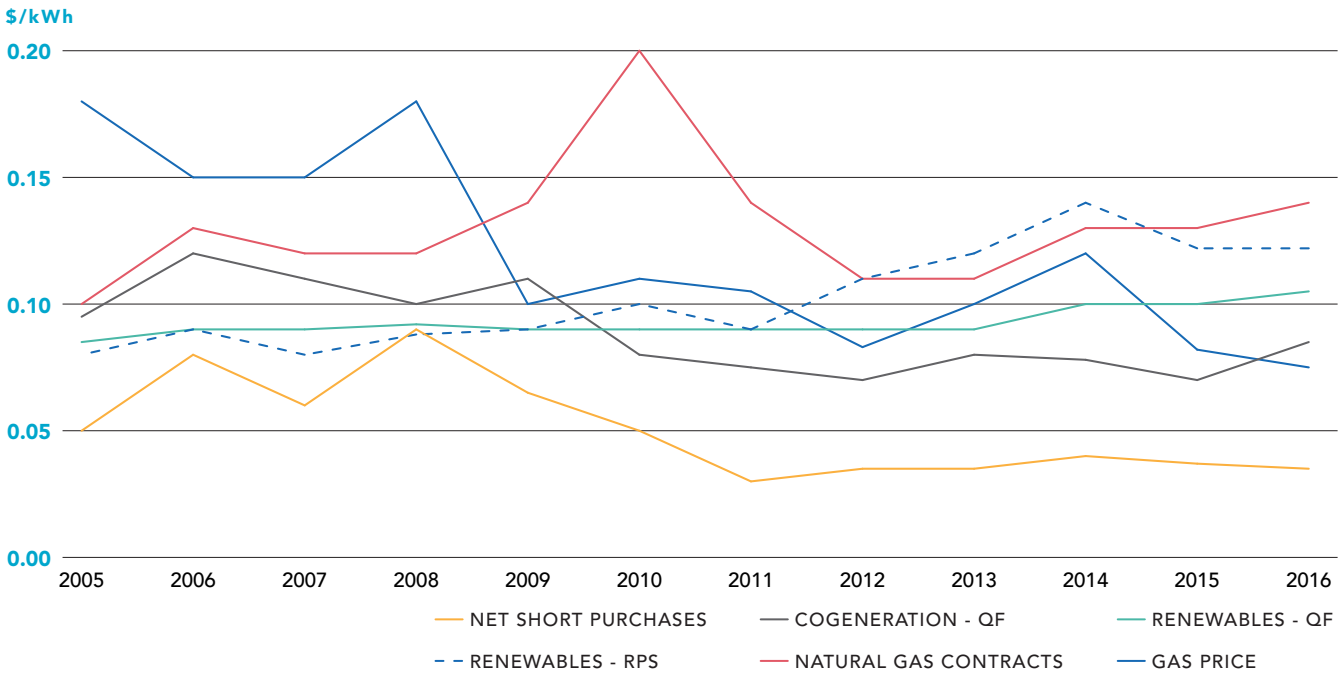
Source: California Energy Commission[81]

TABLE 11 Economic Impact of Switching from Electricity Generation with Natural Gas to Generation with Renewable Sources (Wind and Solar) in the Inland Empire, 2014-16

Impact Category	Direct Effects ($ and jobs)	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Reduced Natural Gas Generation	-$1,968 million -1,167 jobs	-$2,021 million	-3,299 jobs	-$175.4 million
Increased Wind Generation	$587 million 265 jobs	$808 million	2,046 jobs	$29.8 million
Increased Solar Generation	$1,306 million 669 jobs	$1,592 million	2,967 jobs	$36.4 million
Net Total	**-$75 million -233 jobs**	**$379 million**	**1,714 jobs**	**-$109.2 million**

Source: IMPLAN. Results reported in 2017 dollars. **Excludes property tax revenue.*

FIGURE 6 Average Cost for Select Purchased Power Sources in California, 2005-2016



Source: California Public Utilities Commission [83]

2014 to 2016, we estimate the value from natural gas generation decreased by almost $2 billion, while combined generation from wind and solar utilities increased by approximately $1.9 billion.[82] The economic impact of the switch from gas-based to wind and solar power generation is reported in Table 11.

The reason for this net negative direct economic impact is twofold. First, according to data reported by the California Public Utilities Commission and reproduced in Figure 6, natural gas power contracts were more expensive than renewables for most years (compare red line to teal line in Figure 6). As a result, for every megawatt hour of switching to renewables, less revenue is generated by the industry.

Second, wind and solar generation use workers more efficiently. During the generation phase, our analysis indicates that a natural gas plant produces 11.4 GWh per worker, compared with 18.4 GWh for wind and 17.9 GWh for solar. In economic terms, the output per worker for wind and solar farms is higher than for natural gas plants. As a result, the decrease of approximately $2 billion in gas-powered generation means a loss of over 1,100 direct jobs, while the increase in generation at wind and solar utilities of $1.9 billion is associated with the employment of 934 workers. State and local tax revenue is also reduced by this shift. The negative impact on state and local revenue is probably due to reduced sales tax; whereas natural gas plants need to purchase fuel to generate electricity, solar and wind, once built, don't pay sales tax on the sunshine or breeze that fuels their power generation.[84]

Although the direct effects show a net negative *direct* impact, the net *total* impact on jobs and economic activity due to switching from electricity generation with natural gas to renewable sources is positive. The combined impact of wind and solar electricity generation has increased economic activity in the region by about $2.4 billion ($808 million from wind and $1,592 million from solar). After accounting for the negative impact in natural gas generation. the net total impact in the regional economy is about $380 million.

The combined *total* employment impact for wind and solar power generation of over 5,000 jobs (2,046 from the wind impact and 2,967 from solar) is greater than the 3,300 *total* jobs lost due to reduced generation using natural gas, so the net positive employment effect associated with renewable power generation is approximately 1,700 jobs. This net positive impact is due to the relatively larger purchase of local supplies and materials of the wind and solar sector in the Inland Empire. For example, purchases from local suppliers associated with the $1.9 billion increase in renewable power generation exceeded $360 million while the comparable decrease in local supplies from $2 billion less in generation from natural gas was $150 million.[85]

As generation from renewable power increased in the Inland Empire between 2014 and 2016, local supply industries responded by adding more than 2,900 jobs.[86] This represents 59 percent of the total employment impact for renewable-based generation (2,946 jobs / 5,013 jobs). These findings suggest that while utility-level solar and wind generation may not directly employ many workers, it nonetheless can increase local employment, which is likely largely associated with industries that supply renewable power generators. The supplier impact will depend on whether these industries are present in the region. The more suppliers that are present, the greater the positive impact of renewable energy generation will be.

POTENTIAL ECONOMIC IMPACTS OF RENEWABLES PORTFOLIO STANDARD THROUGH 2030

The potential range of economic and job impacts in the Inland Empire from renewable deployment will depend on a number of factors related to policy, market, and technology developments, including:

- The amount of new renewable deployment that occurs in-state versus out-of-state or in other regions of the state, particularly if California decides to more aggressively expand its grid footprint throughout the western region;
- The ability of California to export surplus renewables out of state, such as through grid integration across the western region of the United States;
- Potential technology improvements, including compatible technologies like energy storage, and cost decreases that could affect the scalability and demand for solar PV;
- Increased future energy efficiency savings from California's commitment to doubling the energy efficiency of buildings, which means the state could potentially see less demand for electricity by 2030 (if not offset by population increase and the increase in consumer goods, like electric vehicles, requiring electricity);
- Fuel switching, including electrification of building heating and thermal processes and of transportation, particularly through electric passenger vehicles but also goods movement and rail transit, thus increasing energy demand; and
- Cost decreases and greater deployment of energy storage technologies, which could change the demand patterns for in-state renewable energy.

The costs and benefits of this deployment to the Inland Empire, in terms of economic impacts, jobs, and ratepayer impacts, will depend on factors such as:

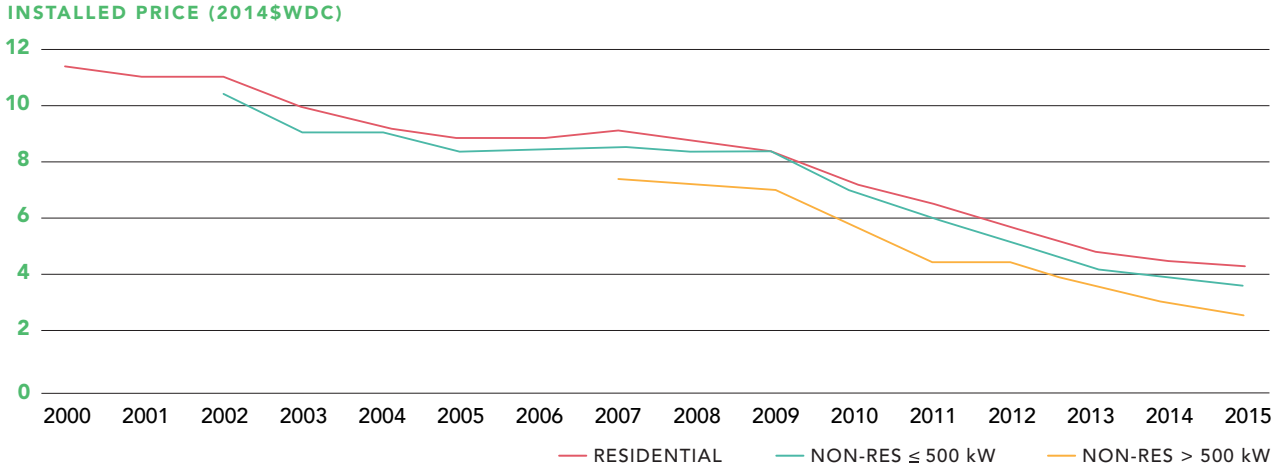
- The increase or decrease in electricity costs for Inland Empire ratepayers and consumers as a result of costs of renewable technologies;
- Reduced demand of fossil-fuel-based power plants in the Inland Empire, which could lead to reduced economic output locally;
- The amount of renewables and related transmission infrastructure built in the Inland Empire, which generates employment and economic activity;
- The number and quality of jobs generated; and
- Public health and other co-benefits from decreased localized air pollution in the Inland Empire, which could boost economic productivity and lower health costs.

Overall, given the region's good location for solar exposure (insolation), the state's ambitious renewable goals, and the growing demand for electricity, the Inland Empire is well positioned to continue to benefit economically from renewable deployment through 2030.

DISTRIBUTED SOLAR PROGRAMS

A suite of state and federal policies aided the rapid expansion of distributed solar in California. The California Solar Initiative (CSI) was signed in 2006 by then-Governor Arnold Schwarzenegger with the goal to install 2,000 MW of distributed residential and commercial solar by 2016. CSI provided $2.167 billion in incentives statewide before the allocated funding was exhausted in 2014—two years ahead of schedule.[87] Funded through charges to electric ratepayers, residential and commercial customers could apply for a per-watt rebate for solar installation. The level of available rebate decreased over time as the share of renewable energy generation on the grid for each utility service territory increased.[88] The CSI intended to create a self-sustaining solar market in California, and, according to the most recent CPUC report, it was successful in that goal. Solar installations continued to increase in 2014 and 2015 largely without rebate incentives.[89]

FIGURE 7 Residential and Non-residential PV System Sample and Median Installed Price, 2000-2015



Source: Lawrence Berkeley National Laboratory [91]

Other programs that supported the expansion of solar in California include the federal Solar Investment Tax Credit, which refunds 30 percent of the cost for residential and commercial systems. First offered in 2006, the tax credit has been renewed until 2019, at which time the rebate will decrease until ending in 2022.[90] Arguably the biggest driver behind the acceleration of distributed solar deployment, however, was the generous net energy metering policy. Net metering allows customers that install less than 1 MW of generation capacity for on-site generation to sell unused electricity back to their utility. The customer then receives a financial credit for money off their electric bill. In March 2016, nearly 500,000 California customers were enrolled in the net metering program. These residential and non-residential systems account for more than 90 percent of solar PV arrays connected to the grid. Net metering stabilizes the annual energy cost of customers and offers a secure financial payback in the form of lower electricity bills to offset the high upfront cost of solar investment. In combination, the CSI, the federal tax credit, and net metering facilitated a rapid decrease in the cost of solar as the market matured (see Figure 7).

This report accounts for the costs and benefits associated with the direct incentives for distributed solar: the California Solar Initiative and the federal Solar Investment Tax Credit. We do not attempt to quantify the regional costs and benefits of net metering.

BEYOND 2020

Beyond 2020, state policy appears headed toward general diminishment of incentives for distributed solar. While the state acted in January 2016 to preserve current net metering incentives, regulators did impose a new one-time interconnection fee for new solar customers and instituted a minimum monthly charge. Furthermore, regulators will revisit the arrangement in 2019, portending further diminishment in indirect incentives provided through net metering arrangements, particularly as pressure grows to pair distributed solar with energy storage technologies, which can capture surplus renewables for use on-site and decrease the need for retail credit from utilities for any overage.[92] The advent of community choice energy for the Inland Empire (in which cities and counties contract with a licensed energy service provider to purchase energy, build renewable energy facilities, and implement energy efficiency programs) could also provide ratepayers in the region with electricity options that involve more distributed renewable energy generation based on community development goals and greater incentives for distributed solar.[93]

ECONOMIC IMPACT OF DISTRIBUTED SOLAR PROGRAMS IN THE INLAND EMPIRE

Between 2010 and 2016, approximately $1.1 billion in distributed solar in the Inland Empire was financed by federal and state incentives. These subsidies represent new dollars for the region (net of higher utility costs paid by local ratepayers for state-funded programs; see the section titled "Costs of Programs to Ratepayers in the Inland Empire" on page 46). The economic impact of these incentive programs is reported in Table 12. The federal government's share was 81 percent of total subsidies, or $893 million. State subsidies added another $210 million in incentives over the period. The spending of these funds on the installation of residential solar panels created approximately 5,970 construction jobs. This new construction increased economic activity in the two-county region by about $1.5 billion, added over 10,000 jobs, and generated over $50 million in state and local tax revenue.

Between 2010 and 2016, households and businesses in the Inland Empire spent an additional $1.8 billion of their own money on distributed solar panel installation. This spending created approximately 10,000 more construction jobs in the region. This additional spending on solar is not included in the impact reported in Table 12.

By not accounting for the shift in consumer spending from electricity bills to solar investments, the only costs to account are the ratepayer costs of funding the California Solar Initiative, which provided the state subsidies. We account for these and other ratepayer costs in the section titled "Costs of Programs to Ratepayers in the Inland Empire" on page 46.

POTENTIAL ECONOMIC IMPACTS OF DISTRIBUTED SOLAR PROGRAMS THROUGH 2030

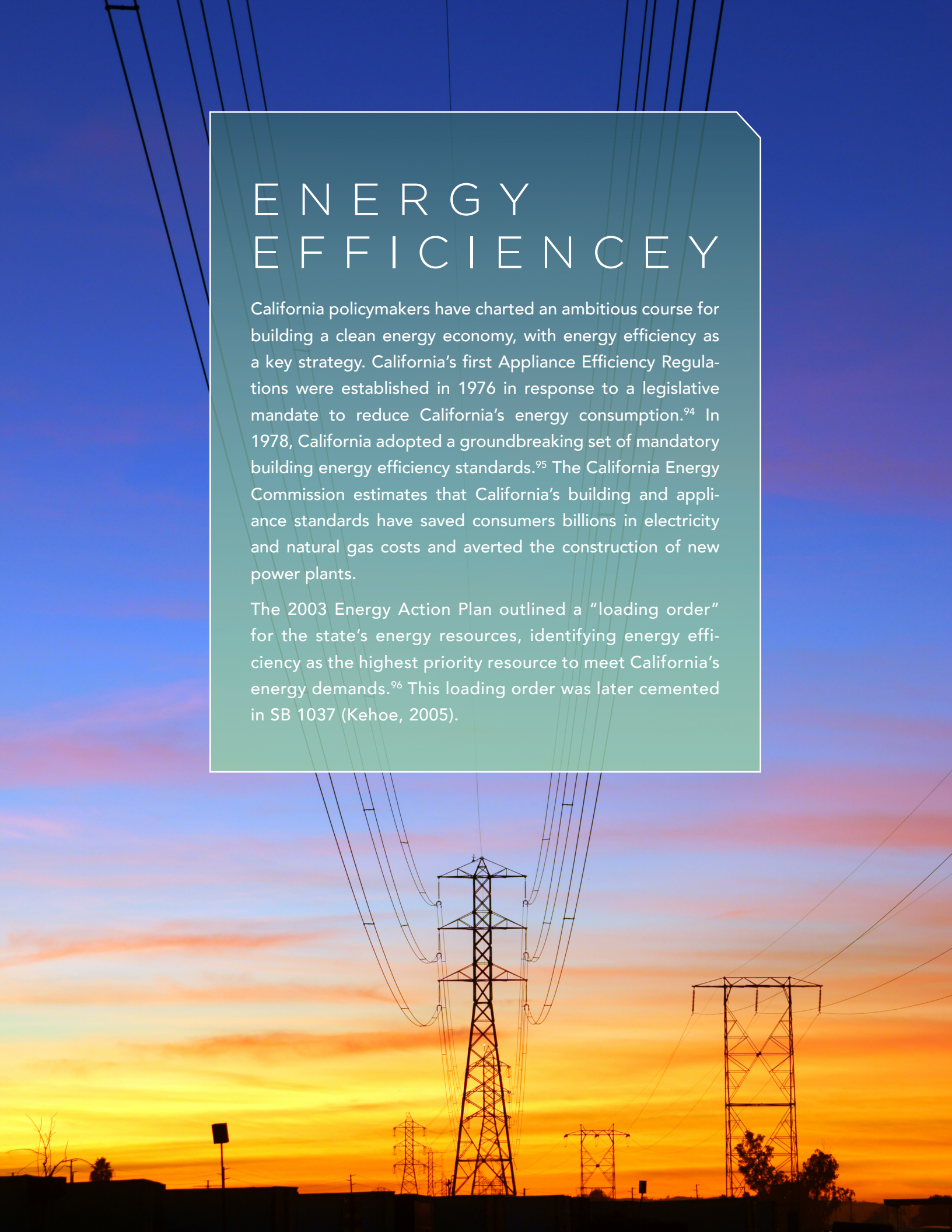
The future of distributed solar in California is uncertain. As discussed, recent decisions from the California Public Utilities Commission have slightly diminished the incentives under net metering, leading to declines in the rooftop solar market. Given the current general trends around the country to roll back state net metering programs, the future of distributed solar may depend more on options to pair these systems with energy storage technologies (including potentially electric vehicle batteries) to capture surplus production for use on-site. Community solar programs and microgrids, as well as the potential for a community choice energy program in the Inland Empire, may also play larger roles in distributed solar in the region and beyond. As a result, the uncertainty related to policy and technology makes projections on distributed solar deployment through 2030 in the Inland Empire difficult to estimate.

TABLE 12 Economic Impact of Federal and State Subsidies for Distributed Solar in the Inland Empire, 2010-16

Impact Category	Direct Effects ($ and jobs)	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Federal Subsidies	$893 million 4,836 jobs	$1,220 million	8,195 jobs	$40.7 million
State Subsidies (California Solar Initiative)	$210 million 1,134 jobs	$286 million	1,922 jobs	$9.6 million
Total	**$1,103 million 5,970 jobs**	**$1,506 million**	**10,117 jobs**	**$50.3 million**

Source: IMPLAN. Results reported in 2017 dollars.

**Excludes property tax revenue.*



ENERGY EFFICIENCEY

California policymakers have charted an ambitious course for building a clean energy economy, with energy efficiency as a key strategy. California's first Appliance Efficiency Regulations were established in 1976 in response to a legislative mandate to reduce California's energy consumption.[94] In 1978, California adopted a groundbreaking set of mandatory building energy efficiency standards.[95] The California Energy Commission estimates that California's building and appliance standards have saved consumers billions in electricity and natural gas costs and averted the construction of new power plants.

The 2003 Energy Action Plan outlined a "loading order" for the state's energy resources, identifying energy efficiency as the highest priority resource to meet California's energy demands.[96] This loading order was later cemented in SB 1037 (Kehoe, 2005).

A major component of California energy efficiency programs has consisted of utility rebate and incentive programs. Financial support for these programs began in 1996 with a "Public Goods Charge" on investor-owned utility (IOU) bills.[97] However, since 2012 funding has been provided through energy procurement funds from IOU ratepayers.[98] IOU revenues are decoupled from sales, so IOUs have no incentive to sell more energy. In fact, due to the Energy Savings Performance Incentive, utilities can earn a profit based on efficiency performance.[99] The state's IOUs, directed by the California Public Utilities Commission, now administer about $1 billion per year through state energy efficiency incentives and rebate programs serving the residential, commercial, industrial, and agricultural sectors.[100]

The success of these efforts is unambiguously evident throughout the state. Combining efficiency gains from codes and standards, efficiency programs, and market and price effects, the cumulative annual efficiency and conservation savings for electricity were estimated to reach nearly 70,000 gigawatt hours (GWh) through 2013.[101] This is reflected in the modest growth in electricity consumption statewide that was proportionally lower than gross state product and employment growth.[102] Building on this success, SB 350, passed in 2015, mandated a doubling of energy efficiency by 2030.

The Inland Empire is one of the hottest regions of the state, and per capita residential electricity use is higher than for the state as a whole. Therefore, the requirements in SB 350 and other statutes and regulations to promote energy efficiency have special significance for the Inland Empire, with its enormous efficiency potential.

Almost 80 percent of the Inland Empire's electrical load is served by Southern California Edison (SCE), and most of the region receives both gas and electric service. Pacific Gas and Electric and a few publicly owned utilities (POUs) make up the rest of the utility service.[103] The POUs also administer energy efficiency programs, but they are small and therefore excluded from this analysis. This section estimates the economic impact of the investor-owned utility energy efficiency programs in the Inland Empire. The IOUs represent the largest consolidated source of funding for energy efficiency in the state.

BEYOND 2020

AB 758 (Skinner, 2009) addressed the need to lower emissions through reduced energy consumption in existing buildings, and directed the California Energy Commission to adopt the Existing Buildings Energy Efficiency Action Plan (EBEE Action Plan).[104] In response to SB 350, the September 2015 update to the EBEE plan is to double energy savings in California's buildings, which is equivalent to a 17 percent reduction in statewide building energy use by 2030 compared to projected levels of usage. The plan predicts that implementation of the energy efficiency program will stimulate an $8 billion per year efficiency marketplace.[105] The EBEE plan should help achieve SB 350's goal of doubling energy efficiency by 2030. What remains unknown is the pathway California will take to achieve these goals.

ECONOMIC IMPACTS OF IOU ENERGY EFFICIENCY PROGRAMS IN THE INLAND EMPIRE

Between 2010 and 2016, IOU energy efficiency expenditures in the Inland Empire totaled approximately $612 million (in 2017 dollars).[106] These funds were divided between residential and non-residential energy efficiency construction and program administration. Construction activity received $365 million in investments.[107] Twenty-five percent of these funds were directed to residential efficiency projects with 75 percent going to non-residential projects. Program administration expenditures totaled $247 million.[108]

BENEFITS FROM ENERGY EFFICIENCY PROGRAM IMPLEMENTATION

The economic impact of these new funds on the Inland Empire is reported in Table 13. The direct spending of $365 million in investments for energy efficiency construction activity created over 2,000 construction jobs and increased economic activity by approximately $490 million. Indirect and induced effects resulted in increased employment of about 3,300 jobs and increased state and local tax revenues of over $16 million. The spending and employment multipliers indicate that an additional $1.00 spent on energy efficiency construction increases economic activity by $1.34, and an additional energy efficiency construction job increases overall employment by about 1.6 jobs.

The expenditure of $247 million on energy efficiency program administration created about 4,000 jobs in the business services industry. The effect of this new spending increased economic activity in the two-county region by about $360 million, increased employment by over 4,600 jobs, and increased state and local tax revenue by over $13 million. The spending and employment multipliers indicate that an additional $1.00 spent on local program administration increases economic activity by about $1.44, and an additional administrative job increases overall employment by about 1.2 jobs.

The combined construction and administration programs brought approximately $612 million and over 6,000 direct jobs to the Inland Empire, and increased economic activity by about $850 million. In turn, this increase in economic activity increased employment by about 8,000 jobs and increased state and local tax revenue by approximately $29 million. The combined spending and employment multipliers for construction and administration indicate that an additional $1.00 spent on energy efficiency in the Inland Empire increases overall economic activity by about $1.38, and an additional efficiency program job created a total of 1.3 local jobs.

Between 2010 and 2016, households and businesses in the Inland Empire invested their own money in energy efficiency; IOU investments covered a small fraction of these total project costs. This additional spending is difficult to estimate, but created at least as many construction jobs in the region as were created from the investment. Since the consumer spending on efficiency was funding from within the region, it represented a shift from other purchasing decisions. Therefore, it was not considered new spending in the region and not included in the economic impact results shown in Table 13.

TABLE 13 Economic Impact of Energy Efficiency Programs in the Inland Empire, 2010–16

Impact Category	Direct Effects ($ and jobs)	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Energy Efficiency Installation Activity	$365.0 million 2,080 jobs	$488.9 million	3,292 jobs	$16.1 million
Program Administration	$247.0 million 3,972 jobs	$356.5 million	4,643 jobs	$13.5 million
Total	**$612.0 million 6,052 jobs**	**$845.4 million**	**7,935 jobs**	**$29.6 million**

Source: IMPLAN. Results reported in 2017 dollars. **Excludes property tax revenue.*

BENEFITS FROM LONG-TERM SAVINGS

Upfront investments in efficiency lead to cost savings over the long-term, through reduced utility bills. Although we did not include this impact in the analysis presented in Table 13, these savings amplify the economic benefits for the region.

Investments made in energy efficiency equipment save energy and money over the life of the equipment, which is typically 12 to 15 years, with some lighting measures lasting fewer years and some insulation and HVAC measures lasting longer. Many efficiency investments end up saving more money than their upfront cost. The IOUs manage an energy efficiency portfolio in which the avoided future costs exceed the upfront costs. This "cost effectiveness" has been a guiding principle of California's energy efficiency programs.

Cost effectiveness is measured in several ways. The "Total Resource Cost" (TRC) test measures the costs and benefits from the perspective of the Program Administrator (IOUs) as well as the customers. However, the costs and benefits are not balanced in California's test, which is the subject of current discussion at the CPUC. In 2010-16, the (unevaluated) TRC for the IOU energy efficiency programs in the Inland Empire was about 1.6 (the evaluated TRC is typically lower). This means that for every dollar spent, ratepayers saw $1.60 in avoided costs and greenhouse gas benefits. From 2010-2016, the IOU programs spent $612 million (adjusted for 2017 dollars), resulting in combined gas and electric benefits of $1.074 billion (adjusted to 2017 dollars).[109]

COSTS OF ENERGY EFFICIENCY PROGRAMS

By not accounting for the shift in consumer spending (or long-term savings) from utility bills to efficiency investments, the only costs we accounted for are the ratepayer costs of funding the IOU efficiency programs, which provided the investment in efficiency activities. We account for these and other ratepayer costs in the section titled "Costs of Programs to Ratepayers in the Inland Empire" on page 46.

Interestingly, the Inland Empire accounts for about 9.1 percent of the IOU energy consumption (combined gas and electricity) in the state, and the region has also accounted for 9.1 percent of the energy efficiency expenditures in the 2010-16 period. While this shows an equitable distribution of energy efficiency

resources to the region, energy consumption in the region grew as a percentage of the state total (from 9 percent in 2010 to 9.3 percent in 2015) at the same time expenditures shrank as a percentage of the state total: in the 2010-12 program cycle the region received 13.2 percent of the IOU expenditures but by 2016 this was down to 4.1 percent.[110]

POTENTIAL ECONOMIC IMPACTS OF ENERGY EFFICIENCY INVESTMENTS THROUGH 2030

Energy efficiency investments are among the most cost-effective carbon-saving measures available. The reduced energy usage can translate to less need for utility investment in new energy generation as well as transmission and distribution infrastructure, with those avoided costs accruing to ratepayers.

Assuming avoided energy costs continue to exceed up-front investment costs, efficiency efforts will continue to provide positive economic benefits in the Inland Empire and beyond. Factors that would influence future impacts include:

- The amount of energy use reduction achieved by the efficiency investments and the extent to which those savings will be re-spent in the local economy;
- The number and quality of jobs created in the Inland Empire from energy efficiency investments;
- The amount of outside, capital market investment that could flow to the Inland Empire for efficiency investments, particularly based on SB 350's directive to encourage more pay-for-performance program model;
- The potential public health benefits associated with decreased emissions from Inland Empire generation assets, which can translate to decreased public health costs and increased productivity.

Estimating the potential energy efficiency savings in the Inland Empire through 2030 requires additional information and analysis, particularly as California's energy agencies are still determining how to implement SB 350 and what target savings are needed by 2030 to achieve the law's goals. If the statewide doubling of efficiency goal were applied to the Inland Empire, the region would presumably see an increase in benefits, particularly if investments from outside the Inland Empire increase.

COSTS OF PROGRAMS TO RATEPAYERS IN THE INLAND EMPIRE

This report has detailed the economic impacts from new money flowing into the Inland Empire as a result of California's climate programs. This section details the costs to the region's residential and non-residential consumers of these programs. While we have already accounted for the costs to industry of cap and trade and the renewables portfolio standard, and omitted the consumer investment in (and long-term savings from) distributed solar and energy efficiency, we have not yet accounted for the costs incurred by consumers in the Inland Empire to help fund these programs.

For example, cap-and-trade regulations allow the costs of compliance to be passed through to consumers, in the form of higher energy and fuel prices. Although energy costs increase, consumers benefit from the requirement that investor-owned utilities sell all of their allocated allowances and distribute the proceeds from these sales back to their customers. As reported by the CPUC, energy prices are also increased by the costs of IOU energy efficiency and solar incentives.[111] This section examines the net economic impact of these costs and benefits. The costs and benefits of the programs are reported in Table 14. Data on funds collected from electricity customers to finance the renewables portfolio standard, energy efficiency, and solar incentive polices are available from 2010 to 2016. The total cost of these programs for residential and non-residential ratepayers in the Inland Empire was approximately $990 million (in 2017 dollars) over this period.[112] These figures were derived from the Inland Empire's share of the costs reflected in higher electricity rates due to these programs. Cap-and-trade regulations increased Inland Empire ratepayer expenses by about $339 million. Electricity customers in the region received approximately $436 million in dividends associated with the sale of utility allowances. The data on cap-and-trade costs and benefits starts in 2014 when allowance revenue was first distributed back to ratepayers. The net effect of all of these programs is a cost of about $893 million.

The costs to residential electricity customers is based on the decrease in household incomes as higher electricity rates mean less income to spend on other goods and services. The impact on non-residential, commercial customers is based on the same method used to measure the effect of cap and trade.

TABLE 14 Inland Empire Ratepayer Costs and Benefits of Cap and Trade, Solar Initiative, and Energy Efficiency, 2010–16[113]

Cost/Benefit Category		Cost/Benefit Amount
Energy Efficiency and Solar Initiative	Cost	–$990.7 million
	Returns	$1,714.0 million
Cap and Trade	Cost	–$339.1 million
	Returns	$436.4 million
Total (net)		**$820.6 million**

Source: California Public Utilities Commission, AB 67 Reports plus data from Distributed Solar and Energy Efficiency sections of this report[114]

TABLE 15 Inland Empire Economic Impact of Ratepayer Costs from Cap and Trade, the RPS, Solar Initiative, and Energy Efficiency, 2010–16.

Impact Category	Direct Effects	Total Impact on Economic Activity	Total Impact on Employment	Impact on State and Local Tax Revenue*
Household Income	–$748.7 million	–$449.5 million	–3,568 jobs	–$21.7 million
Supplier Industries	–$120.6 million	–$141.8 million	–1,441 jobs	–$4.6 million
Proprietor Income	–$24.1 million	–$14.2 million	–113 jobs	–$0.7 million
Total Costs	**–$893.4 million**	**–$605.5 million**	**–5,122 jobs**	**–$27 million**

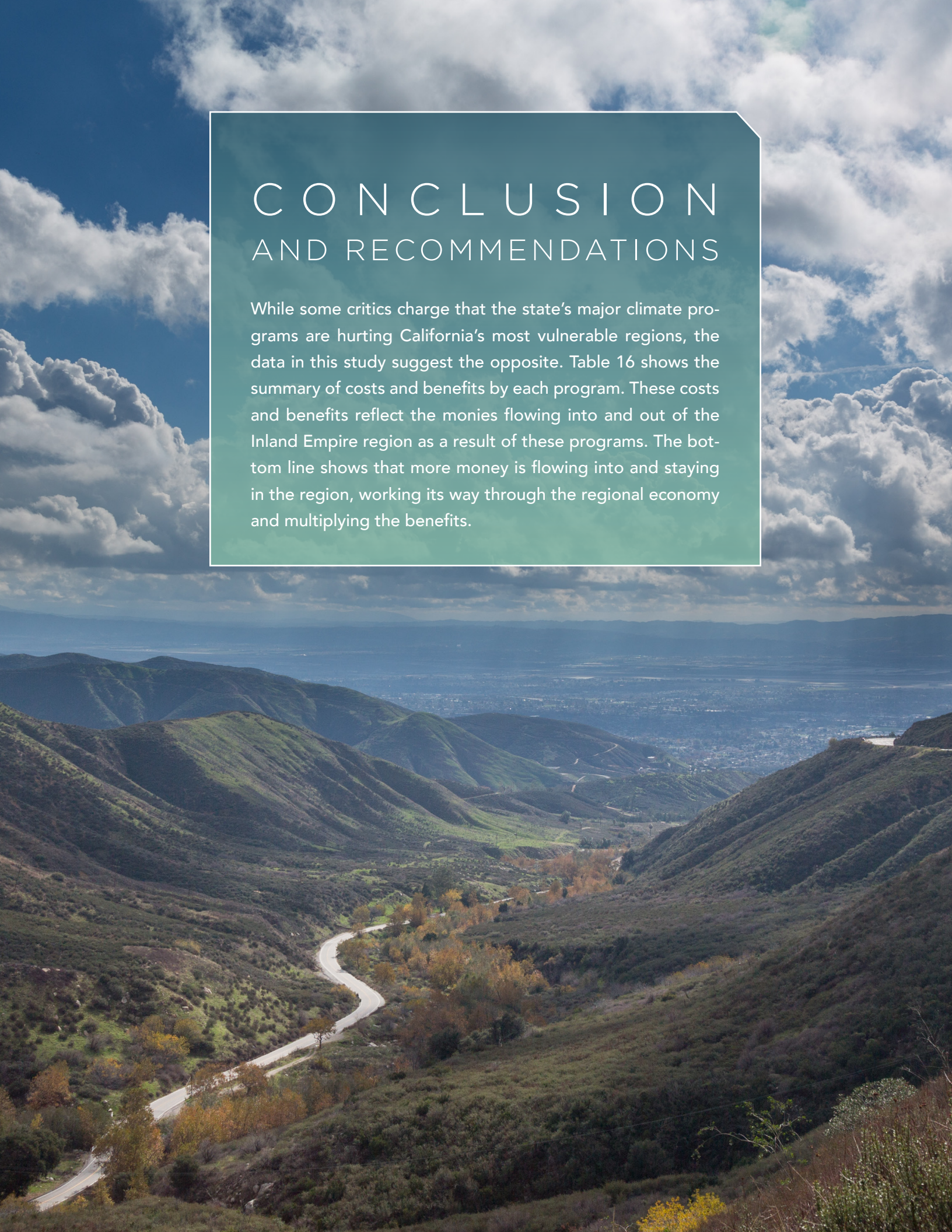
Source: IMPLAN. Results reported in 2017 dollars. **Excludes property tax revenue.*

The additional electricity costs mean fewer resources are available in the short run for companies to spend on production. Consequently, businesses have less to spend on supplies, labor service, and proprietor income. However, the ratepayer funds going to energy efficiency programs are more than recouped through lower rates from the avoided costs of generation, transmission, and distribution.

ECONOMIC IMPACT OF THE COST OF PROGRAMS TO RATEPAYERS

To measure the economic impact in the region, the total cost of $893.4 million is first allocated between residential and non-residential customers based on the weighted average distribution (46 percent for residential ratepayers and 54 percent for non-residential). The non-residential portion is further adjusted based on the characteristics of suppliers to the major industries in the region. This information was obtained from the IMPLAN software and data for the two-county region indicates that, on average, these particular industries allocate their costs as follows: 70 percent for employee compensation, 25 percent for indirect costs, and 5 percent for proprietor income.

As a consequence of these allocations, household incomes (combined employee compensation, proprietor income, and the effect on residential customers) bear the largest cost burden of the policies. The cost allocations are reported in Table 15 and indicate that about $749 million (84 percent) of costs are shared by residential ratepayers and employee compensation (under "Household Income"), plus an additional $24 million in proprietor income.[115] Approximately $120 million in costs are allocated to supplying industries. The impact of these cost allocations is also reported in Table 2. The total impact of $893 million in costs is associated with an approximate $600 million decrease in economic activity in the two-county region. This is lower than the direct effect because IMPLAN adjusts income impacts for spending that takes place outside of the region. The decrease in economic activity is associated with the loss of over 5,000 jobs and about $27 million in state and local tax revenue.



CONCLUSION
AND RECOMMENDATIONS

While some critics charge that the state's major climate programs are hurting California's most vulnerable regions, the data in this study suggest the opposite. Table 16 shows the summary of costs and benefits by each program. These costs and benefits reflect the monies flowing into and out of the Inland Empire region as a result of these programs. The bottom line shows that more money is flowing into and staying in the region, working its way through the regional economy and multiplying the benefits.

TABLE 16 Economic Impacts (Costs and Benefits) of California's Major Climate Programs in the Inland Empire, 2010-16 (reported in 2017 dollars)

Impact	Direct Effects	Direct Employment	Total Impact on Economic Activity	Total Impact on Employment	Impact on State & Local Tax Revenue
	($ million)	(jobs)	($ million)	(jobs)	($ million)
Cap and Trade Costs (Non-Electricity	-$54		-$32	-255	-$1.5
Cap-and-Trade Benefits (Non-Electricity)	$95	240	$58	409	$2.4
Cap and Trade Costs (Electricity Ratepayers)	-$339		-$230	-1,944	-$10.2
Cap and Trade Benefits (Electricity Ratepayers)	$436		$296	2,502	$13.2
Renewables Portfolio Standard Benefits	$10,261	30,189	$14,489	63,511	$426.3
Renewables Portfolio Standard Costs	-$1,968	-1167	-$2,021	-3,299	-$175.4
Distributed Solar Benefits	$1,103	5970	$1,507	10,117	$50.3
Energy Efficiency Benefits	$612	6052	$845	7,935	$29.6
Distributed Solar and Energy Efficiency Electricity Ratepayer Costs	-$991		-$671	-5,680	-$29.9
Net Impact	**$9,155**	**41,284**	**$14,240**	**73,296**	**$304.7**

As with any economic transition, the costs and benefits are not uniformly distributed across all sectors. Policy leaders should continue the positive momentum generated to date by considering enhancements to existing policies and adopting additional ones, including transition support for those workers and communities that experience hard as a result of these policies. We recommend policy makers prioritize the following policy changes to ensure the state's climate programs continue to benefit the Inland Empire, other vulnerable regions, and the state as a whole:

- Develop a comprehensive transportation program equal in scale to the renewable energy programs for electricity adopted in the state. It could build on the foundation of SB 375, the low carbon fuel standard, and other transportation programs, such as the California Sustainable Freight Action plan, to maximize benefits and minimize harm for local industry and residents. The importance of warehousing and logistics and the distances traveled by residents each day to and from work makes transportation the greatest unknown of California's climate program.
- Improve implementation of the cap-and-trade program through 2030 by considering provision of dividends to consumers in the Inland Empire to account for the higher than average transportation fuel and electricity use in the region.
- Disburse auction proceeds in a timely and predictable manner and ensure that all regions receive appropriate levels of statewide spending based on their economic and environmental needs.
- Ensure that cap-and-trade auction proceeds are spent on programs (including potentially dividends) that create jobs, further greenhouse gas reduction benefits, and reduce co-pollutants, particularly in disadvantaged communities, per SB 535 (de Leon), AB 1550 (Gomez), and AB 398 (Garcia) governing auction revenue spending.
- Review existing policies and consider expanding energy efficiency incentives and expenditures for the Inland Empire and other regions where per capita energy use is higher than the state average. This will improve the building and housing stock in these areas, reduce energy costs for residents, businesses, and industry, create jobs, and increase economic activity in these regions. GGRF funding should be used, in addition to ratepayer funds.
- Develop robust transition programs for workers and communities affected by the decline of greenhouse gas-emitting industries. Programs should include re-training and job placement programs, income supports, bridges to retirement for older workers, and regional economic development and diversification initiatives.
- Improve the economic and job benefits of renewable energy and energy efficiency projects through labor agreements that promote local and career-track jobs.

While this report has focused on the key climate programs related to cap and trade, renewable energy, distributed solar, and energy efficiency, California leaders have developed a suite of other policy measures to meet AB 32 and SB 32 2030 greenhouse gas goals. For example, the low carbon fuel standard, vehicle electrification mandates and incentives, and land use/housing policies related to SB 375 (Steinberg, 2008) will all play critical roles in achieving the state's climate policy goals in a cost-effective—and potentially economically beneficial—manner. Future studies should analyze the combined impacts of these programs in addition to the ones studied here.

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114. The following is an illustration of how the percentages determine the cost allocations presented in Table 16 and Table 17: we estimated that 46 percent of $893 million in costs are shared by residential customers (about $411 million). The other 54 percent for non-residential ratepayers is about $482 million in higher electricity costs (.54 x $893 million). The cost of non-residential ratepayers is assumed to mean that these entities have less to spend on production-related expenses (labor, supplies, and profit). We use data from IMPLAN for the ten largest industries in the two-county region to determine these production expenditures. The top ten industries include real estate, wholesale trade, restaurants, local government, service industries (including hospitals), and general merchandise stores. Data for these industries indicate that 70 percent of costs are labor costs, 5 percent goes to proprietor income, and 25 percent goes to indirect costs (supplies, materials, energy, etc.) Based on these percentages, 70 percent of the $482 million ($337 million) in non-residential rate payer costs are labor costs (employee compensation), $24 million is proprietor income (0.05 x $482 million), and $120 million is spent on supplies, energy, materials, etc. (.25 x 482). Summing these figures indicates that the total costs for "household income" is $411 million (residential ratepayers), plus $337 million (employee compensation), for a total of $748 million. Costs incurred by local suppliers are $120 million. Total costs of $893 million are the sum of household income ($748 million), reduced spending on supplies ($120 million), and proprietor income ($24 million). The distinction between household and proprietor income is a result of IMPLAN's differentiating household income, employee compensation, and proprietor income.