Appendix 11

Cost Effectiveness and Disproportionate Analysis

County of San Diego Climate Action Plan Update

Cost Effectiveness and Disproportionate Cost Analysis

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Glossary

BAU: Business As Usual

CALGreen: 2022 California Green Building Standards Code

CalEPA: California Environmental Protection Agency

CAP Update: Climate Action Plan Update

CEA: Cost-Effectiveness Analysis

CEC: California Energy Commission

CPI-U: Consumer Price Indexes for All Urban Consumers

DOE: U.S. Department of Energy

EDD: California Employment Development Department

EPA: U.S. Environmental Protection Agency

EV: Electric Vehicle

EVMT: Electric Vehicle Miles Traveled

FY: Fiscal year

GHG: Greenhouse Gas

GDP: Gross Domestic Product

HVAC: Heating, ventilation, and air conditioning

ICE: Internal Combustion Engine

$MTCO_2e$: Metric tons of carbon dioxide (CO_2) equivalent

NAICS: North American Industry Classification System

NO_x: Nitrogen oxides

O-D model: Origin-Destination model

OMB: U.S. Office of Management and Budget

$PM_{2.5}$: Particulate Matter <2.5 microns wide

RL: Registered Location

SANDAG: San Diego Association of Governments

State: State of California

UHI: Urban Heat Island

VMT: Vehicle Miles Traveled

VOC: Volatile organic compound

ZEV: Zero emission vehicles

Introduction

The County of San Diego (County) has drafted a Climate Action Plan Update (CAP Update) to reduce greenhouse gas (GHG) emissions within unincorporated areas and from County operations, with the goal of achieving net zero emissions by 2045. The CAP Update consists of 21 measures and 34 implementing actions, not including Path to Net Zero Actions, designed to reduce GHG emissions across five sectors: Built Environment & Transportation, Energy, Solid Waste, Water & Wastewater, and Agriculture & Conservation. Implementing these measures and actions will cost time, capital, and effort and will produce a variety of benefits. This report estimates those costs and benefits, and also assesses the disproportionate impacts on unincorporated communities (since they will not be felt evenly across the county), with a focus on frontline communities, as defined in the CAP Update.

This report has three components, which will help understand the broader economic impacts of the CAP Update:

1. The upfront costs analysis estimates the initial construction costs the CAP Update may have on housing and other development. This focuses on new building code requirements that are to be developed by 2026. Since the code updates have not been created yet, these cost impacts are rough estimates and will help understand how the code can be developed to reduce cost impacts.
2. The cost effectiveness analysis takes a broad view of the costs and benefits of CAP Update actions, identifies which are net costly and which are net beneficial
3. The disproportionate cost analysis identifies how CAP Update actions could create disproportionate costs and benefits for communities, occupations, and other groups in the unincorporated area.

Upfront cost analysis

This analysis provides an estimate of upfront construction costs that could result from code updates included in the CAP Update. These code updates will occur by 2026 and therefore the codes have not been developed yet. The information provided can help the County determine how to mitigate upfront construction costs through waivers, exemptions, approach modifications to different climate zones, or other strategies, while still meeting GHG emission reduction targets. Additionally, that State will update the baseline building code in 2025, which may take on many of the requirements noted in this analysis. The result from this analysis is programmatic and may differ from a project specific analysis.

Key Findings

- The upfront cost analysis shows that the following building code update requirements may increase construction costs: electric vehicle (EV) charging stations, renewable energy, electric loading docks, energy and water efficiency, and electrical equipment. However, cost savings could occur from omitting natural gas equipment and infrastructure from new construction projects.
- One of the largest factors for the increase in initial construction costs is the increased requirement for on-site renewable energy. However, permit data shows that this size equipment is largely being provided by the market already. Therefore, on paper this appears as cost increase but within the construction market this is in alignment with current practices.
- The costs are higher for new residential construction (an estimated average of $3,775 per unit additional cost) than major retrofits (an estimated average of $2,037 per unit).
- Energy efficiency improvements offset the increased cost for new construction.
- All increased upfront costs are recuperated over the lifetime of the building through energy efficiency and onsite renewable energy.
- The State will update the building code in 2025 and may require many of components included in this analysis. Any components that are included in State level requirements would therefore not be an additional cost associated with local regulations and the CAP Update.

Methodology

Upfront costs are obtained from public sources or are County-provided and span recent years, with the most recent being preferred over prior years. To ensure comparability of the costs throughout time, costs are normalized to a reference year, 2023, using the annual Consumer Price Index (CPI) for All Urban Consumer for all items in San Diego-Carlsbad.

Displacement of capital, in the form of implementation of plans, acquisition of real

assets, or even incentives, carries a cost opportunity insofar as the capital could be invested instead, for instance in financial assets, and gain returns. This analysis uses the shadow price of capital approach as a way of measuring the effects of the displacement in easier terms to understand, like consumption values: how will future spending affect present consumption? It is worth noting that the shadow price of capital approach is the analytically preferred method in guidelines that drive budgeting across the Executive Branch and Federal agencies, namely Circular A-4.

The discount rate used in the analysis is 2.0%, and it is also consistent with Circular A-4; it is meant to represent a risk-free rate of return, like investing in 10-year Treasury Inflation-Protected Securities. The chosen approach requires providing a range of shadow prices. This analysis' methodology adheres to the U.S. Office of Management and Budget's recommendations of a low value of 1.0, and a high value of 1.2, which reflect an open and closed economy respectively. The former scenario is one where capital can move freely across borders and obtain the highest rates of return, and the latter is where there is no trade beyond borders. The recommended value is the middle-cost of 1.1. Table 1 and Table 2, lies right in the middle and is consistent with recent academic literature published in the National Bureau of Economic Research, see (Newell et al., 2023).

Specific methodologies for each of the actions are detailed in APPENDIX I.

Code Changes

This analysis quantifies the upfront costs to transition from the 2022 California Green Building Standards Code (CALGreen) Mandatory Measures to Tier 2 Requirements, both for residential and non-residential buildings. The costs reflected in this section account for the difference between the mandatory measures and Tier 2, and not the entire cost of complying with the baseline. For instance, for measure T-3.1, it is assumed that the necessary EV charging infrastructure to comply with the mandatory code has already been met, so only the cost of the chargers to meet Tier 2 requirements is considered.

The State of California will update the CALGreen code in 2025, ahead of the CAP Update-directed code updates in 2026. State code updates may incorporate some of the code modifications considered in the CAP Update, which would reduce the initial construction costs identified in this report. The State codes are anticipated to increase requirements beyond the current code.

While the code requirements could raise the initial construction costs of residential or non-residential development, the code update itself will have to prove to be cost neutral over time to receive approval from the State. Cost neutrality is measured by estimating the cost savings these code requirements will have over the building's life. In other words, any code updates that go beyond State CALGreen base code (i.e., reach code) would have to prove energy efficiency and cost effectiveness before going into effect. This means that any increases in upfront costs would be offset by savings over the life of the building. For instance, increased renewable energy in a building will cover the cost of using electrical appliances and other equipment.

Findings

Table 1 and Table 2 summarize the upfront costs to comply for residential and non-residential construction.

One of the largest factors for the increase in initial construction costs is the increased requirement for on-site renewable energy. However, historical County permit data shows that developers are already up-sizing on-site renewable energy systems larger than what would be considered in the CAP Update code modifications.

For projects that are subject to the California Environmental Quality Act, the County estimates an average savings of $805/unit for avoided costs for environmental review through use of the CAP Checklist. These savings are not included in the analysis.

The actions analyzed in this report lead towards building electrification. Another cost saving measure that developers may incorporate is the removal of natural gas infrastructure, including natural gas meter(s), which can save an estimated $3,000 - $10,000 per unit. These savings are not included in the analysis.

Table 1: Upfront Costs to Comply for Residential Construction

			2025 Anticipated Cost ($/unit)[1]		
Construction Type	CAP Action	Description	Lower Bound[2]	Recom-mended	Upper Bound
New Residential	T-3.1	EV Charging Infrastructure	$373	$410	$448
	E-2.1	Energy Efficiency	-$512	-$563	-$615
	E-3.1	Renewable Energy	$2,695	$2,964	$3,233
	W-2.1	Water Efficiency	$876	$964	$1,051
		Total	$3,432	**$3,775**	$4,118
Retrofitted Existing Residential	E-2.2	Energy Efficiency	$976	$1,073	$1,171
	W-2.2	Water Efficiency	$877	$964	$1,052
		Total	$1,852	**$2,037**	$2,223

[1] All values are in 2023 dollars.

[2] The lower bound uses a shadow price of capital of 1.0, and it reflects an economy where capital can move freely across borders and obtain the highest rates of return. The upper bound uses a value of 1.2 and reflects an economy with no trade beyond its borders. The recommended value lies in the middle, at 1.1, and follows research published by the National Bureau of Economic Research.

Table 2: Upfront Costs to Comply for Non-Residential Construction

Construction Type	CAP Action	Description	2025 Anticipated Cost ($/sq.ft.)[1] Lower Bound[2]	Recom-mended	Upper Bound
New Non-residential	T-3.1	EV Charging Infrastructure	$1.01	$1.11	$1.21
		Electrification of Loading Docks	$2.7	$3.0	$3.3
	E-2.1	Energy Efficiency	-$3.8	-$4.1	-$4.5
	E-3.1	Renewable Energy	$109	$119	$130
	W-2.1	Water Efficiency	$11	$12	$13
		Total	$119	**$131**	$143
Existing Retrofitted Non-residential	E-2.2	Energy Efficiency	$2.2	$2.5	$2.7
	W-2.2	Water Efficiency	$11	$12	$13
		Total	$13	**$14**	$16

[1] All values are in 2023 dollars.

[2] The lower bound uses a shadow price of capital of 1.0, and it reflects an economy where capital can move freely across borders and obtain the highest rates of return. The upper bound uses a value of 1.2 and reflects an economy with no trade beyond its borders. The recommended value lies in the middle, at 1.1, and follows research published by the National Bureau of Economic Research.

Cost effectiveness analysis

This section describes the methods and key findings of the Cost Effectiveness Analysis (CEA) for the County's CAP Update.

Key findings

- The actions included in the CAP Update that are evaluated in this report would reduce GHG emissions by an estimated 741,171 $MTCO_2e$.
- The net costliest action per $MTCO_2e$ is W-1.1, largely because it also has the lowest number of yearly $MTCO_2e$ reductions, which implies that the return for investing in its implementation is met with an overall low emission reduction, however this program's primary objective is to achieve water savings rather than reduce emissions.
- The single most net beneficial action is W-2.2, which saves participating residents money by reducing their water usage.
- Additional highly net beneficial actions are T-4.1, T-6.1, T-6.2, and T-6.3. The benefits from these transportation actions largely come from reducing the number of miles that residents of the unincorporated area need to travel through investments that support transit use, reducing both costs to the residents and GHG emissions.

Methodology

The CEA compares the relative costs and benefits of the actions in the CAP Update. It estimates the costs to implement the 34 actions listed below and the benefits that arise from implementation. The actions covered in this CEA are T-1.1, T-1.2, T-2.1, T-2.2, T-3.1, T-4.1, T-4.2, T-5.1, T-5.2, T-6.1, T-6.2, T-6.3, E-1.1, E-2.1, E-2.2, E-3.1, E-3.2, E-3.3, SW-1.1, SW-2.1, SW-4.1, W-1.1, W-2.1, W-2.2, W-2.3, W-2.4, W-3.1, A-1.1, A-1.2, A-2.1, A-2.2, A-3.1, A-4.1 and A-5.1.

The costs in this analysis are limited to capital expenditure on human capital or to attain fixed assets or services and supplies. The benefits reflect capital gains from selling fixed assets, savings in utilities and gas consumption, subsidies and incentives, or savings resulting from reducing carbon emissions. It is worth pointing out that other types of benefits, like the value of health savings from improving air quality and reducing pollution, or those arising from the creation of jobs, whether from salary and benefits or services have been excluded from the analysis. The Disproportionate Cost Analysis portion of this report provides further discussion of the latter.

The costs and benefits are tailored to the stakeholders partaking in the implementation of the actions, with four specific types also referred to as participants: the County and residents and businesses of the unincorporated area. The cost of rebates and incentives are absorbed by the County.

This CEA uses a base year of 2025, a target year of 2030, and a dollar-year base of 2023. This analysis used non-seasonally adjusted CPIs from the Bureau of Labor

Statistics for the San Diego-Carlsbad Metropolitan Statistical Areas (which is co-terminus with San Diego County) for 2020 (302.564), 2023 (362.022), and 2024 (369.3875). This analysis used 2.0% as the consumption rate, reflecting the 30-year average of the yield on 10-year Treasury marketable securities plus a 0.3% per year to reflect inflation as measured by Personal Consumption Expenditures inflation index.[1] This analysis used a shadow price of capital, which accounts for capital displacement, of 1.1.[2]

County costs were obtained from CAP Update Appendix 10, Implementation Cost Analysis, and they are broken down by action and disaggregated by type: capital, salary and benefits, and services and supplies. When applicable, the capital costs for rebates and incentives of the County are alternatively assigned as benefits to residents or businesses. The costs and benefits of participants are estimated on a per-unit basis and scaled using factors such as the number of housing units, businesses, County employees, or acres of land.

The number of housing unit estimates and projections and the corresponding distribution into single and multifamily units is reflective of the CAP Update Appendix 4, 2019 Greenhouse Gas Emissions Inventory and Projections. For certain actions, the number of multifamily units had to be disaggregated by number of units (2 to 4, 5 to 9, 10 to 19, and 20 or more). Given that this local level of detail about housing unit size is not readily available from the U.S. Census or other data sources, proxy information was used from the West region, which includes California and 12 other states. This analysis does not use the total number of units, but their proportions, and applied these to the housing unit estimates used in the CAP Update. This results in an estimated number of multifamily housing in the unincorporated area by number of units.

The number of businesses in San Diego County from 2015 to 2022 was obtained from the Employment Development Department (EDD)[3] and projected into 2030 using the average growth rate. To estimate the number of businesses in the unincorporated area the methodology used a commercial jobs ratio of Unincorporated County to San Diego region which is consistent with estimates and projections in the 2024 CAP Update.

For certain actions, detail on the size of the businesses is required. SANDAG Series 15 Regional Growth forecast was used to estimate the average business size, such as, County Development from 2022 to 2032 which provides industrial and commercial development in acres. Given that the requirements from actions like the number of EV chargers are a function of commercial square footage, the number of acres was then

[1] OMB Circular A-4, Nov. 2023

[2] Newell, et al. 2024. The Shadow Price of Capital: Accounting for Capital Displacement in Cost Benefit Analysis. Environmental and Energy Policy and the Economy, vol 5. (as cited in OMB Circular A-4, Nov. 2023)

[3] Employment Development Department. (2024). Employment Development Department, State of California. https://edd.ca.gov/

converted to square feet. Since the most recent data from EDD[4] showed that nearly 70% of the businesses in San Diego County had between zero and four employees, the square footage of small businesses (1,400 feet) was used as a proxy for average business size.

Each action has an annual GHG emission reduction in metric tons of carbon dioxide (CO_2) equivalent ($MTCO_2e$). This report uses the U.S. Environmental Protection Agency (EPA) social cost of carbon to convert the emission reduction to savings in dollars for each ton of carbon emissions. These savings occur every year throughout the action's useful life. This report calculates the present value of yearly savings, called externalities, using a 2.5% discount rate based on the EPA's Report on the Social Cost of Green House Gases: Estimates Incorporating Recent Scientific Advances (2023). In this context, externalities refer only to the positive effects of CAP Update actions, accounting for net emission reductions such as emissions from increased EV use and equipment transitions. Finally, externalities are treated like other benefits and use the shadow price of capital approach to convert them into consumption-equivalent values before discounting.

Results

The CEA estimates costs and benefits for the CAP Update's actions and shows how cost-effectively the CAP Update reduces GHG emissions. The tables included below summarize the findings of the CEA analysis by emission reduction sector: Built Environment & Transportation; Energy; Solid Waste; Water & Wastewater; and Agriculture & Conservation.

Tables 3 - 7 show the cost per $MTCO_2e$ for actions for the County and residents and businesses of the unincorporated area. These costs and benefits are considered together with GHG emission reductions in the Society column. Net costs are shown in Table 3 for the Built Environment and Transportation actions, Table 4 for the Energy actions, Table 5 for the Solid Waste actions, Table 6 for the Water and Wastewater actions, and Table 7 for the Agriculture and Conservation actions. It is worth pointing out that actions with negative net costs (that is, with higher costs than benefits), are generally associated with low yearly $MTCO_2e$ reductions.

[4] Employment Development Department. (2023). Table 3A: Payroll and Number of Businesses by Size Category Classified by County for California Third Quarter, 2022. Retrieved from https://labormarketinfo.edd.ca.gov/LMID/Size_of_Business_Data.html

Table 3: Dollar per $MTCO_2e$ to Achieve the 2030 GHG Emission Reduction Target for Built Environment & Transportation Sector

Action	$MTCO_2e$ Reduced in 2030	Net cost[1] per $MTCO_2e$ to achieve 2030 GHG target				
		County	Residents	Businesses	Externalities	Society
T-1.1	7,900	-$209	$0	$28	$162	-$20
T-1.2	5	-$36,197	$0	-$970	$139	-$37,029
T-2.1	2,072	-$379	$27	$148	$139	-$66
T-2.2	7,638	-$7	$71	$55	$139	$258
T-3.1	218,884	-$11	$348	$0	$149	$487
T-4.1	12,800	-$5	$587	$0	$139	$720
T-4.2	903	-$32	$207	$0	$162	$337
T-5.1	1,756	-$6,274	$5,328	$0	$171	-$775
T-5.2	214	-$302	$0	$0	$171	-$131
T-6.1	3,051	-$168	$757	$0	$171	$760
T-6.2	12,615	-$22	$627	$0	$171	$776
T-6.3	994	-$230	$831	$0	$171	$771

[1] All values are in 2023 dollars.

Table 4: Dollar per $MTCO_2e$ to Achieve the 2030 GHG Emission Reduction Target for Energy Sector

Action	$MTCO_2e$ Reduced in 2030	Net cost[1] per $MTCO_2e$ to achieve 2030 GHG target				
		County	Residents	Businesses	Externalities	Society
E-1.1	13,715	-$338	$0	$0	$158	-$180
E-2.1	17,734	-$10	-$34	-$138	$158	-$25
E-2.2	124,742	-$15	$6	$30	$158	$178
E-3.1	252	-$410	-$9,561	-$1,173	$171	-$10,973
E-3.2	29	-$33,316	$38,317	$0	$171	$5,172
E-3.3	176,625	$0	$0	$0	$171	$171

[1] All values are in 2023 dollars.

Table 5: Dollar per $MTCO_2e$ to Achieve the 2030 GHG Reduction Target for Solid Waste Sector

Action	$MTCO_2e$ Reduced in 2030	Net cost[1] per $MTCO_2e$ to achieve 2030 GHG target				
		County	Residents	Businesses	Externalities	Society
SW-1.1	1,305	$492	$0	$0	$166	$658
SW-2.1	37,804	$223	$0	$0	$166	$389
SW-4.1	1,373	-$19,883	$0	$0	$166	-$19,718

[1] All values are in 2023 dollars.
Note: Action SW-3.1 is not included in this analysis because its emissions target is for 2045 and does not have a 2030 target.

Table 6: Dollar per $MTCO_2e$ to Achieve the 2030 GHG Emission Reduction Target for Water & Wastewater Sector

Action	$MTCO_2e$ Reduced in 2030	Net cost[1] per $MTCO_2e$ to achieve 2030 GHG target				
		County	Residents	Businesses	Externalities	Society
W-1.1	3	-$272,213	$0	$0	$171	-$272,042
W-2.1	37	-$2,244	-$1,839	$8,471	$171	-$12,383
W-2.2	320	-$377	$1,628	$153	$166	$1,569
W-2.3	64	$219	$5,107	-$7,868	$166	-$13,029
W-2.4	21	-$25,309	$14,254	-$425	$171	-$11,310
W-3.1	10,046	-$922	$15	$0	$139	-$769

[1] All values are in 2023 dollars.

Table 7: Dollar per $MTCO_2e$ to Achieve the 2030 GHG Emission Reduction Target for Agriculture & Conservation Sector

Action	$MTCO_2e$ Reduced in 2030	Net cost[1] per $MTCO_2e$ to achieve 2030 GHG target				
		County	Residents	Businesses	Externalities	Society
A-1.1	63,242	-$444	$13	$0	$139	-$292
A-1.2	76	-$4,005	$81	$0	$139	-$3,785
A-2.1	2,498	-$231	$7	$0	$178	-$45
A-2.2	439	$0	-$215	$0	$178	-$37
A-3.1	9,699	-$205	$44	$0	$139	-$23
A-4.1	10,758	-$85	$0	$0	$139	$54
A-5.1	1,559	-$453	$0	$345	$139	$31

[1] All values are in 2023 dollars.

Disproportionate costs analysis

Introduction

This section discusses disproportionate benefits and costs to communities in the unincorporated area as a result of implementing the CAP Update.

The first step is to identify which communities within the unincorporated area are likely to experience disproportionate impacts from the CAP Update. This could include those as defined in the CAP Update as "frontline communities." The analysis includes and evaluation of the impacts to the economy and labor, heat, energy, and transportation as they relate to the CAP Update, with a focus on frontline communities.

Data from the U.S. Census American Community Survey,[5] the California Environmental Protection Agency (CalEPA),[6] and the federal government's Justice40 initiative[7] was used to identify these communities. IMPLAN, a web-based platform for analyzing economic impacts of government policies and plans, was used to estimate the economic impacts of the CAP Update and identify disproportionate impacts to industries and occupations. Peer-reviewed and industry research literature was used to understand the impacts of heat on people in the unincorporated area. The American Community Survey data was used to contextualize housing data provided by the County. Finally, Replica data was used to contextualize transportation data provided by the County.

Frontline communities

Of the 737 census tracts in San Diego county, 192 are partially (n=131) or totally (n=61) located in the unincorporated area. Of those 192 census tracts, 38 census tracts were designated as "disadvantaged communities" under one or more definitions. The CalEPA designates four types of geographic areas as disadvantaged: those experiencing disproportionate burden due to pollution: either 1) the top 25% of census tracts by overall score in CalEnviroScreen 4.0 or 2) those missing overall scores due to data gaps but in the top 5% of the cumulative pollution burden scores; 3) those previously recognized as disadvantaged, or 4) those under the control of a federally recognized Tribe. Separately, the State of California designates some census tracts as low-income Communities (i.e., those with median household incomes at or below 80% of the statewide median income or the threshold set by the California Department of Housing and Community Development). Finally, the federal government has provided the Justice40 disadvantaged community designation to "capture vulnerable populations,

[5] US Census Bureau. (n.d.). *American Community Survey (ACS)*. Census.Gov. Retrieved July 11, 2024, from https://www.census.gov/programs-surveys/acs

[6] California Environmental Protection Agency. (n.d.). *SB 535 Disadvantaged Communities 2022*. Retrieved July 11, 2024, from https://experience.arcgis.com/experience/1c21c53da8de48f1b946f3402fbae55c/page/SB-535-Disadvantaged-Communities/

[7] *Justice40 Disadvantaged Tracts by State*. (n.d.). Retrieved July 11, 2024, from https://www.arcgis.com/apps/dashboards/b18141f64a9748068f6b9ca36980beec

health, transportation access and burden, energy burden, fossil dependence, resilience, and environmental and climate hazards."[8] All 38 "disadvantaged communities" census tracts were federally designated Justice40 communities; 37 were California-designated low-income communities. One census tract was both a California-designated low-income and CalEPA designated "disadvantaged community".

The total population of these 38 Justice40 communities equaled 196,784 individuals in 2022 (tract populations ranged from 2,616 to 8,790). The average median income for these census tracts was $80,638 (range=$54,217-$125,000); all but three communities had a median income below the area median income ($106,900) and all but five had a median income below the state median income ($101,600) for that year.[9] The bachelor's degree or higher attainment rate for individuals 25 years and older ranged from 12.4% to 44.8%, with an overall rate of 24.9%. This compares to the County's rate of 43% that year, which could have implications for career opportunities associated with the CAP Update.

Impacts on these census tracts are analyzed, where possible in the following sections. For those impact areas without census-tract level data, information is discussed instead as directional or qualitative impacts and specifies, when possible, what specific areas or groups (e.g., age, income) are most impacted. In general, decarbonization actions in California are expected to lead to air quality improvements that benefit socially and economically disadvantaged populations.[10]

Estimated economic impacts of CAP Update expenditures

Key findings

The expenditures from the CAP Update will have a positive impact on the local economy as the money from these projects flows through local businesses and households. Total direct effects from CAP Update actions from FY25/26 through FY29/30 is $495 million (output, or total regional economic activity) and almost 2,900 job-years,[11] increased wages of $266 million, and a value added (increase in regional GDP) of $272 million. The indirect effects are $151 million, and almost 700 job-years. The induced effects are estimated to be $231 million, and over 1,200 job years. The differences among these types of impacts are described in the following section.

[8] California Natural Resources Agency. (2024). California and Justice40 Disadvantaged or Low-income Communities. California Energy Commission. https://data.cnra.ca.gov/dataset/california-and-justice40-disadvantaged-or-low-income-communities

[9] Kirkeby, M. (2022). State Income Limits for 2022. Division of Housing Policy Development, Department of Housing and Community Development. https://www.hcd.ca.gov/docs/grants-and-funding/inc2k22.pdf

[10] Zhu, S., Mac Kinnon, M., Carlos-Carlos, A., Davis, S. J., & Samuelsen, S. (2022). Decarbonization will lead to more equitable air quality in California. *Nature Communications*, *13*(1), 5738. https://doi.org/10.1038/s41467-022-33295-9

[11] A "job-year" means one person employed for one year. The employment increase is on an annual basis, not permanent.

The largest CAP Update expenditures are in transportation infrastructure upgrades. The industry that sees the greatest increase in employment (the most "job benefits") is Maintenance & Repair Construction of Highways, Streets, Bridges, & Tunnels (see Table 10). The greatest increase in jobs by occupation is in Construction Trades Workers (see Table 11). The increases in employment come from transportation infrastructure upgrades to encourage walking, biking, and transit use, and upgrades to County buildings.

Economic impacts

The economic impact of CAP Update spending was analyzed using IMPLAN input-output modeling, which traces the effects of spending through the economy to produce a broad picture of how CAP Update expenditures influence the County economy[12] in terms of jobs, wages, income, regional gross domestic product (GDP), and gross revenue to local businesses (output). The results are summarized in Table 8. **Direct effects** are simply the direct expenditures that the County makes within the region (based on the size and structure of the county economy, the model estimates that some expenditures are made outside the county, and these expenditures have no local impact). **Indirect effects** are the result of economic activity related to the supply chain for the direct effects; for example, when the County pays a contractor for building efficiency improvements, the contractor buys building supplies, the building supply company buys additional supplies from other companies, and so on. This chain reaction multiplies the direct effects, to the extent that it happens within the county economy. The indirect effects are $151 million, and almost 700 job-years. The **induced** effects come from the increased spending of additional employees. New jobs are created by CAP Update expenditures, and those employees purchase housing, essential goods, entertainment, etc., causing another chain reaction within the economy. The induced effects are estimated to be $231 million, and over 1,200 job years.

In total, the CAP Update is estimated to result in increases of over 4,700 jobs, nearly $400 million in increased income to County households (from the jobs shown in Table 10 and 11), almost $150 million increase in regional GDP (technically Gross Regional Product), and about $880 million in revenue to businesses in San Diego county.

[12] California Natural Resources Agency. (2024). California and Justice40 Disadvantaged or Low-income Communities. California Energy Commission. https://data.cnra.ca.gov/dataset/california-and-justice40- disadvantaged-or-low-income-communities

Table 8: Direct, Indirect, and Induced Effects of CAP Update Spending on Select Economic Variables

Effect Type	Employment (number of job-years)	Labor Income (millions of dollars)	Value Added (millions of dollars)	Output (millions of dollars)
Direct	2,834	$266	$272	$495
Indirect	683	$49	$92	$151
Induced	1,242	$76	$144	$231
TOTAL	**4,759**	**$391**	**$508**	**$877**

The total costs to the County associated with the CAP Update from FY25/26 through FY29/30 are $650 million. Those expenditures were allocated into the model's sectors as shown in Table 9. The capital expenditures for land acquisition and implementation of conservation easements were not included in the analysis (a cost of $96 million), as they generate no economic activity within the model.[13] These lands can be used for recreational activity, which was not included in this model.

The total expenditures (excluding land acquisition and conservation easements) from CAP Update actions are $553.5 million (see Table 9). This results in a direct impact in San Diego county of $495 million (again, the model assumes some "leakage" outside the county economy) and roughly 2,800 job-years,[14] increased wages of $266 million (from the jobs outlined in Table 10 and 11), and a value added (increase in regional GDP) of $272 million over the five-year expenditure period.

As Table 19 shows, the biggest direct effects come from transportation infrastructure improvements, County building upgrades, staff salaries, and consulting services. The transportation infrastructure upgrades are particularly notable and important, as they have positive effects, such as reductions in travel time, that are not captured in this modeling. Reductions in travel time have economic benefits (like reduced energy costs), social benefits (like increased time connecting with family), and health benefits (like reduced stress discussed below in Transportation). These often-overlooked advantages are particularly significant for those with long commutes, such as low-income and rural residents.[15] Additionally, low-income residents are more likely to be rural residents as

[13] Acquisition of land and easements are considered "transfer payments," which generate no economic activity in the model. If the landowner were to invest the proceeds of the purchase or easement into the local economy, there would be positive impacts, but to be conservative this assumption isn't made.

[14] A "job-year" mean one person employed for one year. The employment increase is on an annual basis, not permanent.

[15] California Department of Housing and Community Development. (2024). *Housing and Transportation*. Retrieved June 27, 2024, from https://www.hcd.ca.gov/policy-and-research/intersectional-policy-work/housing-and-transportation

housing in cities has become more expensive, low-income workers are often forced to move to rural areas, increasing their commutes.[16,17]

These direct, indirect, and induced effects refer to economic activity alone, and do not reflect other important impacts of CAP Update expenditures, like GHG emission reductions, residents' access to energy efficient technology, and increased amenities, which are captured in the Cost Effectiveness Analysis.

The overall "multiplier effect" of 1.77 (the total output impact divided by the direct output impact, $877M/$495) means that for every dollar spent in the county on the CAP Update, $1.77 of economic activity is generated in San Diego county. This multiplier figure indicates that San Diego county has a relatively large economy with suppliers for a broad range of goods and services, and that there is only modest "leakage" (goods and services being purchased outside the county) and is comparable to other estimates of projects in the region. One way of thinking about this multiplier effect is that, in addition to the GHG emission reductions and costs and benefits described in the cost effectiveness analysis, CAP Update expenditures would generate a 77% "return" in terms of economic activity. This type of analysis can only capture the magnitude of the economic activity created by the CAP Update expenditures, not the many other benefits that accrue from its implementation.

Table 9 shows the CAP Update spending IMPLAN model sectors over time. The largest category is transportation infrastructure upgrades to encourage walking, biking, and transit use. Upgrades to County buildings are also a large expenditure, as are staff and consultant costs. Land acquisition costs for conservation are not included in the table, as it creates limited economic activity within the model, as described above.

[16] California Department of Housing and Community Development. (2024). *Housing and Transportation*. Retrieved June 27, 2024, from https://www.hcd.ca.gov/policy-and-research/intersectional-policy-work/housing-and-transportation

[17] Low-income residents have fewer housing and transportation choices, and are therefore more likely to live further from work centers, and more likely to rely on alternative or public transportation.

Table 9: CAP Update Spending by Fiscal Year and IMPLAN Sector (in millions)

IMPLAN Sector	Category	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30	Total
62	Transportation Infrastructure Upgrades	$34.8	$35.9	$36.5	$37.6	$38.7	$183.6
544	Staff Salaries	$13.8	$14.5	$15.5	$16.4	$17.8	$78.0
463	Consulting Services	$11.3	$13.2	$14.3	$15.5	$16.0	$70.2
395	Equipment	$5.6	$6.7	$7.1	$7.3	$22.7	$49.6
60	County of San Diego Building Upgrades	$9.3	$9.5	$9.8	$10.1	$10.4	$49.2
49	Water Treatment	$7.7	$8.4	$9.2	$9.5	$9.8	$44.6
402	Electric Vehicles	$5.4	$6.1	$4.9	$9.3	$9.6	$35.4
61	Residential Building Upgrades	$3.1	$5.8	$6.0	$6.2	$6.4	$27.5
532	Transit Upgrades	$1.9	$1.9	$2.0	$2.0	$2.1	$9.8
477	Tree and Landscape	$1.6	$1.6	$1.7	$1.7	$1.8	$8.5
405	Agricultural Improvements	$0.3	$0.3	$0.3	$0.3	$0.3	$1.4
479	Waste Management	$0.2	$0.3	$0.2	$0.1	$0.1	$0.7
	TOTAL	**$95.0**	**$104.2**	**$107.5**	**$116.0**	**$135.7**	**$558.5**

Table 10 and Table 11 show employment impacts by industry sector and occupation. Employment impacts are greatest in the construction and transportation infrastructure sectors and occupations because of direct and indirect expenditures. Retail and restaurant employment impacts result from induced spending. Although most of the employment and economic impact of the CAP Update is in sectors where there is direct CAP Update investment, the indirect and induced effects flow to many sectors of the economy, even if only a few job-years are added in a sector. The IMPLAN model covers economic activity but does not cover all impacts to jobs. Additional jobs impacts are covered in the Labor Impacts section below.

Table 8: Employment Impacts of CAP Update Spending by Top Ten Sectors (in job-years)

Rank	IMPLAN Sector	Industry	Total Impact Employment (in job-years)[18, 19]
1	62	Maintenance & repair construction of highways, streets, bridges, & tunnels	59
2	544	Local govt, other services	32
3	463	Environmental and other technical consulting services	36
4	60	Maintenance and repair construction of nonresidential structures	17
5	405	Retail - Building material and garden equipment and supplies stores	14
6	61	Maintenance and repair construction of residential structures	11
7	49	Water, sewage and other systems	9
8	477	Landscape and horticultural services	8
9	509	Full-service restaurants	7
10	447	Other real estate	7

[18] Employment impact will be region-wide. The numbers here show the impact on employment for unincorporated areas by scaling the total San Diego county employment impact using a factor of 9% of county employment, with the exception of agriculture, which used 88% of county employment.

[19] County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

Table 11 shows the breakdown of jobs by occupation. Note that while employment gains are again largest in occupations that are directly tied to CAP Update implementation, including construction workers, the benefits of CAP Update spending ranges throughout the economy.

Table 91: Employment Impacts of CAP Update Spending by Top Ten Occupations (in job-years)

Rank	Occupation	Employment (in job-years)[20], [21]
1	Construction Trades Workers	37
2	Business Operations Specialists	16
3	Retail Sales Workers	16
4	Information and Record Clerks	13
5	Material Moving Workers	12
6	Other Office and Administrative Support Workers	11
7	Other Installation, Maintenance, and Repair Occupations	10
8	Food and Beverage Serving Workers	9
9	Executives	8
10	Secretaries and Administrative Assistants	8

Labor impacts

The transition to a green economy involves shifting from fossil fuel-based energy and industrial practices to more sustainable, environmentally friendly methods. This transition, while beneficial for the environment, can lead to job impacts in certain sectors that are heavily dependent on fossil fuel-based technologies and processes. To better understand and learn how to address these concerns, the County commissioned a

[20] Employment impact will be region-wide. The numbers here show the impact on employment for unincorporated areas by scaling the total San Diego county employment impact using a factor of 9% of county employment, with the exception of agriculture, which used 88% of county employment.

[21] County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

study as part of the Regional Decarbonization Framework.[22] The study, "Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050"[23] provides social policies and investment opportunities to ensure a just transition for workers and the community towards a carbon-neutral economy.

Transportation

EVs on average require less mechanical maintenance than vehicles with internal combustion engines (ICE) [24] as they do not need the same maintenance on transmissions, spark plugs, oxygen sensors, or timing belts. They also have fewer types of filters and fluids that need to be replaced.

As internal combustion vehicles are replaced with electric ones, fewer vehicle maintenance jobs will be necessary to maintain vehicles.[25] The CAP Update aims to increase the number of EVs on the road, adding to State and federal efforts. People currently working as mechanics may need to retrain to meet the needs of customers with EVs by going through EV Technician certification training programs. However, this transition can be compared to the expected increase in jobs related to the installation and maintenance of charging infrastructure for these vehicles.

CAP Update actions encouraging the use of bikes and scooters and other alternative transportation types could create new jobs in the installation of infrastructure and the sales, maintenance, and repair of alternative transportation vehicles and equipment.

CAP Update actions supporting public transportation and first/last mile connections could increase the number of jobs available for transportation services drivers, benefiting residents of the unincorporated area who have or can acquire the appropriate license and endorsements. San Diego county, like the rest of the country, currently has a shortage of transportation services drivers[26] so this may represent an opportunity for

[22] McCord, Gordon C., Elise Hanson, Murtaza H. Baxamusa, Emily Leslie, Joseph Bettles, Ryan A. Jones, Katy Cole, Chelsea Richer, Eleanor Hunts, Philip Eash-Gates, Jason Frost, Shelley Kwok, Jackie Litynski, Kenji Takahashi, Asa Hopkins, Robert Pollin, Jeannette Wicks-Lim, Shouvik Chakraborty, Gregor Semieniuk, David G. Victor, Emily Carlton, Scott Anders, Nilmini Silva Send, Joe Kaatz, Yichao Gu, Marc Steele, Elena Crete, and Julie Topf. San Diego Regional Decarbonization Framework: Technical Report. County of San Diego, California. 2022.

[23] Carol Zabin, Maggie Jones, and Betony Jones, June 13, 2022, "Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050," Inclusive Economics, Oakland, CA.

[24] Office of Energy Efficiency & Renewable Energy. (2021). *FOTW #1190, June 14, 2021: Battery-Electric Vehicles Have Lower Scheduled Maintenance Costs than Other Light-Duty Vehicles*. Energy.Gov. Retrieved June 28, 2024, from https://www.energy.gov/eere/vehicles/articles/fotw-1190-june-14-2021- battery-electric-vehicles-have-lower-scheduled

[25] Carol Zabin, Maggie Jones, and Betony Jones, June 13, 2022, "Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050," Inclusive Economics, Oakland, CA.

[26] Martinez HIckey, S., & Cooper, D. (2023). *The school bus driver shortage remains severe: Without*

residents seeking jobs.

Construction & Facilities Management

CAP Update actions would encourage more all-electric development in residential, industrial, and commercial construction (E-2.1) and electrification in existing buildings (E-2.2).

Electricians and related occupations are projected to benefit from more electrification, because their expertise is required for installation in new construction, retrofitting, and ongoing maintenance. Indeed, the Bureau of Labor Statistics expects the electrician occupation to grow 6% from 2022 to 2032; double the average occupation's growth rate.[27]

In the case of new construction, electric appliances are already being installed instead of gas-powered ones. Therefore, electricians and related occupations are likely to benefit instead of other workers (e.g., those who would otherwise be installing natural gas infrastructure in new construction).

Additionally, electricians and related occupations could benefit from electrical retrofitting. There are multiple CAP Update actions that provide incentives to encourage retrofitting in cases where it would not otherwise occur. In the case of these additional retrofits, electricians and related occupations would benefit without comparable losses in natural gas occupations.

Solar-related jobs may benefit from the CAP Update, including actions E-3.1, E-3.2, E-3.2a, and E-3.3. However, some solar jobs, particularly in rooftop solar installation, pay relatively low wages, offer unstable hours, and have limited advancement potential.[28] In implementing the CAP Update, the County can consider policies that favor employers that offer higher quality jobs.

Energy management is an emerging, high-paying career that could benefit from CAP Update actions, like those adding EV charging stations (T-3.1), increasing renewable energy generation and electrification on County of San Diego properties (E-1.1) or increasing the number of electrified commercial and industrial buildings through renovation or new construction (E-2.1 and E-2.2). Energy managers work for schools, large office parks or industrial buildings, and other institutions with large facilities or campuses. They manage energy use and even production on their grounds, making decisions about fixtures, controls, fleets, and sourcing. CAP Update actions could incentivize the employment of energy managers by the owners and operators of large

job quality improvements, workers, children, and parents will suffer. Economic Policy Institute. https://www.epi.org/blog/the-school-bus-driver-shortage-remains-severe-without-job-quality-improvements-workers-children-and-parents-will-suffer/

[27] *Electricians*. (n.d.). Bureau of Labor Statistics. Retrieved July 10, 2024, from https://www.bls.gov/ooh/construction-and-extraction/electricians.htm

[28] Jones, B., & Zabin, C. (n.d.). Are Solar Energy Jobs Good Jobs? *UC Berkeley Labor Center*. Retrieved June 28, 2024, from https://laborcenter.berkeley.edu/are-solar-energy-jobs-good-jobs/

facilities, and perhaps by the County as they implement the County's Zero Carbon Portfolio Plan. The number of these types of careers resulting from the CAP Update might not be robust but is important to note.

Table 12 shows the industries in construction and utilities employing the most San Diegans. Not all construction occupations will benefit from the CAP Update or the transition to the green economy, but larger occupations such as electrical, plumbing, heating, ventilation, and air conditioning (HVAC) contractors, are likely to see increased demand from efficiency retrofits.

Natural gas distribution industries will likely be negatively impacted by increasing electrification of appliances, especially where they are used in place of natural gas appliances. "Putting San Diego on the High Road" details impacts on natural gas jobs in the county, estimating a drastic contraction of 75% starting in 2030. The report recommends opportunities to reduce job loss, create green jobs using skills from these occupations, and retrain workers to areas that are expected to see high demand as the number of gas jobs are reduced.[29]

Table 102: Industries in the Construction and Utilities Sectors Employing at Least 10 People in Unincorporated Area in 2024[30]

NAICS Code[1]	Description	2024 Jobs
238220	Plumbing, Heating, and Air-Conditioning Contractors	1,405
238210	Electrical Contractors and Other Wiring Installation Contractors	1,341
236118	Residential Remodelers	1,068
236220	Commercial and Institutional Building Construction	980
238990	All Other Specialty Trade Contractors	728
238310	Drywall and Insulation Contractors	577
238320	Painting and Wall Covering Contractors	554
236115	New Single-Family Housing Construction (except For-Sale Builders)	495

[29] Carol Zabin, Maggie Jones, and Betony Jones, June 13, 2022, "Putting San Diego County on the High Road: Climate Workforce Recommendations for 2030 and 2050," Inclusive Economics, Oakland, CA.

[30] Estimates were created using U.S. Bureau of Labor Statistics data, retrieved June 2024, assuming that 9% of jobs in these industries in San Diego county are located in unincorporated areas. 9% assumption derived from:

County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

238910	Site Preparation Contractors	466
221210	Natural Gas Distribution	457
238160	Roofing Contractors	331
238350	Finish Carpentry Contractors	315
237310	Highway, Street, and Bridge Construction	245
238330	Flooring Contractors	245
238110	Poured Concrete Foundation and Structure Contractors	206
238130	Framing Contractors	183
237110	Water and Sewer Line and Related Structures Construction	178
238340	Tile and Terrazzo Contractors	178
238390	Other Building Finishing Contractors	152
238150	Glass and Glazing Contractors	151
238120	Structural Steel and Precast Concrete Contractors	149
237130	Power and Communication Line and Related Structures Construction	124
237990	Other Heavy and Civil Engineering Construction	124
238290	Other Building Equipment Contractors	116
238140	Masonry Contractors	100
238190	Other Foundation, Structure, and Building Exterior Contractors	75
236116	New Multifamily Housing Construction (except For-Sale Builders)	71
237210	Land Subdivision	62
221114	Solar Electric Power Generation	34
238170	Siding Contractors	33
221310	Water Supply and Irrigation Systems	27
236210	Industrial Building Construction	22
236117	New Housing For-Sale Builders	20
221122	Electric Power Distribution	16
221118	Other Electric Power Generation	11
237120	Oil and Gas Pipeline and Related Structures Construction	10
221115	Wind Electric Power Generation	10

[1] NAICS stands for the North American Industry Classification System. Numbers in the NAICS column reflect the identifiers that the Bureau of Labor Statistics uses to identify industries.

Fossil Fuel Industries

Nationwide, the most significant job losses associated with green transitions are expected to occur in fossil fuel industries.[31] As economies move away from coal- fired power plants, the demand for coal decreases, leading to mine closures and layoffs. Similar impacts are seen in the oil and gas industries. As economies shift toward renewable energy sources, the demand for oil and gas declines, affecting jobs in drilling, extraction, and refining.

While San Diego county has no coal mines[32] or coal power plants,[33] San Diego does have gas power plants and a significant number of jobs related to gas industries—particularly in gas distribution (see Table 14).

Countywide there are fewer than 700 jobs associated with the Mining, Quarrying, and Oil and Gas Extraction sector—the sector where we would expect to see the greatest losses. Table 13 shows industries in this sector that provide at least 10 jobs in unincorporated San Diego county.

Table 1113: Industries in the Mining, Quarrying, and Oil & Gas Extraction Sector that Employ at Least 10 Workers in Unincorporated Area, 2024[34]

NAICS Code	Description	2024 Jobs
212321	Construction Sand and Gravel Mining	17
211120	Crude Petroleum Extraction	15

There are more jobs, however, in the Utilities sector and some jobs in this sector are

[31] Hanson, G. (2023). *Local Labor Market Impacts of the Energy Transition: Prospects and Policies* (Economic Policy in a More Uncertain World). https://scholar.harvard.edu/files/gordonhanson/files/hanson-local_labor_market_impacts_of_the_energy_transition.pdf

[32] U.S. Energy Information Administration. (n.d.). US Energy Atlas. https://atlas.eia.gov/datasets/eia::coal- mines-1/explore?location=37.507334%2C-111.484537%2C5.55

[33] U.S. Environmental Protection Agency. (2024). Data Explorer. https://www.epa.gov/egrid/data-explorer

[34] Estimates were created using U.S. Bureau of Labor Statistics data, retrieved June 2024, assuming that 9% of jobs in these industries in San Diego county are located in unincorporated areas. 9% assumption derived from:

County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

likely to be negatively impacted. Table 14 shows all the industries in the Utilities sector that employ at least 10 workers. The largest of these industries—natural gas distribution—provides almost 500 jobs in the region.

It's likely that when considering all industries in the Utilities sector, there will be a net increase in jobs, as described above in Construction and Facilities. The Advanced Water Purification project (W-3.3), landfill gas systems (SW-3.1 and 4.1), and compositing encouragement (SW 4.1a) may offer opportunities for natural gas workers to switch to growing careers with limited retraining necessary.

Table 1124: Industries in the Utilities Sector that Employ at Least 10 Workers in Unincorporated Area, 2024[35]

NAICS Code	Description	2024 Jobs
221210	Natural Gas Distribution	457
221114	Solar Electric Power Generation	34
221310	Water Supply and Irrigation Systems	27
221122	Electric Power Distribution	16
221118	Other Electric Power Generation	11
221115	Wind Electric Power Generation	10

Land Conservation & Agriculture

CAP Update actions in land acquisition, conservation, carbon farming, and restoration may meaningfully increase opportunities for conservation scientists, urban planners, arborists, tree care workers, landscapers and nursery professionals.

Agriculture workers may benefit from easements that protect land for agriculture and carbon farming, reducing job losses that may otherwise occur if that land was used for other purposes.

Farmworkers experience disproportionate health risks from air pollution in general, and

[35] Estimates were created using U.S. Bureau of Labor Statistics data, retrieved June 2024, assuming that 9% of jobs in these industries in San Diego county are located in unincorporated areas. 9% assumption derived from:

County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

especially from proximity to gasoline-powered farm equipment and pesticides.[36,37] These health risks may also accrue to farmworkers' children.[38] A-4.1's farmworker housing improvements, manure management, and cleaner fuels (A-5.1) may reduce the health impacts on farmworkers and their families.

Local food sourcing policies (A-4.1a) could increase demand for locally grown foods and therefore the workers who produce them. Research indicates that farms and ranches that participate in local food sales pay higher wages than those who do not.[39] Implementation of local food sourcing policies could focus on crop production, to encourage plant-based eating, or could expand to animal and fish production, increasing the impact on workers and further reducing the amount of food shipped outside of the county. Local food sourcing programs that encourage institutional purchasing programs (for example, by the County) may support more economic benefit than direct to consumer sales (for example, through farmers' markets).[40]

Table 15 shows the agriculture industries supporting the most employment in San Diego county. Crop and animal production employ over 11,000 San Diegans. These workers may benefit from CAP Update actions that improve the market for locally grown, raised, or landed food.

[36] Aldhous, P. (2024, January 1). *Farmworker deaths, temperature, and air pollution in California.* https://github.com/InsideClimateNews/2023-12-ca-farmworkers (Original work published 2023)

[37] Calvert, G. M., Plate, D. K., Das, R., Rosales, R., Shafey, O., Thomsen, C., Male, D., Beckman, J., Arvizu, E., & Lackovic, M. (2004). Acute occupational pesticide-related illness in the US, 1998–1999: Surveillance findings from the SENSOR-pesticides program. *American Journal of Industrial Medicine*, *45*(1), 14–23. https://doi.org/10.1002/ajim.10309

[38] Arcury, T. A., Chen, H., Quandt, S. A., Talton, J. W., Anderson, K. A., Scott, R. P., Jensen, A., & Laurienti, P. J. (2021). Pesticide exposure among Latinx children: Comparison of children in rural, farmworker and urban, non-farmworker communities. *Science of The Total Environment*, *763*, 144233. https://doi.org/10.1016/j.scitotenv.2020.144233

[39] Shideler, D., Bauman, A., Thilmany, D., & Jablonski, B. B. R. (2018). Putting Local Food Dollars to Work: The Economic Benefits of Local Food Dollars to Workers, Farms and Communities. *Choices*, *33*(3), 1–8.

[40] Shideler, D., Bauman, A., Thilmany, D., & Jablonski, B. B. R. (2018). Putting Local Food Dollars to Work: The Economic Benefits of Local Food Dollars to Workers, Farms and Communities. *Choices*, *33*(3), 1–8.

Table 15: Industries in Agriculture, Forestry, Fishing, and Hunting Employing at Least 10 People in Unincorporated Area in 2024[41]

NAICS Code	Description	2024 Jobs
111000	Crop Production	9,081
112000	Animal Production	1,263
115210	Support Activities for Animal Production	822
115115	Farm Labor Contractors and Crew Leaders	582
115112	Soil Preparation, Planting, and Cultivating	494
115116	Farm Management Services	270
114111	Finfish Fishing	249
115114	Postharvest Crop Activities (except Cotton Ginning)	161
113310	Logging	106
115310	Support Activities for Forestry	67
114112	Shellfish Fishing	64
115113	Crop Harvesting, Primarily by Machine	26
114119	Other Marine Fishing	11
114210	Hunting and Trapping	11

Consumer Product Lifecycle

Materials reuse and zero waste projects (SW-1.1 through SW-4.1b) could negatively impact occupations in the value chains of their single-use alternatives. For example, if people are switching to reusable sandwich bags, people working the design, manufacture, marketing, distribution, and sales of single-use sandwich bags are likely to suffer. In San Diego, this would affect primarily retailers in the county, who could see lower volume as people stop repurchasing single-use items. Partially offsetting this reduction is an increase in demand in refurbishment, repair, the reusable product value chain, and the value chain goods with recycled or reused inputs. Although the sales volume or reusable products is smaller, the price point is generally higher. San Diego has several zero waste stores, offering recycled or reusable products and refills for products often sold with single-use packaging. Partnerships with such stores could

[41] Estimates were created using U.S. Bureau of Labor Statistics data, retrieved June 2024, assuming that 88% of jobs in agriculture in San Diego county are located in unincorporated areas. 88% assumption derived from:

County of San Diego. (2023). *Draft Climate Action Plan Appendices* (p. 222). https://www.sandiegocounty.gov/content/dam/sdc/sustainability/docs/publicreview/CAPDraft_Appendices.pdf

make zero waste habits easier for program participants and increase the local economic benefits of zero waste programs.

On the other hand, companies using recycled or reclaimed materials to create their projects could benefit from an increase in the supply of these materials. Large scale recycling programs often struggle to create a pipeline for recycled materials to be reused because the materials are more expensive than new materials, the supply chain is immature, and the quantity and quality of recycle materials supply is variable.[42] Zero waste programs, like those proposed in CAP Update, could make efforts to connect smaller, local businesses with reusable materials, reducing waste and generating more local economic benefit.

By understanding the potential job losses and implementing effective mitigation strategies, economies can navigate the green transition more smoothly, minimizing negative impacts on the workforce while capitalizing on new opportunities in the green economy.

Heat impact

Key findings

Although the CAP Update actions will not reduce global temperature rise alone, they are an important contribution to a global effort. They can also reduce the impacts of local urban heat, especially through targeted tree planting efforts.

- Temperatures are higher further inland, so unincorporated communities face especially high heat. The costs of heat are adverse health events and higher utility bills.
- Communities with less access to air conditioning experience more hospitalizations from extreme heat. These health risks are not evenly distributed: people of color are less likely to have air conditioning and older adults, very young children, and people with chronic health conditions are most vulnerable to health impacts from extreme heat.[43]
- Action A-2.1 may help reduce local heat created by urbanization.

Costs of extreme heat

Extreme heat is the leading cause of weather-related deaths in the U.S.,[44] and anthropogenic climate change is contributing significantly to heat-related deaths

[42] Koblentz, E. (n.d.). *Economics of Recycling: New Futures for Old Plastics*. NJIT News. Retrieved July 11, 2024, from https://news.njit.edu/economics-recycling-new-futures-old-plastics

[43] Mann, R., & Schuetz, J. (2022). *As extreme heat grips the globe, access to air conditioning is an urgent public health issue*. Brookings. https://www.brookings.edu/articles/as-extreme-heat-grips-the-globe-access-to-air-conditioning-is-an-urgent-public-health-issue/

[44] National Weather Service. (n.d.). Weather Related Fatality and Injury Statistics. Retrieved May 31, 2024 from https://www.weather.gov/hazstat.

worldwide.[45] Extreme heat also impacts productivity and can cause power outages. Heat is the most prevalent climate risk in San Diego—higher than flooding or wildfire.[46]

Extreme heat disproportionately impacts unincorporated communities, because most of those communities are inland, and average temperatures increase with distance from the ocean.

Within the unincorporated area, the health and financial costs of extreme heat are more burdensome for low-income communities and people of color. In San Diego, extreme heat leads to more hospitalizations in communities with lower access to air conditioning and while 38% of white San Diegans have central air conditioning, less than a quarter of Hispanic San Diegans do.[47] Heat waves also disproportionately impact people experiencing homelessness.[48]

San Diegans are already experiencing more dangerously hot days each year, and the threat of excessive heat is projected to increase with time. According to First Street Foundation's Extreme Heat Model, between 1950 and 2005, residents of the median census tract in San Diego county faced three days with a heat index over 90; in 2023, they faced six such days; in 2053 they will face 17 days with a heat index over 90.[49]

As temperatures rise, unincorporated communities will face more adverse health impacts, and the disproportionate cost of heat on low income, rural communities will increase. The economic and health costs of extreme heat are inseparable; lack of access to air conditioning (largely due to financial barriers) is directly correlated with hospitalizations due to extreme heat.[50]

Across the unincorporated areas, the magnitude of heat risk faced by a neighborhood is

[45] Mitchell, D., Heaviside, C., Vardoulakis, S., Huntingford, C., Masato, G., Guillod, B. P., ... & Allen, M. (2016). Attributing human mortality during extreme heat waves to anthropogenic climate change. Environmental Research Letters, 11(7), 074006.

[46] Schuetz, J., Tomer, A., Gill, J., & George, C. (2023). How climate risk data can help communities become more resilient: Insights from San Diego. Brookings Metro. https://www.brookings.edu/articles/how-climate-risk-data-can-help-communities-become-more-resilient/

[47] Guirguis, K., Basu, R., Al-Delaimy, W. K., Benmarhnia, T., Clemesha, R. E., Corcos, I., ... & Gershunov, A. (2018). Heat, disparities, and health outcomes in San Diego County's diverse climate zones. *GeoHealth, 2*(7), 212-223.

[48] Schwarz, L., Castillo, E. M., Chan, T. C., Brennan, J. J., Sbiroli, E. S., Carrasco-Escobar, G., ... & Benmarhnia, T. (2022). Heat waves and emergency department visits among the homeless, San Diego, 2012–2019. *American Journal of Public Health, 112*(1), 98-106.

[49] PIC analysis of First Street Foundation data.

[50] Guirguis, K., Basu, R., Al-Delaimy, W. K., Benmarhnia, T., Clemesha, R. E., Corcos, I., ... & Gershunov, A. (2018). Heat, disparities, and health outcomes in San Diego County's diverse climate zones. *GeoHealth, 2*(7), 212-223.
The California Heat Assessment Tool, found at cal-heat.org, estimates the prevalence of heat health events, which are defined as "any event that results in negative public health impacts, regardless of the absolute temperature."

not correlated with median income,[51] but the financial cost of extreme heat will be more burdensome in low-income households, because families in these households are less able to afford air conditioning and operating expenses.

The dollar amounts of extreme heat health impacts are difficult to estimate, but one attempt at the state level in California estimates that seven heat events from 2013 to 2022 cost a total of $7.7 billion including from power outages (up to $230 million in costs related to power outages for one event in the CA Coastal Inland region), labor productivity losses (up to $210 million for one event), and infrastructure repair (up to $35 million for one event). According to this source, health impacts measured included premature mortality (valued at up to $2.2 billion for one event), hospitalization (up to $75 million for one event), emergency department visits (up to $8 million for one event), outpatient visits (up to $19 million for one event), and impacts on births (valued at up to $6.7 million for one event). This report highlights how costly extreme heat can be, emphasizes the disproportionate impact of these costs on low-income communities, and demonstrates the especially high costs for heat events in inland communities.[52]

GHG emissions and heat

The CAP Update outlines a wide variety of important actions designed to reduce GHG emissions that contribute to global heat rise. These are crucial steps toward limiting the County of San Diego and unincorporated areas impact on the global climate—steps that all jurisdictions across the U.S. and around the world must take to avoid catastrophic warming.

It's important to note that reducing GHG emissions emitted from local sources will not have an appreciable impact on local heat. This is because anthropogenic climate change is driven by global GHG emissions such as carbon dioxide (CO_2), methane, nitrous oxide, and fluorinated gases that are long-lived and "well-mixed" in the atmosphere.[53]

Because GHG emission are well-mixed in the atmosphere on such a short timeframe, global temperature rise is primarily driven by the overall increase in GHG emission concentrations worldwide, which in turn affects local climates. So, while local efforts to reduce GHG emissions represent a crucial contribution to the health of the climate, they

[51] Schuetz, J., Tomer, A., Gill, J., & George, C. (2023). How climate risk data can help communities become more resilient: Insights from San Diego. Brookings Metro. https://www.brookings.edu/articles/how-climate-risk-data-can-help-communities-become-more-resilient/

[52] Industrial Economics, Inc. (2024). Impacts of extreme heat to California's people, infrastructure, and economy: Pioneering analysis measuring the uninsured and insured costs of extreme heat events. https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf

[53] Canadell, J. G., Monteiro, P. M., Costa, M. H., Cotrim da Cunha, L., Cox, P. M., Eliseev, A. V., ... & Zickfeld, K. (2023). Intergovernmental Panel on Climate Change (IPCC). Global carbon and other biogeochemical cycles and feedbacks. In Climate change 2021: The physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change (pp. 673-816). Cambridge University Press.

cannot unilaterally affect heat.

To mitigate global climate impacts, governments at all scales across the globe must do their part to reduce GHG emissions. The CAP Update represents the contribution that the County can offer toward that cooperative effort.

Tree planting and urban heat islands

San Diego county experiences excess heat from urban heat islands (UHI)—urban areas that are significantly warmer than surrounding rural areas due to human activities. Temperature rise due to global climate change exacerbates local impacts of UHIs.

There are four leading causes of UHI:

1. Surface Albedo Reduction: Urban areas often have more asphalt, concrete, and other dark surfaces that absorb and retain more heat compared to natural landscapes. This reduces the overall albedo (reflectivity) of the area, leading to higher temperatures.

2. Heat Absorption in Buildings and Pavement: Buildings, pavement, and other infrastructure absorb and retain heat from the sun during the day and release it slowly at night, causing temperature increases.

3. Reduced Vegetation: Urban areas typically have less vegetation than rural areas. Plants and trees help cool the environment through shading surfaces and via evapotranspiration, where water evaporates from soil and transpires from plant leaves, cooling the air.

4. Waste Heat from Human Activities: The energy used for transportation, industrial processes, and air conditioning in urban areas generates considerable heat, contributing to the urban heat island effect.

Two actions in the CAP Update will reduce heat risk:

- A-2.1 Expand the County of San Diego's existing tree planting initiative and implement an Equity Driven Tree Planting Program to plant 70,560 trees by 2030 and 6,650 trees per year thereafter on County of San Diego property and in the unincorporated area.
- A-2.2 Implement the County of San Diego’s Landscaping Ordinance to require tree planting in new single family residential development in the unincorporated area.

Trees offer several benefits for mitigating urban heat:

- Shade cast by the tree canopy reduces heat in the tree’s immediate vicinity and reduces heat by shading surfaces and buildings, reducing surface albedo, heat absorption of buildings and pavement, and soil temperatures.
- Trees transpire by absorbing water through their roots and release water vapor through their leaves. They also collect water on their leaves which evaporates.
- Trees uptake and store GHG emission, such as CO_2, reducing their presence

and the greenhouse effect, in which gases trap heat within earth's atmosphere.

One of the leading strategies for combating UHI and their resulting health effects is planting trees and other vegetation,[54] so actions A-2.1 and A-2.2 represent an important step toward addressing the risk of extreme heat.

Unfortunately, estimating the effect of these measures is difficult for two major reasons. First, current methods for identifying the presence and magnitude of UHIs suffer from significant flaws. Second, actions A-2.1 and A-2.2 could be implemented in a wide variety of ways, resulting in very different impacts for San Diego Communities. These challenges are discussed in greater detail below.

Shortcomings in current methods for assessing UHIs

A recent systematic review found that existing efforts to identify UHI suffered from a lack of controlled measurement ("half of the sample studies fail to sufficiently control the confounding effects of weather, relief or time on reported 'urban' heat island magnitudes") and insufficient openness of method ("three-quarters fail to communicate basic metadata regarding instrumentation and field site characteristics").[55]

The CalEPA's UHI Index is a good example of the challenges involved when using any current methods for assessing urban heat. CalEPA's UHI Index in San Diego county doesn't seem to reflect heat created by urbanization. For example, Harbison Canyon has one of the highest Index scores in the county, but the population density is less than 300 people per square mile (compared to 783 in San Diego County or 4,256 in the City of San Diego).

As a result, this report recommends considering the following factors in implementation that can increase the benefit of tree planting programs on heat:

- In San Diego, drought-resistant and climate-adaptable trees should be prioritized where possible to limit additional water use.
- Select trees with large crowns, to maximize the shadow cast on buildings and surfaces. Canopy density is the leading factor influencing the cooling potential of trees.[56]
- Trees should be spaced appropriately for their species type to allow for

[54] Iungman, T., Cirach, M., Marando, F., Barboza, E. P., Khomenko, S., Masselot, P., Quijal-Zamorano, M., Mueller, N., Gasparrini, A., Urquiza, J., Heris, M., Thondoo, M., & Nieuwenhuijsen, M. (2023). Cooling cities through urban green infrastructure: A health impact assessment of European cities. *The Lancet*, *401*(10376), 577–589. https://doi.org/10.1016/S0140-6736(22)02585-5

[55] Stewart, I. D. (2011). A systematic review and scientific critique of methodology in modern urban heat island literature. *International Journal of Climatology*. https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.2141

[56] Rahman, M. A., Stratopoulos, L. M. F., Moser-Reischl, A., Zölch, T., Häberle, K.-H., Rötzer, T., Pretzsch, H., & Pauleit, S. (2020). Traits of trees for cooling urban heat islands: A meta-analysis. *Building and Environment*, *170*, 106606. https://doi.org/10.1016/j.buildenv.2019.106606

growing space and airflow, which complement's shade in improving human thermal comfort [57].

- Trees should be placed strategically to provide shade in places where the street and buildings are exposed to heat the longest. Shading windows and roofs is particularly effective. Deciduous trees should be considered for planting near buildings, as they provide shade during warm summer months and allow sunlight to penetrate onto buildings during cool winter months, reducing artificial heating and cooling needs.
- The location in which trees are planted contributes to equity, in that the communities that have higher tree canopy percentages and particularly the residents whose homes are shaded at least some of the day by the tree canopy, are receiving greater benefits provided by the urban forest. When implementing tree planting initiatives, equity and community needs should be considered when deciding the location of the tree planting projects.

There are also some disproportionate costs to the tree planning initiatives, particularly A-2.1. Currently, the costs of watering a tree are estimated at $20 per year, but unexpected rate increases could create an additional cost burden to participating residents. If residents do not water or maintain trees, they may lose its benefits. To address these potential disproportionate costs, the County is looking into ways to provide rebates for the cost of tree watering and mature tree maintenance for low-income participants.

Energy use

Key Findings

- Energy costs significantly affect housing expenses and are influenced by climate change.
- Rising heat levels increase energy consumption.
- Adoption of EVs and electric appliances will likely increase electricity use but reduce costs from previous energy sources.
- Energy costs disproportionately hurt rural residents, especially the elderly, low-income, and people of color.
- Switching from gas heaters and ICE vehicles to electric-powered alternatives will not only make progress on GHG emissions but will also improve indoor air quality and reduce residents' risk for respiratory illnesses.

[57] Profus, G. (2023, August 29). The Urban Heat Island and Extreme Heat: Eight Guidelines for Trees in the Urban Landscape. *New York State Urban Forestry Council*. https://nysufc.org/the-urban-heat-island-and-extreme-heat-eight-guidelines-for-trees-in-the-urban-landscape/2023/08/29/

Energy costs have a substantial impact on residents' housing costs,[58] are impacted by climate change, and could have disproportionate impacts to several communities.

The amount of energy residents use can be impacted by rising heat levels, as discussed in the heat impact section above. Residents who adopt EVs, electric appliances, and other electric alternatives will likely also see an increase in their electricity use, although that increase is likely substantially offset by a reduction in expenditures of the previous energy source. At current rates, natural gas appliances are less expensive to operate in southern California than electric ones, and EVs cost less to charge and maintain than internal combustion vehicles. However, these differences are entirely reliant on rate differences between electricity and fossil fuel alternatives, which change quickly and are influenced by a variety of factors.

Rural residents make less money and pay more on average for utilities than urban residents.[59] Further, rural renters experience a 29% higher cost burden than owners do. Non-white households have a 19% higher cost burden from energy bills than white households, and rural elderly households have a 44% higher cost burden from energy.[60] Low-income rural residents have a higher energy cost burden than wealthy ones, and rural residents living in manufactured homes have a median energy burden that is 42% higher than rural residents living in single family homes.[33]

The specific impact of energy use on residents' utility costs (use levels and rates) is hard to predict without observing the adoption of CAP Update incentives. However, the County can consider the impacts of energy use and rates on one another and on residents' cost of living and note that high energy costs disproportionately impact rural residents. Among rural residents, energy costs disproportionately impact low- income, elderly, and non-white residents, as well as those living in manufactured housing. CAP Update measures E-2 and E-3 are targeted at reducing residents' utility bills, and these measures may help relieve the disproportionate pressure on these communities.

CAP Update actions encouraging renewable energy generation in residences (E-3.1) will help mitigate disproportionate costs for these communities to the extent that the affected communities can afford to live in those housing units and can afford batteries to store energy collected by the solar panels. Implementation could increase the benefit to these communities by ensuring that new senior living and affordable housing

[58] Arzuaga, A. (2023, August 14). Housing Affordability Beyond Brick and Mortar: The Overlooked Impact of Utility Costs. Latino Policy Forum. https://www.latinopolicyforum.org/blog/housing-affordability- beyond-brick-and-mortar-the-overlooked-impact-of-utility-costs

[59] Ross, L., Drehobl, A., & Stickles, B. (2018). *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency*. Energy Efficiency for All, American Council for an Energy Efficient Economy. https://www.aceee.org/sites/default/files/publications/researchreports/u1806.pdf

[60] Ross, L., Drehobl, A., & Stickles, B. (2018). *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency*. Energy Efficiency for All, American Council for an Energy Efficient Economy. https://www.aceee.org/sites/default/files/publications/researchreports/u1806.pdf

development is attractive to developers after the renewable energy generation requirements go into effect.

In addition to impacting the carbon footprint of the unincorporated area, wide-spread adoption of residential renewable energy sources, when paired with home electrification, can improve indoor air quality by reducing emissions from cooking, heating, and cooling systems. Using solar panels to power electric heating or cooling systems can reduce the amount of pollutants released into the air as energy is generated. In terms of energy use inside homes, traditional appliances like gas-powered furnaces and stoves release harmful pollutants directly into the air inside homes, contributing to respiratory problems and other health issues.[61] Electrifying these appliances with technologies like heat pumps and induction stoves minimizes indoor air quality impacts. Powering electrified appliances with renewable energy eliminates emissions from energy generation at the source. This shift to cleaner energy sources and electrified appliances not only creates healthier indoor environments but also reduces outdoor air pollution, leading to broader public health benefits and a cleaner environment for everyone. This matters because clean air is fundamental to our health and well-being, and reducing air pollution can lead to longer, healthier lives[62].

It is, however, important to note that electrification alone may not eliminate indoor air quality issues. Other factors, such as ventilation and the use of certain building materials, can also play a role. Proper ventilation is crucial to maintaining good indoor air quality, as it helps to remove pollutants and contaminants from the air.[63] Enhancements to building ventilation and air filtration systems can benefit the health and productivity of occupants by improving thermal comfort and reducing exposure to particulate matter, carbon monoxide, and volatile organic compounds (VOCs), as well as improving overall indoor air quality. Ensuring that participants are aware that energy-efficient ventilation and filtration systems qualify for incentives under related new construction and retrofit actions may help encourage the adoption of these energy-efficient technologies that can also improve indoor air quality.

Another factor impacting both indoor and outdoor air quality is pollution from transportation. Studies have shown a strong correlation between proximity to high-traffic areas, such as busy streets and freeways, and an elevated risk of developing various

[61] Slanger, D. (2020, May 5). *Indoor Air Pollution: The Link between Climate and Health*. RMI. https://rmi.org/indoor-air-pollution-the-link-between-climate-and-health/

[62] MacNaughton, P., Cao, X., Buonocore, J. J., Laurent, J. G. C., Spengler, J. D., Bernstein, A., & Allen, J. G. (2018, January 30). Energy savings, emission reductions, and health co-benefits of the green building movement. *Springer Nature, 28*(4), 307-318. https://doi.org/10.1038/s41370-017-0014-9

[63] MacNaughton, P., Pegues, J., Satish, U., Santanam, S., Spengler, J. D., & Allen, J G. (2015, November 18). Economic, environmental and health implications of enhanced ventilation in office buildings. *Multidisciplinary Digital Publishing Institute, 12*(11), 14709-14722. https://doi.org/10.3390/ijerph121114709

health problems.[64] As covered in the next section, the CAP Update actions encourage the reduction of VMT from ICE vehicles, instead adopting zero emission vehicles (ZEV) and shifting towards public transit, walking, and cycling, can have a substantial impact on reducing both outdoor and indoor air pollution.

Transportation

Key findings

- Under the CAP Update, the unincorporated county would save an estimated $44 million in pollution costs by 2030 as a result of CAP Update implementation. Roughly 82% of these savings stem from actions to replace ICE vehicles with EVs (action T-3.1).
- Rural mountainous areas have relatively low total VMT, but high per-person VMT because of the low population density.
- The way in which the County decides to allocate the 2,040 chargers across the unincorporated area through implementation of T-3.1 will have large implications on which community has access to public charging stations. This infrastructure will improve the usability of EVs for unincorporated residents.

Introduction

Pollution from ICE vehicles has substantial implications for the health of residents. The EPA designates carbon monoxide, nitrous oxide, and fine particulate matter ($PM_{2.5}$, particulate matter that is 2.5 micrometers or smaller) as some of the most harmful pollutants to humans.[65] Evidence suggests that across the United States, vehicle-related pollution has negative health impacts that are equivalent to between 17,000 and 20,000 premature deaths in 2017.[66] Moreover, the EPA estimates that addressing vehicle pollution will result in a 31:1 benefits costs ratio.[67] Said differently, the transportation sector is a major contributor to both indoor and outdoor air pollution, which can lead to a variety of negative health outcomes. Vehicles release pollutants such as nitrogen oxides (NO_x), particulate matter, and carbon monoxide, which can linger in the air and penetrate buildings, affecting both outdoor and indoor air quality.

[64] California State Policy Evidence Consortium (CalSPEC). (2024, January). Near-Roadway Indoor Air Pollution: Assessing Health Effects and Mitigation Strategies. Sacramento, CA.

[65] U.S. Environmental Protection Agency. (2023). Overview of Air Pollution from Transportation. https://www.epa.gov/transportation-air-pollution-and-climate-change/overview-air-pollution-transportation

[66] Choma, E. F., Evans, J. S., Gómez-Ibánez, J. A., Di, Q., Schwartz, J. D., Hammitt, J. K., & Spengler, J. D. (2021). Health benefits of decreases in on-road transportation emissions in the United States from 2008 to 2017. *Proceedings of the National Academy of Sciences USA, 118*(51). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8713776/#r10

[67] Office of Air and Radiation. (2011). The Benefits and Costs of the Clean Air Act from 1990 to 2020. United States Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-07/documents/fullreport_rev_a.pdf

Exposure to these pollutants has been linked to respiratory problems, cardiovascular disease, and some types of cancer. Additionally, vehicle emissions contribute to the formation of ground-level ozone, a major component of smog.

In totality, the financial costs from vehicle pollution on public health within San Diego county is calculated to be $0.057 cents per mile driven.[68] With an estimated 3 billion VMT from ICE vehicles having taken place within the unincorporated area in 2019, and similar amounts expected annually until 2030, it becomes important to understand how VMT from ICE vehicles have impacted pollution costs in San Diego, how changes in federal and state policy are expected to impact VMT from ICE vehicles across the region, and how the CAP Update will go beyond these policies, aiming to lower VMT from ICE vehicles.

Methodology To Measure Vehicle Miles Traveled

Transportation planners rely on sophisticated models to understand and predict travel patterns within a region. One such model, a standard for estimating VMT, is the Origin-Destination model (O-D). This model forms a cornerstone of transportation planning, providing insights into where trips begin and end, and how they are distributed across the transportation network. By analyzing the relationships between where people live, work, and engage in various activities, the O-D model allows planners to estimate the number of trips made between different zones within a region. This information is then used to calculate VMT from ICE vehicles, a key metric for assessing traffic congestion, air quality, and the overall efficiency of the transportation system. Understanding the principles and applications of the O-D model is essential for developing effective transportation strategies that address transportation-based emission, for example, the reduction of congestion, improvement of air quality, and access to green mobility for all. To calculate VMT totals within the unincorporated area, the CAP Update used the Origin-Destination methodological approach:

- Trips that start and end in unincorporated are included at 100%
- Trips that either start or end (but not both) in unincorporated are included at 50%
- Trips that pass through unincorporated but don't start or end in unincorporated are not included at all

To understand the impact of VMT, as well as their corresponding reduction activities, on communities within the unincorporated area, it is helpful to view them through the lens of pollution cost. Using the O-D model, Table 21 displays the estimated VMT which have occurred or that are predicted to occur in the unincorporated area of the county.

As previously noted, the O-D model discounts VMT at a rate of 50% from trips that start within the unincorporated area and end outside of it, or vice versa.

[68] Choma, E. F., Evans, J. S., Hammitt, J. K., Gómez-Ibánez, J. A., & Spengler, J. D. (2020). Assessing the health impacts of electric vehicles through air pollution in the United States. *Environmental International, 144*.

Vehicle Miles Traveled

In 2019, an expected 3.06 billion VMT were driven in the unincorporated area, with about 99% originating from ICE vehicles (see Table 16). Were the County to do nothing except what was mandated at the state and federal level, VMT from ICE vehicles and their associated pollution costs would reduce to 3.03 billion. If, however, the County was successful in achieving its 2030 CAP targets, a reduction of about 775 million VMT from ICE vehicles, which would bring the estimated VMT to 2.26 billion, by 2030 would occur.

Table 16: VMT and Pollution Figures[1]

VMT From Internal Combustion Engine (ICE) Vehicles	Year	Estimated ICE VMT (billions)	Financial Costs from VMT Pollution (millions of dollars)
VMTs occurring in unincorporated area[2]	2019 (Base)	3.06	$174.56
	2030 (BAU)[3]	3.03	$173.01
	2030 (CAP)	2.26	$128.85

Applying the $0.057 pollution cost per mile to the total VMT which have occurred within unincorporated areas in 2019 equates to a pollution cost of $175 million. Compared to a "Business As Usual" (BAU) scenario in which the CAP Update is not implemented, the reduction in pollution cost is expected to be just under $173 million in 2030. Importantly, this reduction in pollution costs is occurring when both population and VMT from ICE vehicles are projected to increase. This reduction is driven largely by federal and State policies as well as improvement in the fuel efficiency of ICE vehicles. In recognizing that VMT and population are expected to increase within the unincorporated area, the CAP Update prioritizes goals which increase the rate of EV adoption beyond federal and state policies. If the actions laid out in the CAP Update are achieved, this VMT from ICE vehicles and their associated pollution cost decrease to 2.26 billion and about $129 million, respectively. As can be seen in Table 17, most of these pollution cost savings, which are a proxy for external air quality, are attributable to electric vehicle miles traveled (EVMT).

Activities in the CAP Update seek to reduce ICE VMT as well as overall VMT, as seen in Table 17. Action T-3.1 encourages EV use, which is expected to result in a reduction of VMT in the unincorporated area, reducing polluting ICE VMT by a total of over 600 million VMT by 2030 (the majority of all CAP VMT reduction from ICE vehicles). It is expected that action T-4.1 will reduce County employee's ICE VMT by an additional 45 million by 2030. Other activities of the CAP Update will also reduce VMT moderately. Action T-5.1 encourages alternative transportation (e.g., biking, walking, transit), and Measure T-6 looks to "support transit and transportation demand management to

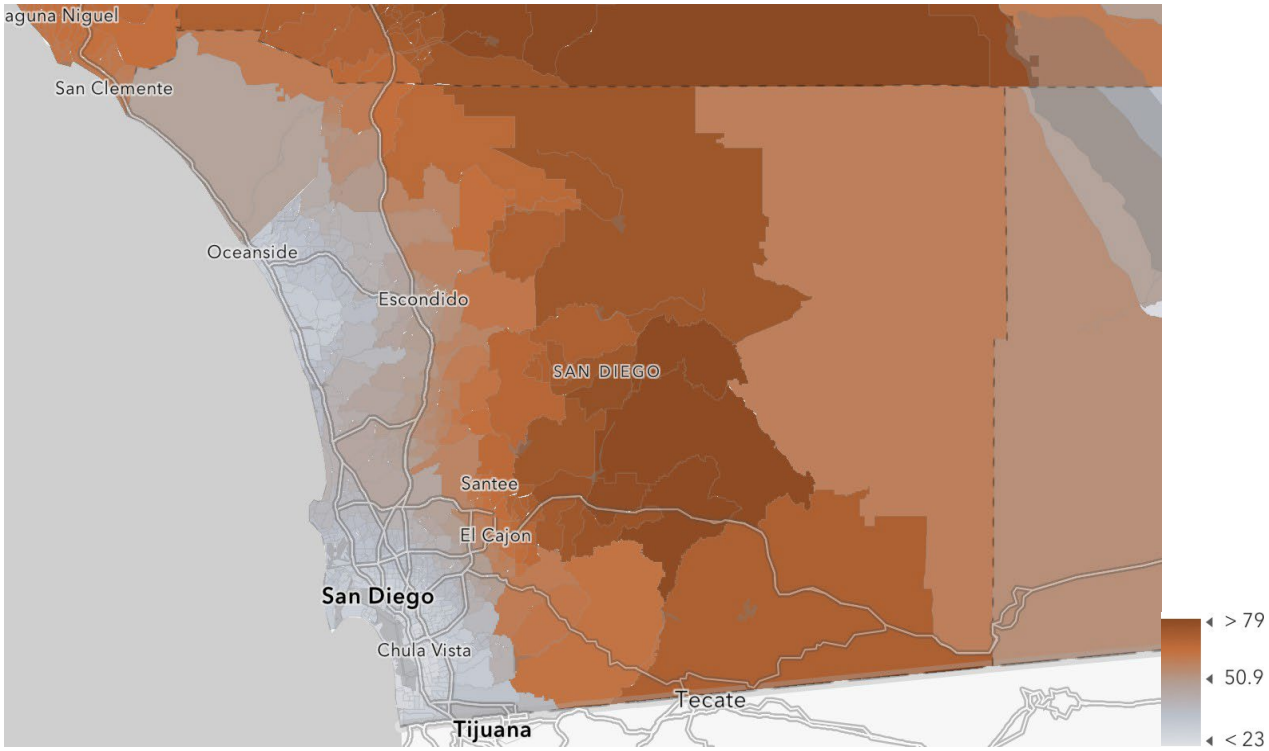
reduce single occupancy vehicle trips in the unincorporated area.” More specifically, T-6.1 and T-6.3 look to reduce VMT within the unincorporated area by a total of 8.2% via public transportation passes and increase accessibility of first and last mile transportation services and connections, respectively. Those reductions are based on baseline VMT which occurred across the unincorporated area.

Table 17: CAP Update Transportation Measurements

VMT Reduction Action	Estimated ICE VMT Reduction (millions)	Financial Savings from Averted VMT Pollution (millions of dollars)
T-3.1: Increase light duty EV/PHEV Population	632.15	$36.03
T-3.1: Increase medium and heavy duty EV/PHEV Population	25.47	$1.45
T-4.1: Expand County of San Diego Benefit Program by 2026 to provide County of San Diego employees with tax-free transportation benefits	45.65	$2.6
T-5.1: Implement the County of San Diego's Active Transportation Plan	6.81	$0.39
T-6.1: Develop a program to provide free transit passes	11.84	$0.68
T-6.2: Increase access to Transit Priority Areas by 5%	48.95	$2.79
T-6.3: Increase access to first/last mile transportation services	3.86	$0.22
Total	**774.73**	**$44.16**

An important disproportionate cost linked to VMT and borne by residents of the unincorporated area is ozone pollution. Importantly, this ground-level ozone isn't released directly into the atmosphere. Instead, it forms when NO_x and VOCs chemically react under the influence of sunlight; vehicles emit NO_x and VOCs. As a detrimental air pollutant, ground-level ozone impacts both human health and the environment, serving as the primary component of "smog." Inhalation of ozone can provoke numerous health issues, especially in vulnerable groups such as children, older adults, and individuals with preexisting pulmonary conditions like asthma.

Figure 1: Ozone Percentile, by Census Tract (CalEnvironScreen 4.0)



While areas with heavy traffic tend to generate high levels of these pollutants, they can be distributed long distances by wind.[69] This is demonstrated starkly by circumstances in the county, as shown in Figure 1: although the urbanized areas near the coast generate ozone, it collects in the unincorporated area. Efforts to reduce VMT within the unincorporated area, without similar efforts in the incorporated areas of the county, will disproportionately impact drivers who commute into urban areas for work, while not impacting ozone in the unincorporated area. As such, efforts to address VMT within incorporated areas are necessary if efforts to reduce ozone are to be realized.

[69] U.S. EPA, O. (2015, May 29). *Ground-level Ozone Basics* [Overviews and Factsheets]. https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics

The Impacts of Electric Vehicle Charging Station Deployment

The electrification of the transportation sector presents a significant opportunity for reducing GHG emissions and mitigating the impacts of climate change. However, this transition also brings about a range of costs, particularly for communities that may bear a disproportionate burden. How the County balances the rapid, substantial mitigation of transportation-based GHG emissions while also providing access to affordable, convenient, and reliable charging infrastructure will ultimately determine their effectiveness in equitably decarbonizing this sector.

To encourage EV adoption, it is estimated that one public charging port is needed for every 10 EVs on the road.[70] While this ratio increases or decreases depending on things like housing type (i.e., single family versus multifamily residential), community type, (e.g., suburban vs. urban vs. rural), and VMT per person, it can be considered a good starting point from which comparisons can be drawn. The California Energy Commission (CEC) estimates that there are about 3,500 public chargers and 132,000 EVs in San Diego county as of December 2023.[71] This equates to about 38 EVs per charger, though it is not clear how many charging ports are available.

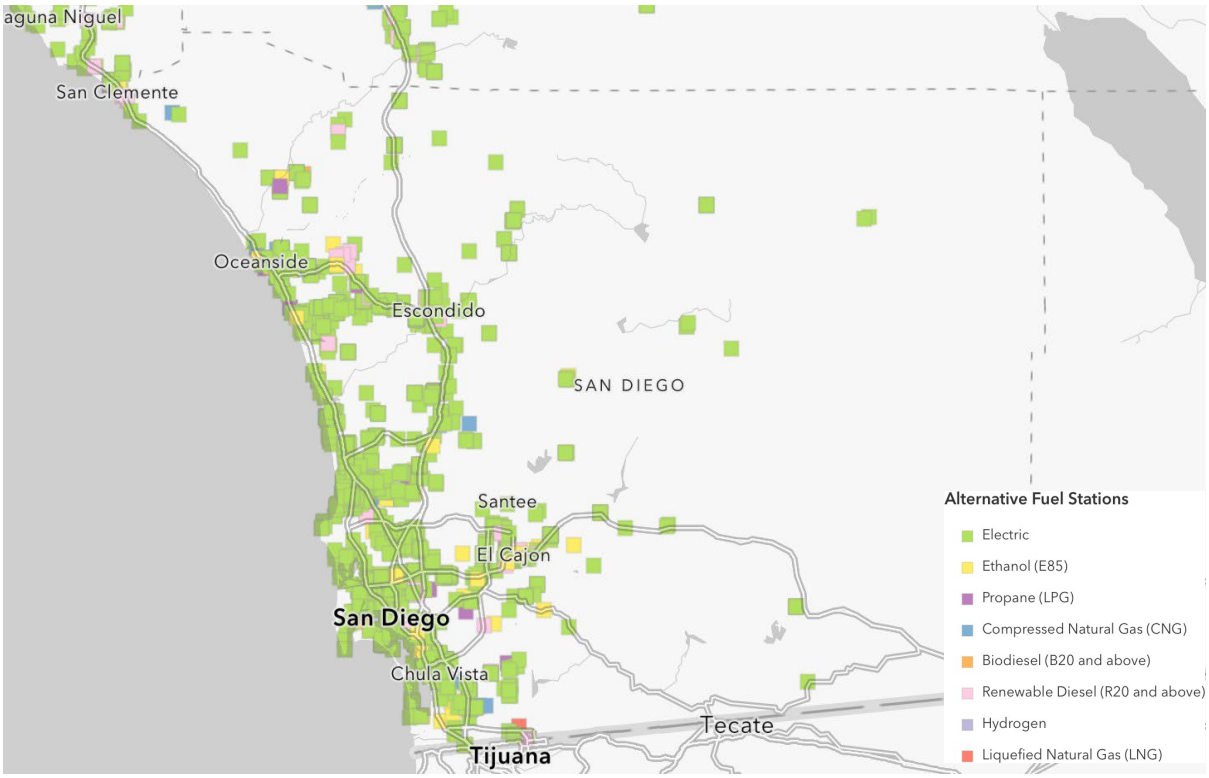
This ratio acts as a ceiling and is likely an overly conservative estimate. This is because it is possible for a charger to have three or more charging ports available; for example, the U.S. averages 2.6 charging ports to each charging station. Assuming the charging port to station ratio from the U.S. Department of Energy (DOE)[72] is representative of the ratio in San Diego county, there would be an expected 9,000 charging ports currently available, or 15 EVs per public charging port. To reach a ratio of 10 EVs to charging port, an additional 4,200 charging ports, or 1,615 charging stations, would need to be installed without an increase in EV adoption. Moreover, the unincorporated areas of the county averages about 45 EVs per charger, or 17 EVs per port. As it stands, most public chargers are located within incorporated areas, Figure 2.

[70] IEA. (2022). Global EV Outlook 2022. https://www.iea.org/reports/global-ev-outlook-2022/trends-in-charging-infrastructure

[71] California Energy Commission. (2024). Electric Vehicle Chargers in California. https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/electric

[72] U.S. Department of Energy. (2024). U.S. Public Electric Vehicle Charging Infrastructure. https://afdc.energy.gov/data/10972

Figure 2: Alternative Fuel Stations



To support an equitable transition to EVs, the County adopted an Electric Vehicle Roadmap[73], leveraging its land use authority, permitting processes, and outreach to increase EV ownership and charging installations in unincorporated areas and at County facilities. Through implementation of the EV Roadmap, the County will install 2,040 Level II or equivalent chargers[74] by 2028 at County facilities and public locations, including commercial areas, workforce destinations, heavily traveled corridors, and disadvantaged communities. These installations will complement shared private chargers that have been added by private development at public locations (e.g., workplaces, shared parking at a multifamily residence). The CAP Update reinforces the County's commitment to supporting EV infrastructure by incorporating the installation goals set forth in the EV Roadmap.

The County prepared the Planning Level Analysis for Public Electric Vehicle

[73] County of San Diego. (2019). Electric Vehicle Roadmap. https://www.sandiegocounty.gov/content/sdc/sustainability/ev-roadmap.html

[74] The County measures progress toward the 2,040 Level II charging stations by 2028 goal through "Level II Equivalent" chargers. This equivalency was established through the County's Planning Level Analysis for Public Electric Vehicle Infrastructure in the Unincorporated County (EVI Planning Analysis) as a way to compare the different charger types against the goal. The analysis reports that, conservatively, a single DCFC station is equivalent to 4.2 Level II chargers.

Infrastructure in the Unincorporated County (EVI Planning Analysis) to optimize the placement of its publicly accessible EV chargers. This analysis helps prioritize sites in unincorporated communities by evaluating existing EV infrastructure, future public EV charging demand, and equitable distribution, allowing the County to make informed decisions as it implements the charger installation program. By referencing this work in CAP Update implementation, the County will ensure that EV charging installations align with community needs and maximize the effectiveness of the EV Roadmap and CAP Update goals.

The availability of public EV chargers improves the practicality of owning an EV by addressing key barriers for potential buyers, including reducing range anxiety and ensuring drivers have convenient access to EV charging options, particularly for people who do not have the option to install home chargers. In addition, EVs are a great way to reduce GHG emissions from driving among a population that often lives far from work, retail, and other resources and cannot afford or do not want to move closer.

The cost of installing EV chargers is significant, as described above in the Upfront Cost Analysis. While property owners may benefit from increased foot traffic at businesses due to individuals utilizing the EV chargers, the broader community might face minor costs, such as reduced parking availability. However, the largest disproportionate impacts of EV installations come not from where the chargers are installed, but where they are *not* installed. Communities without access to EV infrastructure are at risk of being left behind in the transition to cleaner transportation, which can deepen existing disparities in access to the benefits of reduced emissions, improved air quality, and increased transportation options.

Appendix I

T-3.1

Increase the use of electric and other zero-emission vehicles in new construction by:

- Amending the County of San Diego's Code of Regulatory Ordinances by 2026 to require (Tier 2) CALGreen or similar EV charging infrastructure installations and preferential parking for ZEVs for new multi-family residential and non-residential construction.

The CALGreen Mandatory measures and Tier 1 and Tier 2 codes have requirements for new multifamily development (requirements differ for development under 20 units, and 20+ units), with a specification of percentages of 'EV Capable' (dedicated EV parking, conduit, and panel capacity) parking spaces and 'EV Ready' (wired for Level 2 EV chargers). For non-residential, parking space charging requirements are based on square footage.

The number of new residential housing units and non-residential square footage was derived from SANDAG forecast data. SANDAG forecast data is available for 2025 and 2030; interim years are interpolated, for this and other actions.

The costs of EV chargers and required electrical upgrades are estimated from public sources.

- Requiring the electrification of loading docks and idling reduction in new commercial and industrial development by 2030.

E-2.2

Increase energy efficiency and reach 30% electrification in residential and 17% electrification in non-residential existing development in the unincorporated area by 2030 by:

- Amending the County of San Diego's Code of Regulatory Ordinances by 2026 to require (Tier 2) CALGreen or similar energy efficiency requirements for existing development (residential) projects with qualifying improvements.[1]
- Adopting a Building Energy Performance Standard by 2026 for commercial and multi-family residential properties.

The current requirement is the 2022 California Energy Code, while this action requires adoption of efficiency upgrades from a menu of approved actions, such as improved insulation, high-performance windows, electrical upgrades, efficient heat pumps, and battery storage.

The estimated cost of the efficiency upgrades per existing residential unit was just over

$1,000, calculated as an average of the costs of several upgrades, which were estimated from public sources. The number of homes making qualifying

improvements[75] is estimated at 320 units per year.

For non-residential properties, a suite of requirements is listed based on building use type. The estimated costs for these requirements is $2.5 per SF, based on the cost of individual actions, which were estimated from public sources. The SF of improved commercial buildings was estimated at 160 units per year, and it corresponds to historic permit data provided by San Diego County.

E-3.1

- Amend the County of San Diego's Code of Regulatory Ordinances by 2026 to require Tier 2 CALGreen or similar renewable energy requirements for new residential and non-residential construction to increase renewable energy generation in new development.

The requirement in this analysis is the installation of additional solar panels over existing requirements for both new residential and new commercial building. The baseline code, which corresponds to Chapter 4 Residential Mandatory Measures of the 2022 CALGreen Code, Division 4.2 -Energy Efficiency, lists no specific requirement: "For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards".

This implies that the difference between Tier 2 and the baseline was computed using the difference between Tier 1 and Tier 2. The tiers' energy efficiency requirements are stated in Sections A4.203.1, A4.203.1.1, Table A-4.203.1.1, and A4.203.1.3. The Tier 2 and the baseline yearly energy use was estimated. The cost of solar per kW was estimated from public sources.

The number of new residential units is derived from SANDAG data. For non-residential development, the number of units requiring upgraded renewable is estimated from SANDAG forecast data.

E-2.1

- Amend the County of San Diego's Code of Regulatory Ordinances by 2026 to require all- electric equipment in new residential, commercial, and industrial construction to reduce energy emissions from new development in the unincorporated area.

This action requires electric appliances for heating, ventilation, and air conditioning (HVAC), cooking, water heating, and clothes drying. It was estimated from public sources, that electric appliances have no additional upfront cost versus gas appliances and were often less expensive.

W-2.1

[75] Meaning any additions or alterations of residential buildings where the addition or alteration increases the building's conditioned area, volume, or size. Applies only within the alteration or addition.

- Amend the County of San Diego's Code of Regulatory Ordinances by 2026 to require Tier 2 CALGreen or similar water efficiency requirements and reduced outdoor water use for landscaping requirements for new development to reduce potable water consumption from new residential and non0residential development by 17% in the unincorporated area.

For this action, the cost differential was determined between water-efficient fixtures (one toilet, one faucet, and one shower head) and standard fixtures, and multiplied times the corresponding number of new non-residential and residential units. For new residential units, the cost difference between a greywater landscaping system and a sprinkler one was included.

The benefits correspond to the water savings (relative to standard fixtures or landscaping systems) times the cost of water.

W-2.2

- Amend the County of San Diego's Code of Regulatory Ordinances by 2026 to require (Tier 2) CALGreen or similar water efficiency requirements for existing development projects with qualifying improvements.

Like action W-2.1, the cost differential was determined between water-efficient fixtures (one toilet, one faucet, and one shower head) and standard fixtures, and multiplied times the corresponding number of existing non-residential and residential units estimated from the historic number of permits submitted to the County of San Diego.

The benefits correspond to the water savings (relative to standard fixtures or landscaping systems) times the cost of water.