Climate Action Plan
Cost-Effectiveness Analysis

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Prepared for the County of San Diego

Prepared by the Energy Policy Initiatives Center

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About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

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EXECUTIVE SUMMARY

Introduction

This report summarizes the findings of the County of San Diego (County) Climate Action Plan (CAP) Cost-Effectiveness Analysis conducted by the Energy Policy Initiatives Center (EPIC) at the University of San Diego for 29 of the 30 measures included in the CAP.[1]

The goals of this report are to:

- Evaluate the cost-effectiveness of CAP measures to reduce greenhouse gas (GHG) emissions; and
- Determine the financial impact on home and business owners in unincorporated county and the County itself to participate in CAP measures.

These goals form the overall structure of the report. The first part presents results from a Cost-Effectiveness Analysis (CEA) that determines the net cost for each CAP measure to reduce one metric ton of carbon dioxide equivalent ($/MTCO$_2$e). This standardizes results and allows for comparison across all measures to determine the most cost-effective approaches to reducing emissions.

The second part of the report presents results from a Benefit-Cost Analysis (BCA) that evaluates the benefits received and costs incurred by home and business owners in the unincorporated county and the County to participate in CAP measures.

Cost-Effectiveness and Benefit-Cost Analyses Overview

A framework adapted from the California Standard Practice Manual (SPM)[2] was applied to both the CEA and BCA to estimate the benefits and costs associated with each measure. The SPM identifies four major perspectives, which help focus results on who is experiencing costs and benefits. This analysis presents results for the following perspectives, adapted from the SPM:

- The County, who administers and implements the CAP measures (**Administrator**)[3];
- Homes, businesses, and in some cases the County, that participate in an activity defined in the CAP measure (**Participant**);
- County taxpayers or utility ratepayers that fund the subsidies used by certain CAP measures (**Non-Participants**); and
- **Society** in general, which may incur costs or benefits related to external impacts like public health effects.

Combining the Administrator, Participant, and Non-Participant Perspectives, the **Measure Perspective** results in comprehensive programmatic view of the CAP measures. All values in the Executive

[1] Preliminary costs associated with Measure T-4.1: Establish a Local Direct Investment Program have been assessed in a separate report titled "Preliminary Assessment of the County of San Diego Local Direct Investment Program" prepared by Ramboll Environ, Inc.

[2] CPUC. 2001. California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. California Public Utilities Commission.

[3] Detailed estimates for the cost to the County to implement the CAP are included in the CAP Implementation Cost Report conducted by the Energy Policy Initiatives Center.

Summary related to the CEA are results for the Measure Perspective. All values related to the BCA are results for the Participant Perspective.

Primary metrics used in the BCA include the Benefit-Cost Ratio (BCR), discounted Payback Period, and Net Present Value (NPV). The BCR shows the relationship between the costs and benefits to perform an activity defined in a CAP measure (e.g. the cost of installing a solar photovoltaic system relative to the energy savings received from that system). A BCR that is greater than one means the anticipated benefits of the measure outweigh anticipated costs; if it is less than one, costs outweigh benefits. The Payback Period describes how many years it would take for the home or business owner to recover the costs they paid to do the activity. The NPV describes the total net benefit or cost of a project at the end of its lifetime and is useful to compare with the upfront costs associated with a measure for a more complete look at that measure's impact on the Participant.

Key Findings

- **Achieving GHG Reductions in the CAP would Result in an Overall Net Cost** – The measures included in the draft Final CAP to reach GHG reduction targets would have a net cost of $12/ $MTCO_2e$ reduced in 2023, the final year of the County's 5-year budget cycle. This represents an overall net cost of $12 to the CAP Administrator, Participants, and Non-Participants (i.e., from the Measure Perspective) to reduce one metric ton of carbon dioxide equivalent in the year 2023.
- **Existing Programs Included in the CAP are Cost-Effective at Reducing GHG Emissions** – Taken as a group, the 10 CAP measures leveraging Existing Programs have an estimated net benefit of $3 per metric ton reduced and an estimated 208,565 $MTCO_2e$ reduced in 2023. These measures are funded, already underway, and contribute toward CAP emissions targets. The most cost-effective Existing Program is measure W-2.1 Increase Rain Barrel Installations with a net benefit of $1,292/$MTCO_2e$ reduced. While W-2.1 is the most cost-effective measure of this subset of measures, it has a low GHG reduction potential and expansion of this program likely would not yield significant additional GHG reductions. Measure E-2.3 Install Solar Photovoltaics in Existing Homes is also cost-effective at reducing GHG emissions ($45/$MTCO_2e$) and reduces the most GHGs, but there is likely little room for further expansion of the program.
- **Existing Programs that affect County Operations have a Net Benefit** – Four Existing Programs to reduce emissions associated with County facilities and operations would have a net benefit over the lifetime of the associated projects. Activities to reduce emissions in the County's vehicle fleet (measure T-3.4) would have the highest BCR of 5.3 and the shortest Payback Period of 3.2 years.
- **New and Expanded Programs to Reduce GHG Emissions have a Net Cost** – Taken as a group, the 19 CAP measures that are New and Expanded Programs have an estimated net cost of $40 per metric ton reduced and an estimated 114,772 $MTCO_2e$ reduced in 2023. The most cost-effective measure is T-2.3 Reduce County Employee Vehicle Miles Traveled with a net benefit of $255/$MTCO_2e$ reduced. Measure T-3.3 Develop a Local Vehicle Retirement Program is the least cost-effective at reducing GHG emissions (-$681/$MTCO_2e$).
- **CAP Measures Would Increase the Cost of New Buildings but Provide Net Benefits** – The combined effect of CAP measures[4] that focus on new home construction would increase construction cost by an average of $15,381 per home in 2023. Of these upfront costs, energy

[4] Six of seven applicable measures are included in this section of the analysis. The other, measure T-3.1 Use Alternative Fuels in New Residential and Non-Residential Construction Projects may increase construction costs for new development, but insufficient data were available to estimate the average cost per home.

efficiency and zero net energy requirements (measure E-1.1 Improve Building Energy Efficiency in New Development) comprise 90% of the total increase with the remaining five measures making up 10%. While two measures return a net cost over their Useful Lives, the overall impact on the average home will be a net benefit of $5,728 over the life of the improvements. Similarly, measures[5] affecting new non-residential buildings would increase construction cost by an average of $52 per square foot (sq. ft.) of commercial space in 2023. Of these upfront costs, measure E-2.2 Increase Renewable Electricity in Non-residential Development comprises 95% of the total ($49/sq. ft.) with the remaining two measures making up 5% ($3/sq. ft.). All three measures provide a net benefit to the business or commercial space owner when Useful Life benefits and costs are considered ($20/sq. ft.).

[5] Three of six applicable measures are included in this section of the analysis. Measures T-3.1 (Use Alternative Fuels in New Residential and Non-Residential Construction Projects) and T-2.4 (Shared and Reduced Parking in New Non-residential Development) may increase construction costs for new commercial development, but insufficient data were available to estimate the average cost per square foot of commercial space. Measure T-2.2 Reduce New Non-Residential Development Vehicle Miles Traveled is an ongoing subsidy program for employees and is not associated with upfront construction costs for new commercial units.

GLOSSARY OF TERMS

$/MTCO$_2$e – The dollar per metric ton of carbon dioxide equivalent $/MTCO$_2$e) represents the ratio of the Net Present Value of the benefit or cost to the total GHG emissions reduced over the Useful Life of a project.

Administrator Perspective – This perspective represents costs to the County to implement CAP measures, including administrative activities and program development and management, but does not include capital expenditures.

Benefit-Cost Analysis (BCA) – An evaluation of the direct financial benefits and costs associated with an activity.

Benefit-Cost Ratio (BCR) – A metric used to assess the relationship Ratio of cumulative discounted benefits and cumulative discounted costs. A BCR that is greater than one means the anticipated benefits of the measure outweigh anticipated costs; if it is less than one, costs outweigh benefits.

Cost-Effectiveness Analysis (CEA) – An evaluation of the cost to achieve a particular outcome (e.g., reduce a ton of GHG emissions). Results are expressed as dollar per unit of the desired outcome (e.g. $/MTCO$_2$e).

Direct Benefit/Cost – A financial impact of a project or action. Direct Costs include upfront equipment and operation and maintenance costs. Direct Benefits include utility bill savings.

Discount Rate – A rate used to convert future values to present worth. The higher the Discount Rate, the less a future value is worth today.

Existing Program - Any existing action as a part of regular department operations or created through prior Board of Supervisors action.

Expanded Program - Any expansion of an Existing Program as a result of CAP.

Externality – A positive or negative impact that is external to a transaction and generally not included in the price.

Installation Year – The initial year in which an action occurs (also referred to as Install Year).

Internal Rate of Return (IRR) – The Discount Rate necessary to achieve a Net Present Value equal to zero given the benefits and costs of a measure or action over its Useful Life. The IRR is expressed as a percent; a higher percentage means a project is more desirable and negative IRRs indicate the benefits never outweigh the costs.

Measure Perspective – The sum of the Administrator, Participant, and Non-Participant Perspectives. The Measure Perspective represent a comprehensive programmatic view of costs and benefits.

Net Present Value (NPV) – The total present value of the benefits and costs related to an action over its Useful Life. An NPV greater than zero represents a net benefit. An NPV less than zero represents a net cost.

Non-Participant Perspective – The perspective of those not participating in a CAP measure but still incurring costs. This perspective represents the costs to taxpayers and utility ratepayers to subsidize activities related to CAP measures.

Participant Perspective – The perspective of residents and businesses in the cost-effective analysis. This perspective represents the cost to homeowners and business owners to participate in or comply with CAP measures. In some cases, such as with Measure T-3.4 Reduce the County's Fleet Emissions, the County is also a Participant.

Payback Period – The amount of time required for the cumulative benefits of a project to equal or surpass the cumulative costs of an action or measure.

Return on Investment (ROI) – A metric to measure the rate of return, or profitability, of a project. ROI represents the difference between the non-discounted benefits and costs over the non-discounted costs during project's lifetime.

Societal Perspective – The sum of the Measure Perspective and external impacts, like public health effects. This is the broadest view of a cost analysis.

Target Year – The point in time when the CAP measure impacts are considered. This analysis contains results for 2020 and 2023.

Useful Life – The operating life of a project before it must be replaced.

1 INTRODUCTION

The County of San Diego (County) has developed a draft Final Climate Action Plan (CAP). The CAP contains measures, or activities, that can be implemented to reduce greenhouse gas (GHG) emissions within the unincorporated county and County operations.

The purpose of this report is to analyze the cost-effectiveness of CAP measures and the benefits and costs associated with each measure. Understanding the estimated cost associated with implementing the measures, and the potential impact to residents and businesses within the unincorporated county, can be helpful for decision makers. This report summarizes the findings of the County draft Final CAP Cost-Effectiveness Analysis (CEA) and Benefit-Cost Analysis (BCA) conducted by the Energy Policy Initiatives Center (EPIC) at the University of San Diego.

These analyses determine the benefit and cost impacts of CAP measures to achieve GHG reduction targets in 2020 and 2023. The main goals of this report are to:

- Estimate the cost of each CAP measure to reduce a unit of greenhouse gas emissions to comparatively evaluate the cost-effectiveness of CAP measures; and
- Identify the benefits received and costs incurred by home and business owners in unincorporated county and the County to assess the impact of implementing CAP measures.

The County's draft Final CAP comprises five GHG reduction categories, 11 strategies, and 30 measures. The measures are designed to meet State GHG reduction targets for 2020 and 2030.[6] This report includes results for both the BCA and CEA for the 2020 Target Year and the year 2023 to align with the County budget process.

This report addresses 29 of the 30 measures; preliminary costs associated with measure T-4.1: Establish a Local Direct Investment Program have been assessed in a separate report titled "Preliminary Assessment of the County of San Diego Local Direct Investment Program" prepared by Ramboll Environ, Inc.

The cost to the County to implement CAP measures are not included in this report; estimated implementation costs to the County are included in the Climate Action Plan Implementation Cost Report prepared by the Energy Policy Initiatives Center.

This report is divided into seven sections and three appendices. This section provides an introduction to the report. Section 2 provides a CEA and BCA overview: the types of benefits and costs included, perspectives analyzed, and metrics necessary for each analysis. Results of the CEA are provided in Section 3 followed by BCA results in Section 4. Section 5 outlines limitations of the analyses and Section 6 provides the conclusion. References cited in this document are located in Section 7. The appendices detail methods used in both analyses and an extended set of tabular results with data and assumptions for individual measures.

[6] AB 32 set a target of achieving 1990 levels of emissions by 2020, Executive Order S-3-05 sets a long-term goal of 80% below 1990 levels by 2050, and Executive Order B-30-15 sets a target of 40% below 1990 levels by 2030.

2 COST-EFFECTIVENESS AND BENEFIT-COST ANALYSES OVERVIEW

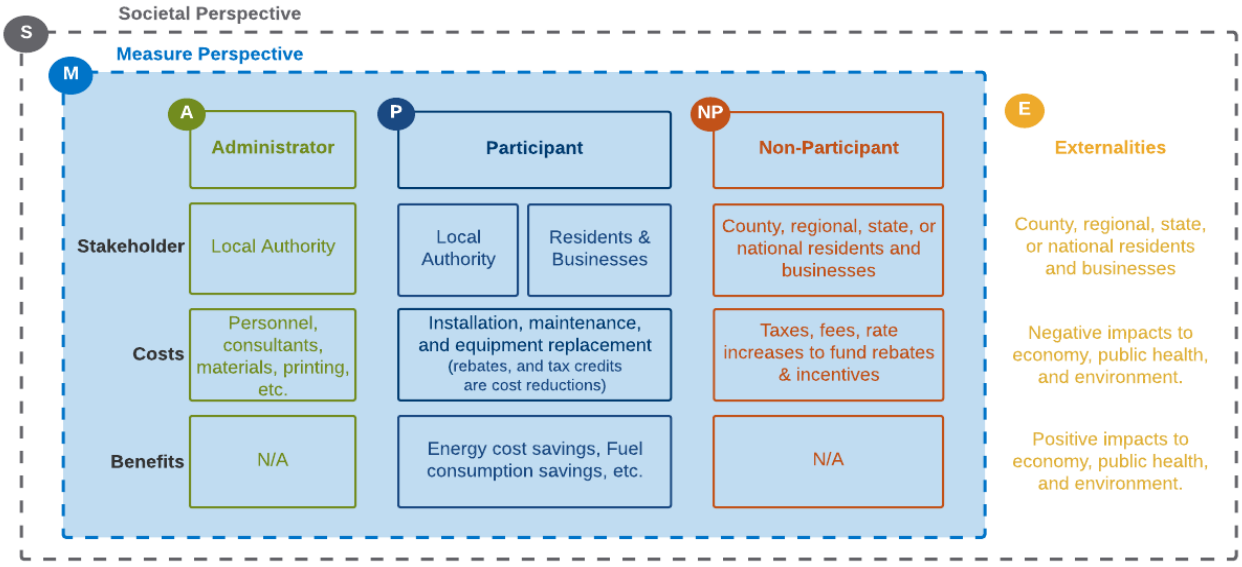
This Cost-Effectiveness Analysis (CEA) and Benefit-Cost Analysis (BCA) of the County draft Final CAP is designed to assist County staff, decision makers, and the public to understand the potential benefit and cost impacts of those measures. The CEA answers the question: **What is the benefit or cost for each measure to reduce one metric ton of carbon dioxide equivalent ($MTCO_2e$)?** The BCA answers the question: **What are the financial impacts associated with each measure to Participants (e.g., home and business owners)?** This section summarizes key concepts related to both the CEA and BCA.

2.1 Perspectives

One consideration, when evaluating the benefits and costs of CAP measures, is to determine whose benefits and costs are being evaluated. In the context of a CAP measure, there are multiple perspectives that determine the scope of analysis, including the Administrator of the program (e.g., County), the Participants in the program (e.g., unincorporated county residents and business), and those who pay the cost to subsidize programs, so called Non-Participants (e.g., taxpayers or utility ratepayers). The Measure Perspective, which combines these three main perspectives, allows for a more comprehensive view of this analysis that includes County costs to administer the program, the costs to homes and businesses, and any subsidies provided. Adding other co-benefits that might not be included in the calculation of Direct Costs and Benefits – so-called externalities – can provide a broad Societal Perspective.

The framework in Figure 1 summarizes these five perspectives and identifies who is affected by a measure and their respective benefits and costs.[7]

Figure 1. Conceptual Framework of BCA Cost Attribution Categories



2.1.1 Administrator Perspective

The Administrator Perspective answers the question: **What are the financial benefits and costs to the County as a result of implementing CAP measure(s)?** While there are no direct monetary benefits

[7] Adapted from the California Standard Practice Manual, a resource used by public utilities to analyze the cost-effectiveness of energy efficiency programs and has recently been adapted into a National Standard Practice Manual (CPUC 2001; NESP 2017).

associated with CAP implementation, there are costs incurred, including personnel, consultants, and supplies/materials. Activities to administer the CAP include research, development, implementation, monitoring, and enforcement of CAP measures. The Climate Action Plan Implementation Cost Report provides further discussion on total costs for the County to implement the draft Final CAP.

For both the CEA and BCA, the costs associated with the Administrator Perspective is a subset of total implementation costs. For example, costs associated with program administration, education and outreach, and enforcement and monitoring are included in these analyses. Capital costs that directly affect County operations (e.g. energy efficiency retrofits for County facilities, replacing County fleet with hybrid or Zero Emission Vehicle alternatives) are not considered Administrator costs, but are included under the Participant Perspective. The County can also be a Non-Participant when distributing monetary incentives, such as fee reductions.

2.1.2 Participant Perspective

The Participant Perspective answers the question: **What are the financial benefits and costs to residents, businesses, and the County to participate in or take action to comply with a CAP measure?** There are benefits and costs associated with a home or business owner participating in or complying with an action defined in a CAP measure. For example, a homeowner who chooses to participate to the full extent in the residential energy efficiency retrofit measure would incur costs for the audit and capital needed for installation of energy efficiency equipment. The reduction in energy consumption due to the retrofit would provide the homeowner with benefits in the form of energy bill reductions over the lifetime of that retrofit. Participants can also receive cost reductions from rebates, fee waivers, incentives, and tax credits, which are considered a cost to Non-Participants in this analysis.

For the County, this perspective includes all capital costs directly associated with the County's participation in, or compliance with, a CAP measure, as well as the resulting benefits. The Climate Action Plan Implementation Cost Report includes further discussion on capital costs anticipated by the County to implement activities defined in CAP measures.

2.1.3 Non-Participant Perspective

The Non-Participant Perspective answers the question: **What are the financial benefits and costs, if any, to residents, businesses, and the County to subsidize activities of Participants?** Residents, businesses, and the County could incur indirect Costs or realize indirect Benefits even though they are not engaging in an activity defined in a CAP measure. For this analysis, Non-Participant costs represent the cost to subsidize activities of Participants through rebates, incentives, and tax credits. Non-Participants incur this cost through taxes, fees, and/or utility surcharges, and are not limited to those within the geographic boundary of the unincorporated county (Figure 2).

Figure 2. Examples of Non-Participants at Various Levels

Level	Incentive Type	Revenue Source	Geographic Scope	Non-Participants
National	Federal tax credit	U.S. tax revenue	U.S.	U.S. taxpayers
State	State grant	California tax or other revenue	California	California taxpayers
Regional	Utility incentive	SDG&E surcharge	SDG&E territory	SDG&E customers
County	County rebate	Local tax	County	County residents & businesses

2.1.4 Measure Perspective

The Measure Perspective answers the question: **What are the total financial benefits and costs associated with a CAP measure?** The three perspectives defined in previous sections do not represent a complete view of the monetary impacts of a CAP measure. The Measure Perspective combines the Administrator, Participant, and Non-Participant Perspectives for a more comprehensive view at the Direct Benefits and Costs associated with a CAP measure. For example, only looking at the Participant Perspective does not adequately capture costs for subsidies paid by Non-Participants; that is, these subsidies are a cost reduction to the Participant, but a cost to taxpayers and/or utility ratepayers (Non-Participants). Understanding the costs of subsidies, particularly if the subsidy are paid by taxpayers, can be important.

2.1.5 Societal Perspective

The Societal Perspective answers the question: **What is the overall financial benefit or cost to society as a whole for a given CAP measure?** This is the broadest perspective; it adds the benefits and costs associated with external impacts to the Measure Perspective. The difference between the Measure and Societal Perspectives is the total benefit or cost of externalities. Externalities valued in this analysis include benefits from criteria pollutant reductions, reductions in storm water treatment, and avoidance of climate change related damages.

2.2 Types of Benefits and Costs

The benefits and costs associated with a CAP measure fall into two broad categories: direct or external. Each type represents the benefit and/or cost impact on different groups.

2.2.1 Direct Benefits and Costs

Direct Benefits and Costs are those directly related to implementing a CAP measure or engaging in an action defined by a CAP measure. Direct Benefits include cost savings, such as utility bill or fuel purchase reductions. Direct Costs include the purchase, installation, and maintenance of equipment or other services. Financial incentives or subsidies, such as rebates, fee waivers, and tax credits, are considered cost reductions, or negative Direct Costs.

2.2.2 External Benefits and Costs

External benefits and costs associated with CAP measures can be difficult to quantify. Benefits and costs associated with positive or negative externalities are the result of indirect effects of an action. Positive externalities associated with the CAP include public health benefits from reduced air pollution, increased ecosystem service value, and reductions in storm water treatment. Negative externalities include public health costs associated with poor air quality from fossil fuel combustion, and pollution created from the disposal of solar panels at the end of their Useful Life.

2.3 Key Concepts

Several key concepts related to the analysis conducted for this report are described below.

2.3.1 Target Year

The Target Year(s) represents a point in time when the CAP measure impacts are considered. While the CEA and BCA consider all benefits and costs over the Useful Life of specified actions, results are specific to the Target Years. This report analyzes the CAP impacts during Target Years 2020 and 2023. The first Target Year, 2020, represents the first GHG reduction Target Year identified in the CAP and includes ten measures that contribute GHG reductions. The 2023 Target Year represents the last year of the County budget cycle analyzed in the draft Final Climate Action Plan Implementation Cost Report; all measures contribute GHG reductions by 2023.

Dollar values expressed in a Target Year are *anticipated values* of a CAP measure, not necessarily actual benefits or costs to be realized in that particular year. The total benefits and costs accrued over the Useful Life are apportioned to the GHG reductions associated with that measure. The anticipated values in the Target Year reflect the value of the GHGs reduced in that year.

Anticipated values are used in lieu of actual cash flows assigned to the Target Year because costs and benefits in earlier years are partially responsible for GHG reductions in that year. For instance, a photovoltaic (PV) system installed in 2015 will still be reducing GHGs in the 2020 Target Year; however, the bulk of the capital costs were experienced earlier on.

2.3.2 Installation Year

The Installation[8] Year (Install Year) is the initial year in which an action occurs. Measures can include multiple Installation Years. For example, the year in which a household installs a solar photovoltaic (PV) system is that household's Install Year; however, not all solar PV systems will be installed in a single year to achieve GHG reductions in the CAP, but over a number of years.

This analysis considers the benefits, costs, and GHG reductions associated with all Installation Years leading up to each Target Year. For most measures, the Installation Year is not included as part of the Useful Life and no benefits or GHG reductions are achieved in that year. This accounts for construction periods during which GHG reductions are not achieved, but capital is being outlaid.

2.3.3 Useful Life

The Useful Life (or project life) is the operating life of a project and represents how long a project will last before it must be replaced. Some actions identified in the County's CAP measures have project lives that are greater than the time period being analyzed. This analysis examines the benefit and cost streams over the entire Useful Life to accurately capture all benefits and costs associated with a

[8] The term 'installation' is being used here to refer to any general type of activity that begins, not necessarily the direct install of equipment. This can also include an alternative fuel vehicle purchase, home retrofit, etc.

measure. Restricting the analysis to the Target Years would significantly undervalue or overvalue an action; ending the analysis before the project has reached its Useful Life would reduce the associated benefits and place a higher emphasis on costs.

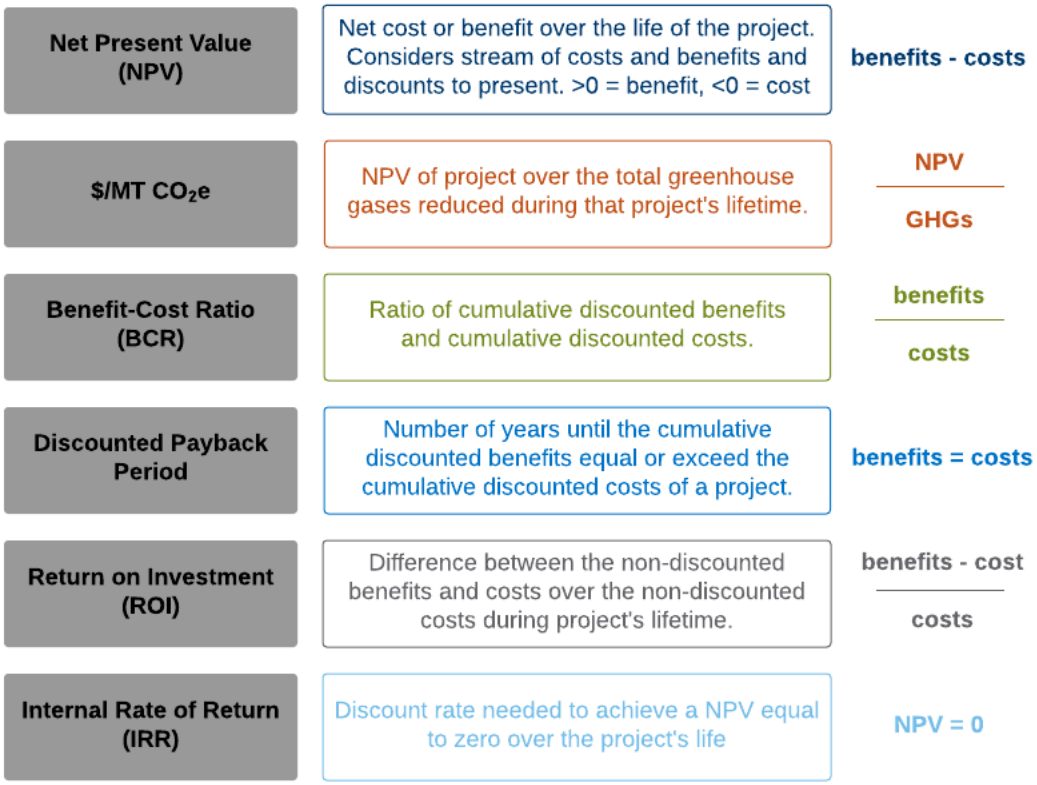
2.3.4 Normalized Dollars

Dollar values are normalized to a constant year to accurately analyze historic and current benefit and cost data.[9] This process reduces the impact of external influencers, such as inflation and deflation, on the value of a good or service. The base year 2015 is used to normalize values for all measures for consistency and to allow for comparison across measures.

2.4 Cost-Effectiveness and Benefit-Cost Analyses Metrics

The metrics used to analyze the results of the CEA and BCA are shown in Figure 3. Metrics are analyzed together in coordination with GHG reductions to understand the potential effects of a given measure.

Figure 3. Metrics for the CAP Cost-Effectiveness and Benefit-Cost Analyses



All metrics are not appropriate to describe results for all perspectives or impacts of CAP measures. For example, there are no Direct Benefits associated with the administrative aspects of implementing the CAP, so several metrics will not apply. Since there are no benefits, it is not possible to calculate a payback for this perspective. This also would apply to the Non-Participant Perspective, because only costs are considered. Similarly, any measure that does not have a net benefit, will not have a payback.

[9] The Consumer Price Index (CPI), one of the most common indices (FRB Dallas 2017), is used for this analysis.

However, two metrics can be calculated across all categories: Net Present Value (NPV) and dollar per metric ton of carbon dioxide equivalent ($/MTCO$_2$e). The Benefit-Cost Ratio (BCR), Payback Period, Return on Investment (ROI), and Internal Rate of Return (IRR) are only appropriate and available to the Participant, Measure, and Societal Perspectives.

The NPV is used for calculating the other metrics for both the CEA and BCA. The CEA uses the $/MTCO$_2$e to compare the cost-effectiveness of measures as they relate to metric tons of CO_2e reduced. The BCA uses the BCR, Payback Period, ROI, and IRR to analyze the benefit and cost impacts of measures.

2.4.1 Net Present Value (NPV)

Net Present Value, or NPV, is the most common way to express BCA results. Calculating the NPV addresses the time value of money (e.g. receiving ten dollars today is worth more than receiving ten dollars in the future) by applying a Discount Rate to both the benefits and costs. This metric represents the total present value of the benefits and costs related to an action over its Useful Life.[10]

A Discount Rate is used to convert future values to present worth. A five percent Discount Rate is applied as the default value with a three percent and seven percent Discount Rate used for sensitivity analyses.[11] Higher Discount Rates lessen the impact of future dollars in the analysis relative to lower Discount Rates.

When calculating the total of all benefits and costs of an action over its Useful Life, a positive NPV is considered a net benefit and a negative NPV is a net cost. A net benefit indicates that benefits received outweigh the costs incurred over its lifetime and a net cost indicates the reverse. To assist in identifying a cost versus a benefit, in tables and figures costs are identified in (red).

2.4.2 Dollar per Metric Ton of CO_2e

The dollar per metric ton of carbon dioxide equivalent ($/MTCO$_2$e) is used to show the cost-effectiveness of measures in reducing one metric ton of CO_2e. Dollar per metric ton standardizes the results of all measures to allow for comparisons across measures and provides a way to estimate the annual value of a measure in relation to its GHG reductions in that year. A positive value indicates a net benefit per ton reduced, whereas a negative value indicates a net cost per ton reduced.

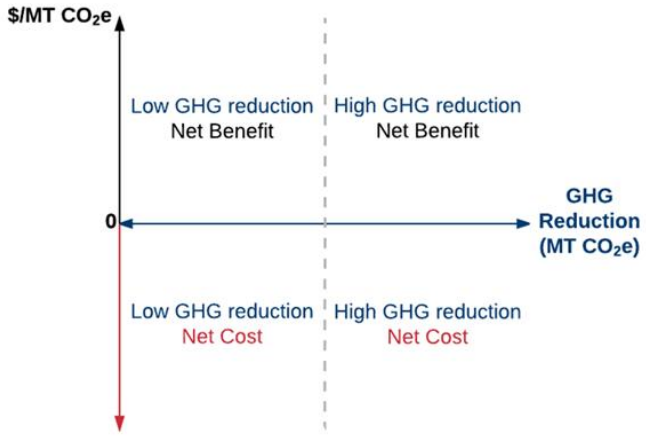
A weighted average $/MTCO$_2$e of all the activities that contribute to GHG reductions is used since the GHGs reduced in the Target Year are not always equal for all actions in previous years. Most measures will have multiple Install Years associated with their defined action(s), and the benefits, costs, and GHGs reduced from an activity in one year could be different from the same type of activity in the following year (e.g. changes in installation price, rebates that have since expired, etc.). For example, for all PV systems that reduce emissions in 2020 but were installed between 2015 and 2020, a weighted average of the $/MTCO$_2$e for all these systems would be used. By calculating the weighted average, all

[10] Present value in this context and going forward represents the value in the start year of the analysis, not the current year.
[11] According to the Federal Environmental Protection Agency (EPA), projects within a short to medium lifespan are assigned a Discount Rate of approximately three percent, derived from consumer-time preferences based on the interest rate of a risk-free asset such as a government bond (US EPA 2010). Conversely, the Federal Office of Management and Budget (OMB) assigns a standard Discount Rate of seven percent, derived from the opportunity cost of capital, measured by the before-tax rate of return to investment (OMB 2000). Both the EPA and OMB suggest performing a sensitivity analysis with multiple Discount Rates to identify how results respond to different time-value preferences

benefits and costs associated with the actions taken to achieve the GHG reductions in the Target Year are scaled according to their contribution of GHG reductions in the Target Year.

While the $/MTCO$_2$e results allow for comparison across all CAP measures, this metric can be misleading if not presented in combination with the total amount of GHG emissions that would be reduced. Plotting the $/MTCO$_2$e for each measure in conjunction with its GHG reductions shows a comparison of cost-effectiveness (Figure 4). The higher a measure is on the plot, the more cost-effective it is; the lower a point is, the less cost effective it is. Measures to the right reduce more GHGs than measures on the left. Each scatterplot shows results for a single perspective (e.g., Measure Perspective).

Figure 4. Interpreting Results of a Scatterplot



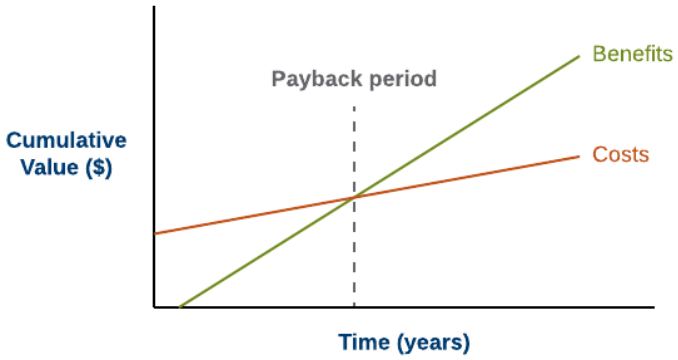
2.4.3 Benefit-Cost Ratio (BCR)

The Benefit-Cost Ratio (BCR) is used to assess the relationship between the benefits and costs of a project or action. A BCR that is greater than one means the anticipated benefits of the measure outweigh anticipated costs; if it is less than one, costs outweigh benefits. This metric illustrates the relative cost-effectiveness when comparing multiple measures; measures with higher BCR values tend to be more cost-effective. How subsidies (rebates and incentives) are calculated for the Participant Perspective will impact the result; this analysis identifies all subsidies as cost reductions to the Participant. Also, results for perspectives or CAP measures that have no Direct Benefits cannot be expressed using a BCR.

2.4.4 Payback Period

A Payback Period is the amount of time required for the cumulative benefits of a project to equal or surpass the cumulative costs of an action or measure (Figure 5). Payback Periods can only be shown for measures or perspectives that have a positive NPV; a negative NPV indicates that the benefits will never equal or outweigh the costs over an action's lifetime.

Figure 5. Conceptual Diagram of an Action's Payback Period



There are two types of Payback Periods: simple and discounted. The simple Payback Period is the easiest to calculate but ignores the time value of money. The discounted Payback Period is a more conservative estimate and is used in this analysis. By discounting future values, the time required for benefits to exceed costs is extended further into the future.

2.4.5 Return on Investment (ROI)

Return on Investment (ROI) measures the rate of return, or profitability, of a project to evaluate its efficiency. ROIs are expressed as a percent; the higher the percent, the greater the return or profitability of a project. For measures where costs significantly outweigh benefits, a highly negative ROI value results (not to exceed -100%). Like the BCR, the ROI is useful when comparing multiple actions to understand which are potentially the most cost-effective. ROIs can be calculated using simple or discounted benefits and costs. A simple ROI is easily understood and comparable to actual interest rates, which do not account for future discounting, and is used in this analysis.

2.4.6 Internal Rate of Return (IRR)

The Internal Rate of Return (IRR) represents the Discount Rate necessary to achieve a NPV equal to zero given the benefits and costs of a measure or action over its Useful Life. The IRR is expressed as a percent; a higher percentage means a project is more desirable and negative IRRs indicate the benefits never outweigh the costs. The IRR is used to compare projects and determine which projects are better investment opportunities.

3 COST-EFFECTIVENESS ANALYSIS RESULTS

The following sections present CEA results for Existing and New and Expanded Programs in the interim year 2023. GHG reductions in interim year 2023 are based on calculations in the County of San Diego draft Final Climate Action Plan Appendix C and assume that an incremental level of activity is achieved each year 2021-2030 necessary to achieve 2030 target reductions identified in the CAP. See Appendix B for an extended set of 2023 tabular results and results for measures with GHG reductions in 2020, the first CAP Target Year. All results shown here are in present value dollars using a five percent Discount Rate and normalized to 2015 dollars. See Appendix C for sensitivity analysis results for all measures using a range of Discount Rates.

3.1 Existing Programs

Measures with Existing Programs are currently operational and fully funded. These programs are done for reasons other than GHG reductions, but still contribute towards CAP targets. Ten measures have been identified as Existing Programs, where the County is leveraging current activities and allocated funds to assist in achieving CAP GHG reduction targets. For purposes of this report, results show the GHG emissions implications of existing activity; however, measures included in this section are primarily done for reasons other than achieving CAP GHG reduction targets.

Table 1 summarizes results in $/MTCO$_2$e by perspective for each measure to achieve anticipated 2023 GHG reductions. Results indicate an overall net benefit per metric ton reduced for measures with Existing Programs for three of the five perspectives and an estimated 208,565 MTCO$_2$e reduced in 2023.

At the Measure Perspective, this group of measures provides a net benefit of $3/MTCO$_2$e. The most cost-effective measure is W-2.1 Increase Rain Barrel Installations with a net benefit of $1,292/MTCO$_2$e reduced. While this measure has a relatively high net benefit, it has a comparably low GHG reduction and could have limited capacity for expansion. This compares to measure T-2.1 Improve Roadway Segments as Multi-modal, which is the least cost-effective for reducing GHGs (-$11,339/MTCO$_2$e) and reduces a relatively small amount of GHGs.

Six of the measures are considered cost-effective at the Participant level and have a positive $/MTCO$_2$e. Of those six, five are still considered cost-effective when Administrator and Non-Participant costs are included (Measure Perspective). Measure W-1.3 Reduce Potable Water Consumption at County Facilities is cost-effective for the Participant ($24/MTCO$_2$e), but costs to implement and administer this measure are high (-$229/MTCO$_2$e), resulting in a net cost at the Measure Perspective (-$206/MTCO$_2$e).

Table 1. Dollar per $MTCO_2e$ to Achieve 2023 GHG Reductions for Existing Programs

CAP Measure		Administrator	Participant	Non-Participant	Measure	Society	GHGs Reduced in 2023 ($MTCO_2e$)
		A	*P*	*NP*	*A+P+NP=M*	*M+E=S*	
Built Environment and Transportation							
T-1.1	Acquire Open Space Conservation Land	($130)	($534)	-	($665)	($639)	4,043
T-2.1	Improve Roadway Segments as Multi-modal	($781)	($10,558)	-	($11,339)	($11,277)	181
T-3.2	Use Alternative Fuels in County Projects	-	($30)	-	($30)	($1)	109
T-3.4	Reduce the County's Fleet Emissions	($4)	$242	-	$238	$242	2,778
Energy							
E-1.4	Reduce Energy Use Intensity at County Facilities	($6)	$77	($0)	$71	$101	7,751
E-2.3	Install Solar Photovoltaics in Existing Homes	($1)	$171	($125)	$45	$72	158,296
E-2.4	Increase On-Site Renewable Electricity Generation for County Operations	($5)	$147	($124)	$19	$46	4,483
Solid Waste							
SW-1.1	Increase Solid Waste Diversion	($1)	($98)	-	($99)	($69)	30,656
Water and Wastewater							
W-1.3	Reduce Potable Water Consumption at County Facilities	($229)	$24	($1)	($206)	($175)	254
W-2.1	Increase Rain Barrel Installations	($14)	$1,501	($195)	$1,292	$1,320	14
Total		**($5)**	**$105**	**($97)**	**$3**	**$30**	**208,565**

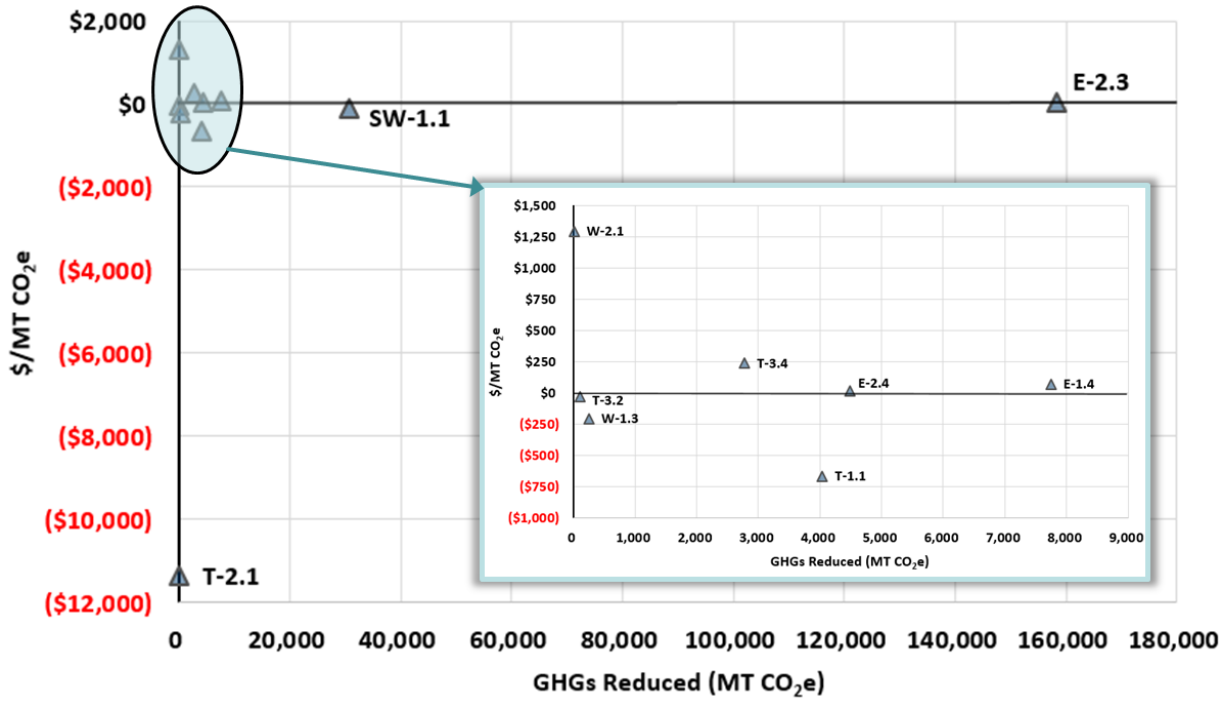
**E* represents quantified externalities

Energy Policy Initiatives Center, USD 2017

*All dollar values are in 2015$

Figure 6 presents results for the Measure Perspective and illustrates the relationship between a measure's $/$MTCO_2e$ and corresponding GHG reductions ($MTCO_2e$) in 2023; it is important to consider both the cost-effectiveness and GHG reduction potential of each measure when comparing them. Measures further to the right have higher GHG reductions. Measures above zero dollars indicate a net benefit per $MTCO_2e$ reduced and measures below zero indicate a net cost. Three measures are considered outliers: measure T-2.1 Improve Roadway Segments as Multi-Modal, measure E-2.3 Install Solar on Existing Homes, and measure SW-1.1 Increase Solid Waste Diversion. Measures E-2.3 and SW-1.1 have the highest GHG reductions in 2023 of all Existing Programs (158,296 and 30,656 $MTCO_2e$, respectively). Measure T-2.1 achieves a small level of GHG reductions (181 $MTCO_2e$) and at a high cost per metric ton reduced (-$11,339). The inset illustrates the relative cost-effectiveness of the remaining measures. Measure W-2.1 Increase Rain Barrel Installations is the most cost-effective ($1,292/$MTCO_2e$), but achieves relatively few GHG reductions (14 $MTCO_2e$). Measure T-1.1 Acquire Open Space Land Conservation is the second least cost-effective measure after T-2.1 with a net cost of $665/$MTCO_2e$ reduced.

Figure 6. Measure Perspective Scatterplot for Existing Programs in 2023



3.2 New and Expanded Programs

New and Expanded Programs require some level of new activity because of the CAP; Expanded Programs are an expansion of Existing Programs, and New Programs have been designed specifically for the CAP. Nineteen measures have been identified as New or Expanded Programs. Results show activity as it relates to GHG reductions; however, measures that expand upon existing activity included in this section are also done for reasons other than achieving CAP GHG reduction targets.

Table 2 summarizes the $/MTCO$_2$e by perspective for each measure to achieve anticipated 2023 GHG reductions. Results indicate an overall net cost per metric ton reduced for measures with New and Expanded Programs for all five perspectives and an estimated 114,772 MTCO$_2$e reduced in 2023.

At the Measure Perspective, New and Expanded Programs have a net cost of $40/MTCO$_2$e. The most cost-effective measure is T-2.3 Reduce County Employee Vehicle Miles Traveled, which has a net benefit of $255/MTCO$_2$e reduced. This compares to measure T-3.3 Develop a Local Vehicle Retirement Program, which is the least cost-effective for reducing GHGs (-$681/MTCO$_2$e).

Ten measures are considered cost-effective at the Participant level and have a positive $/MTCO$_2$e. Of those, seven are still considered cost-effective when Administrator and Non-Participant costs are included (Measure Perspective). Measure E-1.2 Use Alternatively-powered Water Heaters in Residential Development is cost-effective for the Participant ($4/MTCO$_2$e), but the costs to provide subsidies and administer the CAP measure are higher (-$7/MTCO$_2$e and -$1/MTCO$_2$e, respectively) resulting in a net cost at the Measure Perspective (-$4/MTCO$_2$e). Measure E-2.2 Increase Renewable Electricity in Non-residential Development has a benefit to the Participant ($64/MTCO$_2$e) that is less than the cost to provide subsidies and administer the CAP (-$93/MTCO$_2$e and -$7/ MTCO$_2$e, respectively), resulting in a net cost per metric ton reduced of -$36. Measure T-3.3 Develop a Local Vehicle Retirement Program is

the third measure to be cost-effective for the Participant ($219/MTCO$_2$e), but has an overall net cost when CAP Administrator and subsidy costs are included (-$681/ MTCO$_2$e).

Table 2. Dollar per MTCO$_2$e to Achieve 2023 GHG Reductions for New and Expanded Programs

	CAP Measure	Administrator	Participant	Non-Participant	Measure	Society	GHGs Reduced in 2023 (MT CO$_2$e)
		A	*P*	*NP*	*A+P+NP=M*	*M+E=S*	
Built Environment and Transportation							
T-1.2	Acquire Agricultural Easements	($27)	($42)	-	($69)	($46)	925
T-1.3	Update Community Plans	($10)	$185	-	$174	$229	4,185
T-2.2	Reduce New Non-residential Development Vehicle Miles Traveled	($62)	$313	($57)	$194	$265	654
T-2.3	Reduce County Employee Vehicle Miles Traveled	($1)	$380	($124)	$255	$327	2,242
T-2.4	Shared and Reduced Parking in New Now-residential Development	($3)	$233	-	$230	$292	418
T-3.1	Use Alternative Fuels in New Residential and Non-Residential Construction Projects	($40)	($7)	-	($47)	($24)	664
T-3.3	Develop a Local Vehicle Retirement Program	($727)	$219	($174)	($681)	($539)	134
T-3.5	Install Electric Vehicle Charging Stations	($6)	($41)	-	($47)	($1)	4,359
Energy							
E-1.1	Improve Building Energy Efficiency in New Development	($1)	($108)	($66)	($175)	($149)	11,613
E-1.2	Use Alternatively-powered Water Heaters in Residential Development	($1)	$4	($7)	($4)	$22	5,753
E-1.3	Improve Building Energy Efficiency in Existing Development	($16)	$125	($35)	$74	$5	1,108
E-2.1	Increase Renewable Electricity	($9)	($34)	-	($43)	($9)	68,956
E-2.2	Increase Renewable Electricity in Non-residential Development	($7)	$64	($93)	($36)	($12)	4,033
Water and Wastewater							
W-1.1	Increase Water Efficiency in New Residential Development	($562)	$638	($55)	$20	$50	25
W-1.2	Reduce Outdoor Water Use	($3)	$42	($2)	$38	$65	5,261
Agriculture and Conservation							
A-1.1	Convert Farm Equipment to Electric	($5)	($34)	($72)	($111)	($83)	2,021
A-1.2	Convert Stationary Irrigation Pumps to Electric	($7)	($1)	($6)	($13)	$13	1,181
A-2.1	Increase Residential Tree Planting	($8)	($406)	-	($414)	($293)	373
A-2.2	Increase County Tree Planting	($50)	($427)	-	($477)	($343)	867
Total		**($9)**	**($16)**	**($15)**	**($40)**	**($6)**	**114,772**

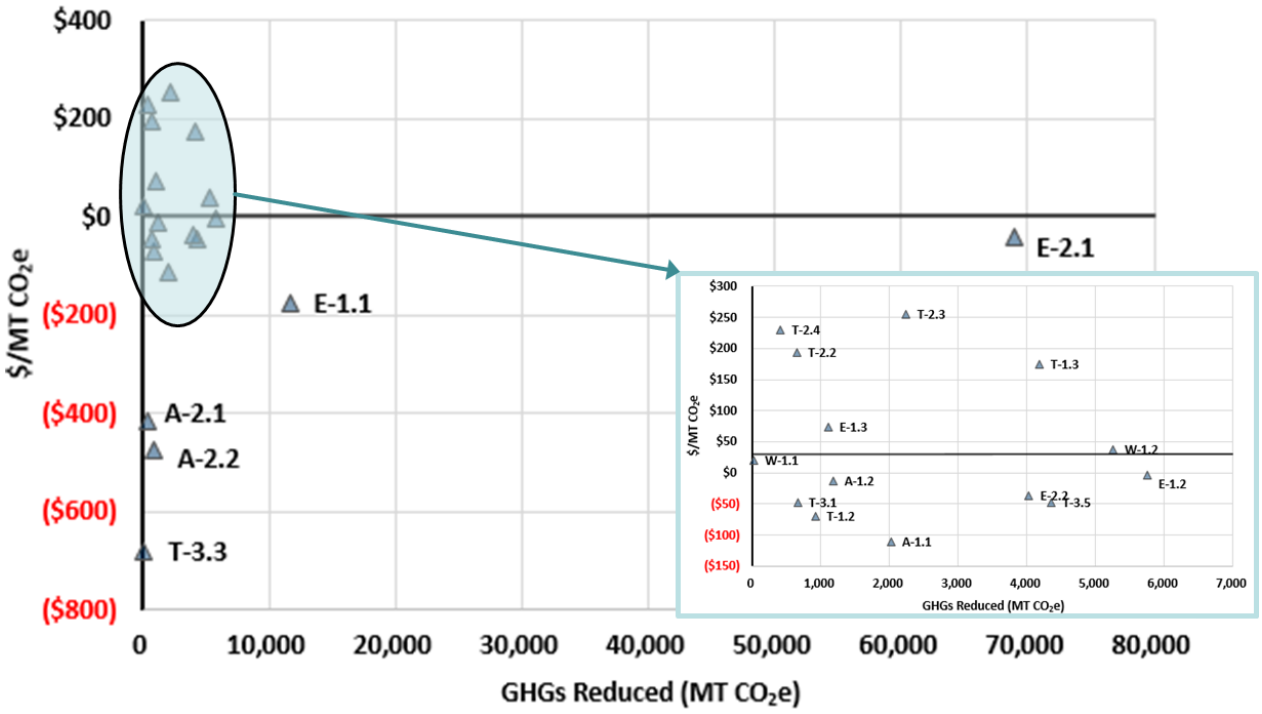
**E* represents quantified externalities

Energy Policy Initiatives Center, USD 2017

*All dollar values are in 2015$

Figure 7 illustrates the relationship between a measure's $/MTCO$_2$e and corresponding GHG reductions (MTCO$_2$e) in 2023 for New and Expanded Programs; it is important to consider both the cost-effectiveness and GHG reduction potential of each measure when comparing them. Measures further to the right have higher GHG reductions. Measures above zero dollars indicate a net benefit per MTCO$_2$e reduced and measures below zero indicate a net cost. Two measures are considered outliers: measure E-2.1 Increase Renewable Electricity and measure T-3.3 Develop a Local Vehicle Retirement Program. Measure E-2.1 has the highest GHG reductions in 2023 of all New and Expanded Programs (68,956 MTCO$_2$e) and comes a relative low cost of $43/MTCO$_2$e. Measure T-3.3 achieves a small level of GHG reductions (134 MTCO$_2$e) and at a high cost per metric ton reduced (-$681). Measure T-2.3 Reduce County Employee Vehicle Miles Traveled is the most cost-effective ($255/MTCO$_2$e) and reduces 2,242 MTCO$_2$e. Measure A-2.2 Increase County Tree Planting is the second least cost-effective measure after T-3.3 with a net cost of $477/MTCO$_2$e reduced.

Figure 7. Measure Perspective Scatterplot for New and Expanded Programs in 2023



4 BENEFIT-COST ANALYSIS RESULTS

This section presents results for the BCA. The purpose of this analysis is to identify the benefits received and costs incurred by home and business owners in unincorporated county and the County to assess the financial impact of implementing CAP measures. Results are included for both Existing and New or Expanded Programs in interim year 2023 along with the upfront cost to comply for residential and commercial buildings (new construction and existing units). See Appendix B for an extended set of 2023 tabular results and results for measures with GHG reductions in 2020, the first CAP Target Year. All results shown here are in present value dollars using a five percent Discount Rate and normalized to 2015 dollars, and represent the benefits and costs associated with Participant actions only.

For Existing and New and Expanded Programs, measures are grouped by Participant type. Three Participant types have been identified: County as Participant, County and non-County as Participant, and non-County as Participant. County as Participant includes those measures where County operations are affected only, for example, when installing equipment at County facilities, benefits and costs are received and/or incurred by the County only. Non-County as Participant includes those measures where only home and business owners are Participants; benefits and costs are received and/or incurred by home and business owners. The third type includes those measures with County and non-County Participants. For example, measures in which the County has capital costs associated with infrastructure improvements that lead to fuel consumption reduction savings for commuters who now bike more. In this case the County incurs costs, but receives none of the Direct Benefits, which would accrue to residents.

4.1 Existing Programs

Measures with Existing Programs are currently operational and fully funded. These programs are done for reasons other than GHG reductions, but still contribute towards CAP targets. Ten measures have been identified as Existing Programs, where the County is leveraging current activities to assist in achieving CAP GHG reduction targets. Of these measures, the County is the only Participant in six measures, home and business owners are the only Participants in three measures, and one measure includes both County and non-County Participants.

Table 3 shows the Participant level BCA results for Existing Programs in 2023 using a five percent Discount Rate. The Participant $/MTCO$_2$e and GHGs reduced for each measure are included for added context. Results indicate that six measures have a net benefit to the Participant. These measures have a Benefit-Cost Ratio (BCR) greater than one and a defined Payback Period. The four remaining measures have a net cost to the Participant over their respective Useful Lives.

For measures where the County is a Participant, four of the seven provide a net benefit, with measure T-3.4 Reduce the County's Fleet Emissions having the highest BCR (5.3) and shortest Payback Period (3.2 years). Measure T-1.1 Acquire Open Space Conservation Land and measure T-3.2 Use Alternative Fuels in County Projects only have costs associated with CAP activities and therefor no BCA metrics are provided. These results show existing activity as it relates to GHG reductions; however, measures included in this section are done for reasons other than achieving CAP GHG reduction targets.

For measures where the County is not a Participant, measure W-2.1 Increase Rain Barrel Installations is the most cost-effective for Participants (BCR=6.8) followed by measure E-2.3 Install Solar Photovoltaics in Existing Homes. While these measures provide a benefit to Participants, it is unlikely that the

programs can be expanded beyond current estimates. Additionally, GHG reductions from rain barrel installations are minimal (14 $MTCO_2e$).

Table 3. Benefit-Cost Metrics by Participant Type for Existing Programs in 2023

CAP Measure		$/MT CO_2e (Participant)	BCR	Payback (yrs)	ROI	IRR	GHGs Reduced in 2023 (MT CO_2e)
County as Participant							
T-1.1	Acquire Open Space Conservation Land	($534)	-	-	-	-	4,043
T-3.2	Use Alternative Fuels in County Projects	($30)	-	-	-	-	109
T-3.4	Reduce the County's Fleet Emissions	$242	5.31	3.2	676%	40%	2,778
E-1.4	Reduce Energy Use Intensity at County Facilities	$77	3.41	4.6	410%	25%	7,751
E-2.4	Increase On-Site Renewable Electricity Generation for County Operations	$147	1.97	10.7	132%	7%	4,483
W-1.3	Reduce Potable Water Consumption at County Facilities	$24	3.81	3.9	416%	31%	254
County and Non-County as Participant							
T-2.1	Improve Roadway Segments as Multi-modal	($10,558)	0.02	-	-	-	181
Non-County as Participant (e.g. home and business owners)							
E-2.3	Install Solar Photovoltaics in Existing Homes	$171	1.63	12.2	111%	6%	158,296
SW-1.1	Increase Solid Waste Diversion	($98)	0.63	-	-	-	30,656
W-2.1	Increase Rain Barrel Installations	$1,501	6.84	3.1	570%	46%	14

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

4.2 New and Expanded Programs

New and Expanded Programs require some level of new activity because of the CAP; Expanded Programs are an expansion of Existing Programs and new programs have been designed specifically for the CAP. Nineteen measures have been identified as New or Expanded Programs. Of these measures, the County is the only Participant in two measures, home and business owners are the only Participants in 11 measures, and six measures include both County and non-County Participants.

Table 3 shows the Participant level BCA results for New and Expanded Programs in 2023 using a five percent Discount Rate. The Participant $/$MTCO_2e$ and GHGs reduced for each measure are included for added context. Results indicate that ten measures have a net benefit to the Participant. These measures have a Benefit-Cost Ratio (BCR) greater than one and a defined Payback Period.[12] The nine remaining measures have a net cost to the Participant over their respective Useful Lives.

For measures where the County is the only Participant, both measures (measure T-1.2 Acquire Agriculture Easements and A-2.2 Increase County Tree Planting) have a net cost to the County over their Useful Life; there are no direct monetary benefits for either. However, these measures are expansions of current programs that are occurring for reasons other than GHG reductions.

For measures where the County is a Participant with home and business owners, three of the five measures provide a net benefit to the Participant (measures T-1.3 Update Community Plans, T-2.3

[12] Measure T-2.3 (Reduce County Employee Vehicle Miles Traveled), T-1.3 (Update Community Plans), T-2.2 (Reduce New Non-Residential Construction Vehicle Miles Traveled), and T-2.4 (Shared and Reduced Parking in New Non-Residential Development) do not have an incremental costs associated with CAP requirements. As such a BCR and Payback Period cannot be estimated even though it provides a net benefit.

Reduce County Employee Vehicle Miles Traveled, and T-3.3 Develop a Local Vehicle Retirement Program). Of those with a net cost to the Participant, measure E-2.1 Increase Renewable Electricity is the least cost-effective; a premium is paid for renewable electricity with no financial benefits received. However, the GHGs from measure E-2.1 reduced are significant.

For measures where the County is not a Participant, measure W-1.2 Reduce Outdoor Water Use is the most cost-effective for Participants (BCR=29.7, Payback Period=1.4 years) followed by measure W-1.1 Increase Water Efficiency in New Residential Development (BCR=4.0, Payback Period=3.8 years). Similar to measures with Existing Programs, not all measures have the potential to be expanded further and not all achieve significant GHG reductions (e.g., measure W-1.1 reduces 25 $MTCO_2e$ in 2023).

Table 4. Benefit-Cost Metrics by Participant Type for New and Expanded Programs in 2023

CAP Measure		$/MT CO_2e (Participant)	BCR	Payback (yrs)	ROI	IRR	GHGs Reduced in 2023 (MT CO_2e)
County as Participant							
T-1.2	Acquire Agricultural Easements	($42)	-	-	-	-	925
A-2.2	Increase County Tree Planting	($427)	-	-	-	-	867
County and Non-County as Participant							
T-1.3	Update Community Plans	$185	-	-	-	-	4,185
T-2.3	Reduce County Employee Vehicle Miles Traveled	$380	-	-	-	-	2,242
T-3.3	Develop a Local Vehicle Retirement Program	$219	1.09	8.9	52%	1%	134
T-3.5	Install Electric Vehicle Charging Stations	($37)	0.59	-	-	-	4,359
E-2.1	Increase Renewable Electricity	($34)	-	-	-	-	68,956
Non-County as Participant (e.g. home and business owners)							
T-2.2	Reduce New Non-residential Development Vehicle Miles Traveled	$313	-	-	-	-	654
T-2.4	Shared and Reduced Parking in New Now-residential Development	$233	-	-	-	-	418
T-3.1	Use Alternative Fuels in New Residential and Non-Residential Construction Projects	($7)	-	-	-	-	664
E-1.1	Improve Building Energy Efficiency in New Development	($108)	0.77	-	14%	-	11,613
E-1.2	Use Alternatively-powered Water Heaters in Residential Development	$4	1.05	19.4	64%	1%	5,753
E-1.3	Improve Building Energy Efficiency in Existing Development	$125	1.81	7.2	81%	18%	1,108
E-2.2	Increase Renewable Electricity in Non-residential Development	$64	1.26	14.2	54%	4%	4,033
W-1.1	Increase Water Efficiency in New Residential Development	$638	4.00	3.8	372%	32%	25
W-1.2	Reduce Outdoor Water Use	$42	29.77	1.4	1901%	269%	5,261
A-1.1	Convert Farm Equipment to Electric	($34)	0.83	-	-	-	2,021
A-1.2	Convert Stationary Irrigation Pumps to Electric	($1)	0.56	-	-	-	1,181
A-2.1	Increase Residential Tree Planting	($406)	-	-	-	-	373

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

4.3 Upfront Costs to Comply

Select measures within the CAP require or encourage activity specific to residential and/or commercial buildings (both new construction and existing units). There are upfront costs to comply with activities defined in these measures that would be experienced by a homeowner, business owner, or a developer in the case of new construction.[13] The upfront cost to comply represents the average cost per unit to engage in an activity defined in a CAP measure in 2023.

These costs are estimates based on historical data and best available literature. Advances in technology and economies of scale as new requirements transition demand towards more efficient products could affect future prices. Values shown here are determined using the same methods as the BCA. As such, values are shown in 2015 dollars (2015$) and discounted to present value using a five percent Discount Rate. Additionally, upfront costs are paired with the net benefit or net cost expected for the home and business owner over the lifetime of the particular action; this provides a more comprehensive view of the impacts associated with each CAP measure.

Values for residential measures are provided as an average dollar per home. Values for commercial measures are provided as an average dollar per square foot to account for the large discrepancy in commercial building sizes.

4.3.1 New Residential Construction

Seven measures have requirements for new residential construction. Six of those measures are included here. Measure T-3.1 Use Alternative Fuels in New Residential and Non-residential Construction Projects may increase construction costs for new development, but insufficient data were available to estimate the average cost per home to switch construction equipment to alternative fuel sources. Renewable diesel is cost-competitive with petroleum diesel under California's Low Carbon Fuel Standard and incentives are available through the Air Pollution Control District to clean up heavy duty engines.

Table 5 shows upfront costs to comply for a new residential unit ($/home) and documents the corresponding net benefit or cost that is expected to be achieved as a result of the activity.

Results indicate an average additional construction cost of $15,381 per home in 2023; this is the incremental cost to meet requirements of all related CAP measures. Of these upfront costs, energy efficiency and zero net energy requirements (measure E-1.1 Improve Building Energy Efficiency in New Development) comprise 90% of the total with the remaining five measures making up 10%. Additionally, four of the measures provide a net benefit to the homeowner over their respective lifetime, with measure W-1.2 Reduce Outdoor Water Use providing the greatest benefit ($10,048). While two measures return a net cost over their Useful Lives, the overall impact on the average home will be a net benefit of $5,728.

[13] Results of this analysis do not specify if upfront cost are experienced by a developer or home and business owner.

Table 5. Upfront Cost to Comply for New Residential Construction and Net Benefit/Cost over Lifetime

CAP Measure		2023 Anticipated Cost	Net Benefit/Cost Over Lifetime
		$/home	
E-1.1	Improve Building Energy Efficiency in New Development	($13,845)	($4,634)
E-1.2	Use Alternatively-powered Water Heaters in Residential Development	($769)	$41
W-1.1	Increase Water Efficiency in New Residential Development	($278)	$849
W-1.2	Reduce Outdoor Water Use	($337)	$10,048
W-2.1	Increase Rain Barrel Installations	($30)	$180
A-2.1	Increase Residential Tree Planting	($123)	($756)
Total		**($15,381)**	**$5,728**

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

4.3.2 New Commercial Construction

Six measures have requirements for new commercial construction. Three of those measures are included here; measure E-1.1 Improve Building Efficiency in New Development, measure E-2.2 Increase Renewable Electricity in Non-residential Development, and measure W-1.2 Reduce Outdoor Water Use.

Measure T-3.1 Use Alternative Fuels in New Residential and Non-Residential Construction Projects may increase construction costs for new commercial development, but insufficient data were available to estimate the average cost per square foot of commercial space to switch construction equipment to alternative fuel sources. Renewable diesel is cost-competitive with petroleum diesel under California's Low Carbon Fuel Standard and incentives are available through the Air Pollution Control District to clean up heavy duty engines. Measure T-2.4 Shared and Reduced Parking in New Non-residential Construction Projects may show a decrease in construction and ongoing maintenance costs; however, insufficient data were available to estimate the average cost (or benefit) per square foot of commercial space for this change in parking requirements. Measure T-2.2 Reduce New Non-Residential Development Vehicle Miles Traveled is an ongoing subsidy program for employees and is not associated with upfront construction costs for new commercial units.

Table 6 shows upfront costs to comply for a new commercial unit ($/sq. ft.) and documents the corresponding net benefit or cost that is expected to be achieved as a result of the activity.

Results indicate an average additional construction cost of $52 per square foot of commercial space in 2023; this is the incremental cost to meet requirements of all related CAP measures. Of these upfront costs, measure E-2.2 Increase Renewable Electricity in Non-Residential Development comprises 95% of the total ($49/sq. ft.) with the remaining two measures making up 5% ($3/sq. ft.). All three measures provide a net benefit ($20/sq. ft.) to the business or commercial space owner when Useful Life benefits and costs are considered. The greatest net benefit is from measure W-1.2 Reduce Outdoor Water Use, which also has the lowest upfront cost.

Table 6. Upfront Cost to Comply for New Commercial Construction and Net Benefit/Cost over Lifetime

CAP Measure		2023 Anticipated Cost	Net Benefit/Cost Over Lifetime
		$/sq.ft.	
E-1.1	Improve Building Energy Efficiency in New Development	($2.05)	$2.83
E-2.2	Increase Renewable Electricity in Non-residential Development	($48.79)	$3.69
W-1.2	Reduce Outdoor Water Use	($0.74)	$13.95
Total(s)		**($51.58)**	**$20.47**

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

4.3.3 Existing Residential Units

Five measures affect existing residential units. A homeowner is not required to participate in all five programs; these measures are either voluntary or required under certain conditions (e.g., time of water heater replacement).

Table 7 shows upfront costs to comply for an existing residential unit ($/home) and documents the corresponding net benefit or cost that is expected to be achieved as a result of the activity.

The results indicate a wide range in upfront costs in 2023 for existing homes to undertake CAP measure activities. Installing a rain barrel has the lowest upfront cost ($30/home), while installing a solar PV system has the highest upfront cost ($13,800). All measures that impact existing residential construction provide the average homeowner a net benefit over the course of their lifetime with the greatest benefit seen with measure W-1.2 Reduce Outdoor Water Use.

Table 7. Upfront Cost to Comply for Existing Residential Units and Net Benefit/Cost over Lifetime

CAP Measure		2023 Anticipated Cost	Net Benefit/Cost Over Lifetime
		$/home	
E-1.2	Use Alternatively-powered Water Heaters in Residential Development	($769)	$41
E-1.3	Improve Building Efficiency in Existing Development	($1,671)	$2,306
E-2.3	Install Solar Photovoltaics in Existing Homes	($13,800)	$2,923
W-1.2	Reduce Outdoor Water Use	($1,370)	$40,906
W-2.1	Increase Rain Barrel Installations	($30)	$180

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

4.3.4 Existing Commercial Units

Two measures affect existing commercial units. A business owner is not required to participate in both programs; these measures are either voluntary or required under certain conditions (e.g., a remodel).

Table 8 shows upfront costs to comply for an existing commercial unit ($/square foot) and documents the corresponding net benefit or cost that is expected to be achieved as a result of the activity.

The results indicate an upfront cost of $15 per square foot for improving building efficiency (measure E-1.3 Improve Building Efficiency in Existing Development) and $1 per square foot for actions to reduce outdoor water consumption (measure W-1.2 Reduce Outdoor Water Use) in existing commercial

buildings. Both measures provide a net benefit to the business owner over the course of their project lives. Reductions in outdoor water use provides the greatest net benefit ($24/sq. ft.) followed by improving building energy efficiency ($6/sq. ft.).

Table 8. Upfront Cost to Comply for Existing Commercial Units and Net Benefit/Cost over Lifetime

CAP Measure		2023 Anticipated Cost	Net Benefit/Cost Over Lifetime
		$/sq.ft.	
E-1.3	Improve Building Efficiency in Existing Development	($15.31)	$6.47
W-1.2	Reduce Outdoor Water Use	($1.25)	$23.51

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

5 LIMITATIONS

5.1 Available Data and Literature

When considering the benefit and cost impacts of a particular CAP measure, the limitations outlined in the following sections apply.

5.1.1 Data Availability

Estimates for current and future costs and benefits are limited to the data presently available. For some measures, extensive datasets exist with historic costs associated with installation and operation that can be applied at a local level. However, not all measures have readily available data to apply to CEA and BCA calculations. Case studies are applied in these analyses where necessary, as they are representative of the best available literature; however, they may not be entirely reflective of current and/or future conditions experienced. Additionally, costs and benefits associated with CAP measures are subject to changes in future conditions, such as:

- Population growth and demands;
- Technological advancements and available technology;
- Energy/fuel availability;
- Residential and commercial development stock; and
- Trends in consumer demands and producer supply.

5.1.2 Monetizing Externalities

Methods described here emphasize the inclusion of as many externalities as possible within the geographic scope of the unincorporated county. However, not all externalities can be readily monetized and their lack of inclusion in the quantitative assessment can skew the results of the BCA by reducing the potential benefits and/or costs experienced under the Societal Perspective. For example, little is known about how increasing the number of bicycle lanes will affect the number of bicycle-auto accidents and how that translates to a medical cost or savings. Externalities included in this analyses were restricted to best available data and literature; not all externalities were captured, potentially under or overvaluing the cost-effectiveness of measures when analyzing the Societal Perspective.

5.2 Scope of Impacts

The approach detailed in this document considers only those benefits and costs anticipated to be experienced within unincorporated county. There are other benefits and costs that can accrue outside of unincorporated county as a result of implementing the CAP. For instance, the production and disposal of materials (e.g. solar photovoltaic panels and hybrid vehicle batteries) can have multiple costs and benefits associated with them. This can include:

- Financial gain by manufacturers;
- Increase in sector jobs;
- Pollution external impacts from hazardous waste disposal at end of Useful Life; and
- Reduction in pollution caused by traditional energy production (e.g. coal).

While the methods described in this document can be applied to these additional benefits and costs, the time and resources needed to consider benefits and costs outside of the unincorporated county are prohibitive.

6 CONCLUSION

This report summarizes the findings for the County of San Diego draft Final CAP Cost-Effectiveness and Benefit-Cost Analyses conducted by the Energy Policy Initiatives Center (EPIC) at the University of San Diego. The overall goal of the report is to examine the cost-effectiveness of and benefits and costs related to measures included in the CAP.

The measures included in the draft Final CAP to reach GHG reduction targets would have a net cost of $12/ $MTCO_2e$ reduced in 2023, the final year of the County's 5-year budget cycle. This represents an overall net cost of $12 to the CAP Administrator, Participants, and Non-Participants (i.e., from the Measure Perspective) to reduce one metric ton of carbon dioxide equivalent in the year 2023.

Taken as a group, the 10 CAP measures leveraging Existing Programs have an estimated net benefit of $3 per metric ton reduced and an estimated 208,565 $MTCO_2e$ reduced in 2023. These measures are funded, already underway, and contribute toward CAP emissions targets. The most cost-effective Existing Program is measure W-2.1 Increase Rain Barrel Installations with a net benefit of $1,292/$MTCO_2e$ reduced. While W-2.1 is the most cost-effective measure of this subset of measures, it has a low GHG reduction potential and expansion of this program likely would not yield significant additional GHG reductions. Measure E-2.3 Install Solar Photovoltaics in Existing Homes is also cost-effective at reducing GHG emissions ($45/$MTCO_2e$) and reduces the most GHGs, but there is likely little room for further expansion of the program.

Four Existing Programs to reduce emissions associated with County facilities and operations would have a net benefit over the lifetime of the associated projects. Activities to reduce emissions in the County's vehicle fleet (measure T-3.4) would have the highest BCR of 5.31 and the shortest Payback Period of 3.2 years.

Taken as a group, the 19 CAP measures that are New and Expanded Programs have an estimated net cost of $40 per metric ton reduced and an estimated 114,772 $MTCO_2e$ reduced in 2023. The most cost-effective measure is T-2.3 Reduce County Employee Vehicle Miles Traveled with a net benefit of $255/$MTCO_2e$ reduced. Measure T-3.3 Develop a Local Vehicle Retirement Program is the least cost-effective at reducing GHG emissions (-$681/$MTCO_2e$).

The combined effect of CAP measures[14] that focus on new home construction would increase construction cost by an average of $15,381 per home in 2023. Of these upfront costs, energy efficiency and zero net energy requirements (measure E-1.1 Improve Building Energy Efficiency in New Development) comprise 90% of the total increase with the remaining five measures making up 10%. While two measures return a net cost over their Useful Lives, the overall impact on the average home will be a net benefit of $5,728 over the life of the improvements.

Similarly, measures[15] affecting new non-residential buildings would increase construction cost by an average of $52 per square foot (sq. ft.) of commercial space in 2023. Of these upfront costs, measure E-2.2 Increase Renewable Electricity in Non-residential Development comprises 95% of the total ($49/sq. ft.) with the remaining two measures making up 5% ($3/sq. ft.). All three measures provide a net benefit

[14] Six of seven applicable measures are included in this section of the analysis. See Section 4.3.1 for further discussion.

[15] Three of six applicable measures are included in this section of the analysis. See Section 4.3.2 for further discussion.

to the business or commercial space owner when Useful Life benefits and costs are considered ($20/sq. ft.).

Given the uncertainty associated with future conditions, updates may be necessary to incorporate updated forecasts based on actual benefits and costs experienced within the unincorporated county as measures are implemented and to integrate any changes to measures and actions over time.

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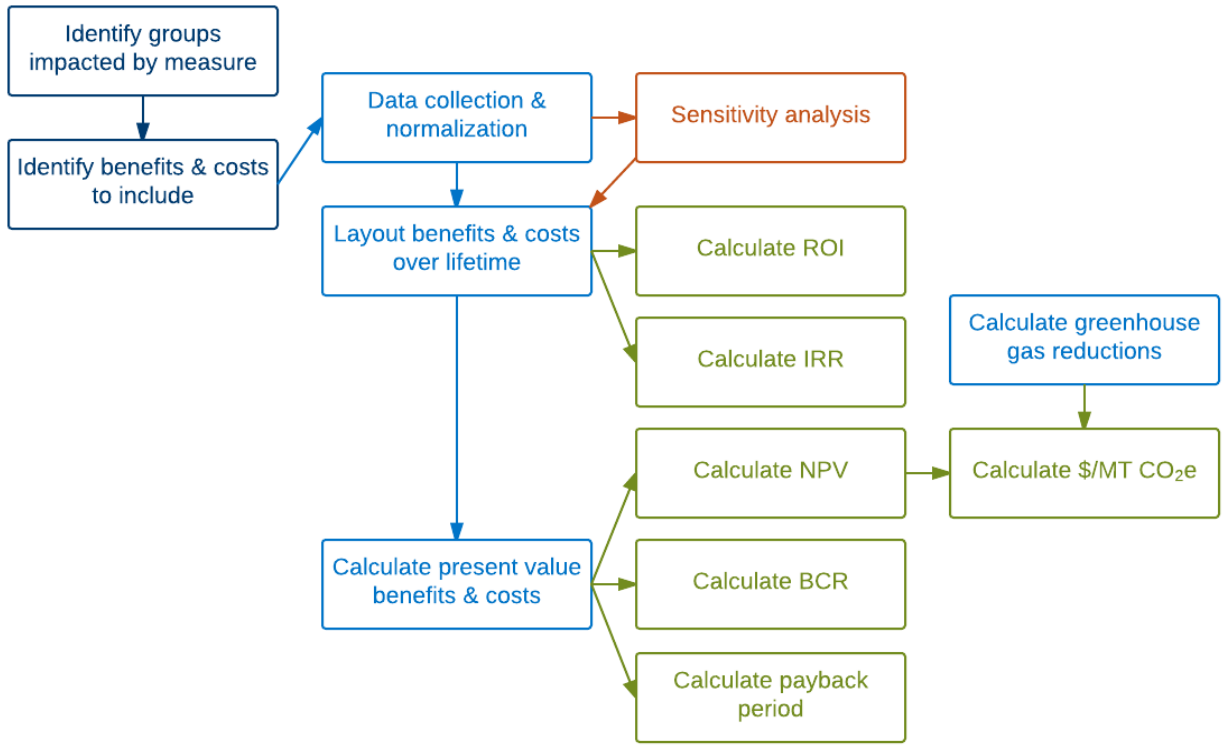
Appendix A. METHODS FOR ANALYZING BENEFITS AND COSTS

The Benefit-Cost Analysis for each measure included in the County of San Diego Draft Final Climate Action Plan follows the same general methods outlined in Figure A1.

Figure A1. General Methods for Climate Action Plan Cost-Effectiveness and Benefit-Cost Analyses



For all measures, greenhouse gas (GHG) calculations are consistent with those used in estimating GHG reductions for the CAP. In some instances, additional data were required beyond what is used to estimate GHG reductions in order to apply calculated GHG reductions at an individual activity level (e.g. average GHGs per piece of farm equipment converted from gas-powered to electric). Requirements vary by measure, but defining assumptions and collecting data all follow the same methods detailed in this appendix.

A.1 Identify Groups Impacted by Measure

The data collection process is guided by understanding those groups which are impacted in each perspective. The following sections help to identify those groups and the benefits/costs included in the analysis that are received/incurred by each.

A1.1 Administrator Perspective

The Administrator Perspective is compromised solely of County departments and agencies who will undertake activities related to implementing a CAP measure.

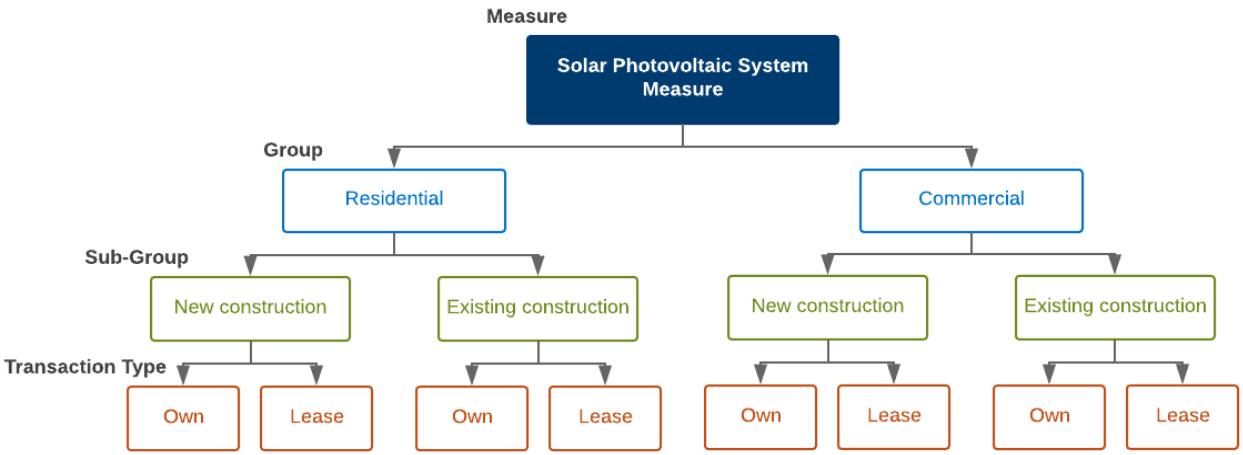
Costs incurred by the County to implement and administer the CAP are gathered from the Climate Action Plan Implementation Cost Report. All costs in the implementation cost report are included here,

with the exception of capital costs specific to the measure activity, which are captured under the Participant Perspective (e.g. capital for purchasing trees, purchasing alternative fuel vehicles).

A1.2 Participant Perspective

An individual measure can have multiple Participant groups that are impacted depending on the level of specificity for each CAP measure. The PV system example in Figure A2 shows that at a higher level, groups include residential and commercial customers, and more specific sub-groups are identified based on the type of construction. For the PV measure, the costs associated with installations on existing development can vary greatly compared to the costs of installing PV systems during construction of a home or office building. The individuals who comprise the two types of construction groups can also vary; existing construction typically refers to current home or business owners, whereas new construction can include developers. For some measures, the County is also a Participant.

Figure A2. Potential Stakeholders Impacted by a Photovoltaic System Ordinance



Key questions asked for each identified Participant includes:

- Are there any upfront costs required for purchase/installation?
- Are there any ongoing maintenance costs and, if so, at what frequency are they incurred (e.g. annually, biannually)?
- Is the activity reducing consumption (electricity, natural gas, water, fuel, etc.)?
- What rebates and incentives are available?
- What rate schedules apply to Participant groups?

The type of transaction involved is also considered; is the Participant purchasing the system outright or leasing it (e.g. through a Power Purchase Agreement)?

A1.3 Non-Participant Perspective

Non-Participants are those who fund rebates and incentives (through taxes, fees, etc.) that Participants use to offset costs, and are difficult to identify unless documenting the rebates and incentives available to Participants. The County can also be a Non-Participant.

Data needed to estimate the impact on Non-Participants is the same as that for any rebates or incentives identified for Participants (shown as cost reductions for Participants and costs for Non-Participants).

A.2 Data Collection and Normalization

Data collection followed the hierarchy outlined in Figure A3. Data specific to the unincorporated county is used whenever possible for benefit and cost values, as well as for key assumptions. In instances where data specific to the unincorporated county is unavailable or incomplete (little historic activity), regional or state data is applied. In the absence of sufficient regional or state data, estimates provided in current literature are used.

Figure A3. Data Collection Hierarchy for Climate Action Plan Benefit-Cost Analyses

All collected data values were normalized to 2015 dollars (2015$). Normalization reduces the impacts of outside influences (inflation, deflation, etc.) on dollar values, and failing to normalize the data can skew results of the analysis. All dollar values were normalized before being integrated into CEA and BCA calculations using the following equation:

Equation 1. Standardization of Data Values Using Consumer Price Index

$$X_0 = X_t * \frac{CPI_0}{CPI_t}$$

Where,

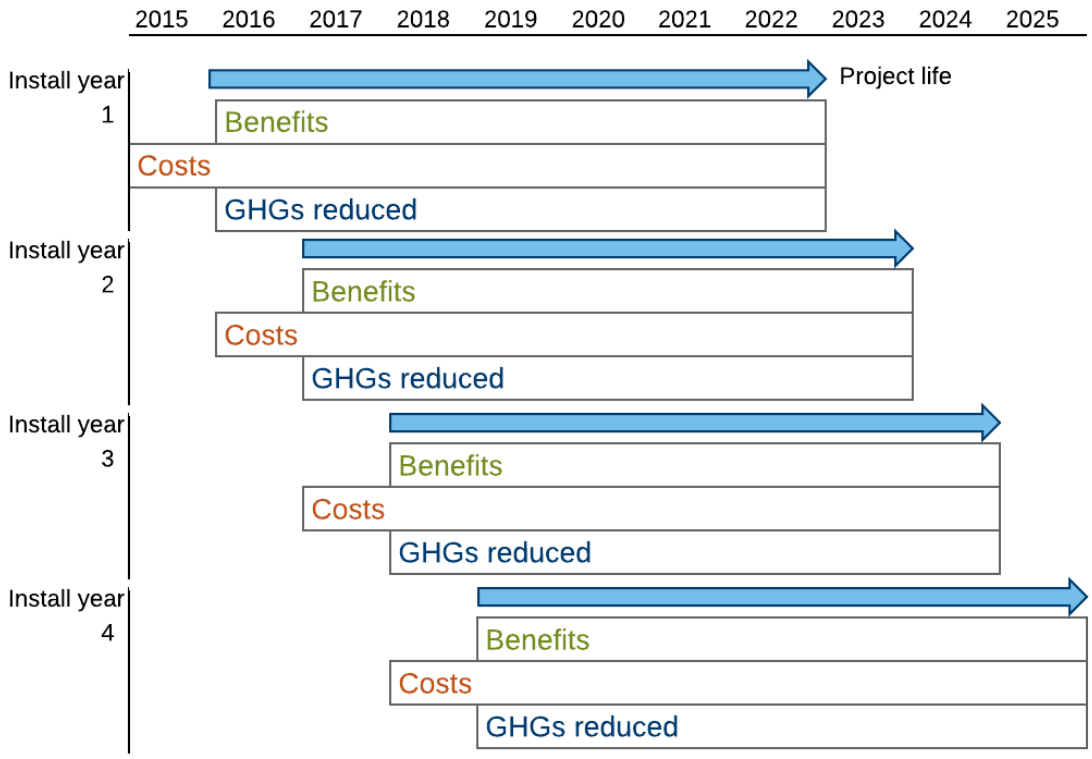
X_0 = normalized dollar value in base year
X_t = nominal dollar value in year t
CPI_0 = Consumer price index in base year
CPI_t = Consumer price index in year t

When the dollar year is not specified for a data value(s) in a report or literature used, the year of publication is applied for normalization.

A.3 Layout Benefits and Costs over Lifetime

For each measure, the benefit and cost streams are laid out over the entire lifetime associated with that particular activity for the particular perspective(s) being analyzed. In the example in Figure A4, 2015 is considered the first Install Year and the Useful Life is seven years (2011-2022). The year 2016 is considered the second Install Year and benefits/costs go out through 2023 (seven-year life). This example does not differentiate between perspectives, but the same process is applied to each by adding or removing the appropriate benefits and costs for that perspective and measure. Additionally, each Installation Year will have corresponding GHGs that are reduced annually. Annual GHG reductions for a particular Install Year will not vary by perspective.

Figure A4. Example of Benefits and Costs Laid Out over Useful Lives for Multiple Install Years



A.4 Calculate Present Value Benefits and Costs

Once all benefits and costs have been laid out over the action's Useful Life, the Discount Rate is applied to both the benefit and cost streams for each Installation Year to calculate their respective present values (Equation 2and Equation 3).

Equation 2. Present Value Benefits Calculation

$$PV_{benefits} = \sum_{0}^{t=i} \frac{B_t}{(1+r)^t}$$

Equation 3. Present Value Costs Calculation

$$PV_{costs} = \sum_{0}^{t=i} \frac{C_t}{(1+r)^t}$$

Where,

$PV_{benefits}$	= present value of benefits stream
B_t	= benefits in year t
PV_{costs}	= present value of costs stream
C_t	= costs in year t
r	= Discount Rate
i	= Useful Life of measure/action

A4.1 Anticipated Present Value Benefits and Costs in Target Year

Present value benefits and costs calculations estimate the total of each over all Useful Lives. However, a CAP BCA is meant to show results with respect to a particular Target Year. To achieve this, the present value benefits and costs are apportioned to the GHGs reduced over each Install Year's Useful Life and then multiplied by the GHGs reduced in the Target Year for that Install Year (Equation 7 and Equation 8). Results are totaled for all Install Years to calculate the total anticipated benefit and cost in the Target Year for a given measure.

Equation 4. Anticipated Present Value Benefits in Target Year Calculation

$$Anticipated\ PV_{benefits}\ in\ target\ year = \frac{PV_{benefits}}{\sum_{0}^{t=i} GHGs_t} * GHGs_{t=target\ year}$$

Equation 5. Anticipated Present Value Costs in Target Year Calculation

$$Anticipated\ PV_{costs}\ in\ target\ year = \frac{PV_{costs}}{\sum_{0}^{t=i} GHGs_t} * GHGs_{t=target\ year}$$

Where,

$PV_{benefits}$ = present value of benefits stream
PV_{costs} = present value of costs stream
$GHGs_t$ = greenhouse gases reduced in year *t*
i = Useful Life of measure/action

A.5 Calculate Net Present Value (NPV)

Net Present Value (NPV) is calculated as the difference between the present value benefits and the present value costs for each Install Year (Equation 6).

Equation 6. Net Present Value Calculation

$$NPV = PV_{benefits} - PV_{costs}$$

Where,

NPV = net present value
$PV_{benefits}$ = present value of benefits stream
PV_{costs} = present value of costs stream

A5.1 Anticipated Net Present Value in Target Year

Similar to the present value benefits and costs, NPV must be apportioned across all GHGs to find the anticipated NPV in the Target Year. This can be done using Equation 4 and substituting *NPV* in for $PV_{benefits}$ or more simply by subtracting the anticipated present value costs from the anticipated value benefits (Equation 7).

Equation 7. Anticipated Net Present Value in Target Year Calculation

$$Anticipated\ NPV\ in\ target\ year = Anticipated\ PV_{benefits}\ in\ target\ year - Anticipated\ PV_{costs}\ in\ target\ year$$

A.6 Calculate Dollar per Metric Ton of CO_2e

The dollar per metric ton is calculated by dividing the NPV for each Install Year by the GHGs reduced over the entire Useful Life for that Install Year (Equation 8).

Equation 8. Dollar per Metric Ton of CO_2e Calculation

$$Dollar\ per\ metric\ ton\ CO_2e = \frac{NPV}{\sum_0^{t=i} GHGs_t}$$

Where,

NPV = net present value
$GHGs_t$ = greenhouse gases reduced in year t
i = Useful Life of measure/action

A6.1 Weighted Average Dollar per Metric Ton of CO_2e

Since GHG reductions in the Target Year are not necessarily the same for each Install Year[16], weighted average values must be calculated to accurately reflect the dollar per metric ton of CO_2e of a particular measure in the Target Year. The weighted average can be found using Equation 9.

Equation 9. Weighted Average Dollar per Metric Ton of CO_2e Calculation

$$Weighted\ average\ \$/MT\ CO_2e = \frac{\sum_{j=1}^{j=k}(\$/MT_j * GHGs_{target\ year;j})}{\sum_{j=1}^{j=k} GHGs_{target\ year;j}}$$

Where,

$\$/MT_j$ = dollar per metric ton of Install Year j
$GHGs_{Target\ Year;j}$ = greenhouse gases reduced in Target Year by actions in Install Year j
j = Install Year
k = number of Install Years

A.7 Calculate Benefit-Cost Ratio

The Benefit-Cost Ratio (BCR) is calculated by dividing the present value benefits by the present value costs for a given Install Year (Equation 10).

Equation 10. Benefit-Cost Ratio Calculation

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

Where,

BCR = benefit-cost ratio
$PV_{benefits}$ = present value of benefits stream
PV_{costs} = present value of costs stream

[16] E.g. reductions form a photovoltaic system installed in 2015 will offset less GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

A7.1 Weighted Average Benefit-Cost Ratio

Since GHG reductions in the Target Year are not necessarily the same for each Install Year[17], weighted average values must be calculated to accurately reflect the Benefit-Cost Ratio of a particular measure in the Target Year. The weighted average can be found using Equation 11.

Equation 11. Weighted Average Benefit-Cost Ratio Calculation

$$Weighted\ average\ BCR = \frac{\sum_{j=1}^{j=k}(BCR_j * GHGs_{target\ year;j})}{\sum_{j=1}^{j=k} GHGs_{target\ year;j}}$$

Where,

BCR_j = Benefit-Cost Ratio of Install Year j

$GHGs_{target\ year;j}$ = greenhouse gases reduced in Target Year by actions in Install Year j

j = Install Year

k = number of Install Years

A.8 Calculate Discounted Payback Period

The Payback Period requires a look at the cumulative flow of discounted benefits and discounted costs for a given Install Year (Equation 12). The number of years with a negative cumulative discounted cash flow, *n*, starts in year one and goes up to the year before cumulative discounted benefits are greater than cumulative discounted costs. The cash flow for any given year is the sum of the benefits and costs in that year (both discounted in this case).

Equation 12. Discounted Payback Period Calculation

$$DPP = n + \frac{CF_{t=n}}{CF_{t+1}}$$

Where,

DPP = discounted Payback Period

n = number of years with a negative cumulative discounted cash flow

$CF_{t=n}$ = discounted cash flow in year t, where $t = n$

CF_{t+1} = discounted cash flow in year $t + 1$

A8.1 Weighted Average Discounted Payback Period

Since GHG reductions in the Target Year are not necessarily the same for each Install Year[17], weighted average values must be calculated to accurately reflect the discounted Payback Period of a particular measure in the Target Year. The weighted average can be found using Equation 13.

Equation 13. Weighted Average Discounted Payback Period Calculation

$$Weighted\ average\ DPP = \frac{\sum_{j=1}^{j=k}(DPP_j * GHGs_{target\ year;j})}{\sum_{j=1}^{j=k} GHGs_{target\ year;j}}$$

Where,

[17] E.g. reductions form a photovoltaic system installed in 2015 will offset less GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

DPP_j = discounted Payback Period of Install Year j
$GHGs_{target\ year;j}$ = greenhouse gases reduced in Target Year by actions in Install Year j
j = Install Year
k = number of Install Years

A.9 Calculate Return on Investment

Unlike most other calculations, the Return on Investment (ROI) is found using non-discounted benefits and costs. The ROI is the difference between all benefits and costs over the Useful Life (Equation 14).

Equation 14. Return on Investment Calculation

$$ROI = \frac{\sum_{t=0}^{t=i}(B_t - C_t)}{\sum_{t=0}^{t=i} C_t}$$

Where,
ROI = Return on Investment
B_t = benefits in year t
C_t = costs in year t
i = Useful Life of measure/action

A9.1 Weighted Average Return on Investment

Since GHG reductions in the Target Year are not necessarily the same for each Install Year[18], weighted average values must be calculated to accurately reflect the Return on Investment of a particular measure in the Target Year. The weighted average can be found using Equation 15.

Equation 15. Weighted Average Return on Investment Calculation

$$Weighted\ average\ ROI = \frac{\sum_{j=1}^{j=k}(ROI_j * GHGs_{target\ year;j})}{\sum_{j=1}^{j=k} GHGs_{target\ year;j}}$$

Where,
ROI_j = discounted Payback Period of Install Year j
$GHGs_{target\ year;j}$ = greenhouse gases reduced in Target Year by actions in Install Year j
j = Install Year
k = number of Install Years

A.10 Calculate Internal Rate of Return

The Internal Rate of Return (IRR) is found by setting the NPV equal to zero and solving for the Discount Rate, r (Equation 16).

Equation 16. Internal Rate of Return Calculation

$$NPV = 0 = \sum_{t=0}^{t=i} \frac{B_t - C_t}{(1+r)^t}$$

Where,

[18] E.g. reductions form a photovoltaic system installed in 2015 will offset less GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

NPV	= net present value
B_t	= benefits in year t
C_t	= costs in year t
r	= Discount Rate to be solved for (IRR)
i	= Useful Life of measure/action

Excel or other analytical software is used to accurately calculate the IRR. Manually solving for the IRR requires inputting a series of estimates for the IRR into Equation 16 until an approximate IRR is found that yields a NPV of approximately zero.

A10.1 Weighted Average Internal Rate of Return

Since GHG reductions in the Target Year are not necessarily the same for each Install Year[19], weighted average values must be calculated to accurately reflect the Internal Rate of Return of a particular measure in the Target Year. The weighted average can be found using Equation 17.

Equation 17. Weighted Average Internal Rate of Return Calculation

$$Weighted\ average\ IRR = \frac{\sum_{j=1}^{j=k}(IRR_j * GHGs_{target\ year;j})}{\sum_{j=1}^{j=k} GHGs_{target\ year;j}}$$

Where,

IRR_j	= discounted Payback Period of Install Year j
$GHGs_{target\ year;j}$	= greenhouse gases reduced in Target Year by actions in Install Year j
j	= Install Year
k	= number of Install Years

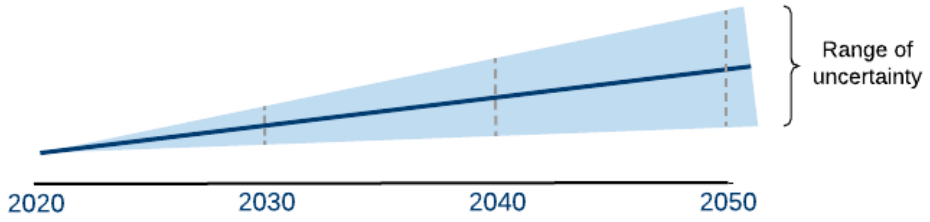
A.11 Conduct Sensitivity Analyses

A sensitivity analysis was conducted using a range of Discount Rates – three percent, five percent, and seven percent. Aside from varying the Discount Rate, all inputs were held constant and the same calculations detailed in the previous sections were performed to calculate results. All values are discounted back to the same year, regardless of an individual measure or action start year to ensure that all results are compatible and comparable.

Since the analysis involves future projections, it acknowledges some level of uncertainty, which increases the further out into the future the projection goes (Figure A5).

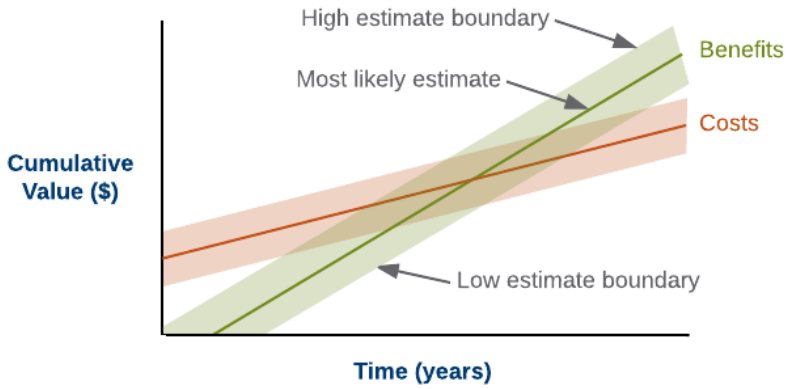
[19] E.g. reductions form a photovoltaic system installed in 2015 will offset less GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

Figure A5. Increasing Uncertainty with Future Projections



Uncertainty can be addressed through sensitivity analyses, which develop a range in outcomes when various inputs and assumptions are modified (Figure A6). A sensitivity analysis was performed using multiple Discount Rates (three percent, five percent, and seven percent).

Figure A6. Conceptual Diagram of Benefit and Cost Ranges Using a Sensitivity Analysis



Appendix B. MEASURE BY MEASURE RESULTS

The following sections include CEA and BCA results for each measure in Target Year 2020 and interim year 2023 along with data inputs and assumptions used in the analyses. All results are in present value dollars using a five percent Discount Rate and normalized to 2015 dollars. See Appendix A for sensitivity analysis results for all measures using a range of Discount Rates.

Target Year 2020 represents the first Target Year identified in the CAP and results are shown only for those measures with quantified GHG reductions in 2020. Interim year 2023 corresponds with the timeframe identified in the Climate Action Plan Implementation Cost Report and results are shown for all measures.

GHG reductions for Target Year 2020 and interim year 2023 are based on calculations in the County of San Diego draft Final Climate Action Plan Appendix C. GHG reductions for interim year 2023 assume that an incremental level of activity is achieved each year 2021-2030 necessary to achieve 2030 target reductions identified in the CAP.

B.1 Measure T-1.1: Acquire Open Space Conservation Land

This section analyzed the benefits and costs of acquiring 2,622 acres of open space conservation land by 2020 and assumes an incremental level of activity is achieved from 2021-2030 to achieve an additional 4,370 acres by 2030 and reach the 2030 GHG reduction target. Actions taken to achieve this target are estimated to offset 3,303 $MTCO_2e$ in 2020 and 4,043 $MTCO_2e$ in 2023.

This measure is an existing and funded program consistent with the County Multiple Species Conservation Program (MSCP) and the County will continue to acquire open space conservation land. Administrative costs include staff and consultant costs for implementation and land management. The County is considered the Participant and Participant costs include land purchase costs. There are no direct financial benefits received and no Non-Participant costs. Externalities considered in this analysis include the social cost of carbon estimated by the EPA.

Table B1. Summary Results for Measure T-1.1 in 2020

T-1.1 Acquire Open Space Conservation Land					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	-	-	-	$90,343
Present Value Costs	($299,502)	($1,842,697)	-	($2,142,199)	($2,142,199)
Net Present Value	($299,502)	($1,842,697)	-	($2,142,199)	($2,051,856)
GHGs (MT CO_2e)	**3,303**				
$/MT CO_2e	($91)	($558)	-	($649)	($621)
BCR	-	-	-	-	0.04
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-93%
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B2. Summary Results for Measure T-1.1 in 2023

T-1.1 Acquire Open Space Conservation Land					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	-	-	-	$104,989
Present Value Costs	($526,728)	($2,160,583)	-	($2,687,311)	($2,687,311)
Net Present Value	($526,728)	($2,160,583)	-	($2,687,311)	($2,582,322)
GHGs (MT CO_2e)	**4,043**				
$/MT CO_2e	($130)	($534)	-	($665)	($639)
BCR	-	-	-	-	0.04
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-94%
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-1.1 are documented in Table B3. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B3. Data Inputs and Assumptions for Measure T-1.1

T-1.1 Acquire Open Space Conservation Land			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average cost per acre	*($13,465)*	P	Provided by County staff
Average annual maintenance cost per acre	*($165)*	P	Provided by County Staff
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Annual acres acquired	437		County of San Diego CAP
Annual dwelling units offset	*184*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Building energy emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Waste emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Water emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*NA*	-	*Analysis examines all install years through 2050 - last year of data provided in CAP Appendix C for energy and transportation savings

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.2 Measure T-1.2: Acquire Agricultural Easements

This section analyzed the benefits and costs of acquiring 443 acres of agricultural easements by 2020 and assumes an incremental level of activity is achieved from 2021-2030 to achieve an additional 4,430 acres by 2030 and reach the 2030 GHG reduction target. Actions taken to achieve this target are estimated to offset 323 $MTCO_2e$ in 2020 and 925 $MTCO_2e$ in 2023.

This measure is an expansion of the County's Purchase of Agriculture Conservation Easement (PACE) program. Administrative costs include staff and consultant costs for implementation and land acquisition. The County is considered the Participant and Participant costs include land purchase costs. There are no direct financial benefits received and no Non-Participant costs. Externalities considered in this analysis include the social cost of carbon estimated by the EPA.

Table B4. Summary Results for Measure T-1.2 in 2020

T-1.2 Acquire Agricultural Easements					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	-	-	-	$8,008
Present Value Costs	($14,231)	($14,256)	-	($28,487)	($28,487)
Net Present Value	($14,231)	($14,256)	-	($28,487)	($20,480)
GHGs ($MT CO_2e$)	**323**				
$/MT CO_2e	($44)	($44)	-	($88)	($63)
BCR	-	-	-	-	0.28
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-48%
IRR	-	-	-	-	-9%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B5. Summary Results for Measure T-1.2 in 2023

T-1.2 Acquire Agricultural Easements					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	-	-	-	$21,670
Present Value Costs	($25,053)	($38,888)	-	($63,941)	($63,941)
Net Present Value	($25,053)	($38,888)	-	($63,941)	($42,272)
GHGs ($MT CO_2e$)	**925**				
$/MT CO_2e	($27)	($42)	-	($69)	($46)
BCR	-	-	-	-	0.34
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-37%
IRR	-	-	-	-	-8%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-1.2 are documented in Table B6. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B6. Data Inputs and Assumptions for Measure T-1.2

T-1.2 Acquire Agricultural Easements			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average cost per acre	*($768)*	P	Provided by County staff
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Annual acres acquired	*184*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Building energy emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Waste emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Water emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*NA*	-	*Analysis examines all install years through 2050 - last year of data provided in CAP Appendix C for energy and transportation savings

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.3 Measure T-1.3: Update Community Plan

This section analyzed the benefits and costs of updating 10 community plans between 2021 and 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 13,949 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 4,185 $MTCO_2e$ in 2023.

This measure is a County initiative to update community plans. Administrative costs include staff and consultant costs for implementation and community plan development. No incremental development costs are considered with this measure as current literature estimates cost reductions for this type of development over more sprawl-type development. Participants include those residents who can utilize alternate forms of transportation as a result of the community plan updates. There are no Non-Participant costs (subsidies) for this measure. Externalities considered in this analysis include the social cost of carbon estimated by the EPA and the value of avoided criteria pollutants associated with transportation emissions.

Table B7. Summary Results for Measure T-1.3 in 2023

T-1.3 Update Community Plans					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$772,466	-	$772,466	$1,002,900
Present Value Costs	($43,194)	-	-	($43,194)	($43,194)
Net Present Value	($43,194)	$772,466	-	$729,272	$959,707
GHGs (MT CO_2e)	**4,185**				
$/MT CO_2e	($10)	$185	-	$174	$229
BCR	-	-	-	17.88	23.22
Discounted Payback Period	-	-	-	3.79	3.53
ROI	-	-	-	3449%	4513%
IRR	-	-	-	63%	74%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-1.3 are documented Table B8. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B8. Data Inputs and Assumptions for Measure T-1.3

T-1.3 Update Community Plans			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
No incremental development costs			
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
VMT reduced	*Varies by year*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	CARB. EMFAC2014
Useful life	*NA*	-	*Analysis examines all install years through 2050 - last year of data provided in CAP Appendix C for energy and transportation savings

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.4 Measure T-2.1: Improve Roadway Segments as Multi-Modal

This section analyzed the benefits and costs of improving 700 centerline miles of road segments with multi-modal enhancements between 2021 and 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 604 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 181 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is both the Administrator and Participant in this measure. Administrator costs include County employee salary and benefits. Participant costs include the capital costs for improving road segments in addition to the fuel savings reductions seen by residents who switch to an alternative mode of transportation. There are no Non-Participant benefits or costs. Externalities include the social cost of carbon and the value of reduced criteria pollutants associated with transportation related emissions.

Table B9. Summary Results for Measure T-2.1 in 2023

T-2.1 Improve Roadway Segments as Multi-modal					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$38,265	-	$38,265	$49,577
Present Value Costs	($141,488)	($1,951,459)	-	($2,092,947)	($2,092,947)
Net Present Value	($141,488)	($1,913,194)	-	($2,054,682)	($2,043,370)
GHGs (MT CO_2e)	**181**				
$/MT CO_2e	($781)	($10,558)	-	($11,339)	($11,277)
BCR	-	0.02	-	0.02	0.02
Discounted Payback Period	-	-	-	-	-
ROI	-	-97%	-	-97%	-96%
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-2.1 are documented in Table B10. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B10. Data Inputs and Assumptions for Measure T-2.1

T-2.1 Improve Roadway Segments as Multi-modal			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Cost per mile for multi-modal improvements	*($252,158)*	P	Provided by County staff
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
VMT reduced	*Varies by year*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	CARB. EMFAC2014
Useful life	*20 years*		CARB 1995. Emission Reduction Calculation Methodologies

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.5 Measure T-2.2: Reduce New Non-Residential Development Vehicle Miles Traveled

This section analyzed the benefits and costs of reducing emissions from vehicle miles traveled (VMT) associated with new non-residential development between 2021 and 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 2,180 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 654 $MTCO_2e$ in 2023.

This measure is a new requirement for new non-residential development. Administrator costs include staff and consultant costs to develop and implement a new transportation demand management ordinance. Participants include those individuals who take advantage of the transportation demand management program and reduce their fuel consumption costs. Participants also receive incentives which are costs to the Non-Participant- agencies that subsidize transit and vanpools. Business owners are also considered Participants; however, it is assumed that they leverage the existing iCommute program provided through the San Diego Association of Governments (SANDAG) to provide subsidies to employees. Externalities include the social cost of carbon and the value of avoided criteria pollutants related to transportation emissions.

Table B11. Summary Results for Measure T-2.2 in 2023

T-2.2 Reduce New Non-residential Development Vehicle Miles Traveled					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$204,915	-	$204,915	$251,814
Present Value Costs	($40,856)	-	($37,491)	($78,347)	($78,347)
Net Present Value	($40,856)	$204,915	($37,491)	$126,569	$173,467
GHGs (MT CO_2e)	**654**				
$/MT CO_2e	($62)	$313	($57)	$194	$265
BCR	-	-	-	2.62	3.21
Discounted Payback Period	-	-	-	5.05	4.39
ROI	-	-	-	385%	521%
IRR	-	-	-	45%	55%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-2.2 are documented in Table B12. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B12. Data Inputs and Assumptions for Measure T-2.2

T-2.2 Reduce New Non-Residential Development Vehicle Miles Traveled			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Carpool/vanpool subsidy	*$424*	P, NP	SANDAG 2017. Vanpool Program Guidelines
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Number of commuters in unincorporated San Diego County	*Varies by year*	-	County of San Diego CAP Appendix C
VMT reduced	*Varies by year*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	CARB. EMFAC2014
Percent of commuter reductions from carpool/vanpool	*12%*	-	CAPCOA 2010. Quantifying Greenhouse Gas Mitigation Measures
Useful life	*NA*	-	*assumes reductions occur same year as action

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.6 Measure T-2.3: Reduce County Employee Vehicle Miles Traveled

This section analyzed the benefits and costs of reducing vehicle miles traveled (VMT) associated with County employee commutes between 2021 and 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 7,473 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 2,242 $MTCO_2e$ in 2023.

This measure is a County initiative to reduce employee VMT and builds upon the existing Government Without Walls (GWOW) Program. Administrator costs include staff and capital required for outreach efforts. Participants include County employees who participate in the program and see fuel consumption reduction savings. Participants also receive incentives which are costs to the Non-Participant (County). Externalities include the social cost of carbon and the value of avoided criteria pollutants related to transportation emissions.

Table B13. Summary Results for Measure T-2.3 in 2023

T-2.3 Reduce County Employee Vehicle Miles Traveled					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$851,717	-	$851,717	$1,012,473
Present Value Costs	($2,449)	-	($277,856)	($280,305)	($280,305)
Net Present Value	($2,449)	$851,717	($277,856)	$571,412	$732,167
GHGs (MT CO_2e)	**2,242**				
$/MT CO_2e	($1)	$380	($124)	$255	$327
BCR	-	-	-	3.04	3.61
Discounted Payback Period	-	-	-	3.05	3.04
ROI	-	-	-	-	-
IRR	-	-	-	323%	355%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-2.3 are documented in Table B14. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B14. Data Inputs and Assumptions for Measure T-2.3

T-2.3 Reduce County Employee Vehicle Miles Traveled			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Carpool/vanpool subsidy	*$292*	P, NP	Provided by County staff
Mass transit subsidy	*$759*	P, NP	Provided by County staff
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Number of commuters in unincorporated San Diego County	*Varies by year*	-	County of San Diego CAP Appendix C
VMT reduced	*Varies by year*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	CARB. EMFAC2014
Percent of commuter reductions from carpool/vanpool	*12%*	-	CAPCOA 2010. Quantifying Greenhouse Gas Mitigation Measures
Useful life	*NA*	-	*assumes reductions occur same year as action

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.7 Measure T-2.4: Shared and Reduced Parking in New Non-Residential Development

This section analyzed the benefits and costs of requiring shared and reduced parking for all new non-residential development between 2021 and 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 1,392 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 418 $MTCO_2e$ in 2023.

This measure is a requirement for new non-residential development. Administrator costs include County staff and consultants for permit checks, amending the San Diego County Code of Regulatory Ordinances, and ordinance implementation. Participants include commuters who see fuel consumption savings as a result of alternate transportation use. Participants also include business owners; current literature estimates a net benefit associated with reductions in parking spaces during construction and ongoing reductions in parking maintenance costs. There are no Non-Participants (subsidies) for this measure. Externalities include the social cost of carbon and the value of avoided criteria pollutants related to transportation emissions.

Table B15. Summary Results for Measure T-2.4 in 2023

T-2.4 Shared and Reduced Parking in New Non-residential Development					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$97,421	-	$97,421	$123,239
Present Value Costs	($1,328)	-	-	($1,328)	($1,328)
Net Present Value	($1,328.28)	$97,421	-	$96,093	$121,910
GHGs (MT CO_2e)	**418**				
$/MT CO_2e	($3)	$233	-	$230	$292
BCR	-	-	-	73.34	92.78
Discounted Payback Period	-	-	-	2.11	2.04
ROI	-	-	-	-	-
IRR	-	-	-	185%	212%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-2.4 are documented in Table B16. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B16. Data Inputs and Assumptions for Measure T-2.4

T-2.4 Shared and Reduced Parking in New Non-residential Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Benefits			
Avoided parking space construction cost ($/space)	*$5,270*	P	VTPI 2017. Transportation Cost Benefit Analysis II - Parking Costs
Avoided annual parking space maintenance ($/space)	*$461*	P	VTPI 2017. Transportation Cost Benefit Analysis II - Parking Costs
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Estimated annual new non-residential construction (sq. ft)	*Varies by year*	-	SANDAG 2013. Series 13 Regional Growth Forecast; Colliers International 2017a. Q32017 San Diego County Industrial Forecast; Colliers International 2017b. Q32017 San Diego County Office Forecast
Average number parking spaces per 1,000 sq. ft	*4*	-	County of San Diego 2013. Zoning Ordinance Part 6: General Regulations
Reduction in number of parking spaces	*20%*	-	County of San Diego CAP Appendix C
VMT reduced	*Varies by year*	-	County of San Diego CAP Appendix C
Transportation emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	CARB. EMFAC2014
Useful life	*20 years*		VTPI 2017. Transportation Cost and Benefit Analysis II - Parking Costs

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.8 Measure T-3.1: Use Alternative Fuels in New Residential and Non-Residential Construction Projects

This section analyzed the benefits and costs of requiring new residential and non-residential construction projects to use alternative fuels in 25% of construction equipment by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 2,213 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 664 $MTCO_2e$ in 2023.

This measure is a requirement for new residential and non-residential construction projects. The County is the Administrator and costs include staff and consultants to administer programs and amend Title 8 of the San Diego County Code of Regulatory Ordinances. Participants include those who are required to switch from diesel to renewable diesel or an electric alternative. It is assumed that no projects switch to electric alternative equipment until after 2023. Costs include the incremental cost of renewable diesel over diesel. There are no Non-Participant benefits or costs. Externalities include the social cost of carbon.

Table B17. Summary Results for Measure T-3.1 in 2023

T-3.1 Use Alternative Fuels in New Residential and Non-Residential Construction Projects					
Present Value Benefits	-	-	-	-	$15,240
Present Value Costs	($26,663)	($4,594)	-	($31,257)	($31,257)
Net Present Value	($26,663)	($4,594)	-	($31,257)	($16,016)
GHGs (MT CO_2e)	**664**				
$/MT CO_2e	($40)	($7)	-	($47)	($24)
BCR	-	-	-	-	0.49
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-28%
IRR	-	-	-	-	-9%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-3.1 are documented in Table B18. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B18. Data Inputs and Assumptions for Measure T-3.1

T-3.1 Use Alternative Fuels in New Residential and Non-Residential Construction Projects			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Cost differential between diesel and renewable diesel	*Varies by year*	P	US DoE Clean Cities Alternative Fuel Price Report (multiple quarters 2010-2017)
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Construction equipment emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of diesel converted to renewable diesel	*Varies by year*	-	County of San Diego CAP Appendix C
Percent of reductions from conversion to renewable diesel by 2023	*100%*	-	
Useful life	*NA*		

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.9 Measure T-3.2: Use Alternative Fuels in County Projects

This section analyzed the benefits and costs of requiring County construction projects to use alternative fuels in 100% of construction equipment by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 364 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 109 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the sole Participant for this measure. Participant costs include the cost of switching from diesel to renewable diesel. There are no Administrator or Non-Participant benefits or costs. Externalities include the social cost of carbon.

Table B19. Summary Results for Measure T-3.2 in 2023

T-3.2 Use Alternative Fuels in County Projects					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	-	-	-	$3,175
Present Value Costs	-	($3,269)	-	($3,269)	($3,269)
Net Present Value	-	($3,269)	-	($3,269)	($94)
GHGs (MT CO_2e)	**109**				
$/MT CO_2e	-	($30)	-	($30)	($1)
BCR	-	-	-	-	0.97
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-2%
IRR	-	-	-	-	-22%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-3.2 are documented in Table B20. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B20. Data Inputs and Assumptions for Measure T-3.2

T-3.2 Use Alternative Fuels in County Projects			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Cost differential between diesel and renewable diesel	*Varies by year*	P	US DoE Clean Cities Alternative Fuel Price Report (multiple quarters 2010-2017)
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Construction equipment emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of diesel converted to renewable diesel	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*NA*		

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.10 Measure T-3.3: Develop a Local Vehicle Retirement Program

This section analyzed the benefits and costs of retiring 1,600 late-model vehicles (model year 1996 or older) by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 446 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 178 $MTCO_2e$ in 2023.

This measure is a new incentive to retire pre-1997 vehicles in the unincorporated county. The County is the Administrator and costs include consultant cost and County employee salary and benefits to implement and manage programs. Additional costs include capital required for program resources and materials. Participants are residents and businesses who take advantage of the incentive and retire their vehicle. It is assumed that 50% of Participants will not purchase a replacement vehicle. The incentives paid out to Participants are considered a cost to Non-Participants. Externalities include the social cost of carbon and the value of avoided criteria pollutants related to transportation emissions.

Table B21. Summary Results for Measure T-3.3 in 2023

T-3.3 Develop a Local Vehicle Retirement Program					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$342,341	-	$342,341	$362,555
Present Value Costs	($97,213)	($649,282)	($23,243)	($769,738)	($769,738)
Net Present Value	($97,213)	($306,941)	($23,243)	($427,397)	($407,183)
GHGs (MT CO_2e)	**178**				
$/MT CO_2e	($547)	($1,728)	($131)	($2,407)	($2,293)
BCR	-	0.53	-	0.44	0.47
Discounted Payback Period	-	-	-	-	-
ROI	-	-24%	-	-37%	-33%
IRR	-	-8%	-	-10%	-9%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-3.3 are documented in Table B22. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B22. Data Inputs and Assumptions for Measure T-3.3

T-3.3 Develop a Local Vehicle Retirement Program			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average cost of new vehicle	*Varies by type*	P	Kelley Blue Book website
Vehicle retirement incentive ($/vehicle)	*$973*	P, NP	Provided by County staff
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Number of vehicles retired	*160*	-	County of San Diego CAP
Vehicle emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Annual VMT per vehicle	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*15 years*	-	BERLA 2017. Average Lifespan for U.S. Vehicles

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.11 Measure T-3.4: Reduce the County's Fleet Emissions

This section analyzed the benefits and costs of reducing the County fleet's GHG emissions 10% by 2020 and assumes an incremental level of activity is achieved each year to achieve a 20% reduction by 2030 and reach the 2030 GHG reduction target of 3,673 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 2,394 $MTCO_2e$ in 2020 and 2,778 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the Administrator and sole Participant in this measure. Administrator costs include County employee salary and benefits. Participant costs include the incremental purchase cost of a hybrid or zero-emissions vehicle over a standard vehicle. Participant benefits include fuel consumption reduction savings. There are no Non-Participant benefits or costs. Externalities include the social cost of carbon.

Table B23. Summary Results for Measure T-3.4 in 2020

T-3.4 Reduce the County's Fleet Emissions					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$937,168	-	$937,168	$946,581
Present Value Costs	($4,294)	($203,559)	-	($207,854)	($207,854)
Net Present Value	($4,294)	$733,609	-	$729,315	$738,727
GHGs (MT CO_2e)	**2,394**				
$/MT CO_2e	($2)	$306	-	$305	$309
BCR	-	6.05	-	6.00	6.06
Discounted Payback Period	-	3.74	-	3.81	3.78
ROI	-	784%	-	778%	786%
IRR	-	47%	-	47%	47%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B24. Summary Results for Measure T-3.4 in 2023

T-3.4 Reduce the County's Fleet Emissions					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$1,067,183	-	$1,067,183	$1,077,882
Present Value Costs	($11,037)	($394,543)	-	($405,580)	($405,580)
Net Present Value	($11,037)	$672,640	-	$661,603	$672,302
GHGs (MT CO_2e)	**2,778**				
$/MT CO_2e	($4)	$242	-	$238	$242
BCR	-	5.31	-	5.26	5.32
Discounted Payback Period	-	3.22	-	3.28	3.25
ROI	-	676%	-	670%	677%
IRR	-	40%	-	40%	40%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-3.4 are documented in Table B25. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B25. Data Inputs and Assumptions for Measure T-3.4

T-3.4 Reduce the County's Fleet Emissions			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Incremental cost of new vehicle (non-hybrid - hybrid)	*($4,774)*	P	Kelley Blue Book website
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Vehicle emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Percent of reductions from gasoline fueled vehicles	*100%*		County of San Diego CAP Appendix C
Average vehicle miles per gallon (MPG)	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*15 years*	-	BERLA 2017. Average Lifespan for U.S. Vehicles

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.12 Measure T-3.5: Install Electric Vehicle Charging Stations

This section analyzed the benefits and costs of installing 2,040 Level 2 electric vehicle charging stations by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 11,987 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 4,359 $MTCO_2e$ in 2023.

This measure is a new County initiative that builds on the State's zero-emission vehicle (ZEV) goal. The County is the Administrator and also a Participant. Administrator costs include County employee salary and benefits to research and develop a program and for project analysis. County Participant costs include the installation of ZEV charging stations. Other Participants include commuters who switch from a gasoline to electric vehicle. Cost and benefits for commuters include the purchase of electricity and the reduction of gasoline purchases. There are no Non-Participant costs for this measure. Externalities include the social cost of carbon and the value of avoided criteria pollutants related to transportation emissions.

Table B26. Summary Results for Measure T-3.5 in 2023

T-3.5 Install Electric Vehicle Charging Stations					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$285,492	-	$285,492	$486,196
Present Value Costs	($26,389)	($464,942)	-	($491,331)	($491,331)
Net Present Value	($26,389)	($179,450)	-	($205,839)	($5,135)
GHGs (MT CO_2e)	**4,359**				
$/MT CO_2e	($6)	($41)	-	($47)	($1)
BCR	-	0.61	-	0.59	1.01
Discounted Payback Period	-	-	-	-	2.86
ROI	-	-	-	-	-
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure T-3.5 are documented in Table B27. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B27. Data Inputs and Assumptions for Measure T-3.5

T-3.5 Install Electric Vehicle Charging Stations			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Cost to install a Level 2 charging station	*($12,255)*	P	Provided by County staff (see CAP Implementation Cost Report)
Electricity bill (charging)	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Benefits			
Value of avoided gasoline purchases (based on grade price forecast)	*Regular grade - varies*	P	US EIA 2017. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	CARB. EMFAC2014 Web Database; CARB 2015. EMFAC2014 Volume III - Technical Documentation; SANDAG 2015. San Diego Forward: The Regional Plan
Other inputs and assumptions			
Vehicle emissions avoided	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of fuel offset	*Varies by year*	-	County of San Diego CAP Appendix C
Increased electricity demand	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*10 years*	-	US DoE 2015 Costs Associated with Non-residential Electric Vehicle Supply Equipment

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.13 Measure E-1.1: Improve Building Energy Efficiency in New Development

This section analyzed the benefits and costs of achieving 10% greater building energy efficiency in all new non-residential development above the 2016 State Energy Code by 2030 and requiring all new residential development to meet the State's Zero Net Energy standards by 2020. It assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 38,708 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 11,613 $MTCO_2e$ in 2023.

This measure is a new requirement for new residential and non-residential development and phases in State ZNE standards to the County's Construction Code. The County is the Administrator and costs include County employee salary and benefits and consultants. Additional costs include capital associated with program resources and materials. Participants are home and business owners (or developers) constructing a home or commercial space. Costs are associated with the incremental energy efficiency (or ZNE) costs above current State standards and any lost utility deductions (commercial only). Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates and tax credits/deductions, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B28. Summary Results for Measure E-1.1 in 2023

E-1.1 Improve Building Energy Efficiency in New Development					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$3,228,256	-	$3,228,256	$3,527,197
Present Value Costs	($7,095)	($4,483,263)	($771,211)	($5,261,569)	($5,261,569)
Net Present Value	($7,095)	($1,255,007)	($771,211)	($2,033,313)	($1,734,372)
GHGs ($MT CO_2e$)	**11,613**				
$/MT CO_2e	($1)	($108)	($66)	($175)	($149)
BCR	-	0.77	-	0.67	0.73
Discounted Payback Period	-	-	-	0.52	0.47
ROI	-	14%	-	0%	9%
IRR	-	-	-	-5%	-4%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-1.1 are documented in Table B29. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B29. Data Inputs and Assumptions for Measure E-1.1

E-1.1 Improve Building Energy Efficiency in New Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Incremental cost of residentail energy efficiency upgrades ($/home)	*($24,051)*	P	ACEEE 2008. Summer Study on Energy Efficiency in Buildings
Residential rebates ($/home)	*$3,600*	P, NP	ACEEE 2008. Summer Study on Energy Efficiency in Buildings
Incremental cost of commercial energy efficiency upgrades ($/sq.ft)	*($3.03)*	P	Stok 2016. Net Zero Energy: Benefits, Strategies and Costs of Achieving the Next Generation of Buildings; Integra Realty Resources 2015. San Diego Construction Costs: 2015 and Beyond
Commerical lost utility deductions	*Varies by year*	P	USDT IRS. 2017a. Business Expenses
Benefits			
Residential electricity bill savings	*Mid-Demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Residential natural gas bill savings	*Varies by year*	P	SDG&E historical tarrifs
Commercial electricity bill savings	*Mid-Demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Commercial natural gas bill savings	*Varies by year*	P	SDG&E historical tarrifs
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from energy conservation	*Varies by year*	-	County of San Diego CAP Appendix C
Number of new residential homes	*Varies by year*		SANDAG 2013. Series 13 Regional Growth Forecast
Residential electricity reductions (kWh)	*Varies by year*	-	County of San Diego CAP Appendix C
Residential natual gas reductions (therms)	*Varies by year*	-	County of San Diego CAP Appendix C
Number of new commercial square feet	*Varies by year*		SANDAG 2013. Series 13 Regional Growth Forecast; Colliers International 2017a. Q32017 San Diego County Industrial Forecast; Colliers International 2017b. Q32017 San Diego County Office Forecast
Commercial electricity reductions (kWh)	*Varies by year*	-	County of San Diego CAP Appendix C
Commercial natural gas reductions (therms)	*Varies by year*	-	County of San Diego CAP Appendix C
Effective commercial tax rate	*22%*	-	US DT IRS 2016. Average Effective Federal Corporate Tax Rates
Useful life	*20 years*	-	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.14 Measure E-1.2: Use Alternatively-powered Water Heaters in Residential Development

This section analyzed the benefits and costs of requiring all new and replacement water heaters in residential development to be alternatively-powered by 2020 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 19,176 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 5,753 $MTCO_2e$ in 2023.

This measure is a requirement for any residential unit installing or replacing a water heater. The County is the Administrator and costs include County employee salary and benefits and consultant costs associated with amending Title 9 of the County Construction Code and permit checks. Participants are home owners and developers who must comply and costs include the incremental cost of an alternatively powered water heater. This analysis assumes all replacement heaters are tankless natural gas. Participant benefits include natural gas bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B30. Summary Results for Measure E-1.2 in 2023

E-1.2 Use Alternatively-powered Water Heaters in Residential Development					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$481,132	-	$481,132	$627,979
Present Value Costs	($5,692)	($456,586)	($39,102)	($501,380)	($501,380)
Net Present Value	($5,692)	$24,546	($39,102)	($20,248)	$126,599
GHGs (MT CO_2e)	**5,753**				
$/MT CO_2e	($1)	$4	($7)	($4)	$22
BCR	-	1.05	-	0.96	1.25
Discounted Payback Period	-	19.35	-	-	15.28
ROI	-	64%	-	54%	102%
IRR	-	1%	-	0%	3%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-1.2 are documented in Table B31. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B31. Data Inputs and Assumptions for Measure E-1.2

E-1.2 Use Alternatively-powered Water Heaters in Residential Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Incremental cost of tankless over tank-based natural gas water heater ($/water heater)	*($1,233)*	P	Energy Star 2008. Residential Water Heaters Final Criteria Analysis
SDG&E rebate ($/water heater)	*$97*	P, NP	SDG&E 2017. Home Energy Efficiency Rebate Application
Benefits			
Residential natural gas bill savings	*Varies by year*	P	SDG&E historical tariffs
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Number of water heaters installed annually	*Varies by year*	-	County of San Diego CAP Appendix C
Natural gas reductions (therms)	*Varies by year*	-	County of San Diego CAP Appendix C
Emissions reductions	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*20 years*	-	US DoE (n.d.) Tankless or Demand-Type Water Heaters

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.15 Measure E-1.3: Improve Building Energy Efficiency in Existing Development

This section analyzed the benefits and costs of achieving energy efficiency improvements in one percent of the residential and non-residential building stock by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 3,694 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 1,108 $MTCO_2e$ in 2023.

This measure is a requirement for existing residential and commercial buildings. It requires an energy audit at the time of remodel/renovation. The County is the Administrator and costs include County employee salary and benefits and consultant costs associated with ordinance development and permit checks. Additional costs include capital associated with program resources and materials. Participants are home and business owners who comply and undertake an energy efficiency audit. Costs are associated with the energy audit, energy efficiency retrofit, and any lost utility deductions (commercial only). Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates, loans, and tax credits/deductions, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B32. Summary Results for Measure E-1.3 in 2023

E-1.3 Improve Building Energy Efficiency in Existing Development					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$318,725	$105,225	$423,950	$347,117
Present Value Costs	($17,561)	($179,685)	($144,386)	($341,632)	($341,632)
Net Present Value	($17,561)	$139,040	($39,161)	$82,318	$5,485
GHGs (MT CO_2e)	**1,108**				
$/MT CO_2e	($16)	$125	($35)	$74	$5
BCR	-	1.81	-	1.30	1.09
Discounted Payback Period	-	7.18	-	13.93	3.85
ROI	-	81%	-	42%	55%
IRR	-	18%	-	4%	1%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-1.3 are documented in Table B33. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B33. Data Inputs and Assumptions for Measure E-1.3

E-1.3 Improve Building Energy Efficiency in Existing Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average residential energy audit cost ($/home)	*($346)*	P	SDG&E 2016. San Diego Gas & Electric Home Upgrade FAQ
Average commercial energy audit cost ($/sq.ft)	*($0.33)*		PNNL 2011. A guide to energy audits
Residential energy efficiency retrofit cost ($/home)	*($7,132)*	P	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program
Commercial energy efficiency retrofit cost ($/sq.ft)	*($23)*	P	Benson et al. 2011 Retrofitting Commercial Real Estate: Current Trends and Challenges in Increasing Building Energy Efficiency
Residential energy efficiency rebates and incentives ($/home)	*$2,351*	P, NP	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program
Average residential ARRA loan amount	*$4,076*	P, NP	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program
Commercial energy efficiency rebates and incentives ($/sq.ft)	*$1.22*	P, NP	US DOE 2013. Tax Deductions for Commercial Buildings
Commercial lost utility deductions	*Varies by year*	P	USDT IRS. 2017a. Business Expenses
Benefits			
Residential electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Residential natural gas bill savings	*Varies by year*	P	SDG&E historical tariffs
Commercial electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Commercial natural gas bill savings	*Varies by year*	P	SDG&E historical tariffs
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Number of residential energy efficiency retrofits	*Varies by year*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Number of commercial energy efficiency retrofits	*Varies by year*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
ARRA loan term	*10 years*	-	ACEEE 2014. Residential Energy Efficiency Financing: Insights and lessons learned from the Better Buildings Neighborhood Program
ARRA loan interest rate	*3.80%*	-	ACEEE 2014. Residential Energy Efficiency Financing: Insights and lessons learned from the Better Buildings Neighborhood Program
Emissions reductions from residential retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Electricity reductions from residential retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Natural gas reductions from residential retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Emissions reductions from commercial retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Electricity reductions from commercial retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Natural gas reductions from commercial retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Effective commercial tax rate	*22%*	-	US DT IRS 2016. Average Effective Federal Corporate Tax Rates
Useful life	*20 years*	-	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.16 Measure E-1.4: Reduce Energy Use Intensity at County Facilities

This section analyzed the benefits and costs of reducing energy use intensity at County facilities by 10% below 2014 levels by 2020 and assumes an incremental level of activity is achieved each year to achieve 20% below 2014 levels by 2030 and reach the 2030 GHG reduction target of 10,702 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 6,486 $MTCO_2e$ in 2020 and 7,751 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the Administrator and sole Participant in this measure. Administrator costs include County employee salary and benefits associated with implementing energy efficiency projects. Participant costs include the cost of energy efficiency audits and retrofits. Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B34. Summary Results for Measure E-1.4 in 2020

E-1.4 Reduce Energy Use Intensity at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$729,689	-	$729,689	$927,071
Present Value Costs	($12,753)	($207,442)	($2,463)	($222,658)	($222,658)
Net Present Value	($12,753)	$522,248	($2,463)	$507,031	$704,413
GHGs (MT CO_2e)	**6,486**				
$/MT CO_2e	($2)	$81	($0)	$78	$109
BCR	-	3.52	-	3.32	4.22
Discounted Payback Period	-	4.55	-	4.84	3.96
ROI	-	430%	-	406%	543%
IRR	-	25%	-	23%	31%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B35. Summary Results for Measure E-1.4 in 2023

E-1.4 Reduce Energy Use Intensity at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$849,338	-	$849,338	$1,079,548
Present Value Costs	($48,206)	($248,795)	($2,954)	($299,955)	($299,955)
Net Present Value	($48,206)	$600,543	($2,954)	$549,383	$779,592
GHGs (MT CO_2e)	**7,751**				
$/MT CO_2e	($6)	$77	($0)	$71	$101
BCR	-	3.41	-	2.98	3.79
Discounted Payback Period	-	4.56	-	5.39	4.37
ROI	-	410%	-	351%	474%
IRR	-	25%	-	20%	27%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-1.4 are documented in Table B36. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B36. Data Inputs and Assumptions for Measure E-1.4

E-1.4 Reduce Energy Use Intensity at County Facilities			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average energy audit cost ($/sq.ft)	*($0.33)*	P	PNNL 2011. A guide to energy audits
Energy efficiency retrofit cost ($/sq.ft)	*($23)*	P	Benson et al. 2011 Retrofitting Commercial Real Estate : Current Trends and Challenges in Increasing Building Energy Efficiency
Energy efficiency rebates and incentives ($/sq.ft)	*$1.22*	P, NP	US DOE 2013. Tax Deductions for Commercial Buildings
Benefits			
Electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Natural gas bill savings	*Varies by year*	P	SDG&E historical tariffs
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Electricity reductions from retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Natural gas reductions from retrofits	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*20 years*	-	DNV KEMA 2014. Impact Evaluation of the California Comprehensive Residential Retrofits Program

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.17 Measure E-2.1: Increase Renewable Electricity

This section analyzed the benefits and costs of achieving 90% renewable electricity for the unincorporated county by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 229,852 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 68,956 $MTCO_2e$ in 2023.

This measure is a County initiative to increase renewable electricity in unincorporated county. The County is the Administrator and costs include County employee salary and benefits and consultant costs related to program research and development. Participants are considered any electric utility customer. SDG&E's existing EcoChoice program was used as a proxy to identify potential costs for Participants. There are no benefits to Participants and no Non-Participant costs. Externalities include the social cost of carbon.

Table B37. Summary Results for Measure E-2.1 in 2023

E-2.1 Increase Renewable Electricity					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	-	-	-	$2,330,618
Present Value Costs	($615,329)	($2,358,068)	-	($2,973,397)	($2,973,397)
Net Present Value	($615,329)	($2,358,068)	-	($2,973,397)	($642,779)
GHGs (MT CO_2e)	**68,956**				
$/MT CO_2e	($9)	($34)	-	($43)	($9)
BCR	-	-	-	-	0.78
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-20%
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-2.1 are documented in Table B38. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B38. Data Inputs and Assumptions for Measure E-2.1

E-2.1 Increase Renewable Electricity			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Premium on electricity rates for higher renewable energy content	*Varies by year*	P	SDG&E Schedule GT; SDG&E 2017. EcoChoice Forecast
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from increased renewables	*Varies by year*	-	County of San Diego CAP Appendix C
Electricity consumption (MWh)	*Varies by year*	-	County of San Diego CAP Appendix C
Percent of electricity as residential consumption	*59%*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Percent of electricity as commercial consumption	*41%*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Useful life	*NA*	-	

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.18 Measure E-2.2: Increase Renewable Electricity in Non-Residential Development

This section analyzed the benefits and costs of requiring the installation of renewable electricity systems on new non-residential development by 2020 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 13,444 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 4,033 $MTCO_2e$ in 2023.

This measure is a new requirement for new non-residential development. The County is the Administrator for this measure. Administrator costs include consultant costs and County employee salary and benefits associated with permit checks and amending the Title 9 of the County Construction Code. Business owners or developers are the Participants and costs are related to the installation and maintenance of a renewable electricity system. This analysis assumes all systems are for solar PV. Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates and tax credits, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B39. Summary Results for Measure E-2.2 in 2023

E-2.2 Increase Renewable Electricity in Non-residential Development					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	$1,245,227	-	$1,245,227	$1,343,407
Present Value Costs	($27,861)	($986,710)	($375,636)	($1,390,206)	($1,390,206)
Net Present Value	($27,861)	$258,517	($375,636)	($144,979)	($46,799)
GHGs (MT CO_2e)	**4,033**				
$/MT CO_2e	($7)	$64	($93)	($36)	($12)
BCR	-	1.26	-	0.90	0.97
Discounted Payback Period	-	14.15	-	-	-
ROI	-	54%	-	28%	38%
IRR	-	4%	-	-1%	0%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-2.2 are documented in Table B39. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B40. Data Inputs and Assumptions for Measure E-2.2

E-2.2 Increase Renewable Electricity in Non-Residential Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Purchase and installation cost per system ($/kW)	*Varies by year*	P	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Annual operations and maintenance ($/kW)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance
Inverter replacement cost ($/W; every 10 years)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance; NREL 2017. U.S. Solar Photovoltaic System Cost Benchmark
Average rebate per system ($/kW)	*Varies by year*	P, NP	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Federal Solar Investment Tax Credit (ITC)	*Varies by year*	P, NP	SEIA. 2016. The Solar Investment Tax Credit (ITC). Solar Energy Industries Association
Tax Deductions (MACRS, bonus depreciation)	*Varies by year*	P, NP	SEIA 2017. 5 year cost recovery period for solar energy property; USDT IRS 2017a. Business Expenses; USDT IRS 2017b. Instructions for Form 1120 U.S. Corporation Income Tax Return
Commercial lost utility deductions	*Varies by year*	P	USDT IRS 2017a. Business Expenses
Benefits			
Commercial electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Solar capacity installed (kW)	*Varies by year*	-	County of San Diego CAP Appendix C
Annual kWh generated per kW	*1,665*	-	County of San Diego CAP Appendix C
Emissions reductions from solar PV installs	*Varies by year*	-	County of San Diego CAP Appendix C
Effective commercial tax rate	*22%*	-	US DT IRS 2016. Average Effective Federal Corporate Tax Rates
Useful life	*25 years*	-	Kneifel et al. 2016. Energy and Economic Implications of Solar Photovoltaic Performance Degradation

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.19 Measure E-2.3: Install Solar Photovoltaics in Existing Homes

This section analyzed the benefits and costs of increasing installations of photovoltaic electrical systems in 52,273 existing homes by 2020 and assumes an incremental level of activity is achieved each year to achieve an additional 77,902 homes by 2030 and reach the 2030 GHG reduction target of 260,322 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 114,571 $MTCO_2e$ in 2020 and 158,296 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the Administrator and homeowners are the Participant for this measure. Administrator costs include County employee salary and benefits, consultant costs, and capital associated with education and outreach. Participant costs include the cost of installing and maintaining a solar PV system. Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates and tax credits, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B41. Summary Results for Measure E-2.3 in 2020

E-2.3 Install Solar Photovoltaics in Existing Homes					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$53,554,601	-	$53,554,601	$56,801,613
Present Value Costs	($53,917)	($32,110,073)	($16,912,707)	($49,076,697)	($49,076,697)
Net Present Value	($53,917)	$21,444,529	($16,912,707)	$4,477,904	$7,724,915
GHGs (MT CO_2e)	**114,571**				
$/MT CO_2e	($0)	$187	($148)	$39	$67
BCR	-	1.69	-	1.10	1.16
Discounted Payback Period	-	11.63	-	16.96	19.49
ROI	-	111%	-	79%	90%
IRR	-	7%	-	1%	2%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B42. Summary Results for Measure E-2.3 in 2023

E-2.3 Install Solar Photovoltaics in Existing Homes					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$71,125,480	-	$71,125,480	$75,406,445
Present Value Costs	($222,375)	($44,073,704)	($19,727,236)	($64,023,315)	($64,023,315)
Net Present Value	($222,375)	$27,051,776	($19,727,236)	$7,102,165	$11,383,130
GHGs (MT CO_2e)	**158,296**				
$/MT CO_2e	($1)	$171	($125)	$45	$72
BCR	-	1.63	-	1.12	1.19
Discounted Payback Period	-	12.17	-	17.60	18.89
ROI	-	111%	-	82%	93%
IRR	-	6%	-	1%	2%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-2.3 are documented in Table B43. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the

Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B43. Data Inputs and Assumptions for Measure E-2.3

E-2.3 Install Solar Photovoltaics in Existing Homes			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Purchase and installation cost per system ($/kW)	*Varies by year*	P	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Annual operations and maintenance ($/kW)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance
Inverter replacement cost ($/W; every 10 years)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance; NREL 2017. U.S. Solar Photovoltaic System Cost Benchmark
Average rebate per system ($/kW)	*Varies by year*	P, NP	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Federal Solar Investment Tax Credit (ITC)	*Varies by year*	P, NP	SEIA. 2016. The Solar Investment Tax Credit (ITC). Solar Energy Industries Association
Benefits			
Residential electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Solar capacity installed (kW)	*Varies by year*	-	County of San Diego CAP Appendix C
Annual kWh generated per kW	*1,665*	-	County of San Diego CAP Appendix C
Average system size per residence (kW)	*5.06*	-	County of San Diego CAP Appendix C
Emissions reductions from solar PV installs	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*25 years*	-	Kneifel et al. 2016. Energy and Economic Implications of Solar Photovoltaic Performance Degradation

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.20 Measure E-2.4: Increase On-Site Renewable Electricity Generation for County Operations

This section analyzed the benefits and costs of generating 10% of the County's operational electricity on-site with renewables by 2020 and assumes an incremental level of activity is achieved each year to achieve 20% by 2030 and reach the 2030 GHG reduction target of 5,417 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 4,083 $MTCO_2e$ in 2020 and 4,483 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the Administrator and sole Participant in this measure. Administrator costs include County employee salary and benefits to manage and implement installations. Participant costs include the cost of solar PV installations. Participant benefits include energy bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Externalities include the social cost of carbon.

Table B44. Summary Results for Measure E-2.4 in 2020

E-2.4 Increase On-Site Renewable Electricity Generation for County Operations					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$1,232,429	-	$1,232,429	$1,349,279
Present Value Costs	($19,788)	($640,179)	($532,234)	($1,192,201)	($1,192,201)
Net Present Value	($19,788)	$592,250	($532,234)	$40,228	$157,078
GHGs (MT CO_2e)	**4,083**				
$/MT CO_2e	($5)	$145	($130)	$10	$38
BCR	-	2.04	-	1.14	1.25
Discounted Payback Period	-	11.25	-	7.29	15.94
ROI	-	138%	-	94%	111%
IRR	-	7%	-	1%	2%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B45. Summary Results for Measure E-2.4 in 2023

E-2.4 Increase On-Site Renewable Electricity Generation for County Operations					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$1,411,934	-	$1,411,934	$1,535,210
Present Value Costs	($21,438)	($750,961)	($556,464)	($1,328,863)	($1,328,863)
Net Present Value	($21,438)	$660,973	($556,464)	$83,071	$206,347
GHGs (MT CO_2e)	**4,483**				
$/MT CO_2e	($5)	$147	($124)	$19	$46
BCR	-	1.97	-	1.14	1.24
Discounted Payback Period	-	10.74	-	10.84	16.38
ROI	-	132%	-	90%	106%
IRR	-	7%	-	1%	2%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure E-2.4 are documented in Table B46. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the

Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B46. Data Inputs and Assumptions for Measure E-2.4

E-2.4 Increase On-Site Renewable Electricity Generation for County Operations			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Purchase and installation cost per system ($/kW)	*Varies by year*	P	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Annual operations and maintenance ($/kW)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance
Inverter replacement cost ($/W; every 10 years)	*Varies by year*	P	NREL 2015. Best Practices in PV System Operations and Maintenance; NREL 2017. U.S. Solar Photovoltaic System Cost Benchmark
Average rebate per system ($/kW)	*Varies by year*	P, NP	Millstein et al. 2016. Tracking the Sun IX - The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States
Federal Solar Investment Tax Credit (ITC)	*Varies by year*	P, NP	SEIA. 2016. The Solar Investment Tax Credit (ITC). Solar Energy Industries Association
Tax Deductions (MACRS, bonus depreciation)	*Varies by year*	P, NP	SEIA 2017. 5 year cost recovery period for solar energy property; USDT IRS 2017a. Business Expenses; USDT IRS 2017b. 2017b. Instructions for Form 1120 U.S. Corporation Income Tax Return
Benefits			
Electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Solar capacity installed (kW)	*Varies by year*	-	County of San Diego CAP Appendix C
Annual kWh generated per kW	*1,665*	-	County of San Diego CAP Appendix C
Emissions reductions from solar PV installs	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*25 years*	-	Kneifel et al. 2016. Energy and Economic Implications of Solar Photovoltaic Performance Degradation
*All dollar values are in 2015$			Energy Policy Initiatives Center, USD 2017

B.21 Measure SW-1.1: Increase Solid Waste Diversion

This section analyzed the benefits and costs of achieving 75% solid waste diversion in the unincorporated county by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 57,103 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 30,656 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and corresponds with the County's Strategic Plan to Reduce Waste. The County is the Administrator, and costs include County employee salary and benefits related to various solid waste diversion programs. Participants are waste haulers and costs include cost of waste diversion and processing. Participant benefits include any sales associated with the processed material. There are no Non-Participant costs. Externalities include the social cost of carbon.

Table B47. Summary Results for Measure SW-1.1 in 2023

SW-1.1 Increase Solid Waste Diversion					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$5,120,638	-	$5,120,638	$6,026,653
Present Value Costs	($34,792)	($8,114,910)	-	($8,149,702)	($8,149,702)
Net Present Value	($34,792)	($2,994,272)	-	($3,029,064)	($2,123,049)
GHGs (MT CO_2e)	**30,656**				
$/MT CO_2e	($1)	($98)	-	($99)	($69)
BCR	-	0.63	-	0.63	0.74
Discounted Payback Period	-	-	-	-	-
ROI	-	-37%	-	-37%	-25%
IRR	-	-	-	-	-

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure SW-1.1 are documented in Table B48. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B48. Data Inputs and Assumptions for Measure SW-1.1

SW-1.1 Increase Solid Waste Diversion			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Cost of diverted waste collection ($/ton)	*($141)*		EPA 2008.
Cost of processing diverted waste ($/ton)	*($46)*		Kessler Consulting 2009. Pinellas County Florida: MRFing Our Way to Diversion: Capturing the Commercial Waste Stream. Materials Recovery Feasibility Study
Benefits			
Reduced disposal costs ($/ton)	*$38*		Repa 2005. NSWMA's 2005 Tip Fee Survey
Revenue form sale of processed waste material ($/ton)	*$80*		ACRC. Keeping Recycling Cool
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Current diversion rate	*62%*		County of San Diego CAP
Tons of waste generated	*Varies by year*		County of San Diego CAP Appendix C
Tons of waste diverted	*Varies by year*		County of San Diego CAP Appendix C
Emissions reductions from solid waste diversion	*Varies by year*		County of San Diego CAP Appendix C
Useful life	*NA*		*assumes reductions are accounted for same year as activity

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.22 Measure W-1.1: Increase Water Efficiency in New Residential Development

This section analyzed the benefits and costs of requiring the installation of water-efficient appliances and plumbing fixtures in all new residential construction by 2020 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 87 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 25 $MTCO_2e$ in 2023.

This measure is a new requirement for all new residential development and accelerates adoption of CalGreen Tier 1 requirements. The County is the Administrator and costs include County employee salary and benefits. Participants are home owners or developers building a new home that are required to comply. Participant costs include the incremental cost of building a home to comply with CalGreen Tier 1 standards. Participant benefits include water bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Additionally, the water utility will experience reduced costs associated with treatment and distribution of water due to the lower demand. Externalities include the social cost of carbon.

Table B49. Summary Results for Measure W-1.1 in 2023

W-1.1 Increase Water Efficiency in New Residential Development					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$21,250.00	-	$21,250	$22,000
Present Value Costs	($14,003)	($5,304)	($1,377)	($20,684)	($20,684)
Net Present Value	($14,003)	($15,882)	($1,377)	$566	$1,316
GHGs (MT CO_2e)	**25**				
$/MT CO_2e	($562)	$638	($55)	$20	$50
BCR	-	4.00	-	1.03	1.07
Discounted Payback Period	-	3.81	-	9.24	8.80
ROI	-	372%	-	46%	51%
IRR	-	32%	-	0%	1%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure W-1.1 are documented in Table B50. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B50. Data Inputs and Assumptions for Measure W-1.1

W-1.1 Increase Water Efficiency in New Residential Development			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Incremental cost of water efficient fixtures	*($518)*	P	Pacific Institute 2016. The Cost of Alternative Water Supply and Efficiency Options in California - Appendix B; online research of available products
Clothes washer rebate	*$107*	P, NP	SoCal WaterSmart 2017. Rebate schedule
Benefits			
Residential water bill savings	*Varies by year*	P	Weighted average of water rates and forecasts for water utilities in unincorporated county
Residential electricity bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Water utility electric bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from water conservation	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of water saved	*Varies by year*	-	County of San Diego CAP Appendix C
Number of new homes	*Varies by year*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Water fixtures included in analysis	*Kitchen faucet, clothes washer, dishwasher*	-	County of San Diego CAP Appendix C
Gallons of water saved per fixture	*Varies by fixture*	-	County of San Diego CAP Appendix C
Electricity reduction (appliance operation)	*Varies by year*		County of San Diego CAP Appendix C
Electricity reduction (treatment and distribution)	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*14 years*	-	Pacific Institute 2016. The Cost of Alternative Water Supply and Efficiency Options in California - Appendix B

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.23 Measure W-1.2: Reduce Outdoor Water Use

This section analyzed the benefits and costs of requiring a 40% reduction from 2014 outdoor water use budgets for landscaping in new and existing residential development by 2020 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 17,535 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 5,261 $MTCO_2e$ in 2023.

This measure is a new requirement for existing and new residential and commercial landscapes. The County is the Administrator and costs include consultant costs and County employee salary and benefits for program development and implementation. Participants are home and business owners. Participant costs include the cost of transitioning to a water efficient landscape. Participant benefits include water bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Additionally, the water utility will experience reduced costs associated with treatment and distribution of water due to the lower demand. Externalities include the social cost of carbon.

Table B51. Summary Results for Measure W-1.2 in 2023

W-1.2 Reduce Outdoor Water Use					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$231,455	-	$231,455	$376,120
Present Value Costs	($15,905)	($7,979)	($9,144)	($33,028)	($33,028)
Net Present Value	($15,905)	$223,475	($9,144)	$198,426	$343,092
GHGs ($MT CO_2e$)	**5,261**				
$/MT CO_2e	($3)	$42	($2)	$38	$65
BCR	-	29.77	-	7.10	11.54
Discounted Payback Period	-	1.37	-	3.25	2.66
ROI	-	1901%	-	927%	1581%
IRR	-	269%	-	58%	92%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure W-1.2 are documented in Table B52. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B52. Data Inputs and Assumptions for Measure W-1.2

W-1.2 Reduce Outdoor Water Use			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Existing construction landscaping cost ($/sq.ft)	*($2.82)*	P	EBUMD (n.d.) WaterSmart Guidebook
New construction landscaping cost ($/sq.ft)	*($1.09)*	P	EBUMD (n.d.) WaterSmart Guidebook
Residential rebate ($/sq.ft); existing development only	*$1.70*	P, NP	SDCWA Turf Replacement Program
Commercial rebate ($/sq.ft); existing development only	*$0.97*	P, NP	SDCWA Turf Replacement Program
Commercial lost utility deductions	*Varies by year*	P	USDT IRS 2017a. Business Expenses
Benefits			
Residential water bill savings	*Varies by year*	P	Weighted average of water rates and forecasts for water utilities in unincorporated county
Commercial water bill savings	*Varies by year*	P	Weighted average of water rates and forecasts for water utilities in unincorporated county
Water utility electric bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from outdoor water conservation	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of water saved annually	*Varies by year*	-	County of San Diego CAP Appendix C
Water savings for landscaping (gal/sq.ft)	*17*	-	EBUMD (n.d.) WaterSmart Guidebook
Percent of water reductions from residential landscaping	*92%*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Percent of water reductions form commercial landscaping	*8%*	-	SANDAG 2013. Series 13 Regional Growth Forecast; County of San Diego CAP Appendix C
Electricity reduction (treatment and distribution)	*Varies by year*	-	County of San Diego CAP Appendix C
Effective commercial tax rate	*22%*	-	US DT IRS 2016. Average Effective Federal Corporate Tax Rates
Useful life	*15 years*	-	Gross 2015. When is the right time to replace an irrigation system

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.24 Measure W-1.3: Reduce Potable Water Consumption at County Facilities

This section analyzed the benefits and costs of reducing potable water consumption at County facilities 15% below 2014 levels by 2020 and assumes an incremental level of activity is achieved each year to achieve 20% below 2014 levels by 2030 and reach the 2030 GHG reduction target of 276 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 244 $MTCO_2e$ in 2020 and 254 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, contributes towards CAP goals, and corresponds with the County's Strategic Energy Plan (SEP). The County is the Administrator and sole Participant in this measure. Administrator costs include County employee salary and benefits to implement water measures and consultant costs. Participant costs include the cost of installations. Participant benefits include water bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Additionally, the water utility will experience reduced costs associated with treatment and distribution of water due to the lower demand. Externalities include the social cost of carbon.

Table B53. Summary Results for Measure W-1.3 in 2020

W-1.3 Reduce Potable Water Consumption at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$7,954	-	$7,954	$15,634
Present Value Costs	($62,870)	($2,077)	($150)	($65,098)	($65,098)
Net Present Value	($62,870)	$5,877	($150)	($57,144)	($49,464)
GHGs (MT CO_2e)	**244**				
$/MT CO_2e	($258)	$24	($1)	($234)	($203)
BCR	-	3.83	-	2.18	4.26
Discounted Payback Period	-	3.84	-	2.43	1.54
ROI	-	418%	-	212%	513%
IRR	-	31%	-	6%	27%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B54. Summary Results for Measure W-1.3 in 2023

W-1.3 Reduce Potable Water Consumption at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$8,116	-	$8,116	$15,991
Present Value Costs	($58,015)	($2,128)	($154)	($60,298)	($60,298)
Net Present Value	($58,015)	$5,987	($154)	($52,182)	($44,307)
GHGs (MT CO_2e)	**254**				
$/MT CO_2e	($229)	$24	($1)	($206)	($175)
BCR	-	3.81	-	2.32	4.56
Discounted Payback Period	-	3.85	-	2.63	1.65
ROI	-	416%	-	232%	556%
IRR	-	31%	-	9%	31%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure W-1.3 are documented in Table B55. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B55. Data Inputs and Assumptions for Measure W-1.3

W-1.3 Reduce Potable Water Consumption at County Facilities			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Water audit cost ($/facility)	*($4,657)*	P	Discussion with County staff
Water retrofit cost ($/sq.ft)	*($3.02)*	P	Discussion with County staff
Landscaping cost ($/sq.ft)	*($8.03)*	P	Discussion with County staff
Rebate ($/sq.ft)	*$0.97*	P, NP	SDCWA Turf Replacement Program
Benefits			
Municipal water bill savings	*Varies by year*	P	Weighted average of water rates and forecasts for water utilities in unincorporated county
Water utility electric bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Emissions reductions from water conservation	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of water saved annually	*Varies by year*	-	County of San Diego CAP Appendix C
Water savings for retrofits (gal/sq.ft)	*8*	-	DeOreo et al. (n.d.) Commercial and Institutional End Uses of Water
Water savings for landscaping (gal/sq.ft)	*17*	-	EBUMD (n.d.) WaterSmart Guidebook
Electricity reduction (treatment and distribution)	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*15 years*	-	Gross 2015. When is the right time to replace an irrigation system

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.25 Measure W-2.1: Increase Rain Barrel Installations

This section analyzed the benefits and costs of installing 1,200 rain barrels by 2020 and assumes an incremental level of activity is achieved each year to achieve an additional 2,000 installations by 2030 and reach the 2030 GHG reduction target of 23 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 10 $MTCO_2e$ in 2020 and 14 $MTCO_2e$ in 2023.

This measure is an existing and funded program, currently operational, and contributes towards CAP goals. The County is the Administrator and costs include County employee salary and benefits and consultant costs for contract management and sales events. Participants include homeowners and costs include the cost of a rain barrel. Participant benefits include water bill reductions. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. Additionally, the water utility will experience reduced costs associated with treatment and distribution of water due to the lower demand. Externalities include the social cost of carbon.

Table B56. Summary Results for Measure W-2.1 in 2020

W-2.1 Increase Rain Barrel Installations					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$18,455	-	$18,455	$18,748
Present Value Costs	($92)	($2,714)	($2,055)	($4,860)	($4,860)
Net Present Value	($92)	$15,742	($2,055)	$13,595	$13,888
GHGs (MT CO_2e)	**10**				
$/MT CO_2e	($9)	$1,574	($205)	$1,360	$1,389
BCR	-	6.81	-	3.80	3.86
Discounted Payback Period	-	3.11	-	4.84	4.78
ROI	-	568%	-	512%	522%
IRR	-	45%	-	23%	24%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B57. Summary Results for Measure W-2.1 in 2023

W-2.1 Increase Rain Barrel Installations					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$24,444	-	$24,444	$24,834
Present Value Costs	($200)	($3,578)	($2,709)	($6,487)	($6,487)
Net Present Value	($200)	$20,866	($2,709)	$17,957	$18,347
GHGs (MT CO_2e)	**14**				
$/MT CO_2e	($14)	$1,501	($195)	$1,292	$1,320
BCR	-	6.84	-	3.77	3.83
Discounted Payback Period	-	3.06	-	4.82	4.76
ROI	-	570%	-	506%	516%
IRR	-	46%	-	23%	24%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure W-2.1 are documented in Table B58. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the

Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B58. Data Inputs and Assumptions for Measure W-2.1

W-2.1 Increase Rain Barrel Installations			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Rain barrel purchase ($/barrel)	*($79)*	P	NASEM 2016. Using Graywater and Stormwater to Enhance Local Water Supplies: An Assessment of Risks, Costs,
SoCal WaterSmart rebate ($/barrel)	*$34*	P, NP	SoCal WaterSmart 2017. Rebate schedule
Benefits			
Residential water bill savings	*Varies by year*	P	Weighted average of water rates and forecasts for water utilities in unincorporated
Water utility energy bill savings	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact
Other inputs and assumptions			
Number of rain barrels installed annually	*Varies by year*	-	County of San Diego CAP Appendix C
Emissions reductions from rain barrels	*Varies by year*	-	County of San Diego CAP Appendix C
Gallons of water saved (gal/barrel/yr)	*3,157*	-	County of San Diego CAP Appendix C
Electricity reduction (treatment and distribution)	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*20 years*	-	NASEM 2016. Using Graywater and Stormwater to Enhance Local Water Supplies: An Assessment of Risks, Costs,

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.26 Measure A-1.1: Convert Farm Equipment to Electric

This section analyzed the benefits and costs of converting 8% of farm equipment from gas- and petroleum-diesel-powered to electric by 2030 and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 6,737 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 2,021 $MTCO_2e$ in 2023.

This measure is an incentive. The County is the Administrator and costs include County employee salary and benefits for administering the Carl Moyer incentive program and for research, program development, and outreach. Participants include individuals who apply for an incentive to convert their farm equipment from diesel to an electric alternative. The Participant cost is the incremental cost of an electric tractor over a diesel tractor. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. It is assumed that Participants can leverage the Carl Moyer program and receive up to 85% of the purchase price. Externalities include the social cost of carbon.

Table B59. Summary Results for Measure A-1.1 in 2023

A-1.1 Convert Farm Equipment to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$435,593	-	$435,593	$508,234
Present Value Costs	($11,035)	($517,776)	($162,440)	($691,251)	($691,251)
Net Present Value	($11,035)	($82,184)	($162,440)	($255,659)	($183,018)
GHGs (MT CO_2e)	**2,021**				
$/MT CO_2e	($5)	($41)	($80)	($126)	($91)
BCR	-	0.84	-	0.63	0.74
Discounted Payback Period	-	-	-	-	-
ROI	-	-11%	-	-33%	-21%
IRR	-	-	-	-	-16%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure A-1.1 are documented in Table B60. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B6o. Data Inputs and Assumptions for Measure A-1.1

A-1.1 Convert Farm Equipment to Electric			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Incremental cost of electric tractor over diesel	*($68,083)*	P	Discussion with County staff
Grant (Carl Moyer Program)	*$11,866*	P, NP	SDAPCD 2017. Grants for Clean Air Carl Moyer Notice of Funding Availability
Electricity bill increase (equipment operation)	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Value of avoided diesel purchases (based on grade price forecast)	*Diesel grade No.2*	P	US EIA 2017a. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017b. Petroleum and Other Liquids Prices
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Number of tractors converted to electric annually	*16*	-	County of San Diego CAP Appendix C
Annual diesel consumption (gal/tractor)	*4220*	-	Discussion with County staff
Annual electricity consumption (kWh/tractor)	*79420*	-	County of San Diego CAP Appendix C (see T-3.1 calculations)
Emissions avoided from equipment conversion	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*14 years*	-	US OMB 1999. Circular No A-76

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.27 Measure A-1.2: Convert Stationary Irrigation Pumps to Electric

This section analyzed the benefits and costs of converting four petroleum-diesel- or gas-powered stationary irrigation pumps to electric by 2020 and assumes an incremental level of activity is achieved each year to achieve an additional 40 conversions by 2030 and reach the 2030 GHG reduction target of 3,249 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 295 $MTCO_2e$ in 2020 and 1,181 $MTCO_2e$ in 2023.

This measure is an incentive. The County is the Administrator and costs include County employee salary and benefits for administering the Carl Moyer incentive program and for research, program development, and outreach. Participants include individuals who apply for an incentive to convert their stationary irrigation equipment from diesel to electric. The Participant cost is the incremental cost of an electric pump over a diesel pump. Participants also receive cost reductions in the form of rebates, which are costs to the Non-Participant. It is assumed that Participants can leverage the Carl Moyer program and receive up to 85% of the purchase price. Externalities include the social cost of carbon.

Table B61. Summary Results for Measure A-1.2 in 2020

A-1.2 Convert Stationary Irrigation Pumps to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$214	-	$214	$8,251
Present Value Costs	($2,112)	($395)	($1,952)	($4,459)	($4,459)
Net Present Value	($2,112)	($181)	($1,952)	($4,246)	$3,792
GHGs (MT CO_2e)	**295**				
$/MT CO_2e	($7)	($1)	($7)	($14)	$13
BCR	-	0.54	-	0.05	1.85
Discounted Payback Period	-	-	-	-	11.19
ROI	-	-3%	-	-92%	204%
IRR	-	-7%	-	-	8%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B62. Summary Results for Measure A-1.2 in 2023

A-1.2 Convert Stationary Irrigation Pumps to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	$817	-	$817	$31,470
Present Value Costs	($7,807)	($1,470)	($7,269)	($16,547)	($16,547)
Net Present Value	($7,807)	($654)	($7,269)	($15,730)	$14,922
GHGs (MT CO_2e)	**1,181**				
$/MT CO_2e	($7)	($1)	($6)	($13)	$13
BCR	-	0.56	-	0.05	1.94
Discounted Payback Period	-	-	-	-	10.13
ROI	-	-3%	-	-92%	217%
IRR	-	-6%	-	-	8%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure A-1.2 are documented in Table B63. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the

Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B63. Data Inputs and Assumptions for Measure A-1.2

A-1.2 Convert Stationary Irrigation Pumps to Electric			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Purchase of new electric irrigation pump	*($13,960)*	P	US EPA 2005. Economic impact analysis of the standards of performance for stationary compression ignition internal combustion engines
Grant (Carl Moyer Program)	*$11,866*	P, NP	SDAPCD 2017. Grants for Clean Air Carl Moyer Notice of Funding Availability
Electricity bill increase (pump operation)	*Mid-demand case*	P	CEC 2016. California Energy Demand Updated Forecast, 2017-2027
Benefits			
Value of avoided diesel purchases (based on grade price forecast)	*Diesel grade No.2*	P	US EIA 2017a. Los Angeles Gasoline and Diesel Retail Prices; US EIA 2017b. Petroleum and Other Liquids Prices
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Other inputs and assumptions			
Number of stationary irrigation pumps converted to electric	*4 per year*	-	County of San Diego CAP Appendix C
Annual diesel consumption (gal/pump)	*32*	-	County of San Diego CAP Appendix C
Annual electricity consumption (kWh/pump)	*127*	-	County of San Diego CAP Appendix C
Emissions avoided from pump conversion	*Varies by year*	-	County of San Diego CAP Appendix C
Useful life	*20 years*	-	CARB 2006. Appendix D: Emission Inventory Methodology Agricultural Irrigation Pumps - Diesel

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

B.28 Measure A-2.1: Increase Residential Tree Planting

This section analyzed the benefits and costs of requiring two trees to be planted with each new residential dwelling unit constructed and assumes an incremental level of activity is achieved each year to reach the 2030 GHG reduction target of 1,244 $MTCO_2e$. Actions taken to achieve this target are estimated to offset 373 $MTCO_2e$ in 2023.

This measure is a new requirement for new residential development and requires two new trees be planted per residential unit. The County is the Administrator and costs include County employee salary and benefits and consultant costs for ordinance development and implementation. Participants include home owners or developers building a new home. Participant costs include the cost to purchase and plant trees, maintenance costs (pruning), and watering costs. There are Participant benefits or Non-Participant costs. Externalities include the social cost of carbon, the value of reduced criteria pollutants associated with trees, and reduced storm water treatment.

Table B64. Summary Results for Measure A-2.1 in 2023

A-2.1 Increase Residential Tree Planting					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
Present Value Benefits	-	-	-	-	$45,256
Present Value Costs	($2,899)	($151,589)	-	($154,488)	($154,488)
Net Present Value	($2,899)	($151,589)	-	($154,488)	($109,232)
GHGs (MT CO_2e)	**373**				
$/MT CO_2e	($8)	($406)	-	($414)	($293)
BCR	-	-	-	-	0.29
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-49%
IRR	-	-	-	-	-11%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure A-2.1 are documented in Table B65. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B65. Data Inputs and Assumptions for Measure A-2.1

A-2.1 Increase Residential Tree Planting			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average purchase and planting cost ($/tree)	*Varies by size*	P	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Average annual maintenance cost ($/tree)	*Varies by year*	P	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Water bill increase ($/tree)	*Varies by year*	P	*An average water rate is applied using current water rate schedules and rate increases for all water utilities serving unincorporated San Diego County
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	McPherson et al. 2006 Coastal Plain Community Tree Guide
Rain interception benefits per gallon	*$0.01*	S	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Other inputs and assumptions			
Number of trees planted	*Varies by year*	-	County of San Diego CAP Appendix C
GHGs sequestered annually per tree	*0.0354*	-	County of San Diego CAP Appendix C
Annual water demand (gal/tree)	*Varies by year*	-	City of San Diego 2015. Draft Urban Forestry Management Plan
Useful life	*30 years*	-	USDA Forest Service 2008. CUFR Tree Carbon Calculator

*All dollar values are in 2015$

Energy Policy Initiatives Center, USD 2017

B.29 Measure A-2.2: Increase County Tree Planting

This section analyzed the benefits and costs of planting 3,500 trees annually starting in 2017. Actions taken to achieve this target are estimated to offset 496 $MTCO_2e$ in 2020 and 867 $MTCO_2e$ in 2023.

This measure is a County initiative that expands upon current efforts. The County is the Administrator and sole Participant. Administrator costs include consultant costs and County employee salary and benefits associated with monitoring, program development, and a tree canopy assessment. County Participant costs include the capital associated with purchasing, planting, and maintaining trees. Additional Participant costs include repairs to infrastructure from tree-related damage and potential liability issues associated with trees (e.g. falling branches). There are Participant benefits or Non-Participant costs. Externalities include the social cost of carbon, the value of reduced criteria pollutants associated with trees, and reduced storm water treatment.

Table B66. Summary Results for Measure A-2.2 in 2020

A-2.2 Increase County Tree Planting					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	-	-	-	$70,661
Present Value Costs	($19,029)	($226,697)	-	($245,725)	($245,725)
Net Present Value	($19,029)	($226,697)	-	($245,725)	($175,065)
GHGs (MT CO_2e)	**496**				
$/MT CO_2e	($38)	($457)	-	($496)	($353)
BCR	-	-	-	-	0.29
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-50%
IRR	-	-	-	-	-12%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table B67. Summary Results for Measure A-2.2 in 2023

A-2.2 Increase County Tree Planting					
	Administrator	Participant	Non-Participant	Measure	Society
Present Value Benefits	-	-	-	-	$115,729
Present Value Costs	($43,581)	($370,009)	-	($413,590)	($413,590)
Net Present Value	($43,581)	($370,009)	-	($413,590)	($297,861)
GHGs (MT CO_2e)	**867**				
$/MT CO_2e	($50)	($427)	-	($477)	($343)
BCR	-	-	-	-	0.28
Discounted Payback Period	-	-	-	-	-
ROI	-	-	-	-	-51%
IRR	-	-	-	-	-12%

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

General data inputs and assumptions for Measure A-2.2 are documented in Table B68. Any applicable rebates, incentives, and tax credits are considered cost reductions for the Participant and costs for the Non-Participant. Emissions reductions were estimated according to calculations in the County of San Diego draft Final Climate Action Plan Appendix C.

Table B68. Data Inputs and Assumptions for Measure A-2.2

A-2.2 Increase County Tree Planting			
Description	**Input**	**Perspective**	**Source**
Costs			
CAP implementation costs	*Varies by year*	A	Provided by County staff (see CAP Implementation Cost Report)
Average purchase and planting cost ($/tree)	*($58)*	P	Provided by County staff
Average annual maintenance cost ($/tree)	*Varies by year*	P	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Water bill increase ($/tree)	*Varies by year*	P	*An average water rate is applied using current water rate schedules and rate increases for all water utilities serving unincorporated San Diego County
Average annual infrastructure damage cost ($/tree)	*Varies by age*	P	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Average annual liability and legal cost ($/tree)	*Varies by age*	P	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Benefits			
NA			
Externalities included			
Social cost of carbon	*3% discount rate scenario*	S	US EPA 2016. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis
Value of avoided criteria pollutants	**See Criteria Pollutants table*	S	McPherson et al. 2006 Coastal Plain Community Tree Guide
Rain interception benefits per gallon	*$0.01*	S	McPherson et al. 2000. Tree Guidelines for Coastal Southern California Communities
Other inputs and assumptions			
Number of trees planted annually	*3,500*	-	County of San Diego CAP
GHGs sequestered annually per tree	*0.0354*	-	County of San Diego CAP Appendix C
Annual water demand (gal/tree)	*Varies by year*	-	City of San Diego 2015. Draft Urban Forestry Management Plan
Useful life	*30 years*	-	USDA Forest Service 2008 CUFR Tree Carbon Calculator

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Appendix C. SENSITIVITY ANALYSIS RESULTS

A sensitivity analysis was conducted to understand how the dollar per metric ton of carbon dioxide equivalent $/MTCO$_2$e) responds to changes in a key input – the Discount Rate. Individual measure results shown here are for 2020 and 2023 using a three, five, and seven percent Discount Rate. Results for 2020 are only shown for those measures with 2020 GHG reductions.

C.1 Measure T-1.1: Acquire Open Space Conservation Land

Table C1 displays sensitivity analysis results for Measure T-1.1 in 2020 and Table C2 displays sensitivity analysis results for 2023.

Table C1. Sensitivity Analysis for Measure T-1.1 in 2020 $/MTCO$_2$e)

T-1.1 Acquire Open Space Conservation Land					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($98)	($607)	-	($705)	($670)
5%	($91)	($558)	-	($649)	($621)
7%	($84)	($519)	-	($603)	($581)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C2. Sensitivity Analysis for Measure T-1.1 in 2023 $/MTCO$_2$e)

T-1.1 Acquire Open Space Conservation Land					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($145)	($597)	-	($743)	($708)
5%	($130)	($534)	-	($665)	($639)
7%	($117)	($484)	-	($601)	($581)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.2 Measure T-1.2: Acquire Agricultural Easements

Table C3 displays sensitivity analysis results for Measure T-1.2 in 2020 and Table C4 displays sensitivity analysis results for 2023.

Table C3. Sensitivity Analysis for Measure T-1.2 in 2020 $/MTCO$_2$e)

T-1.2 Acquire Agricultural Easements					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($48)	($49)	-	($97)	($63)
5%	($44)	($44)	-	($88)	($63)
7%	($40)	($40)	-	($81)	($62)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C4. Sensitivity Analysis for Measure T-1.2 in 2023 $/MTCO$_2$e)

T-1.2 Acquire Agricultural Easements					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($30)	($48)	-	($78)	($45)
5%	($27)	($42)	-	($69)	($46)
7%	($24)	($37)	-	($61)	($44)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.3 Measure T-1.3: Update Community Plans

Table C5 displays sensitivity analysis results for Measure T-1.3 in 2023.

Table C5. Sensitivity Analysis for Measure T-1.3 in 2023 $/MTCO$_2$e)

T-1.3 Update Community Plans					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($12)	$286	-	$274	$359
5%	($10)	$185	-	$174	$229
7%	($9)	$123	-	$114	$151

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.4 Measure T-2.1: Improve Roadway Segments as Multi-Modal

Table C6 displays sensitivity analysis results for Measure T-2.1 in 2023.

Table C6. Sensitivity Analysis for Measure T-2.1 in 2023 $/MTCO$_2$e)

T-2.1 Improve Roadway Segments as Multi-modal					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($858)	($11,798)	-	($12,656)	($12,572)
5%	($781)	($10,558)	-	($11,339)	($11,277)
7%	($712)	($9,464)	-	($10,176)	($10,129)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.5 Measure T-2.2: Reduce New Non-Residential Development Vehicle Miles Traveled

Table C7 displays sensitivity analysis results for Measure T-2.2 in 2023.

Table C7. Sensitivity Analysis for Measure T-2.2 in 2023 $/MTCO$_2$e)

T-2.2 Reduce New Non-residential Development Vehicle Miles Traveled					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($73)	$392	($72)	$247	$337
5%	($62)	$313	($57)	$194	$265
7%	($54)	$252	($46)	$152	$210

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.6 Measure T-2.3: Reduce County Employee Vehicle Miles Traveled

Table C8 displays sensitivity analysis results for Measure T-1.1 in 2023.

Table C8. Sensitivity Analysis for Measure T-2.3 in 2023 $/MTCO$_2$e)

T-2.3 Reduce County Employee Vehicle Miles Traveled					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($1)	$476	($155)	$319	$409
5%	($1)	$380	($124)	$255	$327
7%	($1)	$305	($100)	$205	$262

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.7 Measure T-2.4: Shared and Reduced Parking in New Non-Residential Development

Table C9 displays sensitivity analysis results for Measure T-2.4 in 2023.

Table C9. Sensitivity Analysis for Measure T-2.4 in 2023 $/MTCO$_2$e)

T-2.4 Shared and Reduced Parking in New Now-residential Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($4)	$321	-	$317	$403
5%	($3)	$233	-	$230	$292
7%	($3)	$172	-	$169	$214

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.8 Measure T-3.1: Use Alternative Fuels in New Residential and Non-Residential Construction Projects

Table C10 displays sensitivity analysis results for Measure T-3.1 in 2023.

Table C10. Sensitivity Analysis for Measure T-3.1 in 2023 $/MTCO$_2$e)

T-3.1 Use Alternative Fuels in New Residential and Non-Residential Construction Projects					
3%	($48)	($10)	-	($58)	($25)
5%	($40)	($7)	-	($47)	($24)
7%	($34)	($5)	-	($39)	($22)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.9 Measure T-3.2: Use Alternative Fuels in County Projects

Table C11 displays sensitivity analysis results for Measure T-3.2 in 2023.

Table C11. Sensitivity Analysis for Measure T-3.2 in 2023 $/MTCO$_2$e)

T-3.2 Use Alternative Fuels in County Projects					
	Administrator	Participant	Non-Participant	Measure	Society
3%	-	($38)	-	($38)	($1)
5%	-	($30)	-	($30)	($1)
7%	-	($24)	-	($24)	($1)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.10 Measure T-3.3: Develop a Local Vehicle Retirement Program

Table C12 displays sensitivity analysis results for Measure T-3.3 in 2023.

Table C12. Sensitivity Analysis for Measure T-3.3 in 2023 $/MTCO$_2$e)

T-3.3 Develop a Local Vehicle Retirement Program					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($614)	($1,628)	($147)	($2,389)	($2,243)
5%	($547)	($1,728)	($131)	($2,407)	($2,293)
7%	($489)	($1,747)	($117)	($2,353)	($2,263)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.11 Measure T-3.4: Reduce the County's Fleet Emissions

Table C13 displays sensitivity analysis results for Measure T-3.4 in 2020 and Table C14 displays sensitivity analysis results for 2023.

Table C13. Sensitivity Analysis for Measure T-3.4 in 2020 $/MTCO$_2$e)

T-3.4 Reduce the County's Fleet Emissions					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($2)	$380	-	$378	$383
5%	($2)	$306	-	$305	$309
7%	($2)	$249	-	$247	$251

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C14. Sensitivity Analysis for Measure T-3.4 in 2023 $/MTCO$_2$e)

T-3.4 Reduce the County's Fleet Emissions					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($4)	$311	-	$307	$311
5%	($4)	$242	-	$238	$242
7%	($4)	$190	-	$186	$189

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.12 Measure T-3.5: Install Electric Vehicle Charging Stations

Table C15 displays sensitivity analysis results for Measure T-3.5 in 2023.

Table C15. Sensitivity Analysis for Measure T-3.5 in 2023 $/MTCO$_2$e)

T-3.5 Install Electric Vehicle Charging Stations					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($7)	($46)	-	($53)	$2
5%	($6)	($41)	-	($47)	($1)
7%	($5)	($37)	-	($42)	($4)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.13 Measure E-1.1: Improve Building Energy Efficiency in New Development

Table C16 displays sensitivity analysis results for Measure E-1.1 in 2023.

Table C16. Sensitivity Analysis for Measure E-1.1 in 2023 $/MTCO$_2$e)

E-1.1 Improve Building Energy Efficiency in New Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($1)	($68)	($75)	($143)	($108)
5%	($1)	($108)	($66)	($175)	($149)
7%	($1)	($130)	($59)	($190)	($171)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.14 Measure E-1.2: Use Alternatively-powered Water Heaters in Residential Development

Table C17 displays sensitivity analysis results for Measure E-1.2 in 2023.

Table C17. Sensitivity Analysis for Measure E-1.2 in 2023 $/MTCO$_2$e)

E-1.2 Use Alternatively-powered Water Heaters in Residential Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($1)	$23	($8)	$14	$49
5%	($1)	$4	($7)	($4)	$22
7%	($1)	($7)	($6)	($14)	$5

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.15 Measure E-1.3: Improve Building Energy Efficiency in Existing Development

Table C18 displays sensitivity analysis results for Measure E-1.3 in 2023.

Table C18. Sensitivity Analysis for Measure E-1.3 in 2023 $/MTCO$_2$e)

E-1.3 Improve Building Energy Efficiency in Existing Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($18)	$190	($27)	$146	$61
5%	($16)	$125	($35)	$74	$5
7%	($14)	$82	($40)	$28	($29)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.16 Measure E-1.4: Reduce Energy Use Intensity at County Facilities

Table C19 displays sensitivity analysis results for Measure E-1.4 in 2020 and Table C20 displays sensitivity analysis results for 2023.

Table C19. Sensitivity Analysis for Measure E-1.4 in 2020 $/MTCO$_2$e)

E-1.4 Reduce Energy Use Intensity at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($2)	$104	($0)	$101	$138
5%	($2)	$81	($0)	$78	$109
7%	($2)	$63	($0)	$61	$86

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C20. Sensitivity Analysis for Measure E-1.4 in 2023 $/MTCO$_2$e)

E-1.4 Reduce Energy Use Intensity at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($7)	$101	($0)	$94	$130
5%	($6)	$77	($0)	$71	$101
7%	($6)	$60	($0)	$54	$78

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.17 Measure E-2.1: Increase Renewable Electricity

Table C21 displays sensitivity analysis results for Measure E-2.1 in 2023.

Table C21. Sensitivity Analysis for Measure E-2.1 in 2023 $/MTCO$_2$e)

E-2.1 Increase Renewable Electricity					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($10)	($39)	-	($49)	($10)
5%	($9)	($34)	-	($43)	($9)
7%	($8)	($30)	-	($38)	($8)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.18 Measure E-2.2: Increase Renewable Electricity in Non-Residential Development

Table C22 displays sensitivity analysis results for Measure E-2.2 in 2023.

Table C22. Sensitivity Analysis for Measure E-2.2 in 2023 $/MTCO$_2$e)

E-2.2 Increase Renewable Electricity in Non-residential Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($8)	$128	($107)	$13	$47
5%	($7)	$64	($93)	($36)	($12)
7%	($6)	$24	($81)	($63)	($45)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.19 Measure E-2.3: Install Solar Photovoltaics in Existing Homes

Table C23 displays sensitivity analysis results for Measure E-2.3 in 2020 and Table C24 displays sensitivity analysis results for 2023.

Table C23. Sensitivity Analysis for Measure E-2.3 in 2020 $/MTCO$_2$e)

E-2.3 Install Solar Photovoltaics in Existing Homes					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($1)	$294	($151)	$142	$178
5%	($0)	$187	($148)	$39	$67
7%	($0)	$111	($144)	($33)	($10)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C24. Sensitivity Analysis for Measure E-2.3 in 2023 $/MTCO$_2$e)

E-2.3 Install Solar Photovoltaics in Existing Homes					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($2)	$280	($130)	$149	$184
5%	($1)	$171	($125)	$45	$72
7%	($1)	$96	($120)	($25)	($3)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.20 Measure E-2.4: Increase On-Site Renewable Electricity Generation for County Operations

Table C25 displays sensitivity analysis results for Measure E-2.4 in 2020 and Table C26 displays sensitivity analysis results for 2023.

Table C25. Sensitivity Analysis for Measure E-2.4 in 2020 $/MTCO$_2$e)

E-2.4 Increase On-Site Renewable Electricity Generation for County Operations					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($5)	$228	($138)	$86	$122
5%	($5)	$145	($130)	$10	$38
7%	($5)	$87	($124)	($42)	($19)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C26. Sensitivity Analysis for Measure E-2.4 in 2023 $/MTCO$_2$e)

E-2.4 Increase On-Site Renewable Electricity Generation for County Operations					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($5)	$235	($133)	$97	$132
5%	($5)	$147	($124)	$19	$46
7%	($4)	$87	($116)	($33)	($11)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.21 Measure SW-1.1: Increase Solid Waste Diversion

Table C27 displays sensitivity analysis results for Measure SW-1.1 in 2023.

Table C27. Sensitivity Analysis for Measure SW-1.1 in 2023 $/MTCO$_2$e)

SW-1.1 Increase Solid Waste Diversion					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($1)	($119)	-	($120)	($83)
5%	($1)	($98)	-	($99)	($69)
7%	($1)	($81)	-	($82)	($58)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.22 Measure W-1.1: Increase Water Efficiency in New Residential Development

Table C28 displays sensitivity analysis results for Measure W-1.1 in 2020 and Table C2 displays sensitivity analysis results for 2023.

Table C28. Sensitivity Analysis for Measure W-1.1 in 2023 $/MTCO$_2$e)

W-1.1 Increase Water Efficiency in New Residential Development					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($633)	$854	($62)	$159	$196
5%	($562)	$638	($55)	$20	$50
7%	($501)	$479	($49)	($71)	($47)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.23 Measure W-1.2: Reduce Outdoor Water Use

Table C29 displays sensitivity analysis results for Measure W-1.2 in 2023.

Table C29. Sensitivity Analysis for Measure W-1.2 in 2023 $/MTCO$_2$e)

W-1.2 Reduce Outdoor Water Use					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($3)	$55	($2)	$50	$85
5%	($3)	$42	($2)	$38	$65
7%	($3)	$33	($2)	$29	$50

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.24 Measure W-1.3: Reduce Potable Water Consumption at County Facilities

Table C30 displays sensitivity analysis results for Measure W-1.3 in 2020 and Table C31 displays sensitivity analysis results for 2023.

Table C30. Sensitivity Analysis for Measure W-1.3 in 2020 $/MTCO$_2$e)

W-1.3 Reduce Potable Water Consumption at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($276)	$30	($1)	($246)	($209)
5%	($258)	$24	($1)	($234)	($203)
7%	($241)	$19	($1)	($222)	($196)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C31. Sensitivity Analysis for Measure W-1.3 in 2023 $/MTCO$_2$e)

W-1.3 Reduce Potable Water Consumption at County Facilities					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($245)	$30	($1)	($216)	($178)
5%	($229)	$24	($1)	($206)	($175)
7%	($214)	$19	($1)	($196)	($170)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.25 Measure W-2.1: Increase Rain Barrel Installations

Table C32 displays sensitivity analysis results for Measure W-2.1 in 2020 and Table C33 displays sensitivity analysis results for 2023.

Table C32. Sensitivity Analysis for Measure W-2.1 in 2020 $/MTCO$_2$e)

W-2.1 Increase Rain Barrel Installations					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($10)	$2,011	($213)	$1,787	$1,824
5%	($9)	$1,574	($205)	$1,360	$1,389
7%	($9)	$1,248	($198)	$1,041	$1,065

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C33. Sensitivity Analysis for Measure W-2.1 in 2023 $/MTCO$_2$e)

W-2.1 Increase Rain Barrel Installations					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($16)	$1,962	($207)	$1,739	$1,775
5%	($14)	$1,501	($195)	$1,292	$1,320
7%	($13)	$1,165	($184)	$968	$990

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.26 Measure A-1.1: Convert Farm Equipment to Electric

Table C34 displays sensitivity analysis results for Measure A-1.1 in 2023.

Table C34. Sensitivity Analysis for Measure A-1.1 in 2023 $/MTCO$_2$e)

A-1.1 Convert Farm Equipment to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($5)	($201)	$80	($126)	($91)
5%	($5)	($41)	($80)	($126)	($91)
7%	($4)	($157)	$64	($98)	($76)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.27 Measure A-1.2: Convert Stationary Irrigation Pumps to Electric

Table C35 displays sensitivity analysis results for Measure A-1.2 in 2020 and Table C36 displays sensitivity analysis results for 2023.

Table C35. Sensitivity Analysis for Measure A-1.2 in 2020 $/MTCO$_2$e)

A-1.2 Convert Stationary Irrigation Pumps to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($8)	($1)	($7)	($15)	$20
5%	($7)	($1)	($7)	($14)	$13
7%	($7)	($1)	($6)	($13)	$8

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C36. Sensitivity Analysis for Measure A-1.2 in 2023 $/MTCO$_2$e)

A-1.2 Convert Stationary Irrigation Pumps to Electric					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($7)	($0)	($7)	($15)	$20
5%	($7)	($1)	($6)	($13)	$13
7%	($6)	($1)	($6)	($12)	$8

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.28 Measure A-2.1: Increase Residential Tree Planting

Table C37 displays sensitivity analysis results for Measure A-2.1 in 2023.

Table C37. Sensitivity Analysis for Measure A-2.1 in 2023 $/MTCO$_2$e)

A-2.1 Increase Residential Tree Planting					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($9)	($509)	-	($518)	($330)
5%	($8)	($406)	-	($414)	($293)
7%	($64)	($361)	-	($425)	($332)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

C.29 Measure A-2.2: Increase County Tree Planting

Table C38 displays sensitivity analysis results for Measure A-2.2 in 2020 and Table C39 displays sensitivity analysis results for 2023.

Table C38. Sensitivity Analysis for Measure A-2.2 in 2020 $/MTCO$_2$e)

A-2.2 Increase County Tree Planting					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($41)	($539)	-	($580)	($373)
5%	($38)	($457)	-	($496)	($353)
7%	($36)	($397)	-	($433)	($331)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017

Table C39. Sensitivity Analysis for Measure A-2.2 in 2023 $/MTCO$_2$e)

A-2.2 Increase County Tree Planting					
	Administrator	Participant	Non-Participant	Measure	Society
3%	($55)	($517)	-	($572)	($373)
5%	($50)	($427)	-	($477)	($343)
7%	($46)	($361)	-	($407)	($314)

*All dollar values are in 2015$ Energy Policy Initiatives Center, USD 2017