Climate Action Plan
Benefit-Cost Analysis

January 2019

Prepared for the City of Oceanside

Prepared by the Energy Policy Initiatives Center

University of San Diego, 5998 Alcalá Park, San Diego, CA 92110 ◆ www.sandiego.edu/epic

– This page left intentionally blank –

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.

Prepared in partnership with the San Diego Association of Governments (SANDAG) and the Energy Roadmap Program. This program is partially funded by California utility customers and administered by San Diego Gas & Electric Company under the auspices of the California Public Utilities Commission.

Table of Contents

Contents

EXECUTIVE SUMMARY

Introduction

This report summarizes the findings of the City of Oceanside Climate Action Plan (CAP) benefit-cost analysis (BCA) conducted by the Energy Policy Initiatives Center (EPIC) at the University of San Diego for 10 of the 19 measures included in the CAP.[1]

The goals of this report are to:

- Estimate the benefit or cost of each CAP measure to reduce a unit of greenhouse gas (GHG) emissions to compare the relative cost-effectiveness of CAP measures; and
- Identify the financial benefits received and costs incurred by those directly involved in CAP measure activities in order to assess the impact of implementing CAP measures.

Benefit-Cost Analysis Overview

A framework adapted from the California Standard Practice Manual (SPM)[2] was applied to the 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 two perspectives adapted from the SPM — participant (the City of Oceanside, business owners, commuters, etc.) and measure perspectives (participants and non-participants).

Cost-effectiveness results are presented for the measure perspective and include the benefits and costs to those who participate in CAP measure activities and the costs to non-participants to subsidize rebates and incentives. Results are shown using a dollar per metric ton of carbon dioxide equivalent ($/MT CO_2e), which standardizes results across all measures and allows for comparison to determine the most cost-effective approaches to reducing emissions.

Primary metrics used to assess the impacts on participants (participant perspective) include the benefit-cost ratio (BCR) and discounted payback period. 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 greater than one means the anticipated benefits of the measure outweigh anticipated costs; if the BCR is less than one, costs outweigh benefits. The payback period describes how many years it would take for a participant (e.g., a home or business owner) to recover their costs to engage in the activity.

Key Findings

- **CAP measures identified to achieve GHG reduction targets have an overall net cost.** Measures included in the CAP to reach GHG reduction targets and evaluated in this analysis have an

[1] Measure E1: Renewable Energy Procurement requires a detailed feasibility study outside the scope of this analysis. Other measures not included are supporting measures only with no quantified GHG reductions identified in the CAP. Supporting measures include: E3: Residential Energy Conservation and Disclosure, E4: Promotion of Low Income Financing Programs, E5: Non-Residential Building Energy Benchmarking and Disclosure, W2: Non-Residential Water Use Benchmarking and Disclosure; TL3: Preferential Parking Spaces for Zero Emission Vehicles; TL4: Expand Complete Streets; AF2: Urban Agriculture and Community Gardens, and AF4: Carbon Farming Program.

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

overall net cost of $27 per MT CO_2e reduced in interim target year 2025 and reduce an estimated 52,884 MT CO_2e.[3] This represents a combined net cost to participants and non-participants (measure perspective) to reduce one MT CO_2e in the year 2025.

- **Measure cost-effectiveness ranges from a cost of $315 per MT CO_2e to a benefit of $1,974 per MT CO_2e reduced.** Of the 10 measures included in this benefit-cost analysis, measure W1 (Implementation of the Water Conservation Master Plan) is the most cost effective at reducing GHG emissions ($1,974/MT CO_2e) and reduces 589 MT CO_2e in 2025. Measure AF1 (Urban Forestry Program) is the least cost effective at reducing GHG emissions (-$315/MT CO_2e) and reduces 176 MT CO_2e in 2025.
- **CAP measure activities impact multiple participant groups.** CAP measure activities require different groups of participants to actively engage in some type of activity, resulting in direct benefits and/or costs to those participants. Of all participant groups, drivers/commuters experience the greatest overall benefit as a result of transportation related measures. As a participant, the City of Oceanside incurs direct costs associated with three of the evaluated CAP measures — measure W3 (Local Water Supply Development), AF1 (Urban Forestry Program), and AF2 (Agriculture Lands Conservation Program). Together, these three measures have a cost to the City of $68/MT CO_2e; however, all measures with costs to the City of Oceanside include activities that have already been planned for independently from the CAP. Non-City participants (e.g., homeowners, business owners, commuters) have a collective average cost of $2/MT CO_2e. Removing measure SW2, which impacts the waste hauler and has the highest weighting, there is an overall net benefit to participants of $96/MT CO_2e.

[3] Not including the estimated GHG reductions and cost-effectiveness of measure E1 (Renewable Energy Procurement).

GLOSSARY OF TERMS

dollar per metric ton of carbon dioxide equivalent ($/MT CO_2e) – The $/MT CO_2e 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 measure's action(s).

Administrator Perspective – This perspective represents staffing costs to a jurisdiction to implement CAP measures, including administrative activities and program development and management. It does not include capital expenditures related to CAP measure activities.

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 of cumulative discounted benefits and cumulative discounted costs. A BCR that is greater than one means anticipated benefits of the measure outweigh anticipated costs; if it is less than one, costs outweigh benefits.

Direct Benefit/Cost – A financial impact that is a direct result of a measure or action. Examples of direct costs include the upfront purchase of equipment or services and ongoing operation and maintenance costs. Examples of direct benefits include reductions in utility bills and fuel 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.

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

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

Measure Perspective – The sum of the administrator, participant, and non-participant perspectives. The measure perspective represents a comprehensive, programmatic view of a measure's costs and benefits.

Net Present Value (NPV) – The total present value of the benefits and costs related to an action over its useful life. A NPV greater than zero represents a net benefit. A 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 through rebates and incentives.

Participant Perspective – The perspective of those who participate in a CAP measure activity. Typically, this perspective refers to home and business owners, but can also include the jurisdiction are direct benefits and/or costs associated complying with an action defined in a CAP measure.

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

Social Cost of Carbon (SCC) – The marginal cost of a ton of CO_2 emissions in a given year as calculated by the United States Environmental Protection Agency. It is meant to be a comprehensive estimate of climate change damages.

Societal Perspective – The sum of the measure perspective and externalities. This is the broadest view of a BCA.

Target Year/Interim Target Year – The point in time when the CAP measure impacts are considered and analyzed.

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

1 INTRODUCTION

The City of Oceanside (City) has developed a draft Climate Action Plan (CAP) for public review. The CAP contains measures with specific activities that can be implemented to reduce greenhouse gas (GHG) emissions within the city. The Energy Policy Initiatives Center (EPIC) at the University of San Diego School of Law conducted a benefit-cost analysis (BCA) of the CAP to estimate the cost-effectiveness of CAP measures and the direct financial benefits and costs associated with activities defined in each CAP measure. More specifically, it answers the questions: **how cost-effective are CAP measures at reducing one metric ton of carbon dioxide equivalent (MT CO_2e)** and **what are the financial impacts to those who directly participate in CAP measure activities?** Understanding the monetary implications associated with implementing the CAP measures and the potential impacts to those who participate in measure activities can help decision makers in the City prioritize measures and educate stakeholders on the relative benefits and costs associated with emissions reduction measures. This report summarizes the analysis findings to achieve GHG reductions in interim target year 2025.

1.1 CAP Measures

The CAP comprises five GHG reduction categories with a total of 19 measures. This analysis examines 10 of the 19 measures included in the CAP. Measure E1 (Renewable Energy Procurement) requires a detailed feasibility analysis that is outside the scope of this study.[4] The remaining eight measures[5] not included have no quantified GHG reductions and are considered voluntary.

To estimate the incremental impact of the CAP, the 10 measures included in the analysis are categorized as existing, expanded, or new (Table 1).

Measures with existing activities would be implemented regardless of CAP adoption. As such, results for these measures do not represent a benefit or cost as a result of the CAP, but indicate the marginal impact if the level of activity were to be increased because of the CAP. Measures with expanded activity have some level of activity that would occur regardless of CAP adoption but would have an additional level of activity occurring as a result of CAP adoption; the incremental level of activity associated with the CAP is not explicitly known. Measures with new activity are wholly a result of the CAP and all benefits and costs associated with the activity are considered incremental.

[4] The City of Oceanside is currently participating in a CCA feasibility study with the Cities of Encinitas, Carlsbad, and Del Mar. The study is anticipated to be released early 2019.

[5] Supporting measures not analyzed here include: E3: Residential Energy Conservation and Disclosure; E4: Promotion of Low Income Financing Programs; E5: Non-Residential Building Energy Benchmarking and Disclosure; W2: Non-Residential Water Use Benchmarking and Disclosure; TL3: Preferential Parking Spaces for Zero Emission Vehicles; TL4: Expand Complete Streets; AF2: Urban Agriculture and Community Gardens; and AF4: Carbon Farming Program.

Table 1. CAP Measures Included in Analysis

CAP Measure	GHGs Reduced in 2020 (MT CO_2e)	GHGs Reduced in 2025 (MT CO_2e)
Existing Activity		
W1: Implementation of the Water Conservation Master Plan	268	589
W3: Local Water Supply Development	-	2,102
SW1: Implementation of Zero Waste Strategic Resource Plan	10,331	-
Expanded Activity		
SW2: Beyond 2020 - Enhanced Waste Diversion	-	17,510
AF1: Urban Forestry Program	50	176
New Activity		
E2: Solar Photovoltaic Promotion Program	7,375	17,903
TL1: Smart Growth Policies	756	1,799
TL2: Expanded Electric Vehicle Charging Infrastructure	1,496	3,562
TL5: Transportation Demand Management Programs	675	1,608
AF3: Agriculture Lands Conservation Program	-	7,636

Energy Policy Initiatives Center, USD 2018

1.2 Organization of Report

This report is divided into six sections and three appendices. Section 2 provides an overview of BCAs: perspectives analyzed, types of benefits and costs, key concepts, and metrics used. Section 3 presents cost-effectiveness results and Section 4 presents results for individual measure impacts on participants. Section 5 details limitations of the analysis and the conclusion is provided in Section 6. The appendices outline methods used and provide an extended set of tabular results with data and assumptions for individual measures.

2 BENEFIT-COST ANALYSIS OVERVIEW

2.1 Types of Benefits and Costs

The benefits and costs associated with a CAP measure fall into two broad categories: direct or external.

2.1.1 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, for participants.

2.1.2 External Benefits and Costs

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. External benefits and costs associated with CAP measures can be difficult to quantify.

2.2 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., the jurisdiction), **participants** in the program (e.g., residents and businesses within the jurisdiction), and those who pay the cost to subsidize programs (**non-participants**; e.g., taxpayers or utility ratepayers). The **measure** perspective, which combines these three main perspectives, allows for a more comprehensive view and includes costs to administer CAP programs, costs to homes and businesses, and any subsidies provided. Adding externalities, which are not accounted for in the direct costs and benefits, to the measure perspective provides a broader **societal** perspective.

The framework in Figure 1 summarizes these five perspectives, identifies who is potentially affected by a measure, and provides examples of their respective benefits and costs.[6]

[6] Adapted from the California Standard Practice Manual, which is used by the California Public Utilities Commission (CPUC) to evaluate the cost-effectiveness of energy efficiency programs and has recently been adapted into a National Standard Practice Manual (CPUC, 2001; NESP, 2017).

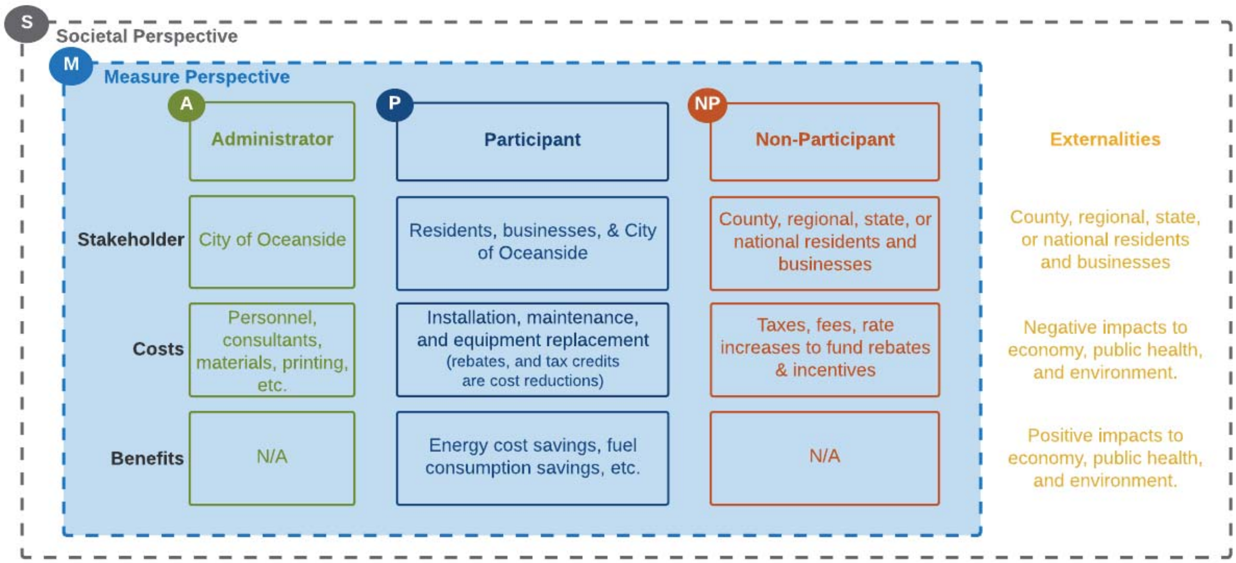


Figure 1. Conceptual Framework of BCA Perspectives

2.2.1 Administrator Perspective

The administrator perspective answers the question: **What are the financial benefits and costs to the City of Oceanside as a result of implementing CAP measure(s)?** While there are no direct monetary benefits associated with CAP implementation, there are costs incurred for CAP related activities. Activities to administer the CAP include research, development, implementation, monitoring, and enforcement of CAP measures. Costs for these activities can include staffing, consultants, and supplies and materials. Analysis of this perspective is not considered in this report.[7]

2.2.2 Participant Perspective

The participant perspective answers the question: **What are the financial benefits and costs to those who participate in or take action to comply with a CAP measure?** There can be direct benefits and/or costs to comply with an action defined in a CAP measure. For example, a business owner who chooses to install a solar photovoltaic system under measure E2 (Solar Photovoltaic Promotion Program) would incur capital costs for the purchase, installation, and operation of the system. The reduction in energy purchased from the local utility would then provide the business owner with benefits in the form of energy bill reductions over the lifetime of that system. Participants can also receive cost reductions in the form of rebates, incentives, and tax credits, which are considered a cost to non-participants.

For measures where the City of Oceanside is a participant[8], this perspective includes all capital costs directly associated with the City's participation in or compliance with the CAP measure, as well as the resulting benefits received by the City.

[7] A CAP Implementation Staff Impact Analysis was conducted for an earlier version of the CAP. Results identify the staffing impacts associated with the first five fiscal years of CAP implementation. (Oceanside, 2018)

[8] This includes CAP measures W3 (Local Water Supply Development), AF1 (Urban Forestry Program), and AF3 (Agriculture Lands Conservation Program).

2.2.3 Non-Participant Perspective

The non-participant perspective answers the question: **What are the financial benefits and costs, if any, to subsidize activities of participants?** Residents, businesses, and the City of Oceanside could incur indirect costs even though they are not engaging in an activity defined in a CAP measure. In general, non-participant costs are defined as the cost to subsidize activities taken by participants through rebates, incentives, and tax credits. Non-participants incur this cost through taxes, fees, and/or utility surcharges. Who is defined as a non-participant can vary and is not limited to those within the geographic boundary of the City of Oceanside (Table 2).

Table 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
City of Oceanside	City rebate	Local tax	City of Oceanside	City residents & businesses

2.2.4 Measure Perspective

The measure perspective answers the question: **What are the total direct financial benefits and costs associated with a CAP measure?** The three perspectives defined above provide discrete and valuable insights, but individually represent an incomplete view of the monetary impacts of a CAP measure. For instance, looking solely at the participant perspective may obscure the true cost of a measure, particularly if an action is highly subsidized. Because no administrator costs are included in this analysis, results shown provide a modified measure perspective that includes only the participant and non-participant perspectives.

2.2.5 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. Potential externalities include impacts to the economy, public health, and the environment. In general, externalities are more difficult to quantify and a qualitative assessment is incorporated where sufficient quantitative data is not available (see Appendix B).

Externalities for transportation-related measures include positive health impacts associated with reduced criteria pollutants (CO_2, $PM_{2.5}$, PM_{10}, NO_X, ROG, and SO_2). Externalities for urban forestry-related measures include positive health impacts associated with reduced criteria pollutants (O_3, NO_2, SO_2, PM_{10}, VOC, and

BVOC) and reductions in storm water treatment from enhanced rainfall interception. In addition to these measure-specific externalities, the EPA's social cost of carbon (SCC) is applied to all measures to estimate a base level of avoided environmental damages and health costs associated with the reduction of CO_2.

This analysis provides a modified societal perspective that includes externalities in addition to a modified measure perspective (participant and non-participant perspectives only).

2.3 Key Concepts

The following key concepts were used in developing CAP BCA calculations used in this report.

2.3.1 Target Year

The target year represents a point in time when CAP measure impacts are considered. While the BCA considers all benefits and costs over the useful life of specified actions, results are specific to actions that lead to GHG reductions in the target year. This report analyzes CAP impacts during interim target year 2025.

Dollar values expressed in a target year are 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 values in the target year reflect the value of the GHGs reduced in that year and 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 the target year. For instance, a solar PV system installed in 2018 will still be reducing GHGs in the 2025 interim target year; however, the bulk of capital costs were experienced earlier on.

2.3.2 Installation Year

The installation[9] year is the initial year in which an action occurs. Measures can include multiple installation years. For example, the year in which a business installs a solar PV system is that business'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 the interim target year. For some 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 (e.g., installing a solar PV system, retrofitting a home with energy efficiency upgrades) during which GHG reductions are not achieved, but capital is being outlaid.

2.3.3 Useful Life

A useful life (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 City's CAP measures have project lives that extend well past the target year analyzed. This analysis examines the benefit and cost streams over the entire useful life to accurately capture all benefits and costs associated with a measure. Restricting the analysis to the target year would significantly undervalue or overvalue an action; ending the analysis before the project has reached its useful life typically reduces the associated benefits and places a higher emphasis on costs.

[9] Note: 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, water rate increase, etc.

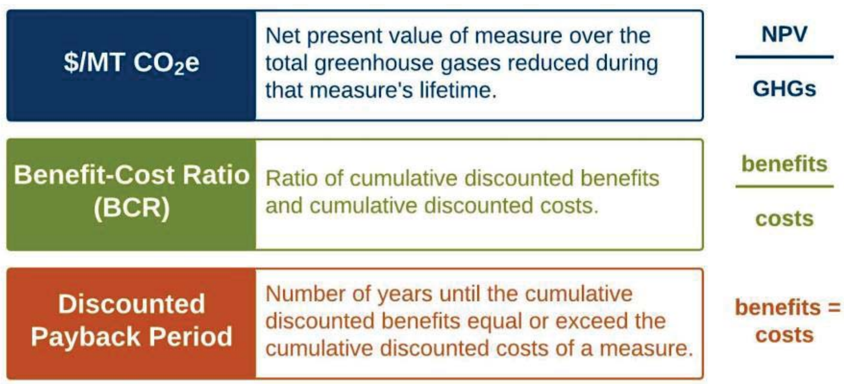
2.3.4 Normalized Dollars

Dollar values are normalized to a constant year to accurately analyze historic and current benefit and cost data. This process reduces the interannual impact of external influences, such as inflation and deflation, on the value of a good or service. While several indices exist to normalize dollar values, the Consumer Price Index (CPI) is one of the most common and is applied in this analysis (FRB Dallas 2017). The base year 2018 is used for normalization for all measures for consistency and for comparison across measures.

2.4 Benefit-Costs Analysis Metrics

The metrics used to analyze results for measure cost-effectiveness and impacts on participants are shown in Figure 2. Measure cost-effectiveness is assessed using dollar per metric ton of carbon dioxide equivalent ($/MT CO_2e) for the measure perspective. Impacts on participants are assessed using the benefit-cost ratio (BCR), discounted payback period, and $/MT CO_2e for the participant perspective. Methods used to calculate BCA metrics are provided in Appendix A.

Figure 2. Metrics for the CAP Cost-Effectiveness and Benefit-Cost Analyses



Results may not be available for all metrics for all measures. For example, if a participant only incurs costs or only receives benefits, a BCR and payback period cannot be calculated. Similarly, a BCR and payback cannot be calculated for participants who only receive benefits.

All metrics are calculated using present value dollars. Using the present value[10] 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 the benefits and costs. A five percent discount rate is applied in this analysis and a sensitivity analysis is performed using a three and seven percent discount rate.[11] Higher discount rates lessen the impact of future dollars in the analysis relative to lower discount rates.

2.4.1 Dollar per Metric Ton of CO_2e

The $/MT CO_2e is used to show the cost-effectiveness of measures in reducing one metric ton of CO_2e. This metric 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

[10] Present value in this context and going forward represents the value in the start year of the analysis, 2018.

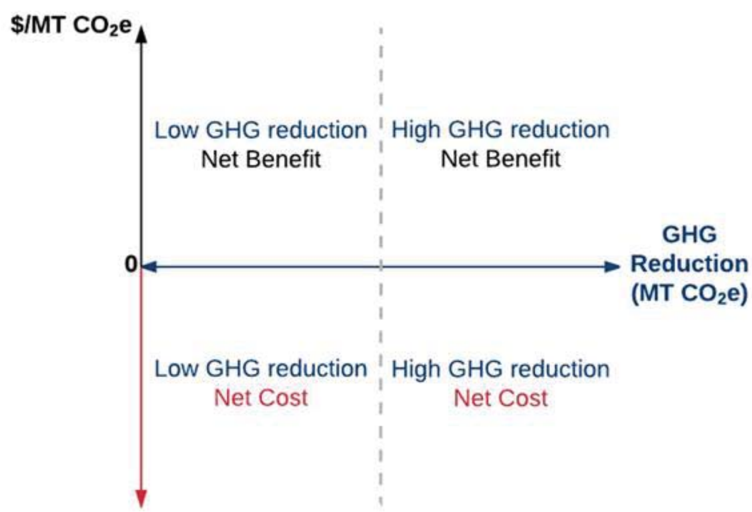
[11] According to the U.S. EPA, projects within a short to medium lifespan (less than 50 years) are assigned a discount rate of approximately 3%, derived from consumer-time preferences based on the interest rate of a risk-free asset such as a government bond (U.S. EPA 2010). Conversely, the federal Office of Management and Budget (OMB) assigns a standard discount rate of 7%, derived from the opportunity cost of private capital, measured by the before-tax rate of return to investment, for projects with similar lifespans (OMB 2000). A 5% discount rate was selected to account for this range in recommendations.

positive value indicates a net benefit per ton reduced, whereas a negative value indicates a net cost per ton reduced.

A weighted average \$/MT CO_2e of all the activities that contribute to GHG reductions is used since the GHGs reduced in the interim 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 2025 but were installed between 2018 and 2025, a weighted average of the \$/MT CO_2e for all these systems would be used. By calculating the weighted average, all benefits and costs associated with the actions taken to achieve the GHG reductions in the target year are scaled according to their contribution to GHG reductions in the target year.

While the \$/MT CO_2e 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 reduced. Plotting the \$/MT CO_2e for each measure in conjunction with its GHG reductions in the target year shows a comparison of cost effectiveness (Figure 3). 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.

Figure 3. Interpreting Results of a Scatterplot



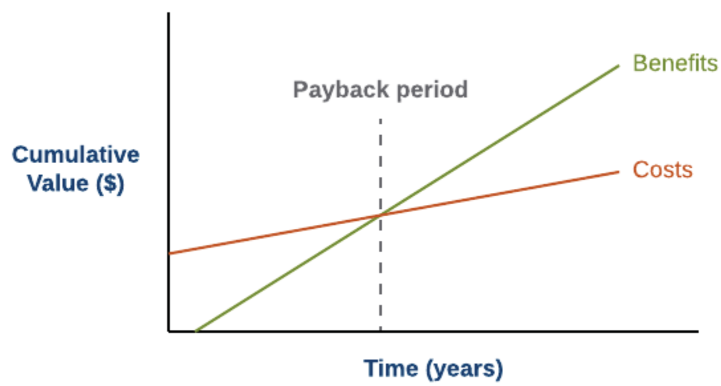
2.4.2 Benefit-Cost Ratio

The 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. BCRs can only be shown for measures that have both benefits and costs for a given group of participants. How subsidies (rebates and incentives) are calculated for the participant perspective will impact the result; this analysis identifies all subsidies as cost reductions to participants.

2.4.3 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 4). 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 4. 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 does take into consideration the time value of money and, by discounting future values, the time required for benefits to exceed costs is extended further into the future. The discounted payback period is calculated in this analysis.

3 COST-EFFECTIVENESS RESULTS

This section presents cost-effectiveness results for (1) existing and (2) expanded and new CAP measures in interim target year 2025. GHG reductions are based on calculations in the City of Oceanside Climate Action Plan Technical Methods (Appendix C; City of Oceanside 2018) and assume an incremental level of activity is achieved each year necessary to achieve reduction targets identified in the CAP. Results demonstrate the cost-effectiveness of measures to reduce GHGs only. Measures included in the CAP may seek to achieve additional goals (e.g., increase the recycled water supply to reduce demand pressure on the potable water supply, increase the resiliency of the urban forest); the cost-effectiveness to achieve those goals are not included in this analysis.

All results shown here are in present dollars using a five percent discount rate and normalized to 2018 dollars (2018$). Additionally, results indicate the value associated with GHG emissions reduced in that year considering the lifetime benefits and costs associated with the activity; they do not indicate actual cash flows for the given year. For further discussion on inputs and assumptions used in this analysis, see Appendix B. For sensitivity analysis results using three and seven percent discount rates, see Appendix C.

3.1 Existing Activity

Measures with existing activities have already been implemented or are planned to be implemented regardless of CAP adoption. As such, results for these measures do not represent a benefit or cost as a direct result of the CAP.

Table 3 summarizes results in \$/MT CO_2e for the measure perspective (participants and non-participants) for each measure to achieve estimated 2025 GHG reductions. Results indicate an overall net benefit for existing measures in 2025 of \$248/MT CO_2e and an estimated 2,691 MT CO_2e reduced in that year. Measure SW1 (Implementation of Zero Waste Strategic Resource Plan) ends in 2020 and has no GHG reduction activity occurring in 2025.[12]

Table 3. Measure Perspective Cost-Effectiveness for Existing Activity

CAP Measure	Measure Perspective (\$/MT CO_2e)	GHGs Reduced in 2025 (MT CO_2e)
Water and Wastewater		
W1: Implementation of the Water Conservation Master Plan	\$1,974	589
W3: Local Water Supply Development	(\$235)	2,102
Solid Waste		
SW1: Implementation of Zero Waste Strategic Resource Plan*	-	-
Weighted Average for All Existing Activity	\$248	2,691

All dollar values are in 2018\$ Energy Policy Initiatives Center, USD 2018
*Measure SW1 does not go past 2020

[12] Measure SW1 is superseded by measure SW2, a new measure, post 2020.

Measure W1 (Implementation of the Water Conservation Master Plan) is the most cost-effective measure with existing activity. The high net benefit per metric ton reduced for measure W1 ($1,974/ MT CO_2e) can be attributed to the relatively high savings for water customers paired with low GHG reductions relative to other measures (589 MT CO_2e). Measure W3 is the least cost-effective at reducing GHG emissions for this group of measures with a net cost of $235/MT CO_2e, but reduces the greatest amount of GHGs in 2025 (2,102 MT CO_2e).

3.2 New and Expanded Activity

Measures with expanded and new activities require some level of new activity because of the CAP; expanded measures are an expansion of existing City programs and new measures have been developed specifically for the CAP. Eight measures with quantified GHG reductions were identified in the CAP and seven are included in this analysis.[13] Results show measure cost effectiveness as it relates to GHG reductions; however, measures with expanded and/or new activities can contribute towards achieving non-CAP related goals identified by the City.

Table 4 summarizes results in $/MT CO_2e for the measure perspective (participants and non-participants) for each measure to achieve estimated 2025 GHG reductions. Results indicate an overall net cost for expanded and new measures in 2025 of $42/MT CO_2e and an estimated 50,193 MT CO_2e reduced in that year.

Table 4. Measure Perspective Cost-Effectiveness for Expanded and New Activity

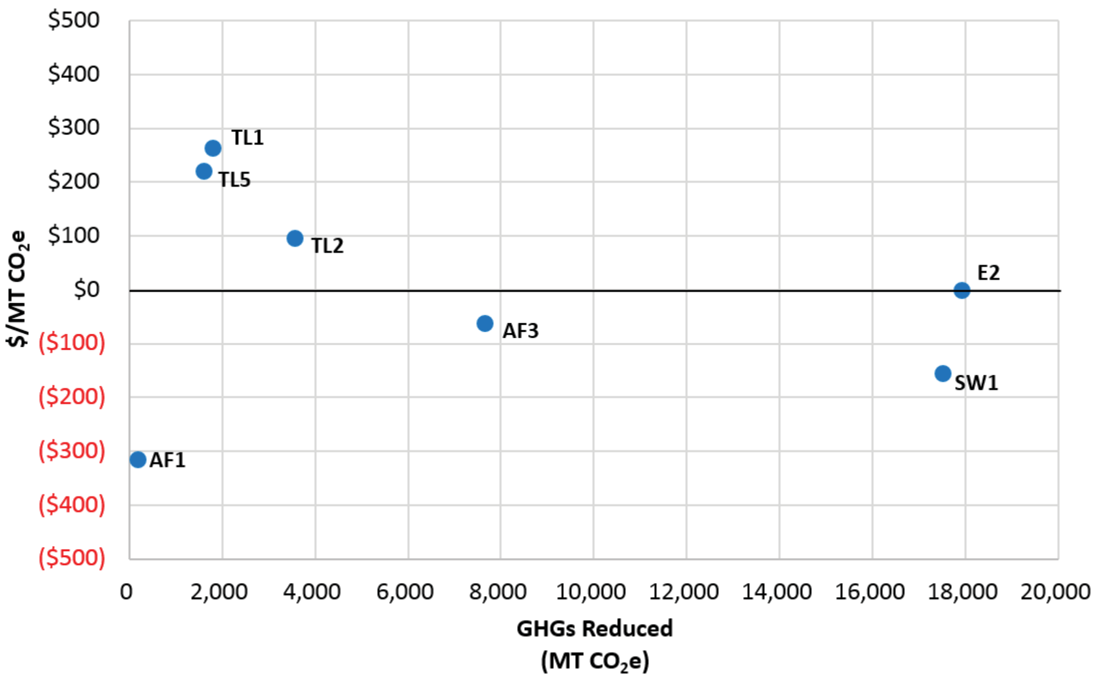
CAP Measure (new unless specified as expanded)	Measure Perspective ($/MT CO_2e)	GHGs Reduced in 2025 (MT CO_2e)
Energy and Buildings		
E2: Solar Photovoltaic Promotion Program	< $1	17,903
Solid Waste		
SW2: Beyond 2020 – Enhanced Waste Diversion *(expanded)*	($156)	17,510
Transportation and Land Use		
TL1: Smart Growth Policies	$264	1,799
TL2: Expanded Electric Vehicle Charging Infrastructure	$95	3,562
TL5: Transportation Demand Management Programs	$221	1,608
Agriculture and Forestry		
AF1: Urban Forestry Program *(expanded)*	($315)	176
AF3: Agriculture Lands Conservation Program	($63)	7,636
Weighted Average for All New and Expanded Activity*	($42)	50,193

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018
*Excluding measure E1 (Renewable Energy Procurement)

[13] Measure E1 (Renewable Energy Procurement) requires an in-depth feasibility analysis outside the scope of this report.

Figure 5 plots a measure's cost effectiveness at reducing GHG emissions ($/MT CO_2e) against its corresponding GHG reductions (MT CO_2e) in 2025. Measures further to the right have higher GHG reductions. Measures above zero dollars indicate a net benefit per MT CO_2e reduced and measures below zero indicate a net cost. Measure E2 (Solar Photovoltaic Program) reduces the most GHG emissions in 2025 (17,903 MT CO_2e) and is slightly cost-effective with a net benefit under $1 per MT CO_2e reduced. Measure AF1 (Urban Forestry Program) is the least cost-effective measure reducing GHG emissions (-$315/MT CO_2e) and reduces the least amount of GHGs in 2025 (176 MT CO_2e). The low cost-effectiveness of measure AF1 can be attributed to two reasons; measure activities have no associated direct financial benefits stream and annual GHG reductions are low compared to other measure activities.[14]

Figure 5. Measure Perspective Scatterplot for Expanded and New Activity in 2025



[14] Note: the measure perspective only captures the direct benefits and costs associated with measure activities. Measure AF1 (Urban Forestry Program) is one of several measures with a suite of external benefits not captured at this level.

4 FINANCIAL IMPACTS ON PARTICIPANTS

This section presents results on the financial impacts to participants who engage in activities necessary to achieve specified reductions in interim target year 2025. BCR, payback, and \$/MT CO_2e results are provided based on the participant type for each measure. Some measures have more than one participant group (e.g., commercial and residential). For some participants, not all metrics are available. For instance, if a participant has only costs or only benefits, a BCR and payback period cannot be calculated. Additional discussion on the overall impact on participants (minus the City) is provided in section 4.11.

For additional measure participant results and further discussion on inputs and assumptions used in this analysis, see Appendix B.

4.1 Measure E2: Solar Photovoltaic Promotion Program

GHG reduction estimates included in the CAP for measure E2 are for commercial and industrial customers only. Two participant groups were analyzed — commercial and industrial entities who own the PV system they are operating, and those who enter into a power purchase agreement (PPA). Under a PPA, participants purchase electricity generated by a solar PV system installed and maintained by a third-party. Both participant groups achieve a positive BCR, indicating the benefits outweigh the costs associated with the activity. Commercial and industrial entities that purchase their PV system can expect a discounted payback period of roughly 10.6 years.

Table 5. Measure E2 Impacts on Participants to Achieve 2025 GHG Reductions

E2: Solar Photovoltaic Promotion Program				
Participant Group	**BCR**	**Payback Period (years)**	**Participant \$/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
Commercial & Industrial – System Owner	1.45	10.6	\$7	16,450
Commercial & Industrial – Power Purchase Agreement	4.55	-	\$4	1,453

All dollar values are in 2018\$ Energy Policy Initiatives Center, USD 2018

4.2 Measure W1: Implementation of the Water Conservation Master Plan

GHG reduction estimates included in the CAP for measure W1 are for residential and commercial activity. Results are provided for both residential and commercial participant groups; the type of activity and, consequently, the resulting GHG reductions differ significantly between both groups. For residential and commercial participant groups, installing water conservation fixtures is cost-effective (BCR of 2.75 and 3.01 respectively). In addition, the relatively low costs are offset quickly with water bill reductions (approximately three years for residential and one year for commercial).

Table 6. Measure W1 Impacts on Participants to Achieve 2025 GHG Reductions

W1: Implementation of the Water Conservation Master Plan				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
Residential	2.75	3	$2,038	176
Commercial	3.01	1	$2,192	413

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.3 Measure W3: Local Water Supply Development

GHG reductions identified in the CAP for measure W3 require actions by two participant groups: San Luis Rey Wastewater Treatment Plant (SLR WWTP) and water consumers who are currently on the irrigation water rate schedule. This measure assumes a specific amount of water consumption is shifted from potable water currently purchased on the irrigation water rate schedule to recycled water. To meet this increase in recycled water demand, the SLR WWTP would need to undergo capital improvement projects. As a result, GHG reductions in 2025 are a result of the joint activity of both participant groups.

This analysis captures the participant groups that are directly impacted by CAP measure activities. For the water consumer, the direct impact is the incremental water rate savings (recycled minus irrigation water rates). The SLR WWTP may pass on the cost of capital improvements to water customers through rate increases; however, those potential indirect costs are not included here.

Table 7. Measure W3 Impacts on Participants to Achieve 2025 GHG Reductions

W3: Local Water Supply Development				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
San Luis Rey Wastewater Treatment Plant	0.50	-	($286)	2,102
Recycled Water Consumer (Irrigation only)	-	-	$51	

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.4 Measure SW1: Implementation of Zero Waste Strategic Resource Plan

This measure aligns with the City's Zero Waste Strategic Resource Management Plan (adopted June 2012), which identifies multiple programs to reduce solid waste and increase waste diversion within the City. Reductions for this measure are expected only through 2020, at which point measure SW2 (Beyond 2020 – Enhanced Solid Waste Diversion) takes effect. This analysis only captures the participant groups that are directly impacted by CAP measure activities and provides results for 2020 GHG reductions. The waste hauler may pass on costs to its customer base through rate increases; however, those potential indirect costs are not included here.

Table 8. Measure SW1 Impacts on Participants to Achieve 2020* GHG Reductions

SW1: Implementation of Zero Waste Strategic Resource Plan				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2020* (MT CO_2e)**
Waste Hauler	0.63	-	($205)	10,331

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018
*Measure SW1 does not go past 2020

4.5 Measure SW2: Beyond 2020 – Enhanced Waste Diversion

Measure SW2 was analyzed as an extension of measure SW1 (post 2020) to further increase solid waste diversion within the City. This measure relies on continuing those actions identified in measure SW1 and identifies several other opportunities to expand diversion efforts. This analysis only captures the participant groups that are directly impacted by CAP measure activities. The waste hauler may pass on costs to its customer base through rate increases; however, those potential indirect costs are not included here.

Table 9. Measure SW2 Impacts on Participants to Achieve 2025 GHG Reductions

SW2: Beyond 2020 – Enhanced Waste Diversion				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
Waste Hauler	0.63	-	($156)	17,150

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.6 Measure TL1: Smart Growth Policies

GHG reduction estimates in the CAP assume a switch from lower to higher density development type projects. Potential development projects for the City of Oceanside as they relate to this measure are not yet known and, consequently, estimated costs and benefits are not included in this analysis. However, case studies have shown that development costs for medium-density and infill development in urban areas tends to be lower than development costs for more sprawl-type projects (Boyko and Cooper, 2011; Winkelman et al., 2010; Burchell and Mukherji, 2003) since they rely on current infrastructure (roads, sewer, etc.) as opposed to expanding infrastructure further out. Those who receive the direct benefits associated with this measure include drivers and commuters who experience reduced fuel costs associated with shorter drive distances. Smart-growth projects encourage mixed-use development; this can reduce VMT by shortening commute distances and encouraging alternate forms of transportation (e.g., bike or walk). Commuters experience a benefit in the form of avoided fuel purchases because of the reduction in VMT.

Table 10. Measure TL1 Impacts on Participants to Achieve 2025 GHG Reductions

TL1: Smart Growth Policies				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
Drivers/Commuters	-	-	$264	1,799

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.7 Measure TL2: Expanded Electric Vehicle Charging Infrastructure

Measure TL2 reduces GHG emissions by encouraging the installation of public electric vehicle (EV) charging infrastructure, which leads to a shift in fuel consumption from gasoline to electricity. Two participant groups were identified for this measure — those who install public EV chargers and EV drivers — and GHG reductions are a result of the combined activity of the two groups. Installers incur the cost of purchasing and maintaining the equipment, while receiving payments from EV drivers to purchase electricity (BCR=2.08 and estimated 5-year discounted payback). EV drivers incur costs for purchasing electricity to operate their vehicle, but also experience benefits in the form of avoided gasoline purchases.

Table 11. Measure TL2 Impacts on Participants to Achieve 2025 GHG Reductions

TL2: Expanded Electric Vehicle Charging Infrastructure				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
EV Charger Installers	2.08	5	$67	3,562
EV Drivers	1.13	-	$37	

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.8 Measure TL5: Transportation Demand Management Programs

GHG reductions from measure TL5 are a result of reduced vehicle miles traveled (VMT) by commuters in the City of Oceanside. This analysis assumes commuters switch to one of several alternative commute methods that lead to reductions in VMT due to participation in a workplace-provided transportation demand management (TDM) program. There are direct costs to TDM managers to operate these programs, which lead to fuel reduction benefits for participating commuters. For some commuters, there are also costs associated with purchasing mass transit passes or renting a vanpool vehicle. Results for the commuters participant group represent an average for all commuters irrespective of their alternative commute method (BCR=7.79, discounted payback < 1 year).

Table 12. Measure TL5 Impacts on Participants to Achieve 2025 GHG Reductions

TL5: Transportation Demand Management Program				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
TDM Program Managers	-	-	($2)	1,608
Commuters	7.79	< 1	$230	

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.9 Measure AF1: Urban Forestry Program

GHG reductions for measure AF1 are a result of actions taken by both the City of Oceanside and its residents. Both participant groups incur costs associated with the purchase, planting, and maintenance of trees within the urban forest. While there are myriad external benefits associated with tree planting, there are no direct financial benefits to participants that have been identified.

Table 13. Measure AF1 Impacts on Participants to Achieve 2025 GHG Reductions

AF1: Urban Forestry Program				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
City of Oceanside	-	-	($237)	88
Development	-	-	($393)	88

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.10 Measure AF3: Agriculture Lands Conservation Program

Measure AF3 leverages funds from the Sustainable Agricultural Lands Conservation (SALC) Grant Program to place additional acres in South Morro Hills into agricultural easements. This precludes development rights on that land and reduces the forecasted GHG emissions associated with development. This analysis examines the cost to the City of Oceanside to provide the matching funds required under the SALC program for agricultural easements. There are anticipated benefits associated with reduced activity (e.g., avoided fuel costs from reduced VMT); however, it is unclear to whom and how those benefits will be distributed.

Table 14. Measure AF3 Impacts on Participants to Achieve 2025 GHG Reductions

AF3: Agriculture Lands Conservation Program				
Participant Group	**BCR**	**Payback Period (years)**	**Participant $/MT CO_2e**	**GHGs Reduced in 2025 (MT CO_2e)**
City of Oceanside	-	-	($6)	7,636

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

4.11 Overall Impact on Participants

This section details the overall impact of CAP measures on both City and non-City participants identified in sections 4.1-4.10. Measures where the City is a participant include those for which the City outlays capital to achieve the stated goal (e.g., capital outlaid by the City to improve the waste water treatment plant or to plant trees). Measures with non-City participants include those where an individual/business or group of individuals/businesses – other than the City – are directly impacted by a CAP measure. The impact to each group was assessed by weighting the respective participant's $/MT CO_2e by the total GHG emissions reduced.

4.11.1 City as the Participant

Measures included in this analysis and that have a direct financial impact on the City as a participant are identified in Table 15.

Table 15. CAP Measures with the City as a Participant

CAP Measure
W3: Local Water Supply Development
AF1: Urban Forestry Program
AF3: Agriculture Lands Conservation Program

Energy Policy Initiatives Center, USD 2018

Together, these three CAP measures have an overall weighted average cost to the City of $68 per MT CO_2e reduced in 2025.[15] However, most of the costs experienced by the City are not considered new costs associated with CAP implementation, but are part of or an expansion of existing activity.

4.11.2 Non-City Participants

Evaluating the costs and benefits to non-City participants can assist in understanding the overall impacts of CAP measures; however, the type of non-City participant varies by measure and it is unlikely that an individual and/or business will participate in all measures. Measures included in this analysis and that

[15] Both measures W3 and AF1 have City and non-City participants. The impact for each participant group was separated out to determine the overall cost or benefit impact for each (e.g., only the costs and benefits to the City under measure W3 are included in estimating the overall impact on the City).

have a direct financial impact on non-City participants are identified in Table 16 along with the respective participant(s) directly impacted by the measure.

Table 16. CAP Measures with Non-City Participants

CAP Measure	Participant
E2: Solar Photovoltaic Promotion Program	• Commercial and industrial facilities (own and PPA)
W1: Implementation of the Water Conservation Master Plan	• Residential properties • Commercial facilities
W3: Local Water Supply Development	• Recycled water consumers
SW1: Implementation of Zero Waste Strategic Resource Plan	• Waste Hauler
SW2: Beyond 2020 - Enhanced Waste Diversion	• Waste hauler
TL1: Smart Growth Policies	• Drivers/commuters
TL5: Expanded Electric Vehicle Charging Infrastructure	• EV Charger Installers • EV drivers
AF1: Urban Forestry Program	• Development projects

Energy Policy Initiatives Center, USD 2018

Together, these measures have an overall weighted average cost of $2 per MT CO_2e reduced in 2025 for the collective group of non-City participants. [16,17] Measure SW2, which has a net cost to the participant of $156/MT CO_2e, reduces the most emissions by participant type in 2025 (17,510 MT CO_2e), giving the measure the greatest weighting when combining all non-City participants, while directly impacting just the waste hauler. Excluding measure SW-2, non-City participants have an overall weighted net benefit of $96 MT CO_2e reduced in 2025. Following measure SW2, measure E2 has the second highest weighting in determining the impacts to non-City participants (16,450 MT CO_2e reduced by commercial and industrial facilities that own the PV system and 1,453 MT CO_2e reduced by those in a PPA).

[16] Both measures W3 and AF1 have City and non-City participants. The impact for each participant group was separated out to determine the overall cost or benefit impact for each (e.g., only the costs and benefits to the recycled water consumer under measure W3 are included in estimating the overall impact on non-City participants).

[17] Measure SW1 is superseded by measure SW2 post 2020 and is thus not factored into the overall impact in 2025.

5 LIMITATIONS

There are inherent limitations with any BCA which result in a degree of uncertainty that should be considered. This BCA uses the best information, data, and methods available at the time. Nonetheless, when considering the benefit and cost impacts of each CAP measure, the limitations outlined in the following sections should be considered.

5.1 Available Data and Literature

5.1.1 Estimating Benefits and Costs

Estimates for current and future benefits and costs 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 BCA calculations. Case studies are applied 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 to calculate the societal perspective within the geographic scope of the City of Oceanside. 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. Externalities included in these analyses were restricted to the best available data and literature; not all externalities were captured, potentially under or overvaluing the cost-effectiveness of measures at the societal perspective; Appendix B discusses individual measure externalities further.

5.2 Scope of Impacts

The approach detailed in this document considers only those benefits and costs anticipated to be experienced within the City of Oceanside. There are other benefits and costs that can accrue outside of the City of Oceanside because of CAP implementation. For instance, the production and disposal of materials (e.g., solar PV panels and hybrid vehicle batteries) can have multiple costs and benefits associated with them. These can include:

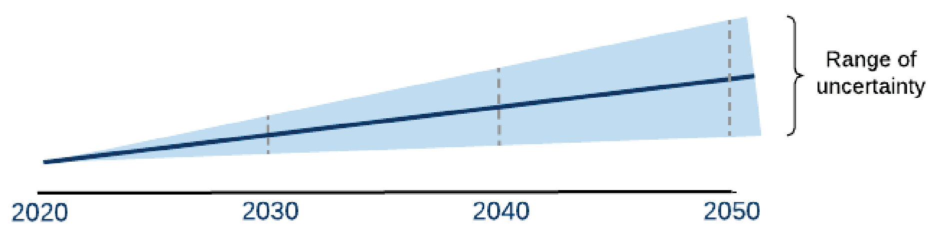
- Financial gain by manufacturers;
- Increase in industry sector jobs;
- Pollution external impacts from hazardous waste disposal at end of useful life; and
- Reduction in pollution caused by traditional energy production (e.g., coal).

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 City of Oceanside are prohibitive.

5.3 Target Year Selection

Any analysis that involves future projections will have to acknowledge some level of uncertainty, which typically increases the farther into the future the projection goes (Figure 6). To reduce increased uncertainty associated with projections made further out, the BCA was restricted to a near-term interim target year (e.g., 2025 in lieu of 2035). As an example, a PV system has a useful life of 25 years. Using a target year of 2025, future projections extend to 2050 to capture the benefits and costs of that measure. If 2035 is selected as the target year for the BCA analysis, projections would need to extend to 2065. For measures with even longer useful lives, this would require extending projections even more, significantly increasing the uncertainty associated with the results.

Figure 6. Increasing Uncertainty with Future Projections



6 CONCLUSION

This report summarized the findings of the City of Oceanside Draft Climate Action Plan (CAP) Benefit-Cost Analysis (BCA) conducted by the Energy Policy Initiatives Center (EPIC) at the University of San Diego School of Law. 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 CAP to reach the specified GHG emissions reduction targets would have a net cost of $27/MT CO_2e reduced in 2025 and reduce an estimated 52,884 MT CO_2e. This represents a combined net cost of $27 to CAP participants and non-participants (measure perspective) to reduce once metric ton of carbon dioxide equivalent in the interim target year 2025.

Taken as a group, the three CAP measures leveraging existing programs have an estimated net benefit of $248 per metric ton reduced and an estimated 2,691 MT CO_2e reduced in 2025.[18] Activities in these measures are already planned for reasons other than the CAP, but still contribute toward CAP emission targets. Measure W1 (Implementation of the Water Conservation Master Plan) is the most cost-effective existing measure with a net benefit per metric ton reduced ($1,974/MT CO_2e), while measure W3 (Local Water Supply Development) is the least cost effective (-$235/MT CO_2e). Collectively, these three measures have a weighted average cost of $68 for each MT CO_2e reduced by the City.

New and expanded measures collectively have a net cost of $51 per metric ton reduced and an estimated 50,193 MT CO_2e reduced in 2025.[19] Two transportation related measures (TL1: Smart Growth Policies and TL5: Transportation Demand Management Program) were identified as providing the greatest benefit to a participant group (drivers/commuters). Measure E2 (Solar Photovoltaic Promotion Program) is estimated to provide the greatest GHG emission reductions in 2025 and achieves a slight net benefit when considering participant and non-participant costs (< $1/MT CO_2e).

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

[18] Excluding measure E1 and all measures considered voluntary and supporting (no associated GHG emissions).

[19] Measure SW1 is considered existing but does not impact the cost-effectiveness of this group of measures in 2025, since no GHG reductions are achieved post 2020.

REFERENCES

Boyko CT, Cooper R. 2011. *Clarifying and re-conceptualising density*. Progress in Planning. 76(1):1-61. https://www.sciencedirect.com/science/article/pii/S0305900611000274

Burchell RW, Mukherji S. 2003. *Conventional Development Versus Managed Growth: The Costs of Sprawl*. American Journal of Public Health. 93(9):1534-1540. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1448006/pdf/0931534.pdf

California Public Utilities Commission (CPUC). 2001. *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/CPUC_STANDARD_PRACTICE_MANUAL.pdf

City of Oceanside. 2018a. Oceanside Climate Action Plan. PDF

FRB Dallas. 2017. *Deflating Nominal Values to Real Values*. Federal Reserve Bank of Dallas. https://www.dallasfed.org/research/basics/nominal.aspx

National Efficiency Screening Project (NESP). 2017. *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources*. https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf

US EPA. 2010. *Guidelines for Preparing Economic Analyses - Ch.6 Discounting Future Benefits and Costs*. United States Environmental Protection Agency. https://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0568-06.pdf/$file/EE-0568-06.pdf

US OMB. 2000. *Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements*. United States Office of Management and Budget. https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/omb/fedreg/cbdraftreport2000.pdf

Winkelman S, Bishins A, Kooshian C. 2010. *Planning for economic and environmental resilience*. Transportation Research Part A. 44:575-586. https://doi.org/10.1016/j.tra.2010.03.011

Appendix A. BENEFIT-COST ANALYSIS METHODS

The Benefit-Cost Analysis (BCA) for each measure in the City of Oceanside's Climate Action Plan (CAP) follow the same general methods outlined in Figure A1.

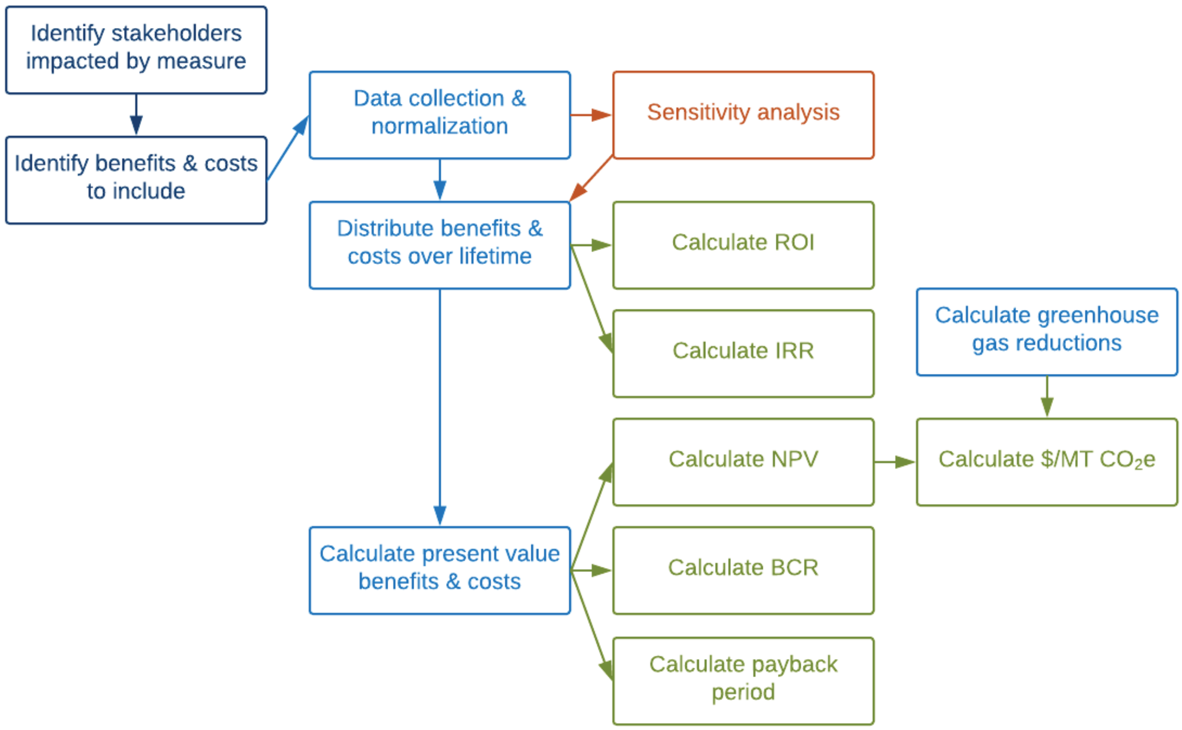


Figure A1. Climate Action Plan Benefit-Cost Analysis General Methods

For all measures, greenhouse gas (GHG) calculations are consistent with those used in estimating GHG reductions for the CAP.[20] In some instances, additional data were required beyond what is used to estimate GHG reductions to apply calculated GHG reductions at an individual activity level (e.g., average GHGs per solar photovoltaic [PV] system installed). Requirements vary by measure, but defining assumptions and collecting data all follow the same methods detailed in this appendix.

A.1 Identify Stakeholders Impacts and Corresponding Benefits and Costs

The data collection process is guided by identifying stakeholders 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 Participant Perspective

An individual measure can have multiple participant groups that are impacted depending on the level of specificity for each CAP measure. The solar PV system example in Figure A2 shows that, at a higher level, stakeholders include residential and commercial customers, and more specific sub-stakeholders are identified based on the type of construction. For the solar PV measure, the costs associated with installations on existing construction can vary greatly compared to the costs of installing solar PV systems

[20] City of Oceanside Climate Action Plan Appendix C – Oceanside Climate Action Plan Technical Methods

during construction of a new home or commercial 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 City of Oceanside is also a participant.

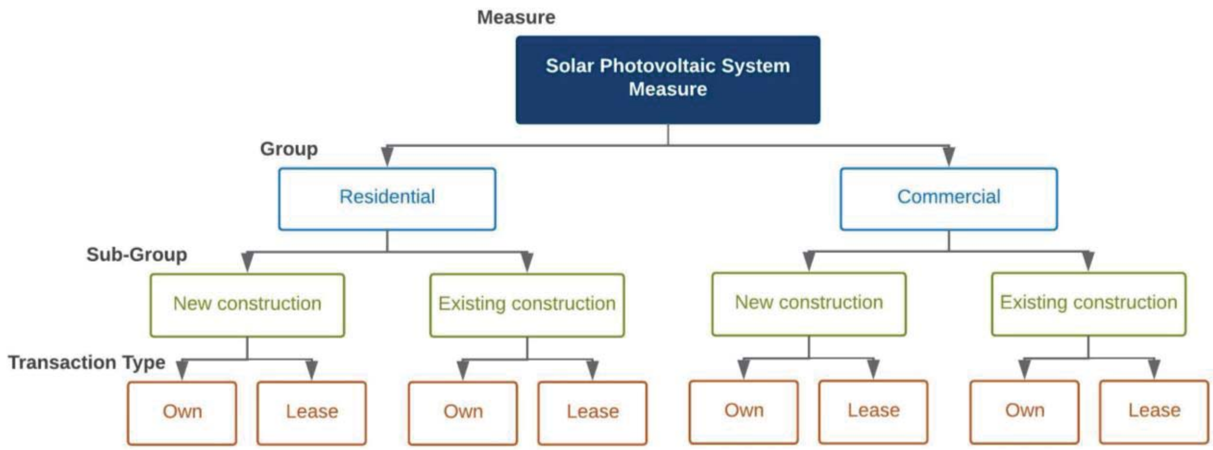


Figure A2. Potential Stakeholders Impacted by a Solar PV System Ordinance

Key questions asked for each identified participant include:

- Are there any upfront costs for purchase/installation?
- Are there any ongoing maintenance costs and, if so, at what frequency are they incurred (e.g., annually, biannually)?
- Does the activity reduce consumption (e.g., electricity, natural gas, water, fuel)?
- What rebates and incentives are available?
- What rate schedules apply to participant groups?
- What type of transaction is involved (e.g., purchase or lease)?
- Are there permitting requirements associated with the measure?

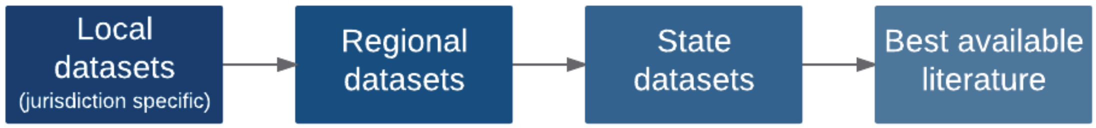
A1.2 Non-Participant Perspective

Non-participants are those who fund rebates and incentives (through taxes, fees, etc.) that participants use to offset costs. Data needed to estimate the impact on non-participants are 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 City of Oceanside are used whenever possible for benefit and cost values, as well as for key assumptions. In instances where data specific to the City are unavailable or incomplete (e.g., little historic activity), regional or statewide data are applied. In the absence of sufficient regional or statewide data, estimates provided in current literature are used. Regional datasets are not specific to the City, but to the local region (e.g., county-level data or water district program data). Statewide datasets refer to data and/or case studies at the state level; case studies might not include the jurisdiction. Examples of best available literature include reports from federal agencies (e.g., USDA Forest Service) applicable to regions broader than the state level.

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



All collected data values were normalized to 2018 dollars (2018$) using the Consumer Price Index (CPI; Table A1). Normalization reduces interannual impacts of outside influences (e.g., inflation, deflation) on dollar values. Failing to normalize the data can skew the results of the analysis.

Table A1. San Diego Region Consumer Price Index

San Diego Region CPI	
Year	CPI Value
2010	245
2011	253
2012	257
2013	260
2014	265
2015	269
2016	275
2017	283
2018	288

All dollar values were normalized before being integrated into BCA calculations using the following equation:

Equation A1. Normaliztion 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 Distribution of Benefits and Costs Over Useful Life

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 installation year and the useful life is seven years (2015-2022). The year 2016 is considered the second install year and the benefits and costs go out through 2023 (a 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 install year will have corresponding GHGs that are reduced annually. Annual GHG reductions for a particular install year will not vary by perspective.

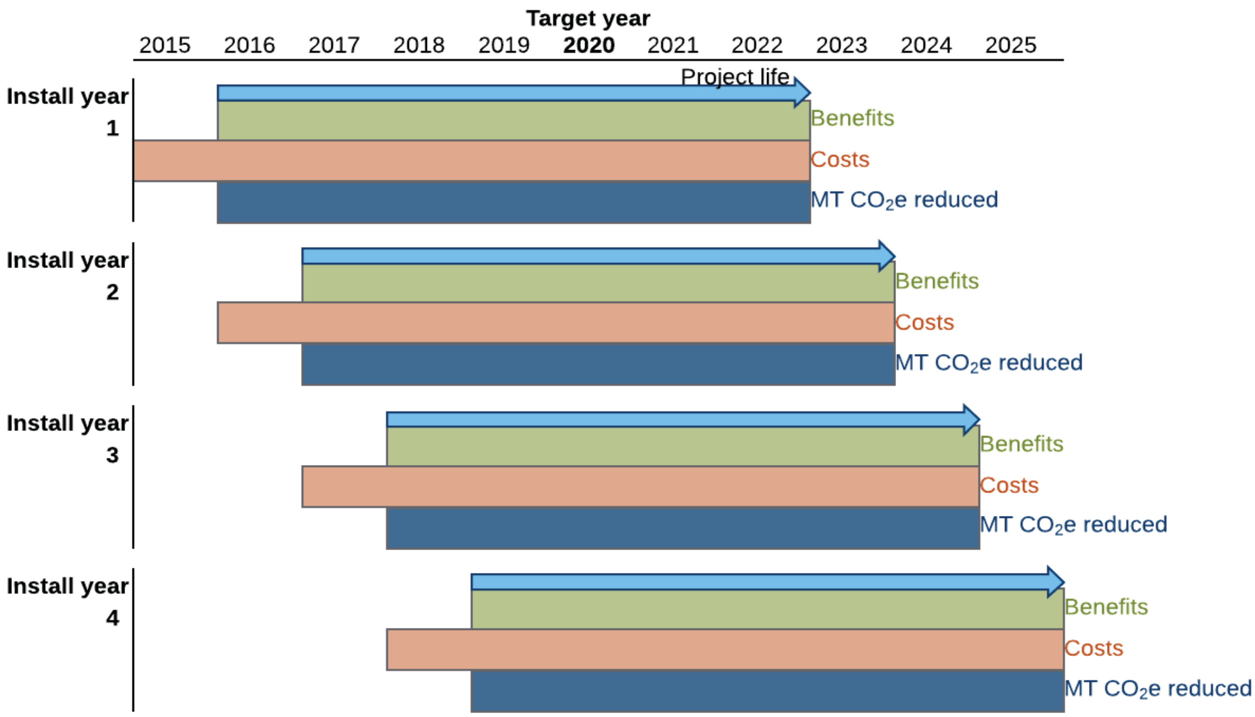


Figure A4. Example of Benefits and Costs Laid Out Over Useful Lives for Multiple Install Years

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 A2 and Equation A3, respectively).

Equation A2.Present Value Benefits Calculation

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

Equation A3. Present Value Costs Calculation

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

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
T	= useful life of measure/action

A4.1 Present Value Benefits and Costs in Target Year

Present value benefits and costs represent the total of either benefits or costs over an action's useful lives. However, a CAP BCA is meant to show results with respect to a specific 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 A4 and Equation A5). Results are totaled for all install years to calculate the total benefit and cost in the target year for a given measure.

Equation A4. Present Value Benefits in Target Year Calculation

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

Equation A5. Present Value Costs in Target Year Calculation

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

Where,

$PV_{benefits}$	= present value of benefits stream
PV_{costs}	= present value of costs stream
$GHGs_t$	= greenhouse gases reduced in year *t*
T	= 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 A6).

Equation A6. 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 Net Present Value in Target Year

Similar to the present value benefits and costs, NPV must be apportioned across all GHGs to find the NPV in the target year. This can be done using Equation A4 and substituting *NPV* in for $PV_{benefits}$, or by subtracting the target year's present value costs from the target year's present value benefits (Equation A7).

Equation A7. 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 total GHGs reduced over its useful life (Equation A8).

Equation A8. Dollar per Metric Ton of CO_2e Calculation

$$Dollar\ per\ MT\ CO_2e = \frac{NPV}{\sum_{t=0}^{T} GHGs_t}$$

Where,

NPV	= net present value
$GHGs_t$	= greenhouse gases reduced in year *t*
T	= 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[21], weighted average values must be calculated to accurately reflect the dollar per metric ton of carbon dioxide equivalent ($/MT CO_2e) of a particular measure in the target year. The weighted average can be found using Equation A9.

Equation A9. Weighted Average Dollar per Metric Ton of CO_2e Calculation

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

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 BCR is calculated by dividing the present value benefits by the present value costs for a given install year (Equation A10).

Equation A10. Benefit-Cost Ratio Calculation

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

[21] E.g., reductions from a solar PV system installed in 2015 will offset fewer GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

Where,

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

A7.1 Weighted Average Benefit-Cost Ratio

Since GHG reductions in the target year are not necessarily the same for each install year[21], weighted average values must be calculated to accurately reflect the BCR of a particular measure in the target year. The weighted average can be found using Equation A11.

Equation A11. Weighted Average Benefit-Cost Ratio Calculation

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

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

Determining the payback period requires calculating the cumulative flow of discounted benefits and discounted costs for a given install year (Equation A12). The cumulative cash flow for any given year is the sum of the benefits and costs (both discounted) for that year and all previous years. 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.

Equation A12. Discounted Payback Period Calculation

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

Where,

DPP	= discounted payback period
n	= number of years with a negative cumulative discounted cash flow
CF_n	= discounted cash flow in year *n*
CF_{n+1}	= discounted cash flow in year *n + 1*

A8.1 Weighted Average Discounted Payback Period

Since GHG reductions in the target year are not necessarily the same for each install year[22], 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 A13.

[22] E.g., reductions from a solar PV system installed in 2015 will offset fewer GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

Equation A13. Weighted Average Discounted Payback Period Calculation

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

Where,

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 a ratio between (1) the difference of all benefits and costs and (2) the costs (Equation A14).

Equation A14. Return on Investment Calculation

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

Where,

ROI	= return on investment
B_t	= benefits in year *t*
C_t	= costs in year *t*
T	= 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[23], weighted average values must be calculated to accurately reflect the ROI of a particular measure in the target year. The weighted average can be found using Equation A15.

Equation A15. Weighted Average Return on Investment Calculation

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

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

[23] E.g., reductions from a solar PV system installed in 2015 will offset fewer GHGs in 2020 than a system of the same size installed in 2019 when a system degradation rate is applied.

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 A16).

Equation A16. Internal Rate of Return Calculation

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

Where,

NPV	= net present value
B_t	= benefits in year *t*
C_t	= costs in year *t*
r	= discount rate to be solved for (IRR)
T	= 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 estimated values for the IRR into Equation A16 until an approximate IRR is found that yields and 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[23], weighted average values must be calculated to accurately reflect the IRR of a particular measure in the target year. The weighted average can be found using Equation A17.

Equation A17. Weighted Average Internal Rate of Return Calculation

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

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 Analysis

A sensitivity analysis is used to estimate the impact of a select input on BCA results, while holding all other inputs constant. For this BCA, a sensitivity analysis was conducted to understand how the $/MT CO_2e responds to changes in the discount rate (three, five, and seven percent). Aside from varying the discount rate, all inputs were held constant and the same calculations detailed in previous sections were performed to calculate results

Appendix B. MEASURE INPUTS, ASSUMPTIONS, AND FURTHER DISCUSSION

The following sections provide an extended set of BCA tabular results[24], data inputs and assumptions used in the analysis, and additional discussion for individual measures.

The following measures do not have quantified GHG reductions and are not included as part of the analysis:

- E1: Renewable Energy Procurement;
- E4: Promotion of Low Income Financing Programs;
- W2: Non-Residential Water Use Benchmarking and Disclosure;
- TL3: Preferential Parking Spaces for Zero Emission Vehicles;
- TL4: Expand Complete Streets;
- AF2: Urban Agriculture and Community Gardens; and
- AF4: Carbon Farming Program.

In addition to metrics discussed in Section 2 of the main report, the return on investment (ROI) and internal rate of return (IRR) are provided here for measure participants where available. The ROI measures the rate of return, or profitability, of a project to evaluate its efficiency. ROIs are expressed as a percentage; the higher the percentage, the greater the return or profitability of a project. The IRR represents the discount 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 percentage; a higher percentage means a project is more desirable. For both metrics, if participant benefits never outweigh costs, a result is not provided.

B.1 Measure E2: Solar Photovoltaic Promotion Program

This section analyzed the benefits and costs of installing solar photovoltaic (PV) systems on commercial and industrial properties by 2025 and assumes an incremental level of activity is achieved annually between 2018 and 2025. Actions taken to achieve this measure are estimated to reduce 17,903 MT CO_2e in 2025.

Participants include commercial and industrial property owners or developers who install an operator-owned PV system or who enter into a power purchase agreement (PPA). Participants with operator-owned systems incur costs related to the purchase, installation, and maintenance of the PV system. Additional costs include lost tax deductions associated with reduced utility bills. For PPA systems, this analysis only considers the costs and benefits to the commercial or industrial entity and does not include costs and benefits to the third-party PV installer. Non-participant costs include the tax impacts associated with providing the Federal Solar Investment Tax Credit, modified accelerated cost recovery system (MACRS) tax deductions, and bonus tax deductions received by participants. Externalities incorporated into calculations include the EPA's social cost of carbon. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure E2 are provided in Table B1 and BCA metrics for participants in Table B2.

[24] Results presented in Appendix B were calculated using a 5% discount rate.

Table B1. Cost-Effectiveness for Measure E2 in 2025 ($/MT CO_2e, all perspectives)

E2: Solar Photovoltaic Promotion Program					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
GHGs Reduced (MT CO_2e)	17,903				
$/MT CO_2e	NA	$7	($7)	$0	$28

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

Table B2. Additional BCA Metrics for Measure E2 Participants

E2: Solar Photovoltaic Promotion Program		
Participant Group	**ROI**	**IRR**
Commercial & Industrial – System Owner	88%	13%

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure E2 are documented in Table B3. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B3. Data Inputs and Assumptions for Measure E2

E2: Solar Photovoltaic Promotion Program		
Description	**Input[1]**	**Source**
Direct Costs		
Purchase and installation ($/kw)	*($3,471)*	Barbose et al., 2017
Operations and maintenance ($/kW/yr)	*($20)*	Fu et al., 2017
Inverter replacement ($/kW)	*($157)*	Fu et al., 2017
Lost utility deductions	*Varies by year*	U.S. Treasury, 2017a; CEC 2018; SDG&E 2018
Federal Solar Investment Tax Credit	*See Table B4*	SEIA, 2016
MACRS tax deduction	*See Table B6*	SEIA, 2017; U.S. Treasury 2017a; U.S. Treasury, 2017b
Bonus depreciation tax deduction	*See Table B5*	SEIA, 2017; U.S. Treasury 2017a; U.S. Treasury, 2017b
Direct Benefits		
Electricity bill savings – Owned ($/kWh)	*Varies by year*	CEC, 2018a; SDG&E 2018
Electricity bill savings – PPA ($/kWh)	*Varies by year*	Review of third party options
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Other Inputs and Assumptions		
Systems installed annually	*4*	Barbose et al., 2017; CAP Appendix C
System size (kW-DC)	*76*	Barbose et al., 2017

Solar generation capacity (kWh/kW)	*1,704*	CAP Appendix C
Inverter replacement frequency (yrs)	*10*	NREL et al., 2016
Effective commercial tax rate	*22%*	U.S. Treasury, 2016
Commercial systems	*68%*	CSI, 2017
Industrial systems	*32%*	CSI, 2017
Commercial systems in PPA	*12%*	CSI, 2017
Industrial systems in PPA	*0%*	CSI, 2017
PPA rate escalator	*2.5%*	Navigant, 2014; Davidson et al. 2015; review of third party options
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*25*	Kniefel et al., 2016

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Solar photovoltaic (PV) systems installed through 2021 are eligible for the federal Solar Investment Tax Credit (ITC). The tax credit is based on a percentage of qualifying installation costs and varies by year (Table B4). In addition to the Solar ITC, two other tax deductions are applied to the installation of commercial and industrial solar PV systems: Modified Accelerated Cost Recovery System (MACRS) and a bonus depreciation. The system value depreciated is the cost of purchase and installation less any rebate, incentives, and/or tax credits. Under bonus depreciation, a business can depreciate a specified percentage of the equipment cost in the first year; the percentage applied varies by year (Table B5). The remaining portion of the equipment is depreciated using the MACRS five-year cost recovery schedule (Table B6). The effective commercial tax rate, 22% (U.S. Treasury 2016), is applied to depreciated amounts to determine savings from tax deductions.

Table B4. Federal ITC

Bonus Depreciation	
Year	**ITC**
2018-2019	30%
2020	26%
2021	22%
2022 +	0%

Energy Policy Initiatives Center, USD 2018

Table B5. Bonus Depreciation

Bonus Depreciation	
Year	**Depreciation**
2018	40%
2019	30%
2020 +	0%

Energy Policy Initiatives Center, USD 2018

Table B6. MACRS Schedule

MACRS Schedule	
Year	**Depreciation**
1	20.00%
2	32.00%
3	19.20%
4	11.52%
5	11.52%
6	5.76%

Energy Policy Initiatives Center, USD 2018

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Increased property values
- Reduced local air pollution near grid electricity generation sources
- Reduced energy price volatility
- Increased energy diversity and security

B.2 Measure W1: Implementation of the Water Conservation Master Plan

This section analyzed the benefits and costs of continuing activities outlined in the City's 2016 Water Conservation Master Plan, which includes the installation of water conservation fixtures in residential and commercial units. Calculations assume an incremental level of activity is achieved annually between 2018 and 2025. Actions taken to achieve this measure are estimated to reduce 589 MT CO_2e in 2025.

Participants include residential and commercial property owners who install water conservation fixtures in their home or business. Costs include the purchase of new fixtures and, for commercial owners, lost tax deductions associated with reduced utility bills. Non-participant costs include the cost to fund rebate programs through SoCal WaterSmart. Externalities incorporated into calculations include the EPA's social cost of carbon. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure W1 are provided in Table B7 and BCA metrics for participants in Table B8.

Table B7. Cost-Effectiveness for Measure W1 in 2025 ($/MT CO_2e, all perspectives)

W1: Implementation of the Water Conservation Master Plan					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	589				
$/MT CO_2e	NA	$2,146	($172)	$1,974	$2,009

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

Table B8. Additional BCA Metrics for Measure W1 Participants

W1: Implementation of the Water Conservation Master Plan		
Participant Group	ROI	IRR
Residential	239%	50%
Commercial	222%	599%

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure W1 are documented in Table B9. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B9. Data Inputs and Assumptions for Measure W1

W1: Implementation of the Water Conservation Master Plan		
Description	**Input[1]**	**Source**
Direct Costs		
Conservation device purchase and installation – Residential ($/AFY)	*($7,964)*	Historic program data provided by City staff; review of product pricing online
Conservation device purchase and installation – Commercial ($/AFY)	*($2,639)*	Historic program data provided by City staff; review of product pricing online
Rebates and incentives – Residential ($/AFY)	*$1,632*	Historic program data provided by City staff; SoCal WaterSmart, 2018a
Rebates and incentives – Commercial ($/AFY)	*$640*	Historic program data provided by City staff; SoCal WaterSmart, 2018b
Lost utility deductions	*Varies by year*	U.S. Treasury, 2017a; City of Oceanside 2018c
Direct Benefits		
Water bill savings – Residential ($/HCF)	*Varies by year*	City of Oceanside 2018a; City of Oceanside 2018b
Water bill savings – Commercial ($/HCF)	*Varies by year*	City of Oceanside 2018c
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Other Inputs and Assumptions		
Water reduced annually (AFY)	*Varies by year*	CAP Appendix C
Electricity savings annually (kWh)	*Varies by year*	CAP Appendix C
Water import energy intensity (kWh/Mgal)	*10,411*	CAP Appendix C
Water reductions from residential activity	*30%*	Historic program data provided by City staff
Water reductions from commercial activity	*70%*	Historic program data provided by City staff
Effective commercial tax rate	*22%*	U.S. Treasury, 2016
Residential fixtures considered	*See Table B10*	Historic program data provided by City staff
Commercial fixtures considered	*See Table B10*	Historic program data provided by City staff
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*10*	Average of estimated useful lives for fixtures considered

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

A complete list of residential and commercial water conservation fixtures included in this analysis are provided in Table B10.

Table B10. Water Conservation Fixtures Included in Analysis

Water Conservation Fixtures
Residential
High efficiency clothes washer
High efficiency toilet
Cistern/Rain barrel
Rotating nozzle
Soil moisture sensor system
Weather-based irrigation control system
Commercial
Flow restrictor
Plumbing flow control
High efficiency toilet
Rotating nozzle
Ultra low and zero water urinal
Weather-based irrigation control system

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Conservation of water resources
- Increased property values

B.3 Measure W3: Local Water Supply Development

This section analyzed the benefits and costs of supplying recycled water to applicable customer through the implementation of capital improvements to the San Luis Rey Wastewater Treatment Plant. Calculations assume 840 million gallons of potable water are replaced with recycled water each year beginning in 2022[25]. Actions taken to achieve this measure are estimated to reduce 2,102 MT CO_2e in 2025.

Participants include the City of Oceanside, which operates the San Luis Rey Wastewater Treatment Plant, and non-residential water customers with the capacity to switch from potable to recycled water for irrigation purposes. Costs to the City include capital improvements necessary to increase capacity at the wastewater treatment plant and benefits are provided in reduced electricity bills associated with the conveyance of potable water from upstream sources. Customers who switch to recycled water experience a benefit in equal to the cost differential between irrigation and recycled water rates. The City may recover capital some or all capital costs by restructuring water rates for some or all customer classes; however, this requires a detailed water rate analysis outside the scope of this analysis. Externalities incorporated into calculations include the EPA's social cost of carbon. No non-participant costs were identified and administrator costs (e.g., CAP monitoring and reporting) are not included.

[25] Potable water reduction estimates are from CAP Appendix C. Year 2022 aligns with the timeframe identified in the City's *2015 Integrated Master Plan: Recycled Water Master Plan*.

An extended set of cost-effectiveness results for Measure W3 are provided in Table B11 and BCA metrics for participants in Table B12.

Table B11. Cost-Effectiveness for Measure W3 in 2025 ($/MT CO_2e, all perspectives)

W3: Local Water Supply Development					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	2,102				
$/MT CO_2e	NA	($235)	-	($235)	($198)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

Table B12. Additional BCA Metrics for Measure W3 Participants

W3: Local Water Supply Development		
Participant Group	ROI	IRR
San Luis Rey Wastewater Treatment Plant	39%	1%

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure W3 are documented in Table B13. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B13. Data Inputs and Assumptions for Measure W3

W3: Local Water Supply Development		
Description	Input[1]	Source
Direct Costs		
San Luis Rey Wastewater Treatment Plant improvements	*Varies by phase*	City of Oceanside, 2015
Direct Benefits		
Water import electricity bill reductions ($/kWh)	*Varies by year*	CEC, 2018a; SDG&E 2018
Water bill reduction – Consumers ($/HCF)	*5.17*	City of Oceanside 2018d
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Other Inputs and Assumptions		
Share of recycled water for general irrigation use	*100%*	Provided through discussion with City staff
Water recycled annually (Mgal)	*840*	CAP Appendix C
Water import energy intensity ((kWh/Mgal)	*10,411*	CAP Appendix C
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*50*	City of Oceanside, 2015

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Conservation of water resources

B.4 Measure SW1: Implementation of Zero Waste Strategic Resource Plan

This section analyzed the benefits and costs of continuing activities identified in the City's Zero Waste Strategic resource Management Plan (City of Oceanside, 2012) to achieve a 75% solid waste diversion rate by 2020. Calculations assume an incremental increase in the diversion rate is achieved annually and that activities taken to achieve this goal reduce an estimated 10,331 MT CO_2e in 2020[26].

This analysis only captures the participant group that is directly impacted by CAP measure activities- the waste hauler. The waste hauler may pass on costs to its customer base through rate increases; however, those potential indirect costs are not included here. Costs include the collection and processing of diverted waste. Benefits to the waste hauler include the revenue from the sale of processed material. Externalities incorporated into calculations include the EPA's social cost of carbon. No non-participant costs were identified and administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure SW1 are provided in Table B14.

Table B14. Cost-Effectiveness for Measure SW1 in 2020 ($/MT CO_2e, all perspectives)

SW1: Implementation of Zero Waste Strategic Resource Plan					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	10,331				
$/MT CO_2e	NA	($205)	-	($205)	($163)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure SW1 are documented in Table B15. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B15. Data Inputs and Assumptions for Measure SW1

SW1: Implementation of Zero Waste Strategic Resource Plan		
Description	**Input[1]**	**Source**
Direct Costs		
Diverted waste collection ($/ton)	*($156)*	EPA, 2008
Processing of diverted waste ($/ton)	*($51)*	Kessler Consulting, 2008
Direct Benefits		
Reduced disposal costs ($/ton)	*$42*	Repa, 2005

[26] Note: measure SW1 is superseded by measure SW2 beginning in 2021; no additional GHG reductions are attributed to this measure post-2020

Revenue from sale of processed waste material ($/ton)	*$89*	ACRC, n.d.
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Other Inputs and Assumptions		
Tons of waste diverted	*Varies by year*	CAP Appendix C; data provided by RECON
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*NA*	*Assumes reductions are accounted for same year as activity

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Conservation of resources

B.5 Measure SW2: Beyond 2020 – Enhanced Waste Diversion

This section analyzed the benefits and costs of continuing activities to divert solid waste and achieve a 90% diversion rate by 2035. Calculations assume an incremental increase in the diversion rate is achieved annually between 2020 and 2035 and that activities taken to achieve this goal reduce an estimated 17,510 MT CO_2e in 2020.

This analysis only captures the participant group that is directly impacted by CAP measure activities- the waste hauler. The waste hauler may pass on costs to its customer base through rate increases; however, those potential indirect costs are not included here. Costs include the collection and processing of diverted waste. Benefits to the waste hauler include the revenue from the sale of processed material. Externalities incorporated into calculations include the EPA's social cost of carbon. No non-participant costs were identified and administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure SW2 are provided in Table B16.

Table B16. Cost-Effectiveness for Measure SW2 in 2025 ($/MT CO_2e, all perspectives)

SW2: Beyond 2020 – Enhanced Waste Diversion					
	Administrator	**Participant**	**Non-Participant**	**Measure**	**Society**
GHGs Reduced (MT CO_2e)	17,510				
$/MT CO_2e	NA	($156)	-	($156)	($120)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure SW2 are documented in Table B17. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B17. Data Inputs and Assumptions for Measure SW2

SW2: Beyond 2020 – Enhanced Waste Diversion		
Description	**Input[1]**	**Source**
Direct Costs		
Diverted waste collection ($/ton)	*($156)*	EPA, 2008
Processing of diverted waste ($/ton)	*($51)*	Kessler Consulting, 2008
Direct Benefits		
Reduced disposal costs ($/ton)	*$42*	Repa, 2005
Revenue from sale of processed waste material ($/ton)	*$89*	ACRC, n.d.
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Other Inputs and Assumptions		
Tons of waste diverted	*Varies by year*	CAP Appendix C; data provided by RECON
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*NA*	*Assumes reductions are accounted for same year as activity

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Conservation of resources

B.6 Measure TL1: Smart Growth Policies

This section analyzed the benefits and costs of locating 50% of new development within SANDAG designated Smart Growth Opportunity Areas (SMOA) to reduce vehicle miles traveled (VMT). Calculations assume an incremental reduction of VMT between 2018 and 2025. Actions taken to achieve this goal are estimated to reduce 1,799 MT CO_2e in 2025.

GHG reduction estimates in the CAP assume a switch from lower to higher density development type projects. Potential development projects for the City of Oceanside as they relate to this measure are not yet known and, consequently, estimated costs and benefits are not included in this analysis. However, case studies have shown that development costs for medium-density and infill development in urban areas tends to be lower than development costs for more sprawl-type projects (Boyko and Cooper, 2011; Winkelman et al., 2010; Burchell and Mukherji, 2003) since they rely on current infrastructure (roads, sewer, etc.) as opposed to expanding infrastructure further out. Those who receive the direct benefits associated with this measure include drivers and commuters who experience reduced fuel costs associated with shorter drive distances. Smart-growth projects encourage mixed-use development; this can reduce VMT by shortening commute distances and encouraging alternate forms of transportation (e.g., bike or walk). Commuters experience a benefit in the form of avoided fuel purchases because of the reduction in VMT. 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. No non-participant costs were identified and administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure TL1 are provided in Table B18.

Table B18. Cost-Effectiveness for Measure TL1 in 2025 ($/MT CO_2e, all perspectives)

TL1: Smart Growth Policies					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	1,799				
$/MT CO_2e	NA	$264	-	$264	$330

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure TL1 are documented in Table B19. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B19. Data Inputs and Assumptions for Measure TL1

TL1: Smart Growth Policies		
Description	**Input[1]**	**Source**
Direct Costs		
No incremental development costs	-	Boyko and Cooper, 2011; Winkelman et al., 2010; Burchell and Mukherji, 2003
Direct Benefits		
Fuel savings – gasoline ($/gal; regular grade)	*Varies by year*	U.S. EIA, 2018a; U.S. EIA, 2018b
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Value of avoided criteria pollutants – $PM_{2.5}$ ($/MT)	*$491,189*	SANDAG, 2015
Value of avoided criteria pollutants - PM_{10} ($/MT)	*$149,711*	SANDAG, 2015
Value of avoided criteria pollutants - NO_x ($/MT)	*$7,812*	SANDAG, 2015
Value of avoided criteria pollutants - ROG ($/MT)	*$6,811*	SANDAG, 2015
Value of avoided criteria pollutants –SO_2 ($/MT)	*$40,558*	SANDAG, 2015
Other Inputs and Assumptions		
Conventional vehicle fuel efficiency (mpg)	*24.3*	U.S. DOE, 2017; CAP Appendix C
Annual VMT (miles/unit/yr)	*26,974*	CAP Appendix C
VMT reduced annually per unit	*24%*	CAP Appendix C
Criteria pollutants avoided annually - PM2.5 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015

Criteria pollutants avoided annually - PM10 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - NOx (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - ROG (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - SO2 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*NA*	*Assumes reductions are accounted for same year as activity

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Increase in walkable and accessible environments
- Increased quality of life
- Conservation of resources

B.7 Measure TL2: Expanded Electric Vehicle Charging Infrastructure

This section analyzed the benefits and costs of installing level II public electric vehicle (EV) charging infrastructure to increase the number of miles driven by EVs in lieu of gasoline vehicles. Calculations assume an incremental uptake in EV miles between 2018 and 2025. Actions taken to achieve this goal are estimated to reduce 3,562 MT CO_2e in 2025.

Participants include EV charger installers and EV drivers who utilize the publically available infrastructure. Installers incur the cost to purchase and install chargers less available rebates and recuperate costs through the sale of electricity to EV drivers. EV drivers incur costs for purchased electricity, but experience a benefit associated with reduced fuel (gasoline) demand. Non-participants incur a cost through the subsidization of EV chargers. 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. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure TL2 are provided in Table B20 and BCA metrics for participants in Table B21.

Table B20. Cost-Effectiveness for Measure TL2 in 2025 ($/MT CO_2e, all perspectives)

TL2: Expanded Electric Vehicle Charging Infrastructure					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	3,562				
$/MT CO_2e	NA	$104	($8)	$95	$167

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

Table B21. Additional BCA Metrics for Measure TL2 Participants

TL2: Expanded Electric Vehicle Charging Infrastructure		
Participant Group	**ROI**	**IRR**
EV Charger Installers	161%	30%
EV Drivers	13%	-

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure TL2 are documented in Table B22. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B22. Data Inputs and Assumptions for Measure TL2

TL2: Expanded Electric Vehicle Charging Infrastructure		
Description	**Input[1]**	**Source**
Direct Costs		
Level II public EV charger purchase and installation	*($7,972)*	U.S. DOE, 2015
Level II public EV charger rebate	*$2,139*	SANDAG, 2015
Permit fee ($/charger)	*($700)*	Provided by City staff
Permit fee waiver ($/charger)	*$700*	Provided by City staff
Electricity purchase (charging; $/kWh)	*Varies by year*	CEC, 2018a; SDG&E 2018
Direct Benefits		
Fuel savings – gasoline ($/gal; regular grade)	*Varies by year*	U.S. EIA, 2018a; U.S. EIA, 2018b
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Value of avoided criteria pollutants – $PM_{2.5}$ ($/MT)	*$491,189*	SANDAG, 2015
Value of avoided criteria pollutants - PM_{10} ($/MT)	*$149,711*	SANDAG, 2015
Value of avoided criteria pollutants - NO_x ($/MT)	*$7,812*	SANDAG, 2015
Value of avoided criteria pollutants - ROG ($/MT)	*$6,811*	SANDAG, 2015
Value of avoided criteria pollutants –SO_2 ($/MT)	*$40,558*	SANDAG, 2015
Other Inputs and Assumptions		
Conventional vehicle fuel efficiency (mpg)	*24.3*	U.S. DOE, 2017; CAP Appendix C
Electric vehicle fuel efficiency (kWh/mi)	*0.32*	U.S. DOE, 2017; CAP Appendix C
VMT reduced annually	*Varies by year*	CAP Appendix C
Chargers installed annually	*Varies by year*	CEC, 2018b
Criteria pollutants avoided annually - PM2.5 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015

Criteria pollutants avoided annually - PM10 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - NOx (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - ROG (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - SO2 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*10*	Smith and Castellano, 2015

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits

B.8 Measure TL5: Transportation Demand Management Programs

This section analyzed the benefits and costs of reducing emissions from vehicle miles traveled (VMT) associated with commercial and industrial development through transportation demand management (TDM) programs. Calculations assume an incremental reduction in VMT annually between 2018 and 2025 and actions taken to achieve this goal are expected to reduce 1,608 MT Co_2e in 2025.

Participants include program managers who incur costs to operate TDM programs. Participants also include those individuals who take advantage of TDM programs. Participating commuters can incur costs associated with alternative modes of transportation (e.g., bus or vanpool), but receive benefits associated with reduced fuel consumption. Participating commuters can also receive incentives which are costs to the non-participant – agencies that subsidize mass transit and vanpools. 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. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure TL5 are provided in Table B23 and BCA metrics for participants in Table B24.

Table B23. Cost-Effectiveness for Measure TL5 in 2025 ($/MT CO_2e, all perspectives)

TL5: Transportation Demand Management Programs					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	1,608				
$/MT CO_2e	NA	$228	($7)	$221	$353

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure TL5 are documented in Table B24. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B24. Data Inputs and Assumptions for Measure TL5

TL5: Transportation Demand Management Programs		
Description	**Input[1]**	**Source**
Direct Costs		
TDM program – program management ($/commuter/yr)	*($4)*	NCTR, 2010
Mass transit pass ($/rider/yr)	*($864)*	MTS, 2018a
Mass transit subsidy ($/rider/yr)	*$86*	MTS, 20018b
Vanpool lease ($/van/yr)	*($8,100)*	OCTA, 2017; Edison, 2015; SANDAG, 2018
Vanpool incentive ($/vanpool/yr)	*$4,800*	SANDAG, 2018
Direct Benefits		
Fuel savings – gasoline ($/gal; regular grade)	*Varies by year*	U.S. EIA, 2018a; U.S. EIA, 2018b
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Value of avoided criteria pollutants – $PM_{2.5}$ ($/MT)	*$491,189*	SANDAG, 2015
Value of avoided criteria pollutants - PM_{10} ($/MT)	*$149,711*	SANDAG, 2015
Value of avoided criteria pollutants - NO_x ($/MT)	*$7,812*	SANDAG, 2015
Value of avoided criteria pollutants - ROG ($/MT)	*$6,811*	SANDAG, 2015
Value of avoided criteria pollutants –SO_2 ($/MT)	*$40,558*	SANDAG, 2015
Other Inputs and Assumptions		
Commuters participating in TDM programs	*Varies by year*	CAP Appendix C
Share of commuters in mass transit program	*9%*	NCTR, 2010
Share of commuters in vanpool program	*1%*	NCTR, 2010
Share of commuters in other (bicycle, alternate work schedule, etc.)	*90%*	-
Conventional vehicle fuel efficiency (mpg)	*24.3*	U.S. DOE, 2017; CAP Appendix C
Vanpool ridership (commuters/van)	*6*	OCTA, 2017
Carpool ridership (commuters/car)	*2.1*	SANDAG, 2015
Commute distance (miles/commuter/yr)	*4,234*	SANDAG, n.d.; CAP Appendix C
VMT reduced annually	*Varies by year*	CAP Appendix C
Criteria pollutants avoided annually - PM2.5 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - PM10 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - NOx (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - ROG (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - SO2 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015

Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*NA*	*Assumes reductions are accounted for same year as activity

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Improved public health benefits
- Increased job satisfaction/reduced turnover
- Increased quality of life
- Reduced traffic congestion

B.9 Measure AF1: Urban Forestry Program

This section analyzed the benefits and costs of planting 400 trees annually – 200 on public rights-of-way and 200 on new development project sites. Calculations assume 400 trees are planted annually between 2018 and 2025 and that GHG reductions are associated with carbon sequestration. Actions taken to achieve this goal are estimated to reduce 176 MT CO_2e in 2025.

Two participants groups were identified for this measure, the City of Oceanside and developers. Both groups incur costs associated with the purchase, planting, and maintenance of trees. In addition, the City may experience costs of tree-related infrastructure damage (e.g., to sidewalks) and liability concerns (e.g., falling branches). There are no direct monetary benefits received by participants and no non-participant costs were identified. Externalities incorporated into calculations include the EPA's social cost of carbon, the value of avoided criteria pollutants, and reduced water treatment costs associated with rain interception. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure AF1 are provided in Table B25 and BCA metrics for participants in Table B26.

Table B25. Cost-Effectiveness for Measure AF1 in 2025 ($/MT CO_2e, all perspectives)

AF1: Urban Forestry Program					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	176				
$/MT CO_2e	NA	($315)	-	($315)	($225)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure AF1 are documented in Table B26. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B26. Data Inputs and Assumptions for Measure AF1

AF1: Urban Forestry Program		
Description	**Input[1]**	**Source**
Direct Costs		
Purchase and planting – City ($/tree)	*($105)*	Provided through discussion with City staff
Purchase and planting – Development ($/tree)	*($82)*	Review of local nursery prices
Tree maintenance – City ($/tree)	*($98)*	Provided through discussion with City staff
Tree maintenance – Development ($/tree)	*($263)*	Review of local contractor estimates
Water bill increase ($/tree)	*Varies by year*	City of Oceanside, 2018a; City of Oceanside, 2018c
Average annual infrastructure damage cost – City only ($/tree)	*Varies by year since planting*	McPherson et al., 2000
Average annual liability and legal cost – City only ($/tree)	*Varies by year since planting*	McPherson et al., 2000
Direct Benefits		
NA	-	-
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Value of avoided criteria pollutants – O_3 ($/lb)	*$1.31*	McPherson et al., 2000
Value of avoided criteria pollutants – NO_2 ($/lb)	*$1.31*	McPherson et al., 2000
Value of avoided criteria pollutants – SO_2 ($/lb)	*$1.62*	McPherson et al., 2000
Value of avoided criteria pollutants – PM_{10} ($/lb)	*$0.96*	McPherson et al., 2000
Value of avoided criteria pollutants – VOC ($/lb)	*$1.87*	McPherson et al., 2000
Value of avoided criteria pollutants – BVOC ($/lb)	*$1.87*	McPherson et al., 2000
Rain interception benefits ($/gal)	*$0.01*	McPherson et al., 2000
Other Inputs and Assumptions		
Trees planted annually – City	*200*	CAP Appendix C
Trees planted annually – Development	*200*	CAP Appendix C
Weekly water demand (gal/tree)	*10*	Provided through discussion with City staff
Years of watering (establishment, yrs)	*3*	City of San Diego, 2015
Frequency of maintenance (e.g., pruning, yrs)	*5*	Provided through discussion with City staff
Criteria pollutants avoided annually – O_3 (lb/tree)	*0.63*	McPherson et al., 2000
Criteria pollutants avoided annually – NO_2 (lb/tree)	*0.28*	McPherson et al., 2000
Criteria pollutants avoided annually – SO_2 (lb/tree)	*0.29*	McPherson et al., 2000
Criteria pollutants avoided annually – PM_{10} (lb/tree)	*1.16*	McPherson et al., 2000

Criteria pollutants avoided annually – VOC (lb/tree)	*<0.001*	McPherson et al., 2000
Criteria pollutants avoided annually – BVOC (lb/tree)	*<0.001*	McPherson et al., 2000
Rain intercepted annually (gal/tree)	*1326*	McPherson et al., 2000
Greenhouse gases reduced annually (MT CO_2e)	*0.063*	CAP Appendix C; McPherson et al., 2001
Useful life (yrs)	*24*	Roman and Scatena, 2011

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Reduced energy use in nearby residential and non-residential buildings
- Reduced urban heat island impacts
- Improved public health benefits
- Increased property values
- Increased quality of life
- Enhanced aesthetic value

B.10 Measure AF3: Agriculture Lands Conservation Program

This section analyzed the benefits and costs of placing 250 acres of land into agricultural easements by 2025, reducing future development potential for those parcels. Calculations assumes 50 acres of land are placed into an agricultural preservation easement annually between 2020 and 2025. Actions taken to achieve this goal are estimated to preclude 7,636 MT CO_2e in 2025.

Participants in this measure include the City of Oceanside. The City will provide matching funding to purchase agricultural easements on applicable properties while leveraging grant funding through the California Strategic Growth Council Sustainable Agricultural Lands Conservation (SALC) Grant Program. Non-participant costs include those funds leveraged through the SALC program. There are anticipated benefits associated with reduced activity (e.g., avoided fuel costs from reduced VMT); however, it is unclear to whom and how those benefits will be distributed. 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. Administrator costs (e.g., CAP monitoring and reporting) are not included.

An extended set of cost-effectiveness results for Measure AF3 are provided in Table B27.

Table B27. Cost-Effectiveness for Measure AF3 in 2025 ($/MT CO_2e, all perspectives)

AF3: Agriculture Lands Conservation Program					
	Administrator	Participant	Non-Participant	Measure	Society
GHGs Reduced (MT CO_2e)	7,636				
$/MT CO_2e	NA	($6)	($56)	($63)	$36

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

General data inputs and assumptions for Measure AF3 are documented in Table B28. Emissions reductions were estimated according to calculations in the City of Oceanside Climate Action Plan Appendix C.

Table B28. Data Inputs and Assumptions for Measure AF3

AF3: Agriculture Lands Conservation Program		
Description	**Input[1]**	**Source**
Direct Costs		
Easement purchase ($/acre)	*($61,306)*	County of San Diego, n.d
SALCP grant funding ($ of easement purchase)	*90%*	SANDAG, 2018
Direct Benefits		
NA	-	-
Externalities Included		
Social cost of carbon	*Varies by year*	U.S. EPA, 2016
Value of avoided criteria pollutants – $PM_{2.5}$ ($/MT)	*$491,189*	SANDAG, 2015
Value of avoided criteria pollutants - PM_{10} ($/MT)	*$149,711*	SANDAG, 2015
Value of avoided criteria pollutants - NO_x ($/MT)	*$7,812*	SANDAG, 2015
Value of avoided criteria pollutants - ROG ($/MT)	*$6,811*	SANDAG, 2015
Value of avoided criteria pollutants –SO_2 ($/MT)	*$40,558*	SANDAG, 2015
Other Inputs and Assumptions		
Acres acquired annually	*50*	CAP Appendix C
Matching funds from City (cash match)	*5%*	Provided through discussion with City staff
Matching funds from City (in-kind match)	*5%*	Provided through discussion with City staff
VMT reduced annually (VMT/acre)	*17,263*	CAP Appendix C
Criteria pollutants avoided annually - PM2.5 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - PM10 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - NOx (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - ROG (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Criteria pollutants avoided annually - SO2 (g/mi)	*Varies by year*	CARB n.d. (EMFAC2014 database); CARB, 2015
Greenhouse gases reduced annually (MT CO_2e)	*Varies by year*	CAP Appendix C
Useful life (yrs)	*30*	CAP Appendix C; CA DOC, 2018

[1]All dollar values are in 2018$ Energy Policy Initiatives Center, USD

Additional externalities associated with this measure, but were not monetarily evaluated in this analysis may include:

- Continued provision of ecosystem services
- Promotes smart growth development (measure TL1)
- Increased Food security
- Conservation of resources
- Improved public health benefits

References (Appendix B)

ACRC (n.d.). *Keeping Recycling Cool*. Arcata Community Recycling Center. http://www.arcatarecycling.org/

Barbose GL, Darghouth NR, Millstein D, LaCommare KH, DiSanti N, Widiss R. 2017. *Tracking the Sun 10: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*. Lawrence Berkeley National Laboratory. LBNL-2001062 https://emp.lbl.gov/publications/tracking-sun-10-installed-price/

Boyko CT, Cooper R. 2011. *Clarifying and re-conceptualising density*. Progress in Planning. 76(1):1-61 https://www.sciencedirect.com/science/article/pii/S0305900611000274

Burchell RW, Mukherji S. 2003. *Conventional Development Versus Managed Growth: The Costs of Sprawl*. American Journal of Public Health. 93(9):1534-1540 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1448006/pdf/0931534.pdf

California Air Resources Board (CARB). 2015. EMFAC2014 Volume III - Technical Documentation. https://www.arb.ca.gov/msei/downloads/emfac2014/emfac2014-vol3-technical-documentation-052015.pdf

California Air Resources Board (CARB). (n.d.). EMFAC2014. California Air Resources Board https://www.arb.ca.gov/emfac/2014/

California Department of Conservation (CA DOC). 2018. *California Sustainable Agricultural Lands Conservation Program Final Grant Guidelines & Applications*. https://www.conservation.ca.gov/dlrp/grant-programs/SALCP/Documents/FINAL%20FY17-18%20SALCP%20Guidelines.pdf

California Energy Commission (CEC). 2018a. *The California Energy Demand 2018-2030 Revised Forecast*. http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-03/TN222287_20180120T141708_The_California_Energy_Demand_20182030_Revised_Forecast.pdf

California Energy Commission (CEC). 2018b. *California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025*. https://www.nrel.gov/docs/fy18osti/70893.pdf

California Solar Initiative (CSI). 2017. *California Distributed Generation Statistics – NEM Currently Interconnected Dataset*. https://www.californiadgstats.ca.gov/downloads/

City of Oceanside. 2018a. *Single Family Residential Water Rates*. http://www.ci.oceanside.ca.us/documents/Single%20Family%20Residential%20Eff%202-1-18%20with%20new%20WW%20eff%207-1-18.pdf

City of Oceanside. 2018b. *Multiple Family Residential Water Rates*. http://www.ci.oceanside.ca.us/documents/Multiple%20Family%20Residential%20Eff%202-1-18.pdf

City of Oceanside. 2018c. *Commercial Water Rates*. http://www.ci.oceanside.ca.us/documents/Commercial%20Eff%202-1-18.pdf

City of Oceanside. 2018d. *Irrigation and Recycled Water Rates*. http://www.ci.oceanside.ca.us/documents/Irrigation%20%20Recycled%20Rates%20Eff%202-1-18.pdf

City of Oceanside. 2015. *2015 Integrated Master Plan: Recycled Water Master Plan*. PDF provided by City staff.

City of Oceanside. 2012. *Zero Waste Strategic resource Management Plan*. PDF provided by City staff.

City of San Diego 2015. *Draft Urban Forestry Management Plan*. https://www.sandiego.gov/sites/default/files/legacy/planning/programs/urbanforest/pdf/city_sd_ufmp_draft_rpt_18_feb_2015.pdf

County of San Diego. N.d. *San Diego County Assessed Values, Property Characteristics, and Maps*. Assessor's Office. https://arcc.sdcounty.ca.gov/Pages/assessor.aspx

Davidson C, Gagnon P, Denholm P, Margolis R. 2015. *Nationwide Analysis of U.S. Commercial Building Solar Photovoltaic (PV) Breakeven Conditions*. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy16osti/64793.pdf

Edison. 2015. *Frequently Asked Questions: Rideshare Program*. http://s3-us-west-2.amazonaws.com/scedison/Commuter+Benefit+Program+Frequently+Asked+Questions+-+Final+04302015.pdf

Fu R, Feldman D, Margolis R, Woodhouse M, Ardani K. 2017. *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy17osti/68580.pdf

Kessler Consulting. 2009. *Pinellas County Florida: MRFing Our Way to Diversion: Capturing the Commercial Waste Stream. Materials Recovery Feasibility Study*. http://www.nswai.com/DataBank/Reports_pdf/reports_aug15/MATERIALS%20RECOVERY%20FACILITY%20TECHONOLOGY%20REVIEW.pdf

Kniefel JD, Webb DH, O'Rear EG. 2016. *Energy and Economic Implications of Solar Photovoltaic Performance Degradation*. National Institute of Standards and Technology. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1203.pdf

McPherson EG, Simpson JR, Peper PJ, Scott KI, Xiao Q. 2000. *Tree Guidelines for Coastal Southern California Communities*. USDA Forest Service http://www.lgc.org/wordpress/docs/freepub/energy/guides/socal_tree_guidelines.pdf

McPherson EG, Simpson JR, Peper PJ, Xiao Q. 2001. *Benefit-Cost Analysis of Santa Monica's Municipal Forest*. USDA Forest Service https://www.fs.fed.us/psw/publications/mcpherson/psw_2001_mcpherson001.pdf

Metropolitan Transit System (MTS). 2018a. *Fares and Passes*. https://www.sdmts.com/fares-passes

Metropolitan Transit System (MTS). 2018b. *ECO Pass*. https://www.sdmts.com/sites/default/files/attachments/ecopass_flyer2.pdf

National Center for Transit Research (NCTR). 2010. *Developing a Technique that Predicts the Impacts of TDM on a Transportation System*. https://www.nctr.usf.edu/pdf/77809.pdf

National Renewable Energy Laboratory (NREL), Sandia, Sunspec Alliance. 2016. *Best Practices in Photovoltaic System Operations and Maintenance: 2nd Edition*. U.S. Department of Energy SuNLaMP Workign Group. https://www.nrel.gov/docs/fy17osti/67553.pdf

Navigant Consulting Inc. 2014. *California Solar Initiative Third-Party Ownership Market Impact Study*. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=7689

Orange County Transportation Authority (OCTA). 2017. *Vanpool Facts.* https://www.octa.net/pdf/Vanpool_FactSheet.pdf

Repa 2005. *NSWMA's 2005 Tip Fee Survey*. NSWMA Research Bulletin 05-3 https://wasterecycling.org/images/documents/our-work/advocacy-issues/Tipping-Fee-Bulletin-2005.pdf

Roman LA, Scatena FN. 2011. *Street tree survival rates: Meta-analysis of previous studies and application to a field survey in Philadelphia, PA, USA*. Urban Forestry and Urban Greening. 10:269-274 https://www.sciencedirect.com/science/article/pii/S1618866711000422

San Diego Association of Governments (SANDAG). 2018. *Redesign Your Commute: SANDAG Vanpool Program.* https://icommutesd.com/docs/default-source/vanpool/sandag-vanpool-program-brochure-2018.pdf?sfvrsn=10

San Diego Association of Governments (SANDAG). 2015. *San Diego Forward: The Regional Plan*. http://www.sdforward.com/pdfs/Final_PDFs/The_Plan_combined.pdf

San Diego Association of Governments (SANDAG). (n.d.). *Commuter Benefit Starter Kit for Employers.* http://resources.cleanenergyroadmap.com/SANDAG_commuter_benefit_starter_kit.compressed.pdf

San Diego Gas & Electric (SDG&E). 2018. *Historical Tariffs*. https://www.sdge.com/rates-regulations/historical-tariffs Accessed 23 Feb 2018

Smith M, Castellano J. 2015. *Costs Associated with Non-Residential Electric Vehicle Supply Equipment: Factors to consider in the implementation of electric vehicle charging stations*. New West Technologies, LLC. https://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

SoCal WaterSmart. 2018a. *Residential Rebates*. http://www.socalwatersmart.com/?page_id=3007

SoCal WaterSmart. 2018b. *Commercial Rebates*. http://socalwatersmart.com/commercial/

Solar Energy Industries Association (SEIA). 2017. *5 year Cost recovery period for solar energy property*. https://www.seia.org/initiatives/depreciation-solar-energy-property-macrs

Solar Energy Industries Association (SEIA). 2016. *The Solar Investment Tax Credit (ITC)*. https://www.seia.org/sites/default/files/ITC%20101%20Fact%20Sheet%20-%2004-19-2016.pdf

U.S. Department of Energy (U.S. DOE). 2017. *Hybrid and Plug-In Electric Vehicle Emissions Data Sources and Assumptions*. https://www.afdc.energy.gov/vehicles/electric_emissions_sources.html

US DOE 2015. *Costs Associated with Non-residential Electric Vehicle Supply Equipment.* United States Department of Energy. https://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

U.S. Department of Labor (U.S. DOL). 2018. *Consumer Price Index – San Diego*. Bureau of Labor Statistics. https://www.bls.gov/regions/west/ca_sandiego_msa.htm

U.S. Energy Information Administration (U.S. EIA). 2018a. *Los Angeles Gasoline and Diesel Retail Prices*. https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_y05la_m.htm

U.S. Energy Information Administration (U.S. EIA). 2018b. *Annual Energy Outlook 2018*. https://www.eia.gov/outlooks/aeo/

U.S. Environmental Protection Agency (U.S. EPA). 2016. *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis*. https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf

U.S. Department of Treasury (U.S. Treasury). 2017a. *Business Expenses*. Internal Revenue Service. Publication 535 Cat No.15065Z. https://www.irs.gov/pub/irs-pdf/p535.pdf

U.S. Department of Treasury (U.S. Treasury). 2017b. *Instructions for Form 1120 U.S. Corporation Income Tax Return*. Internal Revenue Service. Cat No.11455T https://www.irs.gov/pub/irs-pdf/i1120.pdf

U.S. Department of Treasury (U.S. Treasury). 2016. *Average Effective Federal Corporate Tax Rates*. Office of Tax Analysis. https://www.treasury.gov/resource-center/tax-policy/tax-analysis/Documents/Average-Effective-Tax-Rates-2016.pdf

Winkelman S, Bishins A, Kooshian C. 2010. *Planning for economic and environmental resilience*. Transportation Research Part A. 44:575-586 https://doi.org/10.1016/j.tra.2010.03.011

Appendix C. SENSITIVITY ANALYSIS RESULTS

A sensitivity analysis was conducted to understand how the dollar per metric ton of carbon dioxide equivalent ($/MT CO_2e) responds to changes in a key input relevant for all measures – the discount rate. Individual measure results shown here are for year 2025[27] using a three, five, and seven percent discount rate.

- E1: Renewable Energy Procurement;
- E4: Promotion of Low Income Financing Programs;
- W2: Non-Residential Water Use Benchmarking and Disclosure;
- TL3: Preferential Parking Spaces for Zero Emission Vehicles;
- TL4: Expand Complete Streets;
- AF2: Urban Agriculture and Community Gardens; and
- AF4: Carbon Farming Program.

C.1 Measure E2: Solar Photovoltaic Promotion Program

Table C1 displays sensitivity analysis results ($/MT CO_2e) for measure E2 in 2025 using a three, five, and seven percent discount rate.

Table C1. Sensitivity Analysis for Measure E2 in 2025 ($/MT CO_2e)

E2: Solar Photovoltaic Promotion Program					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	$10	($7)	$3	$40
5%	NA	$7	($7)	$0	$28
7%	NA	$4	($6)	($2)	$20

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.2 Measure W1: Implementation of the Water Conservation Master Plan

Table C2 displays sensitivity analysis results ($/MT CO_2e) for measure W1 in 2025 using a three, five, and seven percent discount rate.

Table C2. Sensitivity Analysis for Measure W1 in 2025 ($/MT CO_2e)

W1: Implementation of the Water Conservation Master Plan					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	$2,532	($184)	$2,348	$2,389
5%	NA	$2,146	($172)	$1,974	$2,009
7%	NA	$1,831	($162)	$1,669	$1699

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

[27] Results for measure SW1 (Implementation of Zero Waste Strategic Resource Plan) are presented for 2020, the year in which the measure ends.

C.3 Measure W3: Local Water Supply Development

Table C3 displays sensitivity analysis results ($/MT CO_2e) for measure W3 in 2025 using a three, five, and seven percent discount rate.

Table C3. Sensitivity Analysis for Measure W3 in 2025 ($/MT CO_2e)

W3: Local Water Supply Development					
Discount Rate	**Administrator**	**Participant**	**Non-Participant**	**Measure**	**Society**
3%	NA	($101)	-	($101)	($43)
5%	NA	($235)	-	($235)	($198)
7%	NA	($301)	-	($301)	($275)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.4 Measure SW1: Implementation of Zero Waste Strategic Resource Plan

Table C4 displays sensitivity analysis results ($/MT CO_2e) for measure SW1 in 2020 using a three, five, and seven percent discount rate.

Table C4. Sensitivity Analysis for Measure SW1 in 2020 ($/MT CO_2e)

SW1: Implementation of Zero Waste Strategic Resource Plan					
Discount Rate	**Administrator**	**Participant**	**Non-Participant**	**Measure**	**Society**
3%	NA	($213)	-	($213)	($169)
5%	NA	($205)	-	($205)	($163)
7%	NA	($197)	-	($197)	($157)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.5 Measure SW2: Beyond 2020 – Enhanced Waste Diversion

Table C5 displays sensitivity analysis results ($/MT CO_2e) for measure SW2 in 2025 using a three, five, and seven percent discount rate.

Table C5. Sensitivity Analysis for Measure SW2 in 2025 ($/MT CO_2e)

SW2: Beyond 2020 – Enhanced Waste Diversion					
Discount Rate	**Administrator**	**Participant**	**Non-Participant**	**Measure**	**Society**
3%	NA	($178)	-	($178)	($137)
5%	NA	($156)	-	($156)	($120)
7%	NA	($136)	-	($136)	($105)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.6 Measure TL1: Smart Growth Policies

Table C6 displays sensitivity analysis results ($/MT CO_2e) for measure TL1 in 2025 using a three, five, and seven percent discount rate.

Table C6. Sensitivity Analysis for Measure TL1 in 2025 ($/MT CO_2e)

TL1: Smart Growth Policies					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	$302	-	$302	$377
5%	NA	$264	-	$264	$330
7%	NA	$231	-	$231	$289

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.7 Measure TL2: Expanded Electric Vehicle Charging Infrastructure

Table C7 displays sensitivity analysis results ($/MT CO_2e) for measure TL2 in 2025 using a three, five, and seven percent discount rate.

Table C7. Sensitivity Analysis for Measure TL2 in 2025 ($/MT CO_2e)

TL2: Expanded Electric Vehicle Charging Infrastructure					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	$126	($9)	$118	$199
5%	NA	$104	($8)	$95	$167
7%	NA	$85	($8)	$78	$141

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.8 Measure TL5: Transportation Demand Management Programs

Table C8 displays sensitivity analysis results ($/MT CO_2e) for measure TL5 in 2025 using a three, five, and seven percent discount rate.

Table C8. Sensitivity Analysis for Measure TL5 in 2025 ($/MT CO_2e)

TL5: Transportation Demand Management Programs					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	$261	($8)	$253	$404
5%	NA	$228	($7)	$221	$353
7%	NA	$200	($6)	$194	$309

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.9 Measure AF1: Urban Forestry Program

Table C9 displays sensitivity analysis results ($/MT CO_2e) for measure AF1 in 2025 using a three, five, and seven percent discount rate.

Table C9. Sensitivity Analysis for Measure AF1 in 2025 ($/MT CO_2e)

AF1: Urban Forestry Program					
Discount Rate	Administrator	Participant	Non-Participant	Measure	Society
3%	NA	($399)	-	($399)	($276)

5%	NA	($315)	-	($315)	($225)
7%	NA	($254)	-	($254)	($187)

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018

C.10 Measure AF3: Agriculture Lands Conservation Program

Table C10 displays sensitivity analysis results (\$/MT CO_2e) for measure AF3 in 2025 using a three, five, and seven percent discount rate.

Table C10. Sensitivity Analysis for Measure AF3 in 2025 (\$/MT CO_2e)

AF3: Agriculture Lands Conservation Program					
Discount Rate	**Administrator**	**Participant**	**Non-Participant**	**Measure**	**Society**
3%	NA	($7)	($61)	($68)	$69
5%	NA	($6)	($56)	($63)	$36
7%	NA	($6)	($52)	($58)	$15

All dollar values are in 2018$ Energy Policy Initiatives Center, USD 2018