



MEMO

To: Bill King
CITY OF MERCED

From: Jennifer Venema

Cc: Tammy Seale, Eli Krispi, Chris Read, Xico Manarolla; PMC

Date: November 6, 2014

Re: Updated Technical Memorandum 3

We are pleased to submit the updated Technical Memorandum 3 (TM-3) per Task 3A of PMC's scope of work for the Climate Action Plan implementation program.

This memo presents quantification results of the City's GHG reduction measures, given as **Attachment A**. Now that our team has conducted a full feasibility analysis and cost-benefit assessment, we've included the results as **Attachment B** and **Attachment C**, respectively.

Introduction

This Technical Memorandum summarizes the results from the quantification of greenhouse gas (GHG) reduction measures for the City of Merced. It summarizes 1) reductions from state-level actions, 2) local accomplishments already implemented or planned, and 3) actions to implement the City's adopted Climate Action Plan (CAP). These results will help to prioritize action steps to meet the GHG reduction target of the CAP and to allow for streamlining of development projects under the California Environmental Quality Act (CEQA) Guidelines Section 15183.5(b).

This revised draft of the Technical Memorandum summarizes the GHG reductions from the implementation of these measures. It also proposes potential future criteria to assist in measure evaluation and prioritization, including start dates, costs, and other feasibility considerations.

These measures will enable the community to reduce its emissions to 1990 levels by 2020, in accordance with the goal in the adopted CAP.

Results

In the baseline year of 2008, community-wide emissions from the City of Merced totaled 599,090 metric tons of carbon dioxide equivalent (MTCO_{2e}). Emissions are forecasted to rise to 780,690 MTCO_{2e} in a business-as-usual scenario, without any intervening regulatory actions at the state, regional, or local level or technological changes. However, the state has already taken steps to reduce statewide GHG emissions, which allow for reductions at the local level. As described in Technical Memorandum #2 (dated June 11, 2014), these state actions reducing GHG emissions include the Renewables Portfolio Standard and California Building Code, among others.¹ In addition to the state's actions, Merced has implemented additional GHG reduction measures within the community. These GHG reductions total 179,500 MTCO_{2e} (see **Table I** on Page 3).

If Merced did not experience any population or job growth, it would be capable of achieving its GHG reduction goal of approximately 497,370 MTCO_{2e} solely through state-level actions and existing local accomplishments. However, the community has already added approximately 3,710 people since 2008, including both residents and employees. Annual population growth in Merced since 2008 has equaled approximately 0.6% per year, totaling 81,130 residents² and an estimated 25,100 jobs in 2014.³ Even though historic growth has been slow, the City and MCAG forecast high rates of growth for the next five years. If the community is to meet its 2020 population projections as forecasted by the Merced County Association of Governments (MCAG)⁴ and the City of Merced³, annual population growth from

¹ For more information, refer to the California Air Resources Board First Update to the AB 32 Scoping Plan (May 2014) (http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf).

² California Department of Finance. E-5 Population and Housing Estimates for Cities, Counties, and the State, 2011-2014. <http://www.dof.ca.gov/research/demographic/reports/estimates/e-5/2011-20/view.php>.

³ City of Merced. 2012. *City of Merced Public Facilities Financing Plan*. <http://cityofmerced.org/civicax/filebank/blobdload.aspx?BlobID=11855>.

⁴ City of Merced. 2011. *City of Merced General Plan, Housing Element*. <http://www.cityofmerced.org/civicax/filebank/blobdload.aspx?BlobID=11482>.

2014-2020 will have to increase to 4.3% per year. While this growth represents a sizable change since 2008, this scenario is consistent with growth forecasts in the adopted City of Merced General Plan. For consistency with General Plan buildout, the CAP relies on these Plan forecasts.

Recognizing the rates of growth expected by the City in 2020, the City's CAP measures have the potential to achieve a reduction of approximately 9% below baseline 2008 levels, together with the impact of state programs and existing local accomplishments. Yet this level of reduction falls short of the adopted reduction target of achieving 1990 levels by 2020, equivalent to a 15% below baseline 2008 levels. Although measures from the adopted CAP identify the City's preferred direction to achieve the 2020 target, growth from new development will outpace the rate of reductions anticipated through adopted CAP measures. Emissions from new development will result in approximately 37,760 MTCO_{2e} that are not otherwise mitigated by CAP measures or state programs.⁵ Closing this gap through new development can be achieved with a flexible, performance-based approach that identifies existing regulations or new opportunities for new development that would also support achievement of the City's GHG reduction target. This separate package of performance-based options will equip new development to satisfy standards of both the San Joaquin Valley Air Pollution Control District while demonstrating consistency with the CAP, thereby streamlining local permit requirements. Performance standards for new development also demonstrate the City's implementation of previously adopted General Plan Environmental Impact Report mitigations. By closing the gap to achieve the CAP reduction target, strategies for new development satisfy existing commitments in the General Plan EIR to reduce GHG emissions.

In total, measures for both existing development and performance-based options for new development can achieve a 15% reduction by 2020, achieving the adopted reduction target of the CAP. The City will implement measures in various ways, including programs for existing development on a community-wide scale, and guidance to new development on a project-level scale through the performance-based approach. These measures collectively will reduce 2020 GHG emissions by 91,970 MTCO_{2e}. Together with state actions and existing accomplishments, the City can reduce forecasted 2020 GHG emissions to 1990 levels, or approximately 15% below baseline community levels. These new measures will reduce GHG emissions across all sources of the community's emissions, although the greatest reductions will be achieved in the energy, transportation, and solid waste sectors. **Table I** identifies GHG reductions from the new measures by topic area.

⁵ New development is expected to contribute 108,010 MTCO_{2e} to Merced's annual emissions in 2020. The 37,760 MTCO_{2e} identified here represents approximately 35% of emissions from new development, and only includes the necessary reductions to achieve the target. In 2009, the San Joaquin Valley Air Pollution Control District recommended a set of Best Performance Standards for projects that generally recommends at least a 29% percent reduction below business-as-usual GHG emissions, a target reduction that is not currently being enforced. The overall, cumulative 35% reduction for new development presents the overall estimated percent reduction for new development necessary to achieve the adopted target. Actual reductions would vary project-by-project.

Table I: 2020 GHG Reductions by Topic Area

	2020 MTCO₂e
Baseline (2008) emissions	599,090
Business-as-usual emissions 2020 forecast emissions forecast	780,690
Existing Accomplishments	
State actions	-175,300
Local accomplishments	-4,200
Subtotal – State Actions and Local Accomplishments	-179,500
CAP Measures	
Land Use and Transportation – Density and Connections	-4,410
Land Use and Transportation – Alternative Transportation	-2,570
Land Use and Transportation – Alternative Fuels	-5,550
Energy Efficiency – Existing Buildings	-21,530
Energy – Renewable Energy	-5,960
Water and Wastewater – Water Conservation	-630
Water and Wastewater – Alternative Water Sources	-70
Solid Waste – Increased Diversion	-13,330
Solid Waste – Waste Minimization	0
Off-road Equipment	-160
Performance-Based Options for New Development	-37,760
Subtotal – CAP Measures	-91,970
Summary	
Total Reduction	-271,690
New Community-wide Emissions Total	509,220

2020 MTCO ₂ e	
Reduction achieved from Baseline (percentage)	-15%
Emissions Target (15% reduction from Baseline)	509,230

Note that the total reductions to be achieved in performance-based options for new development present the total reductions to be achieved by all new projects. These reductions will be implemented in a unique manner, project-by-project. Applicants for permits will select from applicable CAP measures in a checklist. These CAP measures, when analyzed collectively for all projects, can offset the GHG emissions from new development that would otherwise prevent the City from achieving the 15% reduction target. Achieving this reduction allows the City to realize its GHG reduction target of returning to 1990 levels by 2020, allowing for permit streamlining of new development.

The CAP checklist for new development will translate CAP measures into relevant project-scale measures. The checklist will allow project applicants to choose from a list, selecting those measures most suitable to their project. This performance-based approach allows developers to be engaged partners in GHG reduction efforts without being mandated to implement specific programs or actions. Most or all of the items in the performance-based approach will also support compliance with San Joaquin Valley Air Pollution Control District's (SJVAPCD) Indirect Source Review mitigations for new development. By implementing SJVAPCD mitigations, project developers reduce or eliminate fees to the Air District while simultaneously demonstrating compliance with the City's CAP. This approach equips new development to satisfy existing environmental regulations in a more efficient manner. The performance-based approach also supports CEQA-based mitigation previously adopted as part of the adopted General Plan. Previously adopted CEQA mitigation measures commit the City to achieve GHG reductions to reduce the impact of the General Plan buildout scenario.

Under the performance-based approach, the CAP provides certainty and flexibility for new development to meet and streamline existing regulatory requirements. By understanding the City's preferred mitigations, new development can choose the most appropriate standards that would satisfy both the City and Air District guidance. The CAP can then provide efficiency, eliminating the need for project-by-project analysis of GHG emissions for purposes of the California Environmental Quality Act. Instead, projects would rely on CAP tools to both 1) satisfy existing legislative and regulatory requirements, and 2) understand applicable City codes and policies. This approach to implementing the CAP also benefits the City and community of Merced, providing an integrated package of tools that 1) collectively achieves community goals, 2) provides clear expectations for new development, 3) reduces regulatory redundancy, and 4) improves the quality of the community and existing development.

Overall, this approach identifies a method for new development to address only those incremental GHG emissions caused by new development. With checklists that identify measures for new development that will satisfy the City's GHG reduction targets, the City will reduce the burden of new projects analyzing GHG emissions on an ad-hoc basis. This approach also satisfies adopted Council priority to 1) streamline regulations for new development, 2) minimize new regulations, and 3) achieve 1990 emissions levels by 2020.

Several supportive measures do not result in direct GHG emissions reductions, but rather indirectly supporting other CAP measures. These measures are known as supportive measures, as they can assist in the implementation of other measures. The supportive measures will be implemented as part of other

City programs and initiatives. This approach is consistent with City Council direction that the PCAP will achieve GHG emissions reduction goals without requirements and fees.

Method and Evaluation

Method

The baseline GHG inventory and forecast serve as the foundation for the quantification of the new reduction measures to identify GHG reduction potential. Quantification begins with activity data from the inventory, including community-wide vehicle miles traveled (VMT), kilowatt-hours (kWh) of electricity or therms of natural gas used, and tons of waste disposed, among others. Various data sources, including government agency tools and reports, case studies in similar jurisdictions, and scholarly research, were used to determine the amount of activity data that can reasonably be reduced per individual participant (e.g., a household, an employee) following the actions identified in the reduction measure. These data sources were also used to help determine a reasonable participation rate (the percent of participants in the community who are expected to implement the measure) known as a performance target, which was adjusted to match local conditions based on community values and the presence of any mandates or incentives in the specific action items. The performance targets and reductions per participant were combined to identify the estimated total reduction in activity data from the implementation of a measure. Lastly, activity data reductions were converted to GHG reductions using emissions factors from the forecast. GHG emission reductions, performance targets, and reductions per participant for individual measures are given in **Attachment A**. These metrics only apply to existing development and community-wide implementation, and do not include reductions or participation levels from implementation through the performance-based approach. Collective reductions from the performance-based approach are identified in **Attachment A** as a separate reduction item, Measure 31. Measures in **Attachment A** that have relevance to new development will be translated into actions applicable at a project scale, providing clarity and certainty for new development. Many of the metrics identified in **Attachment A** will be used to monitor and report on implementation of the reduction measures, in a manner to be described in detail in TM-4.

For clarity and ease of reference, Measures 10, 11, and 23 are preserved as separate items in **Attachment A**. However, these reductions are implemented entirely at a project level through the performance-based approach. As such, all reductions from these items are included in the performance-based target for new development in Measure 31.

Details and results of the feasibility analysis of these measures are included as **Attachment B**. Details and results of the cost-benefit analysis are included as **Attachment C**. Both Attachments B and C provide information that will support the City during CAP implementation and prioritization of measures for funding.

Attachment A: Quantification Results of CAP GHG Reduction Measures

Quantification Results of CAP GHG Reduction Measures

Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Land Use and Transportation - Density and Connections	1 Develop higher-density and mixed-use development to support alternative travel in downtown Merced and appropriate neighborhood centers.	2,730	Average housing units per acre in new development: 6.2	Number of jobs per acre: 4.0				
Land Use and Transportation - Alternative Transportation	2 Support a 30% increase in per-person intracity and intercity transit use by 2020.	180	- Percent increase in transit ridership per person: 30%	Number of Merced County Transit trips taken by Merced residents: 1,161,200				
Land Use and Transportation - Alternative Transportation	3 Promote carpool and car share systems.	510	- Number of shared cars: 20 - Percent of Merced employees eligible for car pooling: 20%	Number of shared cars: 20 (reduction of 1,610 VMT per car-share member)	Number of citywide employees eligible for car sharing: 5,020 (reduction of 100 VMT per eligible employee)			

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Land Use and Transportation - Alternative Transportation	4	230	- New bike miles (post-2013): 35 (8.4 miles of Class I bike lanes, 24.2 miles of Class II bike lanes, 0.7 miles of bike boulevards, and 1.7 miles of sharrow routes)	Number of bike commuters: 540 (reduction of 860 VMT per bike commuter)				
Land Use and Transportation - Alternative Transportation	5	160	- Percent of employed residents telecommuting: 3%	Number of employees telecommuting an average of 1.5 days per week: 730 (reduction of 460 VMT per telecommuting employee)				
Land Use and Transportation - Alternative Transportation	6	1,490	- Percent of UC Merced students living off-campus: 65% - Percent trip reduction from off-campus students: 25%	Number of students living off-campus: 5,420 (reduction of 540 VMT per student)				

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Land Use and Transportation – Density and Connections	7 Synchronize traffic signals along 10 miles of major roads, convert at-grade railroad crossings to underpasses, and replace 4-way stops in downtown with roundabouts to improve fuel efficiency.	1,680	- Road miles with traffic synchronization: 10 - Citywide VMT occurring in downtown area: 25%	Road miles with traffic synchronization: 10 (reduction of 155,820 gallons of fuel)	Downtown streets with traffic calming features: 25%			
Land Use and Transportation - Alternative Fuels	8 Support the use of neighborhood electric vehicles (NEVs, such as lower-speed, street-safe golf carts) by 3% of households by 2020.	630	- Percent of households with a NEV: 3%	Number of households with a NEV: 750(1,650 VMT per NEV, each using 370 kWh)				

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Land Use and Transportation - Alternative Fuels	9 Support the increased use of passenger plug-in electric vehicles (EV) and other alternative fuels to 5% by 2020.	4,920	- Percent of households with an EV: 5% - Number of publicly accessible EV chargers: 15	Number of households with a full EV: 1,250 (8,510 VMT per EV, each using 2,890 kWh)	Number of publicly accessible EV chargers: 15 (4,700 VMT and 1,600 kWh per charging station)			
Energy Efficiency - New Construction	10 Encourage new buildings to exceed the minimum energy efficiency requirements under the state CALGreen standards.		This measure is implemented entirely through the performance-based approach.					
Energy Efficiency - New Construction	11 Site new buildings to take advantage of natural solar resources for heating and cooling.		This measure is implemented entirely through the performance-based approach.					

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Energy Efficiency - Existing Buildings	12 Support improved energy efficiency in existing multifamily units, rental units, and affordable households through voluntary retrofits.	1,890	<ul style="list-style-type: none"> - Low-income/renter-occupied single-family homes participating in basic retrofits and operational changes: 10% - Low-income/renter-occupied single-family homes participating in advanced retrofits: 2% - Multifamily units participating in retrofits: 5% - Home appliance infiltration rate: 50% 	Number of existing low-income/renter-occupied single-family homes undergoing basic energy retrofits: 810 (reduction of 1,120 kWh and 60 therms per house)	Number of existing low-income/renter-occupied single-family homes undergoing advanced energy retrofits: 160 (reduction of 2,980 kWh and 150 therms per house)	Number of existing multifamily units participating in retrofits: 400 (reduction of 1,250 kWh and 80 therms per units)	Number of existing multifamily units and low-income/renter-occupied single-family homes upgrading appliances: 3,240 (reduction of 570 kWh per house)	

Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Energy Efficiency - Existing Buildings	13 Facilitate energy efficiency through voluntary retrofits in 15% of single-family homes, and promote low-cost opportunities to reduce energy use in single-family households.	1,990	- Homes participating in variable frequency drive (VFD) pool pump upgrades: 8% - Homes participating in basic retrofits: 10% - Homes participating in advanced retrofits: 5% - Home appliance infiltration rate: 50%	Owner-occupied existing single-family homes with VFD pool pumps: 120 (reduction of 1,630 kWh per home)	Owner-occupied existing single-family homes undergoing basic energy retrofits: 900 (reduction of 1,120 kWh and 60 therms per home)	Owner-occupied existing single-family homes undergoing advanced energy retrofits: 450 (reduction of 2,980 kWh and 150 therms per home)	Number of owner-occupied existing single-family homes upgrading appliances: 2,260 (reduction of 580 kWh per home)	
Energy Efficiency - Existing Buildings	14 Improve energy efficiency through voluntary retrofits in 16% of businesses and other energy efficiency strategies in existing commercial and industrial facilities.	16,970	- Businesses participating in retrocommissioning : 15% - Standard retrofit participation rate: 10% - Deep retrofit participation rate: 6% - Commercial appliance infiltration rate: 40%	Number of jobs in existing retrocommissioned buildings: 3,660 (reductions of 2,940 kWh and 60 therms per job)	Number of jobs in existing buildings with basic energy retrofits: 2,440 (reductions of 5,350 kWh and 120 therms per job)	Number of jobs in existing buildings with deep energy retrofits: 1,470 (reductions of 6,950 kWh and 150 therms per job)	Number of jobs in existing buildings with energy-efficient appliances: 3,660 (reductions of 580 kWh and 10 therms per job)	

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Energy Efficiency - Existing Buildings	15 Use cool roofs and shade trees to reduce the urban heat island effect in Merced.	140	- Percent of existing houses with a cool roof: 3% - Percent of existing nonresidential buildings with a cool roof: 0.5% - Number of new shade trees planted at existing properties: 500	Number of existing houses with cool roofs: 860 (reduction of 310 kWh per household)	Number of jobs in existing buildings with cool roofs: 120 (reduction of 400 kWh per job)	Number of new mature shade trees at existing properties: 500 (reduction of 200 kWh per tree)		
Energy Efficiency - Existing Buildings	16 Support retrofits to outdoor public lighting in Merced to reduce energy use.	540	- Percent of existing nonresidential buildings with energy-efficient outdoor lighting: 30%	Number of jobs in existing buildings with energy-efficient outdoor lighting: 7,330 (reduction of 210 kWh per job)				
Energy - Renewable Energy	17 Increase the amount of renewable electricity generation for on-site residential use.	2,030	- Percent of existing (2014 and earlier) households with on-site solar panels: 2%	Number of households with on-site solar PV systems: 500 existing households (8 kW PV array per house, with an average production of 11,470 kWh)				

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Energy - Renewable Energy	18 Facilitate renewable energy for on-site commercial and industrial uses.	2,630	- Percent of existing (2014 and earlier) commercial buildings with solar PV arrays: 2%	Number of jobs in buildings with solar PV arrays: 500 existing jobs (average PV array size of 52 kW, with an average production of 74,090 kWh)				
Energy - Renewable Energy	19 Support the use of solar energy to meet on-site water heating needs for domestic and nonresidential uses and swimming pools, exceeding minimum state CALGreen standards.	510	- Existing houses with domestic solar water heaters: 2% - Existing nonresidential buildings with solar water heaters: 1%	Number of homes with domestic solar water heaters: 500 existing homes (average reduction of 300 kWh and 150 therms per existing house)	Number of jobs in buildings with solar water heaters: 250 jobs in existing buildings (average reduction of 30 kWh and 50 therms per job in existing buildings)			
Energy - Renewable Energy	20 Create a community-shared solar program to produce renewable energy for off-site use in Merced.	790	- kW of community-shared solar: 1,550	kW of community-shared solar: 1,550 (average production of 2,223,420 kWh, equivalent to the annual electricity use of approximately 340 homes)				

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Water and Wastewater – Water Conservation	21	530	- Percent of residential units remaining unmetered: 0%	Number of previously unmetered homes with water meters installed: 10,800 (reduction of 94,270 gallons per unit)				
Water and Wastewater - Water Conservation	22	80	- Percent of existing houses conducting water-efficiency retrofits: 40%	Number of existing houses with water-efficiency retrofits: 10,090 (reduction of 8,420 gallons per house)				
Water and Wastewater - Water Conservation	23		This measure is implemented entirely through the performance-based approach.					
Water and Wastewater - Water Conservation	24	20	- Percent of existing (2014 and earlier) landscapes with smart irrigation systems: 20%	Number of people in buildings with landscapes watered by smart irrigation systems: 17,710 residents in existing homes and 5,020 jobs in existing buildings (average reduction of 2,810 gallons per person)				

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Water and Wastewater - Alternative Water Sources	25 Promote individual greywater and rainwater catchment systems to reduce potable water demand.	70	- Percent of houses with greywater systems: 5% Amount of greywater used: 90%	Number of residents in homes with greywater systems: 4,060 (average reduction of 13,150 gallons of potable water per year)				
Solid Waste - Increased Diversion	26 Reduce the amount of waste sent to landfills, excluding recyclables and construction and demolition (C&D) material, by 33%.	3,330	- Reduction in waste generation: 33%	Tons of waste reduced: 12,380 (reduction of 230 pounds per person)				
Solid Waste - Increased Diversion	27 Increase recycling in Merced with a goal of improving diversion of recyclables by 25%.	6,510	- Target pounds of waste per person per day, excluding construction and demolition (C&D) and organics: 0.4	Amount of waste reduced: 7,750 tons (15,495.990 pounds) of waste recycled (reduction of 150 pounds per person)				

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Solid Waste - Increased Diversion	28 Divert 50% of construction and demolition (C&D) waste from new construction projects and renovations.	3,490	- C&D recycling rate: 50%	Amount of waste reduced: 10,910 tons (21,810,780 pounds) of C&D waste recycled (reduction of 210 pounds of C&D waste per person)				
Off-road Equipment	29 Reduce emissions from lawnmowers and leaf blowers by 10%.	10	- Percent of lawnmowers replaced: 10% - Percent of leaf blowers replaced: 10%	Number of lawnmowers replaced: 1,090 (reducing 100 pounds of direct GHG emissions and using 60 kWh per lawnmower)	Number of leaf blowers replaced: 280 (reducing 50 pounds of direct GHG emissions and using 220 kWh per leaf blower)			
Off-road Equipment	30 Use alternative-fuel and fuel-efficient construction equipment, and reduce construction equipment idling time.	150	- Percent of development projects using 25% alternative fuel or hybrid construction equipment: 25% - Maximum minutes of idling time for construction equipment: 4	Percent of development projects using 25% alternative fuel or hybrid construction equipment: 25%	Maximum minutes of idling time for construction equipment: 4			

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Issue Area	Measure Language	2020 GHG Reduction	2020 Assumptions	2020 Performance Metric 1	2020 Performance Metric 2 (if applicable)	2020 Performance Metric 3 (if applicable)	2020 Performance Metric 4 (if applicable)	2020 Performance Metric 5 (if applicable)
Performance-Based Approach	31 Implement a performance-based approach for new development, allowing developers to select from applicable CAP measures that satisfy mitigations of the SJVAPCD Indirect Source Rule and reduce SJVAPCD permit fees.	37,760						

Attachment B: Feasibility Assessment

A feasibility assessment is the process of systematically reviewing each measure for implementation considerations. This results in a simple, user-friendly summary of the multiple variables that determine the feasibility of any particular greenhouse gas (GHG) emissions reduction measure from the CAP, such as capital cost, effectiveness, and co-benefit for other community values. To support this work, PMC created a Microsoft Excel workbook tool as a supplement to the reduction measure workbook. The Excel tool allows PMC and the City to conduct and adjust the feasibility assessment over time.

Feasibility Assessment Goals

The feasibility assessment has two goals: measure implementation prioritization and identification of issues that pose challenges to measure implementation.

- **Measure implementation prioritization.** The City may wish to prioritize measure implementation in a variety of ways. The City can use momentum built through the CAP development process to implement the most challenging measures early on, or it could build more momentum through implementation of “low hanging fruit” measures. The feasibility assessment allows the City to identify which measures it wants to focus on based on its preferred implementation approach. Using the feasibility assessment as a tool to aid with prioritization recognizes that all measures identified in the CAP are necessary to achieve the adopted CAP target of 1990 levels by 2020, equivalent to a 15% reduction below 2008 emissions levels by 2020.
- **Identification of measures that pose challenges to implementation.** Feasibility assessments can identify implementation considerations due to cost, political feasibility, or impacts to staff time. Current measures in the CAP seek to achieve a 15% reduction below baseline 2008 emissions levels by 2020. To aid staff with implementation of these measures and achievement of the reduction target, the feasibility assessment can demonstrate potential barriers to implementation for measures. This supportive information provides additional context for measures as vetted by the Citizen’s Focus Group, Technical Advisory Committee, and City staff.

Feasibility Assessment Process

PMC identified five variables to assess feasibility for each measure. The five variables are:

1. Annual GHG reduction (metric tons of carbon dioxide equivalent (MTCO₂e) in 2020)
2. Partners and programs available to support with measure implementation
3. Consistency with CAP values (as identified in the adopted CAP)
4. Financial impact to community (negative impact, neutral, positive return on investment)
5. Financial impact to City (negative impact, neutral, positive return on investment)

To complete this analysis, PMC ranked each variable in the Excel-based tool on a five-point scale, with five indicating a measure with a low barrier to entry for the variable, and one indicating significant challenges associated with implementation. As an example, **Figure B-1** provides the complete feasibility assessment variables, scales, and scores applied to Measure 14 (Improve energy efficiency through voluntary retrofits in 16% of business and other energy efficiency strategies in existing commercial and industrial facilities). Note that the importance of each variable can be further reflected in additional

weighting through a simple factor that is applied to rankings. Currently, our analysis assumes an equal weighting of all variables to develop a summary feasibility score for each measure. We will confirm and apply weighting to the variables based on the feedback of the Focus Group and City staff.

Figure B-1. Feasibility Assessment Example

Measure 14: Improve energy efficiency through voluntary retrofits in 16% of businesses and other energy efficiency strategies in existing commercial and industrial facilities.						
GHG Reduction	Value	Scale (MTCO ₂ e in 2020)				
	-17,990	<3,000	3,000–6,000	6,001– 9,000	9,001-12,000	>12,000
		1	2	3	4	5
Partners and Programs	Value	Scale				
	Existing partners or resources exist to implement programs	No potential partnerships or programs	Potential programs but no partnerships to facilitate	Partnerships but no funding or programs	Partnerships and programs in place that require support of City staff	Partnerships with funding and programs in place, no support from City required
		1	2	3	4	5
Consistency with CAP Values	Value	Scale (number of values the measure is consistent with)				
	Clean Energy Resources, Public Outreach and Involvement	0	1	2	3	4
		1	2	3	4	5
Financial Impact to the Community	Value	Scale				
	Initial investment required, but costs are revenue positive with savings in energy bills.	Net costs	Limited investment	Cost neutral	Limited return on investment	Substantial return on investment
		1	2	3	4	5
Financial Impact to the City	Value	Scale				
	Some staff time required to distribute materials and promote programs	Net costs	Limited investment	Cost neutral	Limited return on investment	Substantial return on investment
		1	2	3	4	5

The feasibility ranking in **Figure B-I** helps City staff achieve several outcomes. First, this assessment illustrates a number of extremely positive traits associated with the measure, but also flags one possible barrier to entry, which is a financial impact to the City. While the measure has a potential financial impact to the City, the assessment contextualizes this impact relative to other values, such as values adopted by City Council in the CAP document and high GHG reduction potential. Staff can use this information to create a decision-making framework for CAP implementation. The average score for the sample measure is 3.4, allowing for comparison to other measures based on relevant implementation priorities.

As shown in **Figure B-I**, costs and benefits for measure implementation are summarized in the feasibility ranking. PMC also completed a separate cost-benefit assessment for priority measures (see **Attachment C**). Where measures have been analyzed for costs and benefits, the feasibility ranking incorporates those more detailed criteria into the ranking process. Results in the feasibility analysis contextualize the cost-benefit assessment, showing the considerations of costs and savings relative to other feasibility criteria. Please refer to **Attachment C** for additional information on the cost-benefit analysis.

The feasibility assessment provided in this memo assumes equal weighting for each of the variables. Staff can adjust the weighting of variables over time as the importance of ranking criteria shifts. For example, following adoption of a new City budget or with newly elected officials, City staff may place a greater weight on financial impacts to the City, above community values or other benefits of CAP implementation. If financial impact to the City is as important as all the other feasibility factors combined, financial impact to the City could be weighted to account for 50% of a measure's feasibility score. Revisions to the ranking criteria can be an iterative process and change over time, allowing staff to recommend limited resources for CAP implementation in a manner that achieves City objectives.

Feasibility Assessment Outcome

Table B-I provides the draft feasibility assessment outcome, which includes feasibility variable scores for each measure, the measures' weighted average scores, and the measures' rankings based on the average score. This table allows the City to analyze measures and re-prioritize measures over time, depending on the City's implementation priority. Note the following considerations:

- As described above, PMC provided a cost-benefit analysis for several measures in **Attachment C**, along with the basic analysis for all measures. The cost-benefit analysis informed the cost-related scores for those measures in **Table B-I**.
- Measures associated with new development are presented in the table for completeness, but these measures will be implemented on a project-by-project basis using a performance-based approach. This approach provides flexibility for new development. Rather than analyze each measure for new development separately, the City's overall approach to implementing performance-based options for new development is ranked comprehensively for feasibility as Measure 31.

The feasibility scores for each criteria are weighted into an average score. The average score is shown in the table as the "weighted average score" for each measure. Those measures with the highest score indicate the highest priority measure for implementation, based on the framework described above.

Table B-I. Feasibility Summary

Measure	Prioritization Considerations					Weighted Average Score	Priority
	Effectiveness (GHG Reduction)	Partners and Programs	Consistency with CAP Values	Financial Impact to the Community	Financial Impact to the City		
1: Develop higher-density, mixed-use developments to support alternative travel in downtown Merced and appropriate neighborhood centers.	1	2	4	4	2	2.6	11
2: Support a 30% increase in per-person intracity and intercity transit use by 2020.	1	4	3	4	1	2.6	9
3: Promote carpool and car share systems.	1	4	3	4	2	2.8	6
4: Increase the feasibility and use of bicycles in Merced for commute and recreation through new bicycle infrastructure and education.	1	3	3	4	2	2.6	11
5: Promote telecommuting as a viable commute alternative for 3% of Merced employees an average of 1.5 days per week by 2020.	1	1	2	4	2	2.0	26
6: Work with UC Merced to establish a Transportation Demand Management (TDM) program for new student housing located within the City.	1	3	4	3	2	2.6	11
7: Synchronize traffic signals along 10 miles of major roads, convert at-grade railroad crossings to underpasses, and replace 4-way stops in downtown with roundabouts to improve fuel efficiency.	1	3	3	4	1	2.4	17
8: Support the increased use of neighborhood electric vehicles (NEVs, such as lower-speed street-safe golf carts) to 3% of households by 2020.	1	2	3	4	2	2.4	20
9: Support the increased use of passenger plug-in electric vehicles (EV) and other alternative fuels to 5% by 2020.	2	4	2	3	2	2.6	11
10: Encourage new buildings to exceed the minimum energy efficiency requirements under the state CALGreen standards.*	n/a	n/a	n/a	n/a	n/a	n/a	n/a

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Measure	Prioritization Considerations					Weighted Average Score	Priority
	Effectiveness (GHG Reduction)	Partners and Programs	Consistency with CAP Values	Financial Impact to the Community	Financial Impact to the City		
11: Site new buildings to take advantage of natural solar resources for heating and cooling.*	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12: Support improved energy efficiency in existing multifamily units, rental units, and affordable households through voluntary retrofits.	1	4	3	4	1	2.6	9
13: Facilitate energy efficiency through voluntary retrofits in 15% of single-family homes, and promote low-cost opportunities to reduce energy use in single-family households.	1	4	3	4	2	2.8	6
14: Improve energy efficiency through voluntary retrofits in 16% of businesses and other energy efficiency strategies in existing commercial and industrial facilities.	5	4	3	4	1	3.4	2
15: Use cool roofs and shade trees to reduce the urban heat island effect in Merced.	1	3	3	3	2	2.4	20
16: Support retrofits to outdoor commercial lighting in Merced to reduce energy use.	1	4	2	4	4	3.0	5
17: Increase the amount of renewable electricity generation for on-site residential use.	2	4	3	4	2	3.0	3
18: Facilitate renewable energy for on-site commercial and industrial uses.	2	4	3	4	2	3.0	3
19: Support the use of solar energy to meet on-site water heating needs for domestic and nonresidential uses and swimming pools, exceeding minimum state CALGreen standards.	1	4	3	4	2	2.8	6
20: Create a community-shared solar program to produce renewable energy for off-site use in Merced.	1	2	3	3	3	2.4	17
21: Install water meters on remaining unmetered housing units to promote awareness and conservation.	1	2	2	4	1	2.2	22
22: Promote indoor water conservation through retrofits to existing buildings.	1	4	2	4	2	2.6	11

Measure	Prioritization Considerations					Weighted Average Score	Priority
	Effectiveness (GHG Reduction)	Partners and Programs	Consistency with CAP Values	Financial Impact to the Community	Financial Impact to the City		
23: Improve indoor water efficiency in new buildings.*	n/a	n/a	n/a	n/a	n/a	n/a	n/a
24: Reduce the amount of water used for landscaping, while continuing to allow lawn and other turf installations.	1	2	2	4	3	2.4	17
25: Promote individual greywater and rainwater catchment systems to reduce potable water demand.	1	2	2	4	2	2.2	22
26: Reduce the amount of waste sent to landfills, excluding recyclables and construction and demolition (C&D) material, by 33%.	2	3	2	2	2	2.2	25
27: Increase recycling in Merced with a goal of improving diversion of recyclables by 25%.	3	3	3	2	2	2.6	11
28: Divert 50% of construction and demolition (C&D) waste from new construction projects and renovations.	2	2	3	2	2	2.2	22
29: Reduce emissions from lawnmowers and leafblowers by 10%.	1	3	2	2	2	2.0	26
30: Use alternative-fuel and fuel-efficient construction equipment, and reduce construction equipment idling time.	1	1	2	1	1	1.2	28
31: Implement a performance-based approach for new development, allowing developers to select from applicable CAP measures that satisfy mitigations of the SJVAPCD Indirect Source Rule and reduce SJVAPCD permit fees.	5	5	3	4	2	3.8	1

Notes: *Measure is implemented through Measure 31 and is not independently assessed for feasibility.

To illustrate the utility of the feasibility assessment, **Table B-2** presents the measures from **Table B-1** sorted by priority. This sorted list could serve as a work plan to guide CAP implementation. It is important to note that although the two highest-ranking measures have anticipated costs, their reduction potentials are extremely high and therefore, under the current scales and ratings, the ranking presents these measures as top priorities for implementation.

Table B-2. Prioritized Measures

Priority	Weighted Average Score	Measure Number and Measure Language*
1	3.8	Measure 31: Implement a performance-based approach for new development, allowing developers to select from applicable CAP measures that satisfy mitigations of the SJVAPCD Indirect Source Rule and reduce SJVAPCD permit fees.
2	3.4	Measure 14: Improve energy efficiency through voluntary retrofits in 16% of businesses and other energy efficiency strategies in existing commercial and industrial facilities.
3	3	Measure 17: Increase the amount of renewable electricity generation for on-site residential use.
3	3	Measure 18: Facilitate renewable energy for on-site commercial and industrial uses.
5	3	Measure 16: Support retrofits to outdoor commercial lighting in Merced to reduce energy use.
6	2.8	Measure 3: Promote carpool and car share systems.
6	2.8	Measure 13: Facilitate energy efficiency through voluntary retrofits in 15% of single-family homes, and promote low-cost opportunities to reduce energy use in single-family households.
6	2.8	Measure 19: Support the use of solar energy to meet on-site water heating needs for domestic and nonresidential uses and swimming pools, exceeding minimum state CALGreen standards.
9	2.6	Measure 2: Support a 30% increase in per-person intracity and intercity transit use by 2020.
9	2.6	Measure 12: Support improved energy efficiency in existing multifamily units, rental units, and affordable households through voluntary retrofits.
11	2.6	Measure 1: Develop higher-density, mixed-use developments to support alternative travel in downtown Merced and appropriate neighborhood centers.
11	2.6	Measure 4: Increase the feasibility and use of bicycles in Merced for commute and recreation through new bicycle infrastructure and education.
11	2.6	Measure 6: Work with UC Merced to establish a Transportation Demand Management (TDM) program for new student housing located within the City.
11	2.6	Measure 9: Support the increased use of passenger plug-in electric vehicles (EV) and other alternative fuels to 5% by 2020.
11	2.6	Measure 22: Promote indoor water conservation through retrofits to existing buildings.
11	2.6	Measure 27: Increase recycling in Merced with a goal of improving diversion of recyclables by 25%.
17	2.4	Measure 7: Synchronize traffic signals along 10 miles of major roads, convert at-grade railroad crossings to underpasses, and replace 4-way stops in downtown with roundabouts to improve fuel efficiency.
17	2.4	Measure 20: Create a community-shared solar program to produce renewable energy for off-site use in Merced.
17	2.4	Measure 24: Reduce the amount of water used for landscaping while continuing to allow lawn and other turf installations.
20	2.4	Measure 8: Support the increased use of neighborhood electric vehicles (NEVs, such as lower-speed street-safe golf carts) to 3% of households by 2020.
20	2.4	Measure 15: Use cool roofs and shade trees to reduce the urban heat island effect in Merced.

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Priority	Weighted Average Score	Measure Number and Measure Language*
22	2.2	Measure 21: Install water meters on remaining unmetered housing units to promote awareness and conservation.
22	2.2	Measure 25: Promote individual greywater and rainwater catchment systems to reduce potable water demand.
22	2.2	Measure 28: Divert 50% of construction and demolition (C&D) waste from new construction projects and renovations.
25	2.2	Measure 26: Reduce the amount of waste sent to landfills, excluding recyclables and construction and demolition (C&D) material, by 33%.
26	2	Measure 5: Promote telecommuting as a viable commute alternative for 3% of Merced employees an average of 1.5 days per week by 2020.
26	2	Measure 29: Reduce emissions from lawnmowers and leaf blowers by 10%.
28	1.2	Measure 30: Use alternative-fuel and fuel-efficient construction equipment, and reduce construction equipment idling time.

Note: Measures 10, 11, and 23 are implemented with Measure 31 and are not included in this table.

Attachment C: Cost-Benefit Analysis

PMC has prepared a cost-benefit analysis to assess priority CAP measures on five variables. The analysis informs the feasibility assessment for measure implementation, presented in **Attachment B**. The feasibility assessment uses costs and benefits along with other variables that indicate the viability of a measure. Factors include other partners and programs that would lead implementation or consistency with community values.

For purposes of this cost-benefit analysis, five variables categorize the financial impacts to the City of Merced and community members or other entities that will be involved in measure implementation. For many of the measures, financial impacts to the City and the community were estimated based on case studies and professional experience, using the scale shown in **Table C-1**.

Table C-1: Financial Impact Rubric for Feasibility Analysis

Score	Description
1	Net costs
2	Limited investment
3	Cost neutral
4	Limited return on investment
5	Significant return on investment

All measures were analyzed for cost-benefit criteria that include estimates of savings to community members and estimates of City staff time and costs. Twelve reduction measures received a more thorough cost-benefit analysis with estimated costs to community members, payback periods, and other methods associated with implementing the measure. Together, the information in the cost-benefit analysis informed the cost-related scores for the feasibility rankings. Measures with a full cost-benefit analysis represent plan-level cost estimates where reliable case studies, research, and literature is available. A full list of references is provided at the conclusion of this section.

Measure Selection

The twelve measures selected for the detailed cost-benefit analysis represent a diverse range of the measures. This list includes measures whether expected to be high or low in terms of financial impact, which apply to various sources of greenhouse gas (GHG) emissions and are implemented through various programs and collaboration with external agencies. The team selected measures for the detailed cost-benefit analysis based on anticipated importance in terms of contribution to the CAP target, potentially high or low financial impact that represent outliers for implementation, or availability of other resources to leverage against anticipated costs. These measures are expected to have among the greatest financial impacts.

The twelve measures selected for the detailed cost-benefit analysis are as follows:

- Measure 3: Promote carpool and car share systems.
- Measure 5: Establish telecommuting as a viable commute alternative for 3% of Merced employees an average of 1.5 days per week by 2020.

- Measure 6: Work with UC Merced to establish a Transportation Demand Management (TDM) program for new student housing located within the City.
- Measure 7: Synchronize traffic signals along 10 miles of major roads, convert at-grade railroad crossings to underpasses, and replace 4-way stops in downtown with roundabouts to improve fuel efficiency.
- Measure 10: Encourage new and significantly retrofitted buildings to exceed the minimum energy efficiency requirements under the state CALGreen standards.
- Measure 13: Facilitate energy efficiency through voluntary retrofits in 15% of single-family homes, and promote low-cost opportunities to reduce energy use in single-family households.
- Measure 14: Improve energy efficiency through voluntary retrofits in 16% of businesses and other energy efficiency strategies in existing commercial and industrial facilities.
- Measure 15: Use cool roofs and shade trees to reduce the urban heat island effect in Merced.
- Measure 17: Increase the amount of renewable electricity generation for on-site residential use.
- Measure 18: Facilitate renewable energy for on-site commercial and industrial uses.
- Measure 20: Create a community-shared solar program to produce renewable energy for off-site use in Merced.
- Measure 27: Increase recycling in Merced with a goal of improving diversion of recyclables by 25%.

Note that two measures have either been nearly completed or already analyzed for costs by City staff (Measures 7, Synchronization and Traffic Flow, and 27, Improved Recycling). Additional information from City staff has been requested and will be used to complete the analysis. For consistency with City staff's analysis, we will use these costs to complete analysis of the measures. For accuracy and consistency, rather than estimate these costs we will incorporate data from City staff into the final cost-benefit analysis.

Cost-Benefit Analysis Structure

The basic cost-benefit analysis presents the following metrics for each measure:

- Staffing costs to the City, represented in units of full-time equivalence (FTE). These costs are presented over a range of five years (for example, an FTE of 1 for a measure is equal to 0.2 FTE a year for five years).
- Annual community savings from reductions in electricity, natural gas, and gasoline use.

In addition to the above costs, the detailed cost-benefit analysis presents the following metrics for the twelve priority measures for costing:

- Capital costs to the City.
- Average total cost per community participant, such as costs per household or costs per business, depending the measure.
- Payback period (in years).

Rather than presenting total annual savings for all community members, the detailed cost-benefit analysis presents the average annual savings per community participant.

The estimated financial impacts reflect best practices from other jurisdictions throughout California, and to a lesser extent in other states if such examples are reasonably applicable to Merced. The actual costs to implement the measures are likely to vary based on specific program structures and local economic conditions at time of implementation. Additionally, the financial impacts may exclude costs that are difficult to estimate or which may be borne by a third party (e.g., a utility company).

Key Metrics

The cost-benefit analysis relies on several core metrics that are used to inform financial analysis across all measures. These key metrics are presented in **Table C-2**. Note that data sources for these costs are cited at the conclusion of this memo.

Table C-2: Key Metrics for Cost-Benefit Analysis

Metric and Unit	2020 Estimated Value
Miles per gallon (mpg) for personal vehicles	17
Cost per kilowatt-hour (kWh) for residential electricity	\$0.16
Cost per kWh for nonresidential electricity	\$0.15
Cost per therm for natural gas	\$1.08
Cost per gallon of gasoline	\$4.54
Cost per hour of City staff time	\$78.00
Work hours per year (for a full-time employee)	2,080
Years of measure implementation	5

Refer to Works Cited for sources.

Financial Analysis

For the individual measures, the cost-benefit analysis relies on the performance metrics and GHG reductions identified in previous efforts. All data used to calculate costs and benefits is consistent with the number and types of participants, the size of the GHG reductions, and the specific actions for each measure presented in the Technical Memorandum 3. These metrics were combined with estimated costs and savings as determined through reliable case studies and additional research in order to determine the citywide and community-wide costs and savings as presented in the following section. The payback period for each measure was calculated by comparing the annual operational cost savings per participant from measure implementation against the upfront investment costs. For instance, the annual reductions in energy usage for homes undergoing retrofits (Measure 13) provide an annual cost savings in reduced utility bills. These annual savings in utility bills are compared against the one-time upfront

investment to determine the annual equivalent of return-on-investment. Once payback is achieved, a participant will have paid off the upfront investment and start realizing continued cost savings.

The type of participant associated with each measures for the detailed cost-benefit analysis is shown in **Table C-3**. For measures with multiple participant types, the per-participant costs and savings reflect an average of all types.

Table C-3: Participant Type by Detailed Measure

Measure	Participant Type
3: Carpool and car share	Residents (carpool) and jobs (car share)
5: Telecommuting	Jobs
6: TDM program for UC Merced	Off-campus UC Merced students
7: Synchronization and traffic flow	Population
10: CALGreen	New housing units and businesses
13: Single-family home energy retrofits	Housing units built by 2008
14: Nonresidential energy retrofits	Businesses built by 2008
15: Cool roofs and shade trees	Houses and businesses built by 2008 (cool roofs) and number of trees (shade trees)
17: Residential renewable energy	Houses
18: Nonresidential renewable energy	Businesses
20: Community-shared solar	Population
27: Improved recycling	Population

Results

A summary of the results of the basic cost-benefit analysis is presented in **Table C-4**. Note that additional results for other measures are presented in **Table C-5**.

Table C-4: Results of Basic Cost-Benefit Analysis

Measure	City Staff Five-Year FTE	Annual Total Community Savings
I: High density and mixed use	1	\$1,416,900

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Measure	City Staff Five-Year FTE	Annual Total Community Savings
2: Increased transit use	2.25	\$94,900
3: Carpool and car share	0.5	\$293,800
4: Increased bicycle use	1.5	\$121,700
5: Telecommuting	0.5	\$80,780
6: TDM program for UC Merced	1	\$770,150
7: Synchronization and traffic flow	Pending City data	\$783,860
8: Neighborhood electric vehicles	1	\$334,800
9: Electric vehicles	2.25	\$2,640,100
10: CALGreen	0.75	\$2,520/participant*
11: Passive solar design	1.25	\$180,700
12: Multifamily unit, rental unit, and affordable housing energy retrofits	2.5	\$724,300
13: Residential energy retrofits	1	\$755,250
14: Nonresidential energy retrofits	0.75	\$6,304,480
15: Cool roofs and shade trees	1	\$60,090
16: Commercial outdoor lighting retrofits	0.5	\$229,300
17: Residential renewable energy	1.75	\$935,210
18: Nonresidential renewable energy	2.25	\$1,122,820
19: Solar water heating	0.75	\$116,900
20: Community-shared solar	1	\$433,050
21: Water metering	0.75	\$223,400
22: Indoor water conservation retrofits	1.5	\$31,100
23: Water efficiency in new buildings	0.25	\$12,900

Measure	City Staff Five-Year FTE	Annual Total Community Savings
24: Landscaping water efficiency	0.75	\$7,000
25: Greywater and rainwater catchment	0.75	\$25,900
26: Waste reduction	0.75	\$0
27: Improved recycling	Pending City data	Pending City data
28: Construction and demolition waste recycling	0.5	\$0
29: Lawn and garden equipment efficiency	1	\$29,100
30: Construction equipment efficiency	0.5	\$68,200
31: Performance-based approach	0.5	N/A

**Note: this measure will be implemented in new development and the total cost will vary, based on number of participants opting for this measure in the performance approach. All other measures are presented assuming the number of total participants for reduction measure quantification.*

A summary of the results of the detailed cost-benefit analysis is presented in **Table C-5**.

Table C-5: Results of Detailed Cost-Benefit Analysis

Measure	City Costs and Savings		Community Costs and Savings		
	Five-Year Staff Needs (FTE)	Capital Costs	Average Total Cost to Participant	Average Annual Savings per Participant	Payback Period (Years)
3: Carpool and car share	0.5	\$0	\$4	\$12	Less than 1
5: Telecommuting	0.5	\$0	\$0	\$110	1
6: TDM program for UC Merced	1	\$0	\$0	\$142	Less than 1
7: Synchronization and traffic flow	Pending City data	Pending City data	\$0	\$3	Pending
10: CALGreen	0.75	\$0	\$1,700	\$170	17

Measure	City Costs and Savings		Community Costs and Savings		
	Five-Year Staff Needs (FTE)	Capital Costs	Average Total Cost to Participant	Average Annual Savings per Participant	Payback Period (Years)
13: Residential energy retrofits	1	\$0	\$4,200	\$200	21
14: Nonresidential energy retrofits	0.75	\$0	\$59,200	\$2,530	23
15: Cool roofs and shade trees	1	\$35,390	\$1,800	\$60	34
17: Residential renewable energy	1.75	\$0	\$35,300	\$1,870	19
18: Nonresidential renewable energy	2.25	\$0	\$210,000	\$11,190	19
20: Community-shared solar	1	\$0	\$70	N/A	N/A
27: Improved recycling	Pending City data	\$0	Pending City data	\$0	Pending

The assumptions and program costs for each measure that received a detailed cost-benefit analysis, in addition to participation metrics and assumptions identified in Technical Memorandum 3 and the key metrics shown in **Table C-2**, are given in **Table C-6**.

Table C-6: Assumptions and Costs per Detailed Measure

Measure	Key Assumptions and Costs
3: Carpool and car share	<ul style="list-style-type: none"> Annual car share membership: \$55. Annual cost of vehicle maintenance and gas: \$1,330.
5: Telecommuting	<ul style="list-style-type: none"> Telecommute centers are privately built and operated, with City supporting as needed. No membership fee for use of telecommute centers. No increased utility costs from individuals telecommuting from home.
6: TDM program for UC Merced	<ul style="list-style-type: none"> No capital or program-level costs to City or community members. Measure is primarily implemented by UC Merced, with City supporting as needed.

Measure	Key Assumptions and Costs
7: Synchronization and traffic flow	<ul style="list-style-type: none"> • To be completed with actual capital costs from City staff, based on completed and planned capital projects. • Note that although cost savings for community participants is shown at zero, drivers are expected to experience a small cost savings for reduced fuel use resulting from reduced car idling time.
10: CALGreen	<ul style="list-style-type: none"> • Cost premium to build a 2,500 sq. ft. single-family house to Tier 1: \$1,300. • Cost premium to build a 960 sq. ft. multifamily unit to Tier 1: \$500 per unit. • Cost premium to build a 50,000 sq. ft. office/warehouse space, capable of supporting approximately 3 businesses, to Tier 1: \$11,200 (\$3,700 per business). • Cost premium to build a 25,000 sq. ft. retail space, capable of supporting 1-2 businesses, to Tier 1: \$6,700 (\$4,400 per business). • Cost premium to build a 52,000 sq. ft. high-rise office, capable of supporting approximately 16 businesses, to Tier 1: \$27,600 (\$1,700 per business).
13: Residential energy retrofits	<ul style="list-style-type: none"> • Net cost for a basic home retrofit: \$3,700 (includes improved air conditioner, air sealing, leak-free ductwork, and \$1,500 PG&E rebate). • Cost for an advanced home retrofit: \$15,700 (includes \$4,500 PG&E rebate). • Cost for a variable-frequency drive pool pump: \$1,500 (includes \$100 PG&E rebate). • Cost per home to upgrade half of basic appliances: \$2,300. • Home audits are paid for by utility company.

Measure	Key Assumptions and Costs
14: Nonresidential energy retrofits	<ul style="list-style-type: none"> • Businesses pay the cost for audits. Level I audits: \$0.002 per sq. ft. (\$30 per business), 40% of all audits. Level II audits: \$0.15 per sq. ft. (\$2,500 per business), 50% of all audits. Level III audits: \$0.31 per sq. ft. (\$5,100 per business), 10% of all audits. • Cost for retrocommissioning: \$0.41 per sq. ft. (\$6,700 per business). • Cost for a standard business retrofit: \$2 per sq. ft. (\$32,900 per business). • Cost for a deep business retrofit: \$25 per sq. ft. (\$410,400 per business).⁶ • Cost per business to upgrade 40% of commercial-grade appliances: \$8,000 (includes water heater, oven, and refrigerator rebates from PG&E). • Retrofits and retrocommissioning costs do not include any utility or tax rebates.
15: Cool roofs and shade trees	<ul style="list-style-type: none"> • Cost premium of a residential cool roof: \$1,900 per house. • Cost premium of a commercial cool roof: \$8,400 per business. • Cost to plant and maintain a tree: \$140 annually. • Assumes private individuals plant half of shade trees, City plants other half. Capital costs to City are City's share of tree planting and maintenance.
17: Residential renewable energy	<ul style="list-style-type: none"> • Cost per kW for a residential solar array: \$5,000. • Size of residential solar array: 8 kW. • Average rebate size: \$4,500.
18: Nonresidential renewable energy	<ul style="list-style-type: none"> • Cost per kW for a commercial solar array: \$4,600. • Size of commercial solar array: 52 kW. • Average rebate size: \$28,000.
20: Community-shared solar	<ul style="list-style-type: none"> • City does not establish solar array (works with utility, nonprofit, or other third party). • Annual cost per participant exceeds annual costs savings.

⁶ These costs are generally amortized across multiple years. Deep retrofits are also often conducted as part of a more extensive building-wide retrofit cost, and so the costs presented here may include more than energy-efficiency improvements.

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Measure	Key Assumptions and Costs
27: Improved recycling	<ul style="list-style-type: none">• To be completed with additional data from City waste franchise agreements.• Potential for costs to be passed onto waste customers through increased rates, to be confirmed with City staff.

Sources Used in Cost-Benefit Analysis

- Association of Bay Area Governments. 2012. *Retrofit Bay Area Final Report, Attachment A: ABAG Report to CEC on Energy Upgrade California*. https://www.pge.com/regulation/EnergyEfficiency2013-2014-Portfolio/Pleadings/LGSEC/2012/EnergyEfficiency2013-2014-Portfolio_Plea_LGSEC_20120803_245608Atch01_245609.pdf
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