APPENDIX E

STRATEGIES, MEASURES, AND ACTIONS SUPPORTING INFORMATION

COST/BENEFIT ANALYSIS DETAILS

Preliminary high-level estimated ranges for societal cost-effectiveness were estimated for the Climate Action and Adaptation Plan (CAAP) at the measure level. The cost-effectiveness estimates are calculated based on several components.

1. Upfront investment cost for a new or replacement technology.
2. Upfront investment cost for supporting infrastructure, such as electric vehicle (EV) charging stations.
3. Comparative ongoing costs of the new or replacement technology versus the current conventional technology. This often results in net benefits due to lower energy prices and maintenance requirements.
4. Social value of reduced greenhouse gas (GHG) emissions. This component relies on the projected reductions in GHG emissions and the U.S. Environmental Protection Agency's adopted social cost of carbon.
5. Social value of reduced criteria air pollutants such as oxides of nitrogen, reactive organic gases, and particulate matter. As with GHG emissions, this component relies on projected emission reductions and the U.S. Environmental Protection Agency's social cost of pollutants.

The net present value over the expected technology life is divided over the net present value of the emission reductions to arrive at the dollars per ton.

- $$- Large Net Benefit >$1,000/ton
- $- Small Net Benefit $100–$1,000/ton
- $+/- Neutral Costs/Benefits
- $+ Small Net Cost $100–$1,000/ton
- $$+ Large Net Cost >$1,000/ton
- N/A Not yet evaluated

The cost-effectiveness estimates can be further refined as CAAP measures and actions and implemented based on the best information available at that time.

Strategy 1 – Decarbonize Transportation (DT)

Measure DT 3 Encourage Transition to Electric Vehicles

This estimate uses the net upfront cost of an EV compared to a conventional internal combustion engine vehicle, the relative energy/fuel efficiency of each with the price of each energy/fuel type, the relative maintenance costs per mile, and the cost of new charging station infrastructure per EV. It also uses the projected GHG and criteria pollutant emission reductions to estimate the social value of emissions reductions.

Strategy 3 – Decarbonize Energy and Buildings and Increase Energy Efficiency (EB)

Measure EB 1: Increase Energy Efficiency in Buildings

This estimate uses the net upfront cost of energy efficiency measures and the amount of energy use saved multiplied by the utility rate for natural gas and electricity use. The net cost (or savings)

is the difference over the lifetime of the energy efficiency measure. It also uses the projected GHG and criteria pollutant emission reductions to estimate the social value of emissions reductions.

Measure EB 2: Decarbonize and Electrify Buildings

This estimate uses the net upfront cost of electrification measures, focusing on replacing existing buildings' fossil-fueled appliances and furnaces at their end of life. The energy use for the original appliance and furnaces is multiplied by the utility rate for natural gas and for the new use by the electricity rate. It also uses the projected GHG and criteria pollutant emission reductions to estimate the social value of emissions reductions.

Measure EB 3: Increase Renewable Energy Generation and Storage

This estimate uses the costs for installing solar panels and solar panels plus battery storage compared to continued electric service from a grid-connected utility. It also uses the projected GHG and criteria pollutant emission reductions to estimate the social value of emissions reductions. Because Valley Clean Energy (VCE) is projected to achieve 100% green energy by 2030, the expected emission reductions are small. This makes this action expensive for emission reductions, but it has substantial resiliency value that is not easily quantified.

Measure EB 4: Procure Zero-Carbon Electricity

This estimate uses the rate for VCE's UltraGreen electric service compared to continued service under VCE's conventional generation product. It also uses the projected GHG and criteria pollutant emission reductions to estimate the social value of emissions reductions.

Strategy 4 – Optimize Water Use (W)

Measure W 4: Encourage Efficient Water Use in Agricultural Operations

This estimate compares the upfront cost with efficiency investments with the reduced groundwater pumping costs, measured in saved electricity. Because VCE is projected to achieve 100% green energy by 2030, the expected emission reductions are small. However, the incremental costs for these types of measures have historically been small or negative.

Strategy 6 – Reduce Off-Road Equipment Emissions (OFR)

Measure OFR 1: Increase Electric and Zero-Emission Off-Road and Landscaping Equipment Adoption

Costs for these technologies are still uncertain due to the lack of widespread availability. A cost-effectiveness assessment has not yet been prepared.

Measure OFR 2: Decarbonize Agricultural Equipment

Due the technologically challenging environment for electric agricultural equipment, few options are available beyond small local yard uses. Electric alternatives are projected to be expensive relative to conventional equipment for some time, largely due to the need for large battery capacity. This estimate is based on judgement of the significance of this challenge.

Strategy 8 – Sequester and Store Carbon in Natural and Working Lands (NWL)

Measure NWL 1: Encourage Climate-Smart Practices in Working Lands

This estimate is based on relatively small net costs for carbon sequestration activities being offset by the social value of sequestered carbon emissions.

Measure NWL 2: Restore Natural Lands

This estimate is based on relatively small net costs for carbon sequestration activities being offset by the social value of sequestered carbon emissions.

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REDUCTION CALCULATION METHODS

The GHG emissions reduction potential was quantified, where possible, using industry standard methods and assumptions, as detailed below. Some measures were not quantified in the CAAP due to data availability and calculation methodology constraints. However, quantification methods and data may be available in the future to quantify associated GHG emission reductions. All strategies, measures, and actions are important, and many are supporting efforts that promote measures that are quantified. Some measures are quantifiable but were not quantified herein. While many adaptation-focused actions may not be quantifiable from a GHG emission reduction perspective, they are critical to meeting the County's adaptation and resiliency goals.

Strategy 1 – Decarbonize Transportation

Measure DT 1: Electrify County Fleet

Measure DT 1 will require the County to install at least 20 EV charging stations within County-owned facilities and replace the oldest 20% of vehicles within the County's vehicle fleet with battery EV (BEV) or similar zero-emission vehicle (ZEV) technology by 2027. Emission factors for BEVs were applied for 2027 and account for the increasing renewables in the carbon intensity of the local electricity provider (based on weighted average Pacific Gas and Electric [PG&E] and VCE intensity). The entire vehicle fleet would be BEVs or other ZEVs by 2030. Reduction Measure EB 4 requires the County to transition all facilities to VCE and select VCE's UltraGreen option (zero-emission renewables) by 2030.

Having 100% of the County's vehicle fleet transitioned to BEV or other ZEV technology by 2030 combined with using VCE's UltraGreen option results in zero emissions from the vehicle fleet by 2030. The reduction in emissions is based on the average GHG emissions factor for non-electric passenger vehicles (based on diesel and gasoline light-duty automobiles and light-duty trucks) and was calculated in terms of carbon dioxide equivalent (CO_2e) per mile using the U.S. Environmental Protection Agency's EMission FACtor (EMFAC) 2021. The GHG emissions reduction was then estimated for each analysis year by determining the GHG benefit of shifting vehicle miles traveled from non-electric passenger vehicles to ZEVs.

Measure DT 2: Install Electric Vehicle Charging Infrastructure

The goal of Measure DT 2 is to increase the total amount of light-duty vehicles (i.e., light-duty automobiles and light-duty trucks) in unincorporated Yolo County that are ZEVs to 20% by the year 2027, 30% by the year 2030, and 90% by the year 2045. To estimate the portion of the passenger vehicle fleet consisting of ZEVs under this measure, the ZEV performance goals for each future year were applied to the total unincorporated countywide vehicle miles traveled for passenger vehicles and apportioned to BEVs and plug-in hybrid EVs based on the projected ratios from EMFAC 2021. Emission factors for BEVs and plug-in hybrid EVs were estimated for future years and account for the increasing renewables in the carbon intensity of the local electricity provider (based on weighted average PG&E and VCE intensity). The average GHG emission factor for non-EVs (based on diesel and gasoline light-duty automobiles and light-duty trucks) was calculated in terms of CO_2e per mile using EMFAC 2021. The GHG emissions reduction was then estimated for each

analysis year by determining the GHG benefit of shifting vehicle miles traveled from non-electric passenger vehicles to ZEV.

It is anticipated that the percent ZEV performance goals would be supported by the forthcoming ZEV Action Plan and the regional Electrify Yolo Project.

Strategy 2 – Reduce Vehicle Miles Traveled

No measures quantified.

Strategy 3 – Decarbonize Energy and Buildings and Increase Energy Efficiency

Measure EB 1: Increase Energy Efficiency in Buildings

Measure EB 1 aims to incentivize residents and businesses to install cool roofs and green roofs by offering loans, grants, and/or rebates to property owners and by providing educational materials about the costs and benefits of cool roofs and green roofs. Cool roofs are building roofs covered with light-reflecting materials or paints. Green roofs are building roofs with vegetation. The measure aims to install cool roofs and green roofs on 20% of new residential and commercial buildings by 2027, 30% by 2030, and 40% by 2045.

GHG emissions reductions from the installation of cool roofs and green roofs were calculated using total commercial and residential electrical energy per year from the GHG inventory and forecast for 2027, 2030, and 2045. The electrical energy projections for each year were multiplied by the participation rate for each year and multiplied by the Air Conditioning Factor and the Cool Roof Factor to find the reductions in kilowatt-hours (kWh)/year. For commercial buildings, it was assumed that air conditioning takes 15% of commercial energy use; and for residential buildings, it was assumed that air conditioning takes 17% of residential energy use (EIA 2024). For commercial and residential buildings, cool roofs reduce 15% of air conditioning energy use (DOE 2024).

Measure EB 1 also aims to develop policies and incentive programs to implement energy efficiency retrofits for existing residential, commercial, and industrial buildings, such as lighting upgrades and replacing energy-intensive appliances and equipment with more-efficient systems (such as Energy Star-rated equipment and equipment controllers). Measure EB1 aims to get a participation rate of 10% by 2027, 15% by 2030, and 25% by 2045.

GHG emissions reductions from the promotion of participation in green building programs, such as California Solar Initiative, were calculated by using the total number of commercial solar systems, which was determined by dividing the total existing square footage by a commercial building average square footage of 10,000 square feet. Participation with the California Solar Initiative was used as a surrogate for participation in green building and/or energy efficiency programs to represent various incentives the County can implement under Measure EB 1. Commercial square footage data was calculated from Sacramento Area Council of Governments (SACOG) data by assuming 1,000 square feet per person. To calculate the commercial reduction in electrical energy, this number was multiplied by the California Solar Initiative Annual Electrical Savings Rate of 5,883.5. This number was then multiplied by the corresponding participation rate to get the reduction in kWh/year. To calculate the commercial reduction in natural gas consumption, the total number of commercial solar energy systems was multiplied by the California Solar Initiative Annual Natural Gas Savings Rate of 2,282.02. This number was then multiplied by the corresponding participation rate to get the reduction in therms/year.

GHG emissions reductions from the promotion of financing programs, such as Property Assessed Clean Energy, were calculated

by using the total number of commercial solar energy systems through the same method previously detailed. To calculate the commercial reduction in electrical energy, this number was multiplied by the Property Assessed Clean Energy Savings Rate of 1.02. This number was then multiplied by the corresponding participation rate to get the reduction in kWh/year.

GHG emissions reductions were calculated by multiplying kWh and therms by a weighted utility GHG intensity factor assuming that 13% of consumption was PG&E and 87% of consumption was VCE.

Measure EB 2: Decarbonize and Electrify Buildings

Measure EB 2 requires all natural gas appliances within County buildings to be replaced with electric appliances, including retrofitting the heating, ventilation, and air conditioning systems to heat pumps and/or combined heat and power systems by 2030.

This measure aims to adopt an ordinance by 2027 that all new development (residential and nonresidential) is required to install all-electric equipment or zero-GHG-emission equipment. The measure aims to install all electric appliances in 35% of existing residential and commercial buildings by 2027, 75% by 2030, and 100% by 2045. Natural gas reduction was calculated by using the natural gas use projections for 2027, 2030, and 2045 from the GHG forecast for commercial and residential buildings. The increase in electrical energy consumption for the residential, commercial, and industrial sectors was calculated by using the natural gas reduction numbers and converting to kWh by multiplying by 100,000 British thermal units (Btu), dividing by 3,412.14 Btu/hour, multiplying by the conversion efficiency of 91%, and multiplying by the participation rate of 100%.

Measure EB 3: Increase Renewable Energy Generation and Storage

Measure EB 3 requires that by 2030 at least 25% of electric demand by County facilities is generated by photovoltaic (PV) solar panels either mounted on the rooftops of County buildings or installed on elevated racks over the parking areas of County facilities.

Measure EB 3 aims to install rooftop PV solar on 15% of existing residential buildings by 2027, 20% by 2030, and 35% by 2045; install rooftop PV solar on 10% of existing commercial buildings by 2027, 15% by 2030, and 32% by 2045; install rooftop PV solar on 70% of new residential buildings by 2027, 80% by 2030, and 95% by 2045; and install rooftop PV solar on 20% of new commercial buildings by 2027, 40% by 2030, and 70% by 2045.

Residential

GHG emissions reductions from rooftop solar PV were calculated using multifamily and single-family housing data and projections from SACOG. The baseline year for existing residential buildings is assumed to be 2022. Installation of rooftop solar PV on existing multifamily and single-family residential buildings therefore assumes a baseline year of 2022 and installation of rooftop solar PV on new multifamily residential buildings in 2027, 2030, and 2045 is based on the cumulative number of new multifamily households constructed from 2023 through each target year. The total number of existing and new households for each target year was then multiplied by the solar PV installation rate for each target year to obtain the number of participating households installing rooftop solar PV through implementation of Measure EB3. The average multifamily solar system size of 7.1 kW was calculated using data from Berkeley Laboratory's Tracking the Sun database (Berkeley Lab 2024). The average annual system electricity production (or system output) in kWh was then determined by inputting the 7.1 kW average system

size into the National Renewable Energy Laboratory (NREL) PVWatts calculator (NREL 2024) for a project located in Yolo County. The average system output was then multiplied by the number of participating households for both existing and new residential development to determine the total solar production (in kWh) for each target year.

GHG emissions reductions were calculated by multiplying kWh by a weighted utility GHG intensity factor, assuming that 13% of consumption was PG&E and 87% of consumption was VCE.

Commercial

GHG emissions reductions from rooftop solar PV were calculated using multifamily and single-family housing data and projections from SACOG. Commercial square footage data was calculated from SACOG data by assuming 1,000 square feet per person. As for residential buildings, the baseline year for existing commercial buildings is assumed to be 2022. Installation of rooftop solar PV on existing commercial buildings therefore assumes a baseline year of 2022, and installation of rooftop solar PV on new commercial buildings in 2030, 2035, and 2045 is based on the cumulative number of new commercial square footage constructed from 2023 through each target year. Similar to residential buildings, the commercial building square footage was multiplied by the solar PV installation rate for each target year to obtain the total participating commercial square footage installing rooftop solar PV through implementation of Measure EB3. The total number of commercial solar systems was determined by dividing the participating square footage by a commercial building average square footage of 10,000 square feet. The average commercial solar system size was estimated using statewide data from Berkeley Laboratory's Tracking the Sun database; this value is 84 kW per commercial system (Berkeley Lab 2024). The average annual electricity production (or system output) in kWh was then determined by inputting the average system size into the NREL PVWatts calculator for a project located in Yolo County. The average system output was then multiplied by the number of commercial solar systems for both existing and new development to determine the total solar production (in kWh) for each target year.

GHG emissions reductions were calculated by multiplying kWh by a weighted utility GHG intensity factor, assuming that 13% of consumption was PG&E and 87% of consumption was VCE.

Measure EB 4: Procure Zero-Carbon Electricity

Measure EB 4 requires that all County buildings and facilities transition to VCE's UltraGreen option (100% zero-emission renewable energy) by 2030.

This measure will also encourage 50% of residential customers to switch from PG&E to VCE by 2027, 75% by 2030, and 100% by 2045; and encourage 25% of commercial customers to switch from PG&E to VCE by 2027, 50% by 2030, and 75% by 2045. GHG emissions reductions were calculated by switching the PG&E electricity emission factors to the VCE electricity emission factors as applicable in that milestone year.

Strategy 4 – Optimize Water Use

Measure W 2: Encourage Efficient Water Use in Agricultural Operations

Measure W 2 promotes working with University of California Cooperative Extension, Yolo County Flood Control and Water Reclamation District (YCFCWCD), reclamation districts, water districts, and farming organizations to develop an outreach program that encourages farmers to adopt alternative irrigation techniques such as alternative-furrow, drip, and deficit irrigation (as identified in

Measure W 2c) that would more efficiently use water and thus would result in a reduced demand for water, which generates GHG emissions in the form of energy consumption. Agricultural irrigation pumps, which use propane and diesel as fuel, represent over 99% of the GHG emissions from the water sector. A reduction in water demand results in a direct reduction in agricultural irrigation pump use, the accompanying diesel or propane fuel consumed, and the associated GHG emissions. In 2027, no reduction in water use/agricultural pump use was assumed, as W 2c is anticipated to be implemented in Phase 2 of the CAAP. A 15% reduction in water use/agricultural pump use was assumed in 2030, and a 30% reduction in water use/agricultural pump use was assumed in 2045.

Measure W 4: Reduce Water Consumption

Implementing measures to reduce overall water consumption across sectors, including households, industries, and agriculture, directly lowers the demand for groundwater pumping. By conserving water, there is less need for energy-intensive extraction methods, leading to decreased electricity usage and reduced GHG emissions.

The County's actions under Measure W 4 all serve to promote water conservation. The County will target a 15% reduction in water consumption by 2030 and a 30% reduction in water consumption by 2045. The estimated GHG reductions from these water consumption measures are calculated using the estimated energy consumed in the pumping of potable water. The County will track water consumption to determine if groundwater pumping is being adequately reduced to achieve the desired targets for 2030 and 2045.

Strategy 5 – Minimize Waste

Measure SW 3: Reduce Emissions from Waste Management

Measure SW 3 includes exploring existing landfill gas collection and destruction systems at the Yolo County Central Landfill and considering alternatives that improve capture efficiency and emissions reductions. To estimate GHG emission reductions from landfill gas waste-in-place, a 5% improvement on landfill gas capture in 2027, 9% improvement on landfill gas capture in 2030, and 14% improvement on landfill gas capture in in 2045 was applied as a direct percentage GHG emission reduction.

Strategy 6 – Reduce Off-Road Equipment Emissions

Measure OFR 1: Increase Electric and Zero-Emission Off-Road and Landscaping Equipment Adoption

The transition from fossil-fuel-powered off-road and landscaping equipment to electric-powered alternatives will result in GHG reductions through the elimination of the burning of fossil fuels at the point of operation and increasing the portion of equipment powered by electricity. Electric-powered off-road and landscaping equipment relies on electricity, which continues to be increasingly sourced from renewable energy, reducing its carbon content. The County has targeted a 25% electric or zero-emission off-road equipment population by 2027, 75% electric or zero-emission off-road equipment population by 2030, and a complete transition to electric-powered or zero-emission off-road equipment (100%) by 2045.

Measure OFR 1 also requires County-owned off-road equipment to be 25% electric or zero-emission off-road equipment by 2027, and 100% electric or zero-emission off-road equipment by 2030 and maintained thereafter in 2045.

Measure EB 4 requires the County to transition all facilities to VCE and select VCE's UltraGreen option (zero-emission renewables) by 2030. The combination of having 100% of the County's offroad equipment electric by 2045 with VCE's UltraGreen option results in zero emissions from County owned offroad equipment by 2045.

For the community, the County will encourage the transition to electric-powered equipment through various initiatives and incentives, such as implementation of regulatory measures, financial rebates, infrastructure development, public procurement policies, and education and outreach.

Emission reductions achieved by electric-powered equipment were determined by calculating the estimated fossil fuel reduction for the target year (e.g., 25% in 2027, 75% in 2030, and 100% in 2045) and calculating the GHG emissions associated with the displaced fossil fuel in the form of electricity and the remaining fossil fuel use to arrive at the new GHG inventory total. The total reductions achieved were calculated by subtracting the new GHG inventory from the business-as-usual inventory.

Measure OFR 2: Decarbonize Agricultural Equipment

This measure will transition fossil-fuel powered agricultural equipment to cleaner-burning electric-powered alternatives. The measure results in a GHG reduction through the reduction in fossil fuel use and the increase in electric-powered equipment. The electricity to power the agricultural equipment is increasingly sourced from renewable energy, thus reducing its carbon content.

The County has targeted a 25% electric or zero-emission off-road agricultural equipment population, 75% electric or zero-emission off-road agricultural equipment population in 2030, and a complete transition to electric-powered equipment (100%) by 2045.

The County will encourage the transition to electric-powered equipment through various initiatives and incentives, such as implementation of regulatory measures, financial rebates, infrastructure development, public procurement policies, and education and outreach.

Emission reductions achieved by electric-powered equipment were determined by calculating the estimated fuel reduction for the target year (e.g., 25% in 2027, 75% in 2030, and 100% in 2045), and calculating the GHG emissions associated with the displaced fossil fuel in the form of electricity and the remaining fossil fuel use to arrive at the new GHG inventory total. The total reductions achieved were calculated by subtracting the new GHG inventory from the business-as-usual inventory.

Strategy 7 – Support Climate-Smart Agriculture

No measures quantified.

Strategy 8 – Sequester and Store Carbon in Natural and Working Lands

Measure NWL 1 Encourage Climate-Smart Practices in Working Lands

NWL 1 was quantified. See Appendix C for details.

Measure NWL 2 Restore Natural Lands

NWL 2 was quantified. See Appendix C for details.

Strategy 9 – Reduce Carbon Footprint of Consumption and Production

No measures quantified.

Strategy 10 – Build Resilient Infrastructure and Healthy Communities

No measures quantified.

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