F

Ukiah Climate Action Plan

Appendix D - Greenhouse Gas Emissions Measure Reduction Quantification and Substantial Evidence

prepared for

City of Ukiah

Community Development Department
300 Seminary Ave
Ukiah, California 95482
Contact: Craig Schlatter, Community Development Director

prepared with the assistance of

Rincon Consultants, Inc.
66 Franklin Street, Suite 300
Oakland, California 94612

January 23, 2024

RINCON CONSULTANTS, INC.
Environmental Scientists | Planners | Engineers
rinconconsultants.com

Table of Contents

Figures

Tables

1 Introduction

This technical report presents the quantification and substantial evidence that supports the greenhouse gas (GHG) emissions reduction potential of Ukiah's **Climate Action Plan (CAP)**. This report also supports the CAP's classification as a qualified GHG reduction plan. The CAP is Ukiah's community plan to reduce GHG emissions and address climate change. It includes **Measures** with numeric targets to reduce GHG emissions and **Actions** under each Measure that the City will implement through 2045 to reduce GHG emissions and make substantial progress towards the State's carbon neutrality goal.

Section 15183.5(b)(1) of the California Environmental Quality Act (CEQA) guidelines establishes several criteria which a plan must meet to be considered a qualified GHG reduction plan and allow for programmatic CEQA streamlining of project GHG emissions. This report details the evidence substantiating the GHG emissions reduction associated with the CAP measures pursuant to Subsection (D) which requires measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified GHG emissions level. This report demonstrates the Measures in the CAP provide the GHG emissions reduction necessary to meet Ukiah's 2030 GHG emission reduction target, which aligns with the State's GHG emission reduction goal established by Senate Bill (SB) 32 and make substantial progress towards the region's 2045 target which aligns with the State's goal established Assembly Bill (AB) 1279.[1]

Mechanisms to monitor the implementation of the CAP and progress toward achieving the Ukiah's GHG emission reduction targets are included in the CAP, as required in CEQA Guidelines Section 15183.5(b)(e). If, based on the tracking of community GHG emissions, Ukiah is not on track to reach the 2030 GHG emissions reduction specified in this report, the CAP as a whole or specific Measures and Actions will be amended. Based on these amendments, a CAP Update will be prepared that includes altered or additional Measures and Actions supported by substantial evidence, that with implementation can achieve the region's 2030 GHG emission reduction target and make substantial progress towards Ukiah's 2045 target.

1.1 GHG Emission Reduction Targets

The City of Ukiah's GHG emissions reduction targets align with California's goal to reduce GHG emissions 40 percent below 1990 levels by 2030 (SB 32) and California's goal to achieve carbon neutrality by 2045 (AB 1279) defined as achieving carbon neutrality by reducing GHG emissions at least 85 percent below 1990 levels and removing or sequestering the remaining GHG emissions.

Ukiah's short- and long-term GHG emission reduction targets are:

- Reduce GHG emissions 40 percent below 1990 levels by 2030; and
- Achieve carbon neutrality by 2045.

[1] SB 32 established the State goal to reduce GHG emission 40 percent below 1990 levels by 2030. AB 1279 established the State goal to achieve carbon neutrality by 2045. The State defines carbon neutrality as net zero carbon emissions, which is achieved by reducing GHG emissions at least 85 percent below 1990 levels and removing the remaining emissions.

1.2 Measures and Actions Organization

As part of the CAP process, the City of Ukiah has developed a comprehensive set of Measures and Actions to reduce communitywide GHG emissions to achieve the Ukiah's 2030 GHG emission reduction target and make substantial progress towards Ukiah's 2045 target. The Measures are organized around a set of five **Sectors** to reduce GHG emissions. Each **Measure** is then supported by a set of **Actions**. The structure of the mitigation Sectors, Measures, and Actions are as follows:

- **Sector**: Sectors define the GHG emissions category in which the GHG reductions will take place and include Building Energy; Transportation; Solid Waste; Water Resources; and Carbon Sequestration.
- **Measures**: Measures are long-range policies that the City has established to ultimately reduce GHG emissions in line with the State's goals.
- **Actions:** Actions are the discrete steps that the region will take to achieve the established Measures.

The Measures and Actions can be either quantitative or supportive, defined as follows:

- **Quantitative:** Quantitative Measures result in direct and measurable GHG emissions reductions when their Actions, backed by substantial evidence, are implemented. GHG emissions reductions from these Measures and Actions are justified by case studies, scientific articles, calculations, and other third-party substantial evidence that establish the effectiveness of the reduction Actions. Quantitative Measures can be summed to quantify how the Ukiah will meet its 2030 GHG emission reduction target and demonstrate progress towards the 2045 target.
- **Supportive:** Supportive Measures may also be quantifiable and have substantial evidence to support their overall contribution to GHG emissions reduction. However, due to one of several factors – including a low GHG emission reduction benefit, indirect GHG emission reduction benefit, or potential for double-counting– they have not been quantified and do not contribute directly to achieving and making progress towards the region's GHG emission reduction targets. Despite not being quantified, supportive Measures are nevertheless critical to the overall success of the CAP and provide support so that the quantitative Measures will be successfully implemented.

This report outlines both the quantitative and supportive Measures, detailing how each contributes to achieving Ukiah's 2030 GHG emission reduction target and advancing significant progress toward the City's 2045 target.. This report primarily focuses on the quantitative Actions that enable each Measure; however, it does also detail some of the supportive Actions that will aid in implementation. While these supportive Actions do not quantitatively contribute to achieving and making progress towards Ukiah's GHG emission reduction targets, they are nevertheless critical to the overall success of each Measure. Detail on all supportive Actions can be found in the CAP.

1.3 GHG Emissions Reductions

Table 1 summarizes the Measures and the GHG emissions reductions they would achieve in 2030 and 2045 upon the implementation of their Actions.

Table 1 CAP GHG Emissions Reduction Summary by Measure

Measure ID	Measure Text	2030 GHG Emissions Reduction Potential (MT CO_2e)	2045 GHG Emissions Reduction Potential (MT CO_2e)
Building Energy			
Measure BE-1[1]	Procure 77% of electricity from renewable and zero-carbon sources by 2030 and 100% renewable and carbon-free no later than 2045	10,971	0
Measure BE-2	Decarbonize 15% of existing buildings by 2030 and 100% by 2045	4,258	27,920
Measure BE-3	Decarbonize 95% of new building construction by 2026	2,704	15,608
Measure BE-4	Decarbonize 50% of municipal buildings by 2030 and 100% by 2045	Supportive	Supportive
Transportation			
Measure T-1	Increase the total mode share of active transportation to 15% by 2030, and 30% by 2045	373	2,164
Measure T-2	Increase total public transportation mode share to 5% by 2030, and 20% by 2045	997	5,319
Measure T-3	Reduce local vehicle miles traveled (VMT) from single passenger vehicles	Supportive	Supportive
Measure T-4	Achieve zero-emission vehicle (ZEV) adoption rates of 30% for passenger vehicles and 25% for commercial vehicles by 2030 and 100% for all vehicles by 2045	11,847	66,664
Measure T-5	By 2030, electrify or otherwise decarbonize 12% of applicable SORE off-road equipment and replace 35% of fossil diesel consumption with renewable diesel in alignment with EO N-79-20	606	1,541
Measure T-6	Decarbonize the municipal fleet in compliance with the California Advanced Clean Fleet Rule and EO N-79-20 off-road requirements	Supportive	Supportive
Water Resources			
Measure WR-1	Continue to implement wastewater recycling and water conservation projects and reduce per capita potable water consumption	Supportive	Supportive

Measure ID	Measure Text	2030 GHG Emissions Reduction Potential (MT CO_2e)	2045 GHG Emissions Reduction Potential (MT CO_2e)
Solid Waste			
Measure SW-1	Achieve and maintain SB 1383 requirements to reduce organic waste sent to landfills by 75% by 2030	3,511	4,646
Measure SW-2	Achieve SB 1383 procurement requirements (0.08 tons recovered organic waste per person) by 2030	190	228
Carbon Sequestration			
Measure CS-1	Preserve existing trees and plant at least 200 new trees per year or an equivalent amount of high-emissions reduction potential land cover throughout the community, beginning in 2025 and through 2045	149	1,635
Measure CS-2	Pursue opportunities to support the City's sustainable economic development goals with an emphasis on creating green jobs within the region	Supportive	Supportive
Total		**35,606**	**125,726**

Notes:

1. SB 100 requires the State's electricity sector to achieve 100% renewable and zero-carbon electricity by 2045. By that time, the electricity emission factor will be 0 $MTCO_2e/kWh$. As estimated emissions reductions are based on reductions applicable in the target year, as opposed to cumulative GHG emissions reductions, this results in no additional reductions in 2045 beyond the state-mandated baseline.

Together, the Measures and Actions in the CAP provide Ukiah with the GHG emissions reduction necessary to achieve Ukiah's 2030 GHG emissions reduction target (see Table 2). However, the 2045 GHG emissions reduction quantified at the time of this report are not sufficient to meet Ukiah's 2045 target of carbon neutrality. This projected shortfall[2] is due to a combination of limitations at this time in the regulatory and technological capacity for GHG reductions at this time and future regional growth and the assoicated GHG emissions.[3] Additionally, the expiration of transportation-related State requirements between 2025 and 2030 results in diminishing returns in GHG emissions reduction, especially as vehicle miles travelled (VMT) continues to increase in the community as a result of expected regional growth. This trend further contributes to the challenge of meeting Ukiah's 2045 carbon neutrality target.

[2] Table 2 shows the projected 2045 GHG emissions reduction shortfall for the City of Ukiah, amounting to 7,032 MT CO_2e. This shortfall represents just 5.3% of the total GHG emissions forecast for 2045, which the City must address to achieve its carbon neutrality goals. For context, 7,032 MT CO_2e is equivalent to either a) 2.1 utility scale wind turbines running for a year or b) 42 acres of U.S. forests preserved from conversion to cropland in one year (EPA Greenhouse Gas Equivalencies Calculator). While this projected shortfall poses a challenge, it is relatively manageable and can be addressed by additive GHG emissions reduction and/or carbon sequestration measures not yet incorporated in this document.

[3] For more information regarding impacts of projected regional growth on the community's GHG emissions, see the Ukiah GHG Forecast - Targets Memorandum published July 30, 2024.

Achieving carbon neutrality will require a combination of new or updated local and state-level policies targeting GHG emissions across all sectors, new direct emissions reduction technologies, implementation of carbon capture and sequestration innovations, and strengthened Measures and Actions that emphasize carbon sequestration, land use management, and insights gained from implementing this CAP. While the CAP may not achieve full carbon neutrality by 2045, it is consistent with the guidance from the Association of Environmental Professionals (AEP) for making "substantial progress" toward long-term GHG reduction targets, as outlined in CEQA Guidelines Section 15183.5.[4] This approach allows CEQA tiering from GHG Reduction Plans that demonstrate substantial progress in reducing emissions on a path toward long-term reduction goals without requiring full compliance with 2045 targets. Future CAP updates will include new Measures and Actions that the City will implement to close the remaining gap to achieve carbon neutrality.

Table 2 Ukiah GHG Emissions Reductions Pathway

GHG Emissions Forecast or Reduction Target	2030 GHG Emissions (MT CO_2e)	2045 GHG Emissions (MT CO_2e)
Projected GHG Emissions (Adjusted Forecast)[1]	131,128	132,758
GHG Emissions Reduction from Measure Implementation	(35,606)	(125,726)
GHG Emissions Remaining[2]	95,522	7,032
GHG Emissions Reduction Target	96,544	0
Forecasted GHG Emissions Gap[3]	(1,022)	7,032
Target anticipated to be met?	**Yes**	**No**

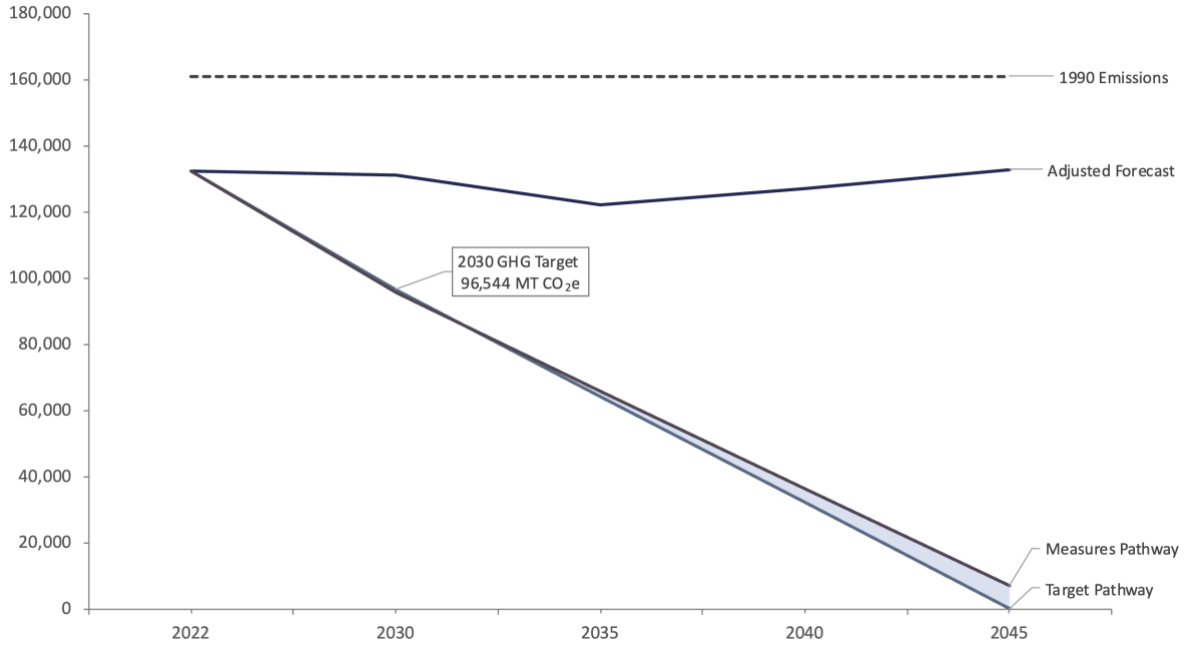
Notes: Numeric numbers denoted in parentheses represent negative numbers.

1. See Ukiah Forecast – Targets Memorandum, publish on July 30, 2024, for more information on the adjusted forecast.
2. GHG Emissions Remaining reflects the subtraction of GHG Emissions Reduction from Measure Implementation from Projected GHG Emissions.
3. Forecasted GHG Emissions Gap reflects the difference between GHG Emissions Reduction Target and the GHG Emissions Remaining after measure implementation. Negative values signify that measures achieve GHG reductions beyond the set GHG target.

Figure 1 shows Ukiah's GHG emissions reduction targets in relation to Ukiah's GHG emissions after implementation of the Measures and Actions included in the CAP. A complete description of each Measure and the quantitative Action is included within the remainder of the report.

[4] Association of Environmental Professionals (AEP). 2016. Final White Paper, Beyond 2020 and Newhall: A Field Guide to New CEQA Greenhouse Gas Thresholds and Climate Action Plan Targets for California. Available at: https://califaep.org/docs/AEP-2016_Final_White_Paper.pdf

Figure 1 Ukiah GHG Emissions Reduction Pathway



2 Sector BE: Building Energy

The City of Ukiah's Building Energy strategy focuses on decarbonizing residential and commercial buildings by leveraging the GHG reduction benefits that come from replacing natural gas with increasingly carbon-free and renewable electricity provided by the City. When coupled with renewable and zero-carbon electricity, all-electric buildings eliminate GHG emissions and transition the building system to a zero-emission operational energy footprint. The first measure emphasizes decarbonizing the City's electricity supply at increasing rates up until 2030, after which the City will support the state in achieving 100% renewable electricity, consistent with the SB 100 regulation.

Electrifying Ukiah's building stock consists of transitioning natural gas appliances—the equipment that traditionally heats our water, heats the spaces we live and work in, cooks our food, and dries our clothes —to efficient electric alternatives. Based on this approach, the CAP's Building Energy strategy consists of the Measures presented in Table 3. The table also indicates which Measures are quantitative and which Measures are supportive. The following subsections detail the substantial evidence and calculation methodologies for the quantitative Measures and the role of the supportive Measures.

Table 3 Sector BE: Building Energy GHG Emissions Reduction Summary

Measure ID	Measure	2030 GHG Emissions Reduction (MT CO_2e)	2045 GHG Emissions Reduction (MT CO_2e)
Measure BE-1[1]	Procure 77% of electricity from renewable and zero-carbon sources by 2030 and 100% renewable and carbon-free no later than 2045	10,971	0
Measure BE-2	Decarbonize 15% of existing buildings by 2030 and 100% by 2045	4,258	27,920
Measure BE-3	Decarbonize 100% of new building construction by 2026	2,704	15,608
Measure BE-4	Decarbonize 50% of municipal buildings by 2030 and 100% by 2045	Supportive	Supportive
Total		**17,934**	**43,528**

Notes:

1. SB 100 requires the State's electricity sector to achieve 100% renewable and zero-carbon electricity by 2045. By that time, the electricity emission factor will be 0 MTCO2e/kWh. As estimated emissions reductions are based on reductions applicable in the target year, as opposed to cumulative GHG emissions reductions, this results in no additional reductions in 2045 beyond the state-mandated baseline.

Measure BE-1: Procure 77% of electricity from renewable and zero-carbon sources by 2030 and 100% carbon-free no later than 2045.

Measure BE-1 aims to increase the share of electricity supplied to Ukiah that is sourced from renewable and carbon-free sources such that 77 percent of all electricity consumed is zero-carbon by 2030, and 100 percent of all electricity is renewable and carbon-free by 2045. The primary Actions that enable this target are:

- **Action BE-1a** which commits the City to evaluate utility-scale battery storage solutions;
- **Action BE-1b** which directs the City to increase local renewable energy supply through increased community adoption of renewable energy solutions, such as residential solar, wind, and battery storage; and,
- **Action BE-1c** which aims to formalize Ukiah's Electric Utility Department resource plan and renewable energy procurement schedule to meet renewable resource targets for 2030 through 2045.

To monitor progress towards the City's procurement goals the City will track completion of the resource plan identified in Action BE-1c which will aid in planning procurement schedules to meet 2030 and 2045 goals. The City will also track the percent renewable content of their utility electricity mix, which is required to be reported to the California Energy Commission (CEC) annually, as the primary performance standard for this measure.

The City of Ukiah provides electricity to its residents through its municipally owned electricity utility, which operates as a department of the City. Under this Measure, the City is committing to increasing the share of electricity procured from eligible renewable and carbon-free sources to 77 percent by 2030, up from 70 percent under existing conditions.[5,6] Currently, the energy sources supplying Ukiah's grid mix is largely obtained from hydroelectric power generated by the City's own facilities and geothermal energy provided through the Northern California Power Agency (NCPA). The remaining energy needs are supplied by natural gas power plants operated by NCPA, a member utility coalition that includes the City of Ukiah.[7]

The NCPA is a not-for-profit joint powers agency that assists its member communities in delivering reliable, affordable, and sustainable energy. Its mission includes advancing renewable energy procurement and resource planning, with a focus on transitioning to cleaner energy sources. To support long-term resource planning, the NCPA is currently developing an Integrated Resource Plan (IRP), which is anticipated to be released in 2025. Currently, Ukiah primarily relies on NCPA for power procurement outside of the City's hydroelectric generation. However, as a municipally owned utility, Ukiah has the unique flexibility to diversify their energy procurement options. NCPA's IRP will help the City further refine its strategy for achieving an increased renewables energy mix by 2030, though Action BE-1c of this plan includes consideration of additional energy procurement options.

As part of its commitment to increasing renewable energy use, NCPA is actively working to decarbonize its operations by transitioning its natural gas power plants to hydrogen fuel. This effort was recently bolstered by NCPA's selection as a recipient of federal hydrogen hub funding through

[5] The Ukiah Daily Journal. Renewable energy: Ukiah '70 percent carbon free'. Available at: https://www.ukiahdailyjournal.com/2015/07/03/renewable-energy-ukiah-70-percent-carbon-free/

[6] Ukiah currently procures and generates enough renewable energy to supply 70 percent of Ukiah's grid mix. However, it is important to note that in 2022, the inventory year for Ukiah's Community GHG Inventory, a portion of this supply was designated as unspecified power. Ukiah's power content label is available at: https://cityofukiah.com/wp-content/uploads/2023/09/City-of-Ukiah-2022-PCL.pdf

[7] Information about the generation sources and procurement rates supplying Ukiah's electric grid mix is supported by data developed as part of NCPA's member utility Integrated Resource Plan (IRP), which is currently under development and expected to be released in 2025.

the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) program[8]. The funding will support the development of on-site hydrogen infrastructure at natural gas power plants to accelerate the transition to hydrogen-based power generation, directly contributing to the City's efforts to reduce emissions associated with the portion of its energy mix currently supplied by natural gas.[9] In addition to this transition, the City plans to achieve its 77 percent renewable and carbon-free energy goal by implementing strategies such as expanding community solar adoption (**Action BE-1b)**.

To support the goal of increasing renewable energy procurement, the City is focusing on expanding incentives for the adoption of alternative energy solutions, including solar, wind, and battery storage. Battery storage plays a crucial role in advancing renewable energy goals by enabling the City to store excess energy generated from intermittent sources like solar and wind. This helps maximize the use of renewable energy and ensures grid resilience during extreme weather events or disruptions.[10,11] Increased adoption of battery storage, as well as solar installations, will be supported through **Actions BE-1a, BE-1b,** and **BE-1c** which include integrating storage solutions into long-term planning and providing incentives to encourage community-wide participation.

Reducing the cost of solar and battery storage systems is expected to drive greater adoption by making these technologies more accessible, with demand for each likely increasing as adoption of the other grows. According to the National Renewable Energy Laboratory (NREL), the combination of lower battery costs and the high value of backup power are key factors driving the installation of distributed storage systems. This trend illustrates how solar and battery storage technologies mutually reinforce each other's adoption. As battery storage becomes more affordable, solar energy systems become increasingly viable for homeowners and businesses, as storage helps manage the intermittent nature of solar energy and maximizes the value of the energy generated. Similarly, as solar installations increase, the demand for battery storage grows to provide backup power and optimize energy use.[12] As part of **Action BE-1b**, the City will offer financial incentives, such as subsidies for low-income households and small businesses in the form of rebates or vouchers, to encourage technology adoption. Additionally, the City may explore other incentive strategies, including streamlined permitting and installation processes and the development of educational materials. By incentivizing solar and battery storage system installations, particularly through financial supports, the City can foster broader community participation in renewable energy adoption, safeguarding equitable access to clean energy solutions. These actions, combined with careful planning and an energy demand forecast, will create a roadmap for long-term growth while addressing equity and reliability concerns.

Table 4 shows the parameters and data sources that support these clean energy GHG emissions reduction and Table 5 shows the calculations as outlined in Equations 1 through 1.1.

---

[8] Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES). 2024. Powering California's Transition to Renewable Energy. Available at: https://archesh2.org/

[9] Northern California Power Alliance (NCPA). 2023. California's Alliance for Renewable Clean Hydrogen Energy Systems Awarded Hydrogen Hub Funding by the U.S. Department of Energy. Available at: https://www.ncpa.com/wp-content/uploads/2023/10/NCPA-Press-Release-ARCHES-Decision-10132023.pdf

[10] Department of Energy (DOE). 2024. Energy Storage RD&D. Available at: https://www.energy.gov/oe/energy-storage-rdd#:~:text=Improved%20stability%20and%20reliability%20of,of%20renewable%20energy%20generation%3B%20and

[11] National Renewable Energy Laboratory (NREL). 2019. Grid-Scale Battery Storage, Frequently Asked Questions. Available at: https://www.nrel.gov/docs/fy19osti/74426.pdf

[12] National Renewable Energy Laboratory. 2021. Lower Battery Costs, High Value of Backup Power Drive Distributed Storage Deployment. Available at: https://www.nrel.gov/news/program/2021/lower-battery-costs-high-value-of-backup-power-the-key-drivers-of-distributed-storage-deployment.html

Renewable Energy Procurement Equations

Equation 1 $CO_2e\ Reduction_{Elec,y,i}=Total\ Elec_{y,i}*Supply\ Rate_i*(EF_{elec,y,i}-EF_{CF,y})$

Equation 1.1 $Total\ Elec_{y,i}=(Elec_{y,i}+Total\ Elec\ Converted_{y,i})*(1+L_{T\&D})$

Table 4 Renewable Energy Procurement Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 1				
$CO_2e\ Reduction_{Elec,y,i}$	Electricity GHG emissions reduction	See Table 5	MT CO_2e	Calculated
$Total\ Elec_{y,i}$	Total electricity consumption	See Table 5	kWh	Calculated
$Carbon\text{-}free\ Percent_{y,i}$	Percent of electricity obtained from carbon-free sources	See Table 5	percentage	—
$Supply\ Rate_i$	Percent of electricity supplied by Ukiah	—	—	—
$Supply\ Rate_{residential}$	—	100.00%	percentage	Ukiah supplies all electric utility
$Supply\ Rate_{nonresidential}$	—	100.00%	percentage	Ukiah supplies all electric utility
$EF_{elec,y,i}$	Forecasted electricity emission factor	See Table 5	MT CO_2e/kWh	Calculated
$EF_{CF,y}$	Electricity emission factor of carbon-free electricity	—	—	—
$EF_{CF,2030}$	—	0.00008631	MT CO_2e/kWh	Measure BE-1 2030 target of 77% renewable and zero-carbon sources
$EF_{CF,2045}$	—	0.00	MT CO_2e/kWh	Measure BE-1 target, carbon-free by 2045
i	Subsector	Residential or Nonresidential	—	—
Equation 1.1				
$Elec_{y,i}$	Forecasted electricity consumption	See Table 5	kWh	—
$Elec\ Converted_{y,i}$	Total electricity usage from conversions	See Table 5	kWh	—
$L_{T\&D}$	Electricity transmission and distribution loss percentage	4.12%	Percentage	—

Notes: "—" means either reference not applicable or see references for disaggregated parameter in the following table rows

Table 5 Renewable Energy Procurement GHG Emissions Reduction Calculations

Definition	Definition	Units	Sector	2030	2045[1]
Equation 1.1					
$Elec_{y,i}$	Forecasted electricity consumption	kWh	Residential	41,659,804	48,686,195
			Nonresidential	91,093,980	135,359,852
$Elec\ Converted_{y,i}$	Electricity usage from conversions, including T&D losses (i.e., building energy and transportation measures)	kWh	Residential	19,678,907	101,481,101
			Nonresidential	12,745,534	72,952,897
$Total\ Elec_{y,i}$	Total electricity consumption	kWh	Residential	63,867,440	156,358,042
			Nonresidential	108,120,367	216,900,580
Equation 1					
$Supply\ Rate_{y,i}$	Percent of electricity supplied by Ukiah	percentage	Residential	100%	100%
			Nonresidential	100%	100%
$EF_{elec,y,i}$	Forecasted electricity emission factor	MT CO_2e/kWh	Residential	0.0001501	0.00
			Nonresidential	0.0001501	0.00
$CO_2e\ Reduction_{Elec,y,i}$	**Electricity GHG emissions reduction**	**MT CO_2e**	**Residential**	**4,074**	**0**
			Nonresidential	**6,897**	**0**

Notes:

1. SB 100 requires the State's electricity sector to achieve 100% renewable and zero-carbon electricity by 2045. By that time, the electricity emission factor will be 0 MTCO2e/kWh. As estimated emissions reductions are based on reductions applicable in the target year, as opposed to cumulative GHG emissions reductions, this results in no additional reductions in 2045 beyond the state-mandated baseline.

Measure BE-2: Decarbonize 15% of existing buildings by 2030 and 100% by 2045.

Measure BE-2 puts Ukiah on a path to reduce residential and commercial natural gas consumption 15 percent by 2030 and 100 percent by 2045 to reduce GHG emissions through both mandatory and voluntary actions. The primary Actions that enable this level of adoption include:

- **Action BE-2a** which commits the City to adopt a zero-NOx threshold requiring replacement of water heaters and HVAC appliances in residential and commercial buildings upon burnout by 2026; and,
- **Action BE-2b** which directs the City to promote and incentives energy efficient solutions including heat pumps, "cool" building strategies, trees, green roofs, and other nature-based solutions.
- **Action BE-2d** which directs the City to work with PG&E to develop a strategy for the equitable decommissioning of the City's natural gas system by 2045.

As an initial performance standard, the City will monitor that the energy performance standard is implemented by 2026 following local adoption. Additionally, to gauge the measure's performance in reducing GHG emissions, the City will annually track the natural gas reduced by existing buildings via PG&E's Energy Data Request Portal.

Mandatory Electrification Actions

Action BE-2a commits the City to develop and adopt a zero-nitrogen oxides (zero-NOx) threshold for existing buildings by 2026. A zero-NOx threshold establishes a performance-based emissions limit for existing building systems such as water heating and space heating, requiring these systems to produce no nitrogen oxide emissions[13]. Zero-NOx thresholds developed by the Bay Area Air Quality Management District's (BAAQMD) established limits such that no natural gas appliances currently available on the market meet the threshold.[14] BAAQMD's zero-NOx thresholds underscore this strategy as an effective means of promoting the adoption of all-electric equipment, such as heat pumps for heating and water heating, which inherently produce zero on-site NOx emissions.

The zero-Nox threshold developed under **Action BE-2a** assumes that appliances reaching the end of their useful life will require a retrofit and must comply with the zero-NOx threshold. By regulating emissions rather than banning specific fuel sources, a zero-NOx standard provides a legally robust strategy for reducing GHG emissions in light of the U.S. Court of Appeals for the Ninth Circuit's decision to overturn the City of Berkeley's natural gas regulation.[15] Unlike direct bans, a zero-NOx threshold complies with federal preemption under the Energy Policy and Conservation Act (EPCA) by focusing on the emissions performance of equipment rather than dictating energy type. Additionally, developing a zero-NOx threshold aligns with State initiative as the California Air Resources Board (CARB) is currently developing zero-NOx rules which are anticipated to come into

[13] Nitrogen oxide emissions, specifically in the form of nitrous oxide (N_2O), have a significant warming potential roughly 300 times more potent than carbon dioxide in terms of contributing to global warming over a 100-year timeframe; meaning that even though it's present in smaller quantities, a single unit of N_2O has a much greater impact on warming the planet compared to carbon dioxide (CO_2).

[14] Bay Area Air Quality Management District (BAAQMD). 2022. Electric Infrastructure Impacts from Proposed Zero NOx Standards. Available at: https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20221220_sr_appd_rg09040906-pdf.pdf?rev=2c9ddef1ee9e4d5f8fafea0f68c9c932&sc_lang=en

[15] CRA V. City of Berkeley, No. 21-16278. Accessed at: https://law.justia.com/cases/federal/appellate-courts/ca9/21-16278/21-16278-2023-04-17.html.

effect by 2030.[16] The zero-emissions standards are being developed by CARB in alignment with 2022 Scoping Plan goals for achieving GHG emissions reductions, and would establish emissions requirements for water and space heating equipment sold in California. Although the State's standards are still under development, it is anticipated that Measure BE-2 will be aligned with the State's standard and stimulate adoption of zero-emissions technologies for building operations.

The quantification of emissions reduction associated with **Action BE-2a** assesses the impact of electrification of water heating and cooling systems. Although there are a range of electric alternatives (e.g. electric resistance space heating, heat pumps), heat pump HVAC and heat pump water heaters are the most cost-effective option on the market due to their significantly higher efficiency (200 to 400 percent) and resulting lower operating costs.[17,18] **Action BE-2a** is thus assumed to set thresholds that promote installation of electric heat pump HVAC and water heaters at the time of their replacements and save homeowners and property owners costs from duplicative infrastructure upgrades.

Implementing thresholds for electrification of appliances under Measure BE-2 is expected to face challenges with permit compliance, which are required for many energy efficiency improvements (e.g., water heaters, insulation, HVAC systems, duct replacement), as many jurisdictions report that only 8 to 30 percent of HVAC installations are properly permitted.[19,20] This trend in permit evasion means jurisdictions may face issues achieving compliance with building ordinances and codes. While permit compliance is critical to enforcing building codes and ordinances, it does not directly correlate to the adoption of electric appliances. Market trends indicate substantial growth in electric appliance technology in California. According to Opinion Dynamics' *California Heat Pump Residential Market Characterization and Baseline Study* (2022), electric space heaters have grown from a 5 percent market share in 2009 to a 20 percent market share in 2019. Likewise, electric water heaters have grown from a 6 percent market share in 2009 to a 12 percent market share in 2019.[21] With the growing number of incentives available for electric appliances and State initiatives to encourage electrification through efforts such as establishing zero-NOx thresholds, it is anticipated that market representation of electric alternatives will continue to rise.

To amplify these efforts and increase the efficacy of **Action BE-2a**, incentives provided under **Action BE-2b** will play a critical role in overcoming key barriers to adoption which include upfront costs and

[16] California Air Resources Board (CARB). 2024. Zero-Emission Space and Water Heater Standards. Available at: https://ww2.arb.ca.gov/our-work/programs/zero-emission-space-and-water-heater-standards

[17] U.S Department of Energy. 2024. Air-Source Heat Pumps. Available at: https://www.energy.gov/energysaver/air-source-heat-pumps?utm_source=chatgpt.com

[18] U.S Department of Energy. 2024. Heat Pump Water Heaters. Available at: https://www.energy.gov/energysaver/heat-pump-water-heaters

[19] Alvarez, Emily and Mast, Bruce. BayREN Codes & Standards Program. Local Government Policy Calculator for Existing Single-Family Buildings – User Guide (2021). Accessed at: https://www.bayren.org/sites/default/files/2021-11/bayren-policy-calculator-user-guide_10.29.2021.pdf

[20] California Public Utilities Commission (CPUC). Final Report: 2014-16 HVAC Permit and Code Compliance Market Assessment (Work Order 6) Volume I – Report (2017). Accessed at: http://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf

[21] Opinion Dynamics. California Heat Pump Residential Market Characterization and Baseline Study (2022). Accessed at: https://pda.energydataweb.com/#!/documents/2625/view.

low program awareness. [22,23] Studies have shown that financial incentives and demonstrated long-term savings are key motivators for consumer adoption of electric technologies. For instance, a study by the American Council for an Energy-Efficient Economy (ACEEE) found that while only 18 percent of participants were aware of electrification programs, 59 percent of those aware were either participating or planning to participate. Providing financial support, education, and robust program outreach through **Action BE-2b** will help bridge these gaps and align adoption with the zero-NOx thresholds. [24]

These combined efforts—clear performance thresholds, financial incentives, community outreach, and growing market trends—are expected not only to increase the rate of appliance adoption but also to improve permit compliance. Though permits are sometimes used to monitor Measure performance, the City will track reductions in natural gas usage as a more accurate measure of success in achieving the goals of Measure BE-2. To address challenges related to rates of adoption and permit compliance, the GHG emissions associated with Measure BE-2 are estimated using a conservative 85 percent zero-NOx threshold compliance for end-of-life replacement of natural gas appliances in existing buildings. Together, the Actions of Measure BE-2 are anticipated to reduce residential natural gas consumption by 12.5 percent and commercial natural gas consumption by 12.2 percent by 2030 through the adoption and enforcement of the zero-NOx threshold and time of burnout. Table 6 shows the parameters and data sources that support this Action's GHG emissions reduction and Table 7 shows the calculations as outlined in Equations 2 through 2.6.

Existing Building Zero-NOx Threshold Equations

Equation 2 $CO_2e\ Reduction_{NG,y,i}=(Fuel\ Avoided_{NG,y,i}*EF_{NG})+(Fuel\ Avoided_{NGL,y,i}*EF_{NGL})-(Elec\ Converted_{y,i}*EF_{elec,y,i}*(1+L_{T\&D}))$

Equation 2.1 $Fuel\ Avoided_{NG,y,i}=Fuel_{NG,y,i}*Reduction_{NG,y,i}$

Equation 2.2 $Reduction_{NG,y,i}=(EOL_{NG,y,i,wh}*Fuel\ Share_{NG,i,wh})+(EOL_{NG,y,i,HVAC}*Fuel\ Share_{NG,i,HVAC})$

Equation 2.3 $EOL_{NG,y,i,wh}=1/LSP_{i,wh}*(y\text{-}imp.y_i)*(1\text{-}NCR_i)$

Equation 2.4 $EOL_{NG,y,i,HVAC}=1/LSP_{i,HVAC}*(y\text{-}imp.y_i)*(1\text{-}NCR_i)$

Equation 2.5 $Fuel\ Avoided_{NGL,y,i}=Fuel\ Avoided_{NG,y,i}*(L_{Pipeline\ NGL}+L_{End\text{-}use\ NGL})$

Equation 2.6 $Elec_{convert,y,i}=Fuel_{\ AvoidedNG,y,i}*CF_{elec}/Eff_{elec}$

Table 6 Existing Building Zero-NOx Threshold Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 2				
$CO_2e\ Reduction_{NG,y,i}$	Natural gas GHG emissions reduction	See Table 7	MT CO_2e	Calculated
$Fuel\ Avoided_{NG,y,i}$	Natural gas consumption avoided	See Table 7	therms	Calculated

[22] University of California Davis. 2024. Innovative Approaches to Residential Heat Pump Promotion. Available at: https://ucdavis.app.box.com/s/0oa771tyj63qaqi2f8beitora56k78ll

[23] American Council for an Energy-Efficient Economy (ACEEE). Marketing and Promoting Electrification Using Behavioral Science: Results from a National Survey. Available at: https://www.aceee.org/research-report/b2406

[24] Ibid

Variable	Definition	Value	Unit	Data Source
EF_{NG}	Natural gas emission factor	0.005311	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel\ Avoided_{NGL,y,i}$	Natural gas leakage avoided	See Table 7	therms	Calculated
EF_{NGL}	Natural gas leakage emission factor	0.053067	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Elec\ Converted_{y,i}$	Electricity usage from conversion	See Table 7	kWh	Calculated
$EF_{elec,y,i}$	Forecasted electricity emission factor	See Table 7	MT CO_2e/kWh	Forecast
$L_{T\&D}$	Electricity transmission and distribution loss percentage	4.12%	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
y	Year	2030 or 2045	year	–
i	Subsector	Residential or Nonresidential	–	–
Equation 2.1				
$Fuel_{NG,y,i}$	Forecasted natural gas consumption after new building electrification	See Table 7	therms	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Reduction_{NG,y,i}$	Natural gas reduction percent	See Table 7	percentage	–
Equation 2.2				
$EOL_{NG,y,i,wh}$	Percent of water heaters reaching end-of-life	See Table 7	percentage	–
$Fuel\ Share_{NG,i,wh}$	Percent of sector natural gas consumption from water heaters	–	–	–
$Fuel\ Share_{NG,Residential,wh}$	Percent of residential natural gas consumption from water heaters	38%	percentage	Decarbonization of Heating Energy Use in California Buildings[1]
$Fuel\ Share_{NG,Nonresidential,wh}$	Percent of nonresidential natural gas consumption from water heaters	28%	percentage	Decarbonization of Heating Energy Use in California Buildings[1]
$EOL_{NG,y,i,HVAC}$	Percent of HVAC units reaching end-of-life	See Table 7	percentage	–
$Fuel\ Share_{NG,i,HVAC}$	Percent of sector natural gas consumption from HVAC units	–	–	–
$Fuel\ Share_{NG,i,HVAC}$	Percent of residential natural gas consumption from HVAC units	39%	percentage	Decarbonization of Heating Energy Use in California Buildings[1]
$Fuel\ Share_{NG,i,HVAC}$	Percent of nonresidential natural gas consumption from HVAC units	42%	percentage	Decarbonization of Heating Energy Use in California Buildings[1]
Equation 2.3				

Variable	Definition	Value	Unit	Data Source
$LSP_{i,wh}$	Average water heater lifespan in sector	–	–	–
$LSP_{residential,wh}$	Average residential water heater lifespan	13	years	EIA[2]
$LSP_{nonresidential,wh}$	Average nonresidential water heater lifespan	10	years	EIA[2]
$imp.y_i$	Threshold implementation year	–	–	–
$imp.y_{residential}$	Threshold implementation year for residential buildings	2026	year	Measure BE-2 target
$imp.y_{nonresidential}$	Threshold implementation year for nonresidential buildings	2026	year	Measure BE-2 target
NCR_i	Threshold noncompliance rate	15%	percentage	Estimate based on permit evasion rates and strategies to increase building code compliance[2,3,4]
Equation 2.4				
$LSP_{i,HVAC}$	Average HVAC unit lifespan in sector	–	–	–
$LSP_{residential,HVAC}$	Average residential HVAC unit lifespan	21.5	years	EIA[5]
$LSP_{nonresidential,HVAC}$	Average nonresidential HVAC unit lifespan	23	years	EIA[5]
Equation 2.5				
$L_{Pipeline\ NGL}$	Natural gas pipeline leakage percentage	2.3%	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$L_{End\text{-}use\ NGL}$	Natural gas end-use leakage percentage	0.5%	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
Equation 2.6				
CF_{elec}	Electricity to therms conversion factor	29.3	kWh/therm	Metric Conversions[6]
Eff_{elec}	Efficiency factor of electric equipment relative to natural gas equipment	3	unitless	European Copper Institute[7]

Notes: "–" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. Synapse Energy Economics, Inc. Decarbonization of Heating Energy Use in California Buildings (2018). Accessed at: https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf
2. 8-29% of HVAC projects are permitted, but implementing certain strategies can help increase permit compliance rate. Assumption is set to 15% non-compliance. See above for further explanation.
3. Alvarez, Emily and Mast, Bruce. BayREN Codes & Standards Program. Local Government Policy Calculator for Existing Single-Family Buildings – User Guide (2021). Accessed at: https://www.bayrencodes.org/wp-content/uploads/2021/11/BayREN-Policy-Calculator-User-Guide_10.29.2021.pdf
4. California Public Utilities Commission (CPUC). Final Report: 2014-16 HVAC Permit and Code Compliance Market Assessment (Work Order 6) Volume I – Report (2017). Accessed at: http://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf
5. EIA. Updated Buildings Sector Appliance and Equipment Costs and Efficiencies (2023). https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf
6. Metric Conversions. Therms (US) to Kilowatt-hours.

Variable	Definition	Value	Unit	Data Source

7. European Copper Institute. Heat Pumps: Integrating technologies to decarbonise heating and cooling (2018). Accessed at: https://www.ehpa.org/wp-content/uploads/2022/10/White_Paper_Heat_pumps-1.pdf

Table 7 Existing Building Zero-NOx Threshold GHG Emission Reduction Calculations

Variable	Definition	Units	Sector	2030	2045
Equation 2.1 & 2.2					
$Fuel_{NG,y,i}$	Forecasted natural gas consumption after new building electrification	therms	Residential	2,501,051	2,525,290
			Nonresidential	2,169,909	2,239,430
ReductionNG,y,i	Natural gas reduction percent	percentage	Residential	16.11%	61.60%
			Nonresidential	15.73%	53.29%
Fuel Avoided$_{NG,y,i}$	Natural gas consumption avoided	therms	Residential	402,817	1,555,461
			Nonresidential	341,298	1,193,422
Equation 2.3 & 2.4					
$EOL_{NG,y,i,wh}$	Percent of water heaters reaching end-of-life since ordinance implementation	percentage	Residential	26.15%	85.00%
			Nonresidential	34.00%	85.00%
$EOL_{NG,y,i,HVAC}$	Percent of HVAC units reaching end-of-life since ordinance implementation	percentage	Residential	15.81%	75.12%
			Nonresidential	14.78%	70.22%
Equation 2.5					
Fuel Avoided$_{NGL,y,i}$	Natural gas leakage avoided	therms	Residential	11,279	43,553
			Nonresidential	9,556	33,416
Equation 2.6					
Elec Converted $_{y,i}$	Electricity usage from conversion	kWh	Residential	3,934,178	15,191,671
			Nonresidential	3,333,347	11,655,751
Equation 2					
$EF_{elec,y,i}$	Forecasted electricity emission factor	MT CO_2e/kWh	Residential	0.0001501	0.0000000
			Nonresidential	0.0001501	0.0000000
CO_2e Reduction$_{NG}$	**Natural gas GHG emissions reduction**	**MT CO_2e**	**Residential**	**2,123**	**10,573**
			Nonresidential	**1,799**	**8,112**

Voluntary Electrification

Based on market trends, the remaining 2.5 percent of residential natural gas consumption and 2.8 percent of nonresidential natural gas consumption that are planned to be reduced by 2030 is assumed to occur through voluntary replacement of gas appliances with electric appliances reaching end of life. Voluntary adoption of electric appliances will be supported by the City through **Action BE-2b**, which calls for pursuing incentives for community adoption. Such incentives may include strategies such as providing subsidies to reduce cost or distributing educational materials to increase community awareness of the availability, benefits, and financial support related to purchasing of electric appliances. Targeted education and outreach programs can increase the likelihood of consumer adoption of energy related technologies, including energy efficiency

solutions.[25] Additionally, awareness of energy efficiency solutions such as heat pumps remains low in California, suggesting that investment in outreach campaigns would prove an effective strategy in increasing electric appliance adoption in the community.[26] As previously discussed, awareness of available programs can result in upwards of 59 percent participation in energy efficiency programs, with potential for increased participation with programs tailored to address the availability of financial resources, long-term benefits, and instructions for easy installation.[27]

Currently available incentives will help continue the growth in the adoption of electric appliances and water heaters seen in California over the past decade. According to Opinion Dynamics' *California Heat Pump Residential Market Characterization and Baseline Study* (2022), electric space heaters have grown from a 5 percent market share in 2009 to a 20 percent market share in 2019. Likewise, electric water heaters have grown from a 6 percent market share in 2009 to a 12 percent market share in 2019.[28] Given market trends showing a 5-15 percent growth in electric alternatives over the last 10 years, it is reasonable to assume that market trends will at least achieve the 2.5 percent growth in electric alternatives in the next 5 years. These growth trends are driven by California's decarbonization goals, supported by local equipment emissions thresholds and state-level initiatives like the Building Initiative for Low-Emissions Development (BUILD) and Technology and Equipment for Clean Heating (TECH) programs. Additionally, growing consumer demand for dual-purpose heating and cooling systems, financial incentives, and advancements in heat pump performance are further accelerating adoption.[29] This trend is not only expected to continue through 2030 as electric appliances become more efficient and more cost-effective, but will also be accelerated when coupled with sufficient funding for community members to replace their space and water heating appliances with electric or heat pump alternatives. While the total amount of funding available will change with sunset dates and budget cycles, the currently available federal (i.e., High Efficiency Electric Home Rebate [HEEHRA], Homeowner Managing Energy Savings [HOMES] Rebate, Inflation Reduction Act), state (i.e., TEHC Clean California), and local (i.e., the City of Ukiah's Energy Efficiency Rebates[30]) funding options make it so that low- and middle-income residents in Ukiah can install electric space and water heaters at no additional cost compared to gas space and water heaters. In some cases, such customers will even be able to install the heat pump water heaters for free.[31] Furthermore, it is anticipated that current funding available to Ukiah residents and businesses, as well as **Action BE-2b**'s new incentives, will remove the current hinderance to electrification in Ukiah and thereby help drive the voluntary market trend for electric space and water heating appliances through 2030.

Additionally, the emissions associated with natural gas consumption from PG&E are expected to decrease due to Senate Bill 1440, which mandates gas utilities, including PG&E, to replace pipeline-supplied natural gas with renewable natural gas (RNG). In 2022, the California Public Utilities

---

[25] Andolfi, Laura and Ortega, Boris. 2024. Smart Choices: The Influence of Energy Literacy on Energy Technology Adoption. Available at: https://www.energy-proceedings.org/wp-content/uploads/icae2024/1732537915.pdf

[26] University of California Davis. 2024. Innovative Approaches to Residential Heat Pump Promotion. Available at: https://ucdavis.app.box.com/s/0oa771tyj63qaqi2f8beitora56k78ll

[27] American Council for an Energy-Efficient Economy (ACEEE). Marketing and Promoting Electrification Using Behavioral Science: Results from a National Survey. Available at: https://www.aceee.org/research-report/b2406

[28] Opinion Dynamics. California Heat Pump Residential Market Characterization and Baseline Study (2022). Accessed at: https://pda.energydataweb.com/#!/documents/2625/view.

[29] Ibid

[30] City of Ukiah. Energy Efficiency Rebates. Available at: https://www.directefficiency.com/ukiah-electric-rebates/

[31] Rincon Consultants, Inc. Installation Costs for Zero-NOx Space and Water Heating Appliances (2024).

Commission (CPUC) set RNG supply requirements for California utilities, requiring them to increase the amount of RNG in the pipeline supplied to residential and commercial customers by 12% by 2030.[32] RNG is derived from organic waste materials, such as landfill waste, sewer, and agricultural waste through processes like anaerobic digestion. Because organic waste naturally releases biogenic carbon dioxide during decomposition, conversion of organic waste into RNG means that any carbon dioxide released during combustion of RNG is considered part of the natural carbon cycle and does not contribute a net increase in carbon dioxide emissions to the atmosphere like combustion of fossil derived natural gas does. Production and consumption of RNG still releases non-biogenic GHG emissions, but to a lesser extent than extraction and consumption of fossil derived natural gas.[33] The information on SB 1440 provided here is for informational purposes only. The potential GHG emissions reductions associated with SB 1440's RNG procurement requirements are not included in the adjusted forecast or quantified in this CAP as it is unclear how extensively SB 1440 might affect emissions linked to natural gas sourced from pipelines. This provides a conservative estimate of GHG reductions attributable to the decarbonization of existing buildings in Ukiah.

In addition to direct building decarbonization efforts, as part of this Measure, the City is committed to pursuing the equitable decommissioning of natural gas infrastructure to discourage investments in new natural gas systems, avoid stranded assets and disproportionate cost burdens, and promote the decarbonization of the community's building stock. Decommissioning natural gas pipelines typically involves capping or removing inactive lines and safely retiring infrastructure to prevent methane leaks, a potent GHG that significantly contributes to climate change. **Action BE-2d** aligns with California's regulatory landscape, in which the California Public Utilities Commission (CPUC) is actively limiting new investments in natural gas infrastructure.[34] Additionally, as part of the Gas System Decarbonization Rulemaking (R.20-01-007), the CPUC is investigating short-term steps to decarbonize and equitably decommission natural gas services, supporting the state's broader transition to clean energy.[35,36]

However, along with these efforts, state legislators and the CPUC will need to eliminate the existing utilities' "obligation to serve," which currently requires that utilities invest in and provide natural gas and the required infrastructure to new and existing residences and neighborhoods. To be able to initiate the equitable decommissioning of natural gas infrastructure and discourage further investments in new natural gas systems, cities like Ukiah will need to initiate strategic neighborhood electrification and advocate for the removal of the obligation to serve. Then, the gas utility will be able to decommission the appropriate parts of the system and right size infrastructure to fit the new, smaller number of gas customers.

[32] Pacific Gas and Electric Company's (PG&E). (2022) Draft Renewable Gas Procurement Plan in Compliance with Commission Decision 22-02-02. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M500/K435/500435651.PDF

[33] U.S. Environmental Protection Agency. (2021). An Overview of Renewable Natural Gas from Biogas. Available at: https://www.epa.gov/sites/default/files/2021-02/documents/lmop_rng_document.pdf

[34] California Public Utilities Commission (CPUC). 2022. CPUC Creates New Framework To Advance California's Transition Away From Natural Gas. Available at: https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-creates-new-framework-to-advance-california-transition-away-from-natural-gas

[35] California Public Utilities Commission (CPUC). 2020. Long-Term Gas Planning Rulemaking. Available at: https://www.cpuc.ca.gov/industries-and-topics/natural-gas/long-term-gas-planning-rulemaking

[36] California Public Utilities Commission (CPUC). 2024. Long-Term Gas Planning Rulemaking Issues Joint Agency White Paper and Draft Scope and Schedule for Comment. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/natural-gas/long-term-gas-planning-oir/acr-and-white-paper-one-pager.pdf

This process is not without challenges, including overcoming financial barriers and addressing community energy preferences. While decarbonizing the building stock through electrification remains the primary driver of GHG reductions under this Measure, **Action BE-2d** plays a supportive role by fostering community independence from natural gas. As a supportive action, it is not directly included in the calculation of GHG reductions attributable to Measure BE-2 but remains a critical element in achieving the City's broader climate goals.

Table 8 shows the parameters and data sources that support these electrification programs and incentives for voluntary replacement, and Table 9 shows the GHG emissions reductions as outlined in Equation 3 through 3.4. The emissions reductions in Table 9 represent calculations occurring after the ordinance calculations (Table 7), ensuring there is no doubling counting between the two.

Existing Building Voluntary Replacement Equations

Equation 3 $CO_2e\ Reduction_{NG,y,i}=\Sigma((Fuel\ Avoided_{j,y,i}*EF_{NG})+(Fuel\ Avoided_{j,y,i}*(L_{Pipeline}+L_{End\text{-}use})*EF_{NGL}))-(Elec\ Converted_{y,i}*EF_{elec,y,i}*(1+L_{T\&D}))$

Equation 3.1 $Elec\ Convert_{y,i} = \Sigma\ (Fuel\ Avoided_{j,y,i}*CF_{elec}/Eff_{elec,j})$

Equation 3.2 $Fuel\ Avoided_{j,y,i}=(Fuel_{y,i}-Fuel_{reduced,y,i})*(EOL_{NG,j,y,i}*Fuel\ Share_{j,i}*MS_{elec,j,y})$

Equation 3.3 $EOL_{NG,j,y,i}=1/LSP_{j,i}*(y\text{-}imp.y_i)$

Equation 3.4 $Eff_{elec,j} = \Sigma\ Eff_{elec,j,k} * Prop_{elec,j,k}$

Table 8 Existing Building Voluntary Replacement Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 3				
$CO_2e\ Reduction_{NG,y,i}$	Natural gas GHG emissions reduction	See Table 9	MT CO_2e	Calculated
$Fuel\ Avoided_{j,y,i}$	Natural gas consumption avoided	See Table 9	therms	Calculated
EF_{NG}	Natural gas emission factor	0.005311	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
EF_{NGL}	Natural gas leakage emission factor	0.053067	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Elec\ Converted_{y,i}$	Electricity usage from conversion	See Table 9	kWh	Calculated
$EF_{elec,y,i}$	Forecasted electricity emission factor	See Table 9	MT CO_2e/kWh	Forecast
$L_{pipeline}$	Natural gas pipeline leakage percentage	2.3%	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$L_{End\text{-}use}$	Natural gas end-use leakage percentage	0.5%	percentage	See Appendix GHG Inventory, Forecast, and Targets Technical Report
$L_{T\&D}$	Electricity transmission and distribution loss percentage	4.12%	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
y	Year	2030 or 2045	year	—
i	Subsector	Residential or Nonresidential	—	—
j	Electric equipment type	HVAC or water heater	—	—
Equation 3.1				
CF_{elec}	Electricity to therms conversion factor	29.3	kWh/therm	Metric Conversions[1]
$Eff_{elec,j}$	Efficiency factor of electric equipment relative to natural gas equipment	See Table 9	unitless	Calculated
Equation 3.2				
$Fuel_{y,i}$	Forecasted natural gas consumption after new building electrification	See Table 9	therms	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel_{reduced,y,i}$	Natural gas reductions from ordinances	See Table 9	therms	Calculated
$EOL_{NG,j,y,i}$	Percent of equipment reaching end of life	See Table 9	percentage	Calculated

Variable	Definition	Value	Unit	Data Source
$Fuel\ Share_{j,i}$	Percent of sector natural gas consumption	—	—	—
$Fuel\ Share_{wh,Res}$	Percent of residential natural gas consumption from water heaters	38%	percentage	Synapse[2]
$Fuel\ Share_{wh,Nonres}$	Percent of nonresidential natural gas consumption from water heaters	28%	percentage	Synapse[2]
$Fuel\ Share_{HVAC,Res}$	Percent of residential natural gas consumption from HVAC units	39%	percentage	Synapse[2]
$Fuel\ Share_{HVAC,Nonres}$	Percent of nonresidential natural gas consumption from HVAC units	42%	percentage	Synapse[2]
$MS_{elec,j,}y$	Market share of electric equipment	—	—	—
$MS_{elec,wh,\ 2030}$	Market share of electric water heaters	12%	percentage	Opinion Dynamics[3]
$MS_{elec,HVAC,2030}$	Market share of electric space heating units	22%	percentage	Opinion Dynamics[4]
$MS_{elec,wh,\ 2045}$	Market share of electric water heaters	100%	percentage	Assuming 100% electric market share by 2045[5]
$MS_{elec,HVAC,2045}$	Market share of electric space heating units	100%	percentage	Assuming 100% electric market share by 2045[5]
Equation 3.3				
$LSP_{i,wh}$	Average water heater lifespan in sector	—	—	—
$LSP_{residential,wh}$	Average residential water heater lifespan	13	years	EIA[6]
$LSP_{nonresidential,wh}$	Average nonresidential water heater lifespan	10	years	EIA[6]
$LSP_{i,HVAC}$	Average HVAC unit lifespan in sector	—	—	—
$LSP_{residential,HVAC}$	Average residential HVAC unit lifespan	21.5	years	EIA[6]
$LSP_{nonresidential,HVAC}$	Average nonresidential HVAC unit lifespan	23	years	EIA[6]
$imp.y_i$	Ordinance implementation year	—	—	—
$imp.y_{residential}$	Ordinance implementation year for residential buildings	2026	year	BE-2 target
$imp.y_{nonresidential}$	Ordinance implementation year for nonresidential buildings	2026	year	BE-2 target
Equation 3.4				
$Eff_{elec,HVAC}$	Efficiency factor of HVAC systems relative to natural gas equipment	See Table 9	unitless	—

Variable	Definition	Value	Unit	Data Source
$Eff_{elec,HVAC,HP}$	Efficiency factor of heat pumps	3	unitless	U.S. Department of Energy[7] and European Copper Institute[9]
$Eff_{elec,HVAC,ER}$	Efficiency factor of electric resistance	1	unitless	Energy.gov[8] and Schnackle Engineering[10]
$Eff_{elec,wh,ER}$	Efficiency factor of water heaters relative to natural gas	1	unitless	Conservative estimate of 1:1 efficiency of gas and electric water heaters[10,11]
$Prop_{elec,HVAC,k}$	Proportion of electric equipment types making up the electric HVAC market	—	—	—
$Prop_{elec,HVAC,HP}$	proportion of heat pump technology for HVAC systems	18%	percentage	Calculated based on the combined market share of heat pumps and electric resistance heaters for space heating[4]
$Prop_{elec,HVAC,ER}$	proportion of electric resistance technology for HVAC systems	82%	percentage	Calculated based on the combined market share of heat pumps and electric resistance heaters for space heating[4]
$Prop_{elec,wh,ER}$	Electric HVAC technology proportion of electric resistance space heaters	100%	percentage	As high efficiency technology (i.e. solar and heat pumps) is 1% of the market, assume all water heaters are electric resistance as a conservative estimation[3]
k	types of options for a given electric equipment system	e.g. heat pumps, electric resistance	—	—

Notes: "—" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. Metric Conversions. Therms (US) to Kilowatt-hours. Available at: https://www.metric-conversions.org/energy-and-power/therms-us-to-kilowatt-hours.htm
2. Synapse Energy Economics, Inc. 2018. Decarbonization of Heating Energy Use in California Buildings, Figure 2. Available at: https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf
3. Opinion Dynamics. 2022. California Heat Pump Residential Market Characterization and Baseline Study, Figure 34. Available at: https://pda.energydataweb.com/api/view/2625/OD-CPUC-Heat-Pump-Market-Study-Report_Final.pdf
4. Opinion Dynamics. 2022. California Heat Pump Residential Market Characterization and Baseline Study, Figure 21. Available at: https://pda.energydataweb.com/api/view/2625/OD-CPUC-Heat-Pump-Market-Study-Report_Final.pdf
5. Given the State's robust efforts, policies, and guidelines supporting electrification, it is assumed that electric water heaters and space heating units will achieve full market share dominance by 2045, aligning with broader statewide decarbonization goals.
6. U.A. Energy Information Administration (EIA). 2023. Updated Buildings Sector Appliance and Equipment Costs and Efficiencies. Available at: https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf
7. U.S Department of Energy. 2024. Air-Source Heat Pumps. Available at: https://www.energy.gov/energysaver/air-source-heat-pumps?utm_source=chatgpt.com
8. Energy.gov. Electric Resistance Heating. Available at: https://www.energy.gov/energysaver/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.
9. European Copper Institute. 2018. Heat Pumps: Integrating technologies to decarbonize heating and cooling. Accessed at: https://www.ehpa.org/wp-content/uploads/2022/10/White_Paper_Heat_pumps-1.pdf

Variable	Definition	Value	Unit	Data Source

10. Schnackel Engineers. 2023. Electric Heating vs Gas Heating. Available at: https://schnackel.com/blogs/electric-heating-vs-gas-heating#:~:text=One%20of%20the%20significant%20advantages,losses%20during%20the%20combustion%20process.
11. Southface Energy Institute. Water Heater Efficiency, Efficiency of Fuel Types and Alternatives for Heating Water. Available at: https://www.ncelec.org/sites/ncelec/files/documents/waterheater_efficiency_041614.pdf
12. Pennsylvania State University. 2023. Energy Efficiency of Water Heaters. Available at: https://www.e-education.psu.edu/egee102/node/2009

Table 9 Existing Building Voluntary Replacement GHG Emission Reduction Calculations

Definition	Definition	Units	Sector	2030	2045
Equation 3.4					
$Eff_{elec,wh}$	Weighted efficiency factor of water heaters relative to natural gas	unitless	Residential	1.00	1.00
			Nonresidential	1.00	1.00
$Eff_{elec,HVAC}$	Weighted efficiency factor of HVAC systems relative to natural gas equipment	unitless	Residential	1.36	1.36
			Nonresidential	1.36	1.36
Equation 3.3					
$EOL_{NG,y,i,wh}$	Percent of water heaters reaching end-of-life since ordinance implementation	percentage	Residential	30.77%	100.00%
			Nonresidential	40.00%	100.00%
$EOL_{NG,y,i,HVAC}$	Percent of HVAC units reaching end-of-life since ordinance implementation	percentage	Residential	18.60%	88.37%
			Nonresidential	17.39%	82.61%
Equation 3.2					
$Fuel_{y,i}$	Forecasted natural gas consumption after new building electrification	therms	Residential	2,661,103	3,145,882
			Nonresidential	2,522,151	3,912,581
$Fuel_{reduced,y,i}$	Natural gas reductions from ordinances	therms	Residential	562,869	2,176,054
			Nonresidential	693,541	2,866,572
Fuel $Avoided_{wh,y,i}$	Natural gas consumption avoided (water heaters)[1]	therms	Residential	29,440	368,535
			Nonresidential	24,577	292,882
Fuel $Avoided_{HVAC,y,i}$	Natural gas consumption avoided (HVAC)[1]	therms	Residential	33,494	334,253
			Nonresidential	29,385	362,920
Equation 3.1					
Elec $Converted_{wh,i}$	Electricity usage from conversion of water heater systems	kWh	Residential	862,587	10,798,074
			Nonresidential	720,092	8,581,455
Elec $Converted_{HVAC,i}$	Electricity usage from conversion of HVAC systems	kWh	Residential	719,667	7,181,975
			Nonresidential	631,385	7,797,931
Equation 3					
$EF_{elec,y,i}$	Forecasted electricity emission factor	MT CO_2e/kWh	Residential	0.0001501	0.0000000
			Nonresidential	0.0001501	0.0000000
CO_2e $Reduction_{NG,y,i}$	**Natural gas GHG emissions reduction**	**MT CO_2e**	**Residential**	**180**	**4,777**
			Nonresidential	**156**	**4,458**

Notes:

1. Natural gas consumption avoided resulting from education, market trends, and voluntary replacement after the energy standard has taken place.

Measure BE-3: Decarbonize 95% of new building construction by 2026.

Measure BE-3 commits the City to decarbonize new building construction in the community. The primary Action that enables this Measure is:

- **Action BE-3a** which directs the City to adopt a single margin hourly source energy threshold (EDR1) performance standard for new construction by 2026;
- **Action BE-3b** which commits the City to incorporate additional climate resilient design requirements as part of any future updates to the City's building code or zoning code; and,
- **Action BE-3c** which directs the City to continue to remove procedural barriers and establish a more streamlined permitting process for all new electric building construction by 2027.

As an initial performance standard, the City will monitor that the energy performance standard is implemented by 2026 following local adoption. Additionally, to gauge the Actions' performance in achieving Measure goals, the City will annually track the annual number of new building permits achieving EDR1 through electrification as part of **Action BE-3c**.

The City is committed to limiting new natural gas developments in the community where feasible. However, the U.S. Court of Appeals for the Ninth Circuit's decision to overturn Berkeley's natural gas regulation—the ordinance that prohibited the installation of natural gas piping within newly constructed buildings—limits the City's ability to establish regulations to ban new natural gas construction.[37] Despite this, through **Action BE-3a**, the City will adopt a single margin hourly source energy threshold (EDR1) performance standard for new construction, considered a legal alternative as discussed under Measure BE-2. This regulation will be designed to strongly encourage electrification of new construction as an energy consumption threshold. **Action BE-3b** will further influence climate resilient design requirements and **Action BE-3c** will help streamline the process for all new construction.

This shift towards electrification is supported by a clear understanding of key consumer and developer considerations in new building design and purchasing. By establishing a performance standard like the EDR1, the City would make electric buildings the more cost-effective option. This aligns with the fact that developers often prioritize cost efficiency in their decision-making, as the financial feasibility of a project depends heavily on material and energy costs.[38,39] Studies indicate that cost is a major factor in consumer purchasing decisions, with many opting for affordable, long-term solutions even when sustainability is a consideration.[40,41] However, a study by PWC indicates that consumers may be willing to pay a 9.7 percent premium for sustainable goods, even despite inflation concerns for cost-of-living.[42] As such, by making high-GHG building designs more expensive

[37] CRA V. City of Berkeley, No. 21-16278. Accessed at: https://law.justia.com/cases/federal/appellate-courts/ca9/21-16278/21-16278-2023-04-17.html.

[38] DesignHorizons Team. 2024. Construction Pricing: Factors, Costs, and Methods Explained. Available at: https://designhorizons.org/construction-pricing-factors-costs-and-methods-explained/

[39] Construction Management Association of America. Member Communications Experience, Construction Estimating: Everything You Need to Know. Available at: https://www.cmaanet.org/sites/default/files/resource/Construction%20Estimating_0.pdf

[40] Mintel. 2022. One in five Americans struggle to cover day-to-day expenses as inflation soars. . Available at: https://www.mintel.com/press-centre/one-in-five-americans-struggle-to-cover-day-to-day-expenses-as-inflation-soars/

[41] PWC. 2024. Consumers willing to pay 9.7% sustainability premium, even as cost-of-living and inflationary concerns weigh: PwC 2024 Voice of the Consumer Survey. Available at: https://www.pwc.com/gx/en/news-room/press-releases/2024/pwc-2024-voice-of-consumer-survey.html

[42] Ibid.

through the EDR1 threshold, developers are financially incentivized to adopt electrification design in new buildings as a lower-cost, sustainable alternative. This strategy not only supports GHG reduction goals but also addresses the market demand for cost-effective, energy-efficient buildings, benefiting both developers and consumers.

A single margin hourly source energy threshold (EDR1) performance standard establishes an energy consumption threshold that all new electric buildings must meet or fall below to comply with the City's energy efficiency requirements. The EDR1 would make building electrification the easiest and most economical pathway to meet the energy standard. However, since the performance standard does not ban natural gas infrastructure outright, it may permit some new construction to include natural gas something that Action BE2-d, decommissioning the city's natural gas pipeline, in part will address. These exceptions are expected to be minimal because of the cost effectiveness of new building electrification and continued natural growth in electric space and water heater installations seen in California over the past decade. Electric space heaters have grown to a 20 percent market share in 2019, while electric water heaters have grown to an 11 percent market share in 2019.[43] This trend is not only expected to continue through 2030 because all-electric new construction has proven to be cost-effective in the region for most all buildings types,[44,45] but also be accelerated when coupled with the large amount of funding available for community members to install electric or heat pump space and water heating appliances (see 'Voluntary Electrification' section above for funding options).

For the purpose of quantification of this Measure, it is assumed that the EDR1 standards will encourage 95 percent of new buildings to opt for all-electric construction as the most cost-effective option. Table 10 shows the parameters and data sources that support these electrification ordinance GHG emissions reduction and Table 11 shows the calculations as outlined in Equations 3 through 3.3.

All-electric New Building Construction Equations

Equation 3 $CO_2e\ Reduction_{NG,y,i}=(Fuel\ Avoided_{NG,y,i}*EF_{NG})+(\ Fuel\ Avoided_{NG,y,i}*EF_{NGL})-(Elec\ Convert_{y,i}*EF_{elec,y,i}*(1+L_{T\&D}))$

Equation 3.1 $Fuel\ Avoided_{NG,y,i}=(Fuel_{NG,y,i}-Fuel_{NG,imp.y,i})*Ord_{target,i}$

Equation 3.2 $Fuel\ Avoided_{NGL,y,i}=(Fuel\ Avoided_{NG,y,i}*(1+L_{End\text{-}use}))*(L_{Pipeline}+L_{End\text{-}use})$

Equation 3.3 $Elec\ Convert_{,y,i} = Fuel\ _{AvoidedNG,y,i}*CF_{elec}/Eff_{elec}$

Table 10 All-electric New Building Construction Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 3				
$CO_2e\ Reduction_{NG,y,i}$	Natural gas GHG emissions reduction	See Table 11	MT CO_2e	Calculated
$Fuel\ Avoided_{NG,y,i}$	Natural gas consumption avoided	See Table 11	therms	Calculated

[43] Opinion Dynamics. California Heat Pump Residential Market Characterization and Baseline Study (2022). Accessed at: https://pda.energydataweb.com/#!/documents/2625/view.

[44] California Energy Codes and Standards. Cost Effectiveness Explorer (2024). Accessed at: https://explorer.localenergycodes.com/jurisdiction/eureka-city/study-results/1-PGE?only_study_type=new-buildings

[45] According to the California Energy Codes and Standards' Cost Effectiveness Explorer, all-electric construction is cost effective for all residential building types.

Variable	Definition	Value	Unit	Data Source
EF_{NG}	Natural gas emission factor	0.005311	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel\ Avoided_{NGL,y,i}$	Natural gas leakage avoided	See Table 11	therms	Calculated
EF_{NGL}	Natural gas leakage emission factor	0.053067	MT CO_2e/therm	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Elec\ Converted_{y,i}$	Electricity usage from conversion	See Table 11	kWh	Calculated
$EF_{elec,y,i}$	Forecasted electricity emission factor	See Table 11	MT CO_2e/kWh	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$L_{T\&D}$	Electricity transmission and distribution loss percentage	4.12%	Percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
y	Year	2030 or 2045	year	—
i	Subsector	Residential or Nonresidential	—	—
Equation 3.1				
$Fuel_{NGy,i}$	Forecasted natural gas consumption	See Table 11	therms	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel_{NG,imp.y}$	Forecasted natural gas in implementation year	See Table 11	therms	Calculated
imp.yi	Ordinance implementation year	—	—	—
imp.y,residential	Ordinance implementation year (residential)	2026	year	Measure BE-3 target
imp.y,commercial	Ordinance implementation year (commercial)	2026	year	Measure BE-3 target
$\%Imp_i$	Effective percent of ordinance implementation	—	—	—
$\%Imp_{residential}$	Effective percent of ordinance implementation (residential)	95%	percentage	Assumed due to electric appliance market trends, cost-effectiveness, and inclusion of all-electric assumption in CEQA documents.
$\%Imp_{commercial}$	Effective percent of ordinance implementation (commercial)	95%	percentage	

Variable	Definition	Value	Unit	Data Source
Equation 3.2				
$L_{Pipeline}$	Natural gas pipeline leakage percentage	2.3%	kWh/therm	Metric Conversions[1]
$L_{End\text{-}use}$	Natural gas end-use leakage percentage	0.5%	unitless	Leonardo Energy[2] and European Copper Institute[3]
Equation 3.3				
CF_{elec}	Electricity to therms conversion factor	29.3	kWh/therm	Metric Conversions[1]
Eff_{elec}	Efficiency factor of electric equipment relative to natural gas equipment	3	unitless	U.S. Department of Energy[2] and European Copper Institute[3]

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. Metric Conversions. Therms (US) to Kilowatt-hours. Available at: https://www.metric-conversions.org/energy-and-power/therms-us-to-kilowatt-hours.htm
2. U.S Department of Energy. 2024. Air-Source Heat Pumps. Available at: https://www.energy.gov/energysaver/air-source-heat-pumps?utm_source=chatgpt.com
3. European Copper Institute. 2018. Heat Pumps: Integrating technologies to decarbonise heating and cooling. Accessed at: https://www.ehpa.org/wp-content/uploads/2022/10/White_Paper_Heat_pumps-1.pdf.

Table 11 All-electric New Building Construction GHG Emission Reduction Calculations

Variable	Definition	Units	Sector	2030	2045
Equation 3.1					
$Fuel_{NG,y,i}$	Forecasted natural gas consumption	therms	Residential	2,661,103	3,145,882
			Nonresidential	2,522,151	3,912,581
$Fuel_{NG,imp,y}$	Forecasted natural gas in implementation year	therms	Residential	2,492,627	2,492,627
			Nonresidential	2,151,370	2,151,370
$\%Imp_i$	Effective percent of ordinance implementation	percentage	Residential	95.00%	95.00%
			Nonresidential	95.00%	95.00%
$Fuel\ Avoided_{NG,y,i}$	Natural gas consumption avoided	therms	Residential	160,052	620,592
			Nonresidential	352,242	1,673,151
Equation 3.2					
$Fuel\ Avoided_{NGL,y,i}$	Natural gas leakage avoided	therms	Residential	4,504	17,463
			Nonresidential	9,912	47,082
Equation 3.3					
$Elec\ Convert_{y,i}$	Electricity usage from conversion	kWh	Residential	1,563,171	6,061,119
			Nonresidential	3,440,233	16,341,106
Equation 3					
$EF_{elec,y,i}$	Forecasted electricity emission factor	MT CO_2e/kWh	Residential	0.0001501	0.00
			Nonresidential	0.0001501	0.00
$CO_2e\ Reduction_{NG}$	**Natural gas GHG emissions reduction**	**MT CO_2e**	**Residential**	**845**	**4,223**
			Nonresidential	**1,859**	**11,385**

Measure BE-4: Decarbonize 50% municipal buildings by 2030 and 100% by 2045.

Measure BE-4 commits the City to lead by example in decarbonizing municipal buildings and facilities City-wide to educate and promote electric conversions throughout the community. To achieve this, the City plans to adopt a policy requiring the decarbonization of 50% of municipal buildings and facilities by 2030 and 100% by 2045, with a focus on prioritizing critical and public access facilities. Additionally, the City will pursue grant funding and eligible rebates to support the electrification of municipal buildings. While the strategies to decarbonize municipal buildings and facilities will reduce GHG emissions, emissions from municipal building energy are included as a subset of the nonresidential building energy sector in the Ukiah 2022 Community GHG Inventory. This means the associated GHG emissions reduction are included within the community mitigation Measures (i.e., BE-1 through BE-3). Thus, to avoid potential double counting, reductions from this municipal mitigation measure are not counted towards the 2030 and 2045 targets. Nevertheless, the City is committed to demonstrating leadership in building decarbonization to support community-wide GHG reduction efforts and to serve as a model for sustainable practices.

3 Sector T: Transportation

The City of Ukiah's Transportation strategy aims to reduce and decarbonize VMT by leveraging renewable and carbon-free electricity (see Sector BE-1) and other renewable fuels to reduce GHG emissions from the transportation system. Reducing VMT consists of transitioning Ukiah residents and visitors out of single-occupancy vehicles and into active transportation mode options (i.e., walking and biking) and public and shared transit options (e.g., public buses, rail, carpools) by improving these modes and adopting policies to discourage single-occupancy vehicle commutes. The remaining VMT will then be decarbonized by increasing the adoption of zero-emission vehicles. When combined with renewable and carbon-free fuels, zero emission vehicles (ZEVs) eliminate GHG emissions from fossil fuel combustion and transition commutes to a zero-emission operational footprint. Additionally, the sector targets small off-road equipment and vehicles for decarbonization in alignment with State regulations. Based on this approach, the CAP's Transportation strategy consists of the following Measures presented in Table 12. The table also indicates which Measures are quantitative and which Measures are supportive. The following subsections detail the substantial evidence and calculation methodologies of the quantitative Measures and the role of the supportive Measures.

Table 12 Sector T: Transportation GHG Emission Reduction Summary

Measure ID	Measure	2030 GHG Emissions Reduction (MT CO_2e)	2045 GHG Emissions Reduction (MT CO_2e)
Measure T-1	Increase the total mode share of active transportation to 15% by 2030, and 30% by 2045.	373	2,164
Measure T-2	Increase total public transportation mode share to 5% by 2030, and 20% by 2045.	997	5,319
Measure T-3	Reduce local VMT from single passenger vehicles.	Supportive	Supportive
Measure T-4	Achieve zero-emission vehicle (ZEV) adoption rates of 30% for passenger vehicles and 25% for commercial vehicles by 2030 and 100% for all vehicles by 2045.	11,847	66,664
Measure T-5	By 2030, electrify or otherwise decarbonize 12% of applicable small off-road engines (SORE) off-road equipment and replace 35% of fossil diesel consumption with renewable diesel in alignment with EO N-79-20.	606	1,541
Measure T-6	Decarbonize the municipal fleet in compliance with the California Advanced Clean Fleet Rule and EO N-79-20 off-road requirements.	Supportive	Supportive
Total		**13,823**	**75,688**

Measure T-1: Increase the total mode share of active transportation to 15% by 2030, and 30% by 2045.

Measure T-1 aims to increase Ukiah's active transportation mode share to 15 percent by 2030 and to 30 percent by 2045. The primary Actions that enable this Measure are:

- **Action T-1a** which directs the City to update and implement the Ukiah Bicycle and Pedestrian Master Plan, increase active transportation infrastructure through safe and accessible bikeways and walkways, and develop and pilot a program that provides communitywide access to bicycles;
- **Action T-1b** which directs the City to establish affordable public transportation options while prioritizing bicycles and other micro-mobility options;
- **Action T-1c** which commits the City to develop a priority list of active transportation projects from Mendocino Council of Governments' (MCOG) Regional Transportation Plan (RTP) and updated Ukiah Bicycle and Pedestrian Master Plan, as well as identify and pursue necessary resources to implement the top 5 projects identified by 2028;
- **Action T-1d** which commits the City to further developing safe bike lane transportation corridors by 2027 across Ukiah using available State and federal funding.

To monitor the performance of these Actions in achieving Measure T-1 goals, the City will preliminarily track the amount of grant funding sourced and distributed through active transportation projects. Miles of bike and pedestrian lanes developed will also be tracked as the primary performance standard for determining the efficacy of listed Actions in achieving Measure goals.

Currently, Ukiah has a low bicycle mode share, but a relatively high walking mode share. In 2022 (i.e. Ukiah's GHG Inventory year), Ukiah's bicycle and pedestrian mode shares were 0.2 percent and 10.9 percent, respectively, equating to a 11.1 percent total active transportation mode share.[46,47] Ukiah's bicycle network currently lacks safety, accessibility and connectivity. Specifically, major areas of the Ukiah lack designated bicycle facilities.[48] **Action T-1a** addresses these problems by directing the City to update its Master Plan and increase bicycle infrastructure through safe and accessible bikeways. **Action T-1d** also addresses these concerns by further developing safe bike lane corridors through State and federal funding. Studies show that investments in active transportation infrastructure have demonstrated significant improvements in active transportation mode shifts and GHG emissions reductions.[49] For example, urban cities that make a strong commitment to bicycle travel can see up to an 11 percent reduction in vehicle miles traveled and associated GHG emissions.[50] Such reductions can be reasonably expected because in 2022, about 16 percent of vehicle trips made nationally were 1 mile or less—a distance easily travelled by foot or bicycle.[51] **Action T-1a** supports this measure by addressing safety and connectivity concerns, as well as

[46] US Census Bureau. 2022: ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex. Accessed at: https://data.census.gov/table?t=Commuting&g=160XX00US0681134

[47] U.S. Census Bureau data includes 'Work from home' mode share. Mode share percentages were re-determined to exclude work from home mode share.

[48] City of Ukiah. 2040 General Plan (2022). Accessed at: https://ukiah2040.com/images/docs/202212_release/UKGP_EntireGP.pdf

[49] Glazener, Andrew and Khreis, Haneen. Transforming our Cities: Best Practices Towards Clean Air and Active Transportation (2019). Accessed at: https://link.springer.com/article/10.1007/s40572-019-0228-1

[50] Jacob Mason et al., Institute for Transportation & Development Policy and the University of California, Davis. A Global High Shift Cycling Scenario (2015). Accessed at: https://itdpdotorg.wpengine.com/wp-content/uploads/2015/11/A-Global-High-Shift-Cycling-Scenario_Nov-2015.pdf

[51] National Household Travel Survey. Population Vehicle Trips Statistics (2021). Accessed at: https://nhts.ornl.gov/vehicle-trips

updating the Ukiah Bicycle and Pedestrian Master Plan. Part of this update includes assessing current active transportation conditions and projects occurring in Ukiah, such as the Urban Core Rehabilitation Project (UCRT)[52] and construction of Phases 1-3 of the Great Redwood Trail – Ukiah (GRT-Ukiah).[53] The UCRT is a project that will enhance multimodal transportation in Ukiah's urban core, including installing or upgrading 2.9 miles of bike lanes. The GRT-Ukiah is expanding from 1.8 miles long to 3 miles long and 100 feet wide, with existing trail miles running adjacent to downtown Ukiah. The expansion of this trail enhances the efficacy of the project serving as an active transportation trail system as well as a linear park which encourages inclusivity and increased connectivity across Ukiah for residents.

To estimate the mode shift potential of updating Ukiah's Bicycle and Pedestrian Master Plan, other cities' bicycle and road networks were analyzed. The City of Davis leads the state with a 17.5 percent bicycle mode share[54] and 9.2 miles of bike lane per square mile of the city.[55] The City of Berkeley has a 9.7 percent bicycle mode[56] with approximately 4.8 miles of bike lane per square mile of the city.[57] Ukiah's current bicycle mode share is 0.2 percent,[58] and has approximately 2.13 miles of bike lane per square mile of the city.[59] With the City adding over 12 additional miles of bike lanes through updates of the Bicycle and pedestrian Master Plan, there would be approximately 4.74 miles of bike lane per square mile of Ukiah.

Bicycle mode share in Ukiah is low partially because of the lack of designated bicycle facilities, making bicycle routes disconnected and inaccessible, as mentioned above. Studies show that increasing the connectivity of bicycle route networks can lead to a higher mode share of bicycle use.[60] Given that Ukiah's projected 4.74 miles of bike lanes per square mile closely aligns with the bike lane networks in cities like Berkeley, where bicycle mode share has reached 9.7 percent, achieving a 4 percent active transportation mode share by 2030 is a realistic and attainable goal, with the increase coming from bicycle mode share while walking mode share is conservatively assumed to remain constant.[61] This assumption provides a conservative and reasonable estimate of bike mode share increase that lies well below similar city references (City of Davis and City of Berkeley, see above), and is supported by the City's efforts to implement 12 miles of new bike lanes.

Like 2030, the 2045 quantification assumes the increases would be attributable to bicycle mode share, while walking mode share remains constant. These active transportation mode share

---

52 City of Ukiah. Urban Core Rehabilitation and Transportation Project (2023). Accessed at: https://cityofukiah.com/ucrt/

53 City of Ukiah. Great Redwood Trail – Ukiah, Linear Park Master Plan (2020). Accessed at: https://cityofukiah.com/wp-content/uploads/2022/06/GRT-Park-Master-Plan-Final.pdf

54 US Census Bureau. 2019: ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex. Accessed at: https://data.census.gov/table/ACSST5Y2019.S0801?q=commute&g=160XX00US0618100

55 City of Davis. Accessed at: https://www.cityofdavis.org/city-hall/public-works-engineering-and-transportation/bike-pedestrian-program/davis-bike-and-pedestrian-infrastructure

56 City of Berkeley. City of Berkeley Bicycle Plan (2017). Accessed at: https://www.cityofberkeley.info/uploadedFiles/Public_Works/Level_3_-_Transportation/Berkeley-Bicycle-Plan-2017-Executive%20Summary.pdf

57 Visit Berkeley. Fact Sheet. Accessed at: https://www.visitberkeley.com/media-press/press-kit/fact-sheet/

58 US Census Bureau. 2022: ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex. Accessed at: https://data.census.gov/table?t=Commuting&g=160XX00US0681134

59 Ukiah currently has 9.82 miles of bike lanes (Ukiah 2040 General Plan). Ukaih land area in square miles is 4.6, according to the 2040 General Plan. Accessed at: https://ukiah2040.com/images/docs/202212_release/UKGP_EntireGP.pdf

60 California Air Pollution Control Officers Association (CAPCOA). Quantifying Greenhouse Gas Mitigation Measures (2010). Accessed at: https://www.aqmd.gov/docs/default-source/ceqa/handbook/capcoa-quantifying-greenhouse-gas-mitigation-measures.pdf

61 The average active transportation trip length used in the quantification is set to 1.5 miles. While average walking trip (1 mile, CARB) is significantly lower than average biking trip (2.1 miles, CARB), a 1.5-mile average was assumed. Increasing biking infrastructure will increase accessibility to biking routes and increase convenience for biking.

estimates also provide VMT reductions for Ukiah well within the reductions shown in the cited studies. Additionally, the key Actions associated with this Measure (**Actions T-1a, 1b, 1c,** and **1d**) will support this increase in mode share by prioritizing efforts to implement bike share programs, increase access, and incentive mode shifts.

Table 13 shows the parameters and data sources that support the GHG emissions reduction from active transportation mode shifts and Table 14 shows the calculations as outlined in Equations 4 through 4.2.

Active Transportation Mode Share Equations

Equation 4 $CO_2e\ Reduction_{i,y} = VMT\ Reduced_{i,y} * VMT\ EF_{i,y}$

Equation 4.1 $VMT\ Reduced_{i,y} = ((VMT_{i,y} * TPM_{i,y})/MS_{pass,by}) * TL_i * MS\ Increase_{Bike,y}$

Equation 5.2 $MS\ Increase_{Bike,y} = MS\ Target_{Active,y} - MS_{Bike,by}$

Table 13 Active Transportation Mode Share Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 4				
$CO_2e\ Reduction$	VMT GHG emissions reduction	See Table 14	MT CO_2e	Calculated
VMT Reduced	VMT reduced	See Table 14	miles	Calculated
VMT EF	VMT emission factor	See Table 14	MT CO_2e/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
Equation 4.1				
$VMT_{i,y}$	Forecasted VMT	See Table 14	miles	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$TPM_{i,y}$	Forecasted trips per mile	See Table 14	trips/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$MS_{pass,by}$	Passenger trip mode share in baseline year	88%	percentage	US Census Bureau. ACS 5-Year Estimates Subject Tables (2022)[1]
TL_i	Average bicycle trip length	1.5	miles	CARB Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks: Technical Documentation[2]
$MS\ Increase_{Bike,y}$	Bicycle mode share increase	See Table 14	percentage	Calculated
i	VMT type	Passenger	–	–
y	Year	2030 or 2045	–	–
Equation 4.2				
$MS\ Target_{Active,y}$	Active transportation mode share target	–	percentage	Conservative estimate based on bicycle mode shares currently seen in Davis and Berkeley.[3,4]
$MS\ Target_{Active,2030}$	–	15.00%	percentage	Measure T-1 target; City of Davis and Berkeley.[3,4]

Variable	Definition	Value	Unit	Data Source
$MS\ Target_{Active,2045}$	–	30.00%	percentage	Measure T-1 target
$MS_{Walk,by}$	Walking mode share in baseline year	10.91%	percentage	US Census Bureau. ACS 5-Year Estimates Subject Tables (2022) [1]
$MS_{Bike,by}$	Bicycle mode share in baseline year	0.22%	percentage	US Census Bureau. ACS 5-Year Estimates Subject Tables (2022)[1]
by	Baseline year	2022	year	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. US Census Bureau. ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex, Ukiah (2022). Available at: https://data.census.gov/table?t=Commuting&g=160XX00US0681134
2. CARB. Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks: Technical Documentation (2019). Accessed at: https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/bicycle_facilities_technical_041519.pdf.
3. US Census Bureau. ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex, Davis (2022). Available at: https://data.census.gov/table/ACSST5Y2022.S0801?t=Commuting&g=160XX00US0618100
4. US Census Bureau. ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex, Berkley (2022). Available at: https://data.census.gov/table/ACSST5Y2022.S0801?t=Commuting&g=160XX00US0606000

Table 14 Active Transportation Mode Share GHG Emission Reduction Calculations

Variable	Definition	Units	VMT Type	2030	2045
Equation 4.2					
$MS\ Target_{Active,y}$	Active transportation mode share target	percentage	Passenger	15.00%	30.00%
$MS\ Increase_{Bike,y}$	Bicycle mode share increase	percentage	Passenger	3.88%	18.88%
Equation 4.1					
VMT	Forecasted VMT	miles	Passenger	150,757,738	197,679,597
TPM	Forecasted trips per mile	trips/mile	Passenger	0.126046	0.131863
VMT Reduced	VMT reduced	miles	Passenger	1,255,643	8,386,864
Equation 4					
VMT EF	VMT emission factor	MT CO_2e/mile	Passenger	0.000297	0.000258
CO_2e Reduction	**VMT GHG emissions reduction**	**MT CO_2e**	**Passenger**	**373**	**2,164**

Measure T-2: Increase total public transportation mode share to 5% by 2030, and 20% by 2045.

Measure T-2 aims to increase Ukiah's public transit mode share to 5 percent by 2030 and to 20 percent by 2045. The primary Actions that enable this Measure are:

- **Action T-2a** which directs the City to work with Mendocino Council of Governments (MCOG) and Mendocino Transit Authority (MTA) to implement a transportation system plan to shift travel behavior away from single-occupancy vehicles and encourage use of public and multi-modal transportation options. The plan will include considerations as to:
  - Increasing MTA ridership through improved routes and modifying schedules to increase efficiency and align with rider needs,
  - Increasing micro-transit access to improved public transit network facilities to promote last-mile commute access to alternative transportation methods,
  - Developing a local electric trolley or bus system that operates year-round;
- **Action T-2b** which commits the City to require parking management plans (i.e., eliminate parking minimums, develop parking maximums) and transportation demand management plans; and,
- **Action T-2c** which directs the City to collaborate with MCOG and Mendocino Transit Authority (MTA), Mendocino College, and other key institutional partners to establish free or subsidized local public transit programs that service local residential and commercial areas.

To monitor the performance of these Actions in achieving Measure T-2 goals, the City will preliminarily track the successful completion of the City transportation system plan identified in **Action T-2a**, as well as the implementation of TDM requirements. Annual MTA ridership rates will also be tracked as the primary performance standard for determining Action efficacy in achieving Measure goals.

In 2022 (i.e., Ukiah's GHG inventory year), Ukiah's public transit mode share was 0.87 percent.[62] Key strategies employed by cities looking to increase public transportation mode share include significant expansions of public transportation service lines (**Action T-2a**), designated streets or lanes for bus lines to decrease headways, implementation of taxes to support transit, and reduced parking availability (**Action T-2b**). Studies have shown that expanding transit coverage through services routes and schedules can increase public transit mode share in a city. Specifically, studies which incorporated factors such as elasticity of transit demand and average mode shift factors have estimated that doubling transit coverage in a city can reduce VMT—and associated GHG emissions—up to 4.6 percent.[63] **Action T-2b** specifies identifying high-trafficked areas of Ukiah to eliminate parking minimums, develop parking maximums, and require parking management and transportation demand management (TDM) plans. The intention of this Action is for employers to implement TDM plans that discourage single-occupancy vehicle trips and encourage alternative modes of transportation such as carpooling, transit, walking, and biking, thereby reducing VMT and GHG emissions. Studies show that implementing such plans have the potential to reduce up to 26 percent GHG emissions from project employee commute VMT.[64] **Action T-2b** also intends to

[62] US Census Bureau. 2022: ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex. Accessed at: https://data.census.gov/table?t=Commuting&g=160XX00US0681134

[63] California Air Pollution Control Officers Association (CAPCOA). Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity (2021).

[64] CAPCOA. Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity (2021). Measure T-6. Accessed at: https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

develop parking management plans. Studies have estimated that implementing paid public parking and limited residential parking can reduce GHG emissions up to 30 percent and 13.7 percent, respectively.[65] With the focus of **Action T-2a** and **Action T-2c** on creating a more connected and reliable network of transit, it is reasonable to estimate that the City can expect a 2.23 percent reduction in passenger VMT in Ukiah which would result from a 4.13 percent increase in public transit mode share.[66] Quantification estimates using third party evidence suggest that a realistic goal set forth by this measure is a public transit mode share of 5 percent by 2030 and 20 percent by 2045. For the purpose of conservatively estimating GHG reductions, these percentages are applied to the remaining VMT after accounting for reductions achieved through active transportation efforts identified in Measure T-1 to determine the expected VMT reduction from public transit actions.

Efforts to increase public transit mode share associated with **Action T-2a** may lead to more frequent transit operations or route changes, potentially increasing GHG emissions. However, MTA is planning to expand its ZEV bus fleet in alignment with California's Innovative Clean Transit (ICT) regulation, which requires all public transit agencies to transition to zero-emission bus fleets by 2040.[67] The ICT regulation mandates a phased transition schedule: by 2023, large transit agencies must ensure 25% of new bus purchases are zero-emission; by 2026, large agencies must increase this to 50%, with small transit agencies beginning their transition at 25%; and by 2029, all new bus purchases statewide must be zero-emission.[68] Additionally, programs such as the Low Carbon Transit Operations Program (LCTOP), established under Senate Bill 862, provide funding to support this transition.[69] For the purposes of quantification, it is assumed that any new buses required to support expanded service or additional routes under this action would be electric or zero-emission in alignment with State regulations. Using electric buses is anticipated to have continual GHG reduction benefits as emissions from electricity decline as a result of implementation of Measures BE-1 to transition the Ukiah grid to renewable energy. As a result, GHG emissions from potential public transit expansion in Ukiah are anticipated to be negligible and are not included in the quantification of net GHG emissions reductions from this measure. Table 15 shows the parameters and data sources that support the GHG emissions reduction associated with reducing vehicle miles traveled through public transit mode share and Table 16 shows the calculations as outlined in Equations 5 through 5.2.

Public Transit Mode Share Equations

Equation 5 $CO_2e\ Reduction_{i,y} = VMT\ Reduced_{i,y} * VMT\ EF_{i,y}$

Equation 5.1 $VMT\ Reduced_{i,y} = (((VMT_{i,y} - VMT_{active,y}) * TPM_{i,y}) / MS_{public,by}) * TL_i * MS\ Increase_{public,y}$

Equation 5.2 $MS\ Increase_{public,y} = MS\ Target_{public,y} - MS_{public,by}$

[65] CAPCOA. Handbook for Analyzing Greenhouse Gas Emission Reductions. Measure T-24 and T-15.

[66] VMT reduction related to transit measures was quantified using CAPCOA T-24, T-25, and T-26 methodology that quantified VMT reduction for the extension of transit network coverage or hours, increase in transit service frequency, and implementation of transit-supportive roadway treatments, respectively.

[67] Mendicino Transit Authority (MTA). 2024. Mendocino Transit Authority Short-Range Transit Development Plan 2024 Update. Available at: https://www.mendocinocog.org/files/18849c841/MTA+2024+SRTDP_Final%28web%29.pdf

[68] California Air Resources Board (CARB). 2024. Innovative Clean Transit (ICT) Regulation Fact Sheet. Available at: https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet

[69] Caltrans. 2024. Low Carbon Transit Operations Program (LCTOP). Available at: https://dot.ca.gov/programs/rail/low-carbon-transit-operations-program-lctop

Table 15 Public Transit Mode Share Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 5				
$CO_2e\ Reduction_{i,y}$	VMT GHG emissions reduction	See Table 16	MT CO_2e	Calculated
$VMT\ Reduced_{i,y}$	VMT reduced	See Table 16	miles	Calculated
$VMT\ EF_{i,y}$	VMT emission factor	See Table 16	MT CO_2e/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
Equation 5.1				
$VMT_{i,y}$	Forecasted VMT after active transportation reductions	See Table 16	miles	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$VMT_{active,y}$	VMT reduction from active transportation targets	See Table 14	miles	Calculated (See Measure T-1)
$TPM_{i,y}$	Forecasted trips per mile	See Table 16	trips/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$MS_{pass,by}$	Passenger trip mode share in baseline year	88%	percentage	US Census Bureau. ACS 5-Year Estimates Subject Tables (2022)[1]
TL_i	Average public transit trip length	3.8	miles	American Public Transportation Association's Public Transportation Fact Book[2,3]
$MS\ Increase_{Public,y}$	Public transit mode share increase	See Table 16	percentage	Calculated
i	VMT type	Passenger	–	–
y	Year	2030 or 2045	–	–
Equation 5.2				
$MS\ Target_{Public,y}$	Public transit mode share target	–	percentage	–
$MS\ Target_{Public,2030}$	Public transit mode share target (2030)	5%	percentage	Measure T-2 target
$MS\ Target_{Public,2045}$	Public transit mode share target (2045)	20%	percentage	Measure T-2 target
$MS_{Public,by}$	Public transit mode share in baseline year	0.87%	percentage	US Census Bureau. ACS 5-Year Estimates Subject Tables (2022)[1]
by	Baseline year	2022	year	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. US Census Bureau. ACS 5-Year Estimates Subject Tables. S0801|Commuting Characteristics by Sex, Ukiah (2022). Available at: https://data.census.gov/table?t=Commuting&g=160XX00US0681134
2. American Public Transportation Association. Public Transportation Fact Book (2018). Accessed at: https://www.apta.com/wp-content/uploads/Resources/resources/statistics/Documents/FactBook/2018-APTA-Fact-Book.pdf.
3. Note: Regular bus trip length was utilized to remain conservative.

Table 16 Public Transit Mode Share GHG Emission Reduction Calculations

Variable	Definition	Units	VMT Type	2030	2045
Equation 5.2					
$MS\ Target_{Public}$	Public transit mode share target	percentage	Passenger	5.00%	20.00%
$MS\ Increase_{Public}$	Public transit mode share increase	percentage	Passenger	4.13%	19.13%
Equation 5.1					
VMT	Forecasted VMT after active transportation reductions	miles	Passenger	150,757,738	197,679,597
VMT_{active}	VMT reduction from active transportation targets	miles	Passenger	1,255,643	8,386,864
TPM	Forecasted trips per mile	trips/mile	Passenger	0.126046	0.131863
VMT Reduced	VMT reduced	miles	Passenger	3,358,554	20,615,627
Equation 5					
VMT EF	VMT emission factor	MT CO_2e/mile	Passenger	0.000297	0.000258
CO_2e Reduction	**VMT GHG emissions reduction**	**MT CO_2e**	**Passenger**	**997**	**5,319**

Measure T-3: Reduce local VMT from single passenger vehicles.

Measure T-3 directs Ukiah to develop programs and policies to discourage travel by single-occupancy vehicles. Although this Measure may produce GHG emissions reductions, it is not quantified in this CAP due to the high potential to double count GHG emissions reduction with Measures T-1 and T-2. This Measure does, however, play a critical role in reducing VMT by promoting infill development, supporting increased EV infrastructure development, and supporting the CAP's active and public transportation mode share goals through infrastructure development and increased access.

Measure T-3 seeks to prioritize infill development and/or increased density of residential development in the downtown core, along transit corridors, and within future planned development areas that is compact, mixed use, pedestrian friendly, and transit-oriented where applicable. Increasing residential density and adding mixed-use development to neighborhoods near transit are key actions in reducing VMT, as they create more opportunities for people to live closer to jobs, services, and public transportation, reducing the need for single-occupancy vehicle trips. Higher densities and mixed-use developments near transit corridors are essential for achieving significant VMT reductions.[70] By encouraging sustainable development strategies that emphasize density, connectivity, and quality of affordable housing options along transit routes, this Measure can reduce reliance on cars, facilitate shorter trips, and support a shift to active modes of transportation like walking, biking, and public transit. Studies show that increasing residential density has the potential to reduce up to 30 percent GHG emissions.[71] Furthermore, providing transit-oriented development has the potential to reduce up to 31 percent GHG emissions.[72]

In support of reducing single passenger VMT and promoting infill projects, this Measure establishes Reach Code requirements to include EV charging infrastructure and local active and public transit facilities (i.e., dedicated bicycle parking stations, implementation of shared mobility hubs, access to transit stops where viable, etc.) in new multi-family construction. Additionally, the City aims to pursue and implement policies that support accessible, walkable neighborhoods and connected bike networks as part of infill development projects. By coupling increased density and diversity in land use with EV, biking, and walking infrastructure, this Measure helps lay the foundation for achieving Ukiah's VMT reduction goals of Measure T-4 (see below) and complements the active transportation and public transit mode share targets set by Measures T-1 and T-2.

[70] Center for Transit-Oriented Development. Transit Oriented Development and the Potential for VMT-Related Greenhouse Gas Emissions Growth Reduction (2010). Accessed at: https://cnt.org/sites/default/files/publications/TOD-Potential-GHG-Emissions-Growth.FINAL_.pdf.

[71] CAPCOA. Handbook for Analyzing Greenhouse Gas Emission Reductions (2021).

[72] CAPCOA. Handbook for Analyzing Greenhouse Gas Emission Reductions (2021).

Measure T-4: Achieve ZEV adoption rates of 30% for passenger vehicles and 25% for commercial vehicles by 2030 and 100% for all vehicles by 2045.

Measure T-4 aims to achieve a passenger and commercial ZEV adoption rate of 30 percent and 25 percent, respectively, by 2030, and 100 percent for all vehicles by 2045. The primary Actions that are designed to enable this Measure are:

- **Action T-4a** which directs the City to complete an inventory of existing EV infrastructure and locations, as well as pursue funding opportunities for the installation of around public EV chargers and residential home EV charging systems by 2030; and,
- **Action T-4b** which commits the City to develop a reach code requiring electric vehicle capable charging spaces to promote EV chargers in new development and existing parking spaces. The reach code would require:
  - Single Family – CalGreen Tier 2 provisions;
  - Multifamily – CalGreen Tier 2 provisions;
  - Non-residential – CalGreen Tier 2 provisions;
  - Expansion of EV charging parking spaces to 30% of parking spaces within multi-family residential buildings by 2030;
  - Larger residential rental building owners (more than 20 tenants) to install working electric vehicle chargers in 30% of parking spaces for new and existing buildings at time of renovation if projects are valued at $250,000 or greater;
  - Acceleration of EV charger permits; and,
  - Installation of EV chargers at City-owned facilities.

The State has established a goal of putting 5 million ZEVs on the road by 2030 and, according to executive order N-79-20, 100 percent of passenger vehicle sales are to be zero emission by 2035. This new executive order puts the total number of ZEVs on the road by 2035 at approximately 15 million.[73] Based on the current number of vehicles registered in California and application of a conservative population growth rate of 2 percent per year, 15 million ZEVs accounts for 35 percent of total passenger vehicles in 2035. The State has also established the Advanced Clean Fleets (ACF) rule, which requires the gradual transition of commercial vehicle fleets to ZEVs in California.[74] Starting in 2024, fleets must begin transitioning to ZEVs, with new trucks added to the fleet required to be zero-emission. Currently, the State is anticipated to reach 26 percent ZEV adoption across all vehicles by 2030.[75,76] To verify alignment with State ZEV regulations and the ZEV adoption goals set forth by Measure T-4, the City will monitor performance of the above actions by tracking registration of ZEVs in the community, as well as the number of public EV charging stations installed.

[73] Davis, A., Hoang, T., Lopez, T., Lu, J., Nguyen, T., Nolty, B., Rillera, L., Schell, D., and Wofford, M. 2023. California Energy Commission Staff Report, Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment. Available at: https://www.energy.ca.gov/publications/2023/second-assembly-bill-ab-2127-electric-vehicle-charging-infrastructure-assessment

[74] CARB. Advanced Clean Fleets Regulation Overview. Accessed at: https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-regulation-overview

[75] California Energy Commission (CEC). 2021. Report Shows California Needs 1.2 Million Electric Vehicle Chargers by 2030. Accessed at: https://www.energy.ca.gov/news/2021-06/report-shows-california-needs-12-million-electric-vehicle-chargers-2030

[76] Based on the zero-emission vehicle goals for passenger vehicles established by Executive Order N-79-20, eight million zero-emission vehicles are anticipated statewide by 2030. The City of Ukiah, through the development of this CAP, estimates that these eight million zero-emission vehicles represent 26 percent of the total passenger vehicles expected statewide by 2030 (based on statewide passenger car and light-duty truck counts in 2016 and population estimates for 2016 and 2030).

Studies have consistently identified that limited charging infrastructure as one of the primary barriers to electric vehicle adoption.[77, 78] **Actions T-4a** and **T-4b** help address this barrier by requiring the identification of gaps in the current infrastructure, pursuing funding to install additional chargers, implementing a reach code to establish minimum charger installation requirements, and simplifying the installation process by accelerating EV charger permits. Publicly accessible electric vehicles chargers make owning an electric vehicle convenient for all drivers—including those who cannot charge at home or drive daily distances longer than their electric vehicle battery range. To this point, it is expected that 20 percent of electric vehicle charging nationally will occur at publicly accessible chargers in 2030.[79]

Estimation of EV infrastructure necessary to meet this Measure's goal is based on the statewide estimate of electric vehicles per publicly accessible electric vehicle charger. This estimate is based on the U.S. Department of Energy's Electric Vehicle Infrastructure Projection Tool and the numbers of ZEVs in the State as reported by the CEC (see Table 17). The quantification assumes all ZEVs will be EVs to remain conservative in the plan for EV chargers. Table 17 shows the parameters and data sources used to calculate the publicly accessible EV chargers needed in 2030 and 2045 and Table 18 shows the calculations as outlined in Equations 6 through 6.1.

Publicly Accessible Electric Vehicle Chargers Equation

Equation 6 $PEV\ Chargers_{y} = EVs_{y}/PEV\ Charger\ Factor\text{-}Existing\ PEV\ Chargers_{by}$

Equation 6.1 $EVs_{y}=Population_{y}*(Vehicles_{by}/Population_{by})*EV\ Target_{Pass,y}$

Table 17 Publicly Accessible Electric Vehicle Charger Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 6				
$PEV\ Chargers_{y}$	New publicly accessible electric vehicle chargers needed	See Table 18	chargers	Calculated
EVs_{y}	Electric vehicles targeted	See Table 18	electric vehicles	Calculated
PEV Charger Factor	Electric vehicles per publicly accessible electric vehicle charger	36	electric vehicles per charger	State-wide estimate based on DOE Infrastructure projection tool and the number of ZEVs in the State as reported by the CEC[1]
$Existing\ EV\ Chargers_{by}$	Existing publicly accessible electric vehicle chargers	33	chargers	PlugShare[2]
y	Year	2030 or 2045	year	–
by	Baseline year	2022	year	–
Equation 6.1				
$Population_{y}$	Forecasted population in region	See Table 18	people	See references in Appendix GHG Inventory, Forecast,

[77] Kumar, Rajeev Ranjan and Kumar Alok. Adoption of Electric Vehicle: A Literature Review and Prospects for Sustainability (2020). Accessed at: https://www.sciencedirect.com/science/article/abs/pii/S095965261934781X

[78] Winjobi, Olumide and Kelly, Jarod. Used Plug-in Electric Vehicles as a Means of Transportation Equity in Low-Income Households (2021). Accessed at: https://www.osti.gov/biblio/1658592

[79] Kampshoff, Philipp et al. Building the Electric-Vehicle Charging Infrastructure America Needs (2022). Accessed at: https://www.mckinsey.com/industries/public-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs

Variable	Definition	Value	Unit	Data Source
				and Targets Technical Report
$Vehicles_{by}$	Vehicles in baseline year	27,195	vehicles	Estimate based on Ukiah Zip Code[1]
$Population_{by}$	Population in baseline year	15,929	people	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$EV\ Target_{Pass,y}$	Electric vehicle adoption target	See Table 18	percentage	Targeted zero-emission vehicle adoption for Measure T-4.

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. California Energy Commission. Light-Duty Vehicle Population in California. Accessed at: https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/light
2. PlugShare. EV Charging in Ukiah, CA. Accessed at: https://www.plugshare.com/directory/us/california/ukiah.

Table 18 Publicly Accessible Electric Vehicle Charger Parameters and Data Sources

Variable	Definition	Units	2030	2045
Equation 6.1				
$Population_y$	Forecasted population	people	17,834	21,407
$EV\ Target_{Pass,y}$	Zero-emission vehicle adoption target	percentage	30%	100%
EVs_y	Electric vehicles targeted	electric vehicles	9,134	36,547
Equation 6				
$PEV\ Chargers_y$	New publicly accessible electric vehicle chargers needed	chargers	223	990

Through public-private funding and partnerships, the City will facilitate the installation of 223 publicly accesible EV chargers by 2030 to support 9,134 EVs, and 763 additional publicly accessible EV chargers by 2045 for a total of 990 at prioritized locations on City-owned properties and across the community. The City of Ukiah will track the number of EVs in the City based on DMV data and will adjust the number of chargers necessary based on adoption rates. The City will play a key role in identifying strategic sites and providing support through direct funding and establishing streamlined permitting for EV charger installations (**Actions T-4a** and **T-4b**). The majority of these installations will be carried out through existing local (e.g., Ukiah's Electric Vehicle Charger Rebate Program[80]), regional and state (e.g., Sonoma Coast Incentive Project[81]), and federal funding opportunities, as well as the potential pursuit of partnerships with private companies.[82] Additionally, these ZEVs will be supported by private electric vehicle chargers in new developments and existing buildings (**Action T-4b**).

Action T-4b directs the City to implement the Tier 2 voluntary measures of the California Green Building Standards Code—Part 11, Title 24, California Code of Regulations—known as CALGreen. Once locally adopted through a reach code in 2026, these Tier 2 requirements will be mandatory for new commercial and multifamily construction in Ukiah and require such buildings to install the

80 City of Ukiah. Electric Vehicle Offers & Information. Accessed at: https://ukiah.chooseev.com/promos/

81 CALeVIP. Sonoma Coast Incentive Project. Accessed at: https://calevip.org/incentive-project/sonoma-coast

82 Public-private partnerships are expected due to the large amount of state and federal funding available to support California's need for over one million public and shared chargers by 2030 to meet Executive Order B-48-18's ZEV goals.

minimum number of EV chargers based on the requirements (i.e., 20 percent of total parking spaces). Additionally, the City will adopt Tier 2 requirements for major commercial and multifamily retrofits through a reach code in 2026. These requirements will require major commercial retrofits to meet Tier 2 requirements for "EV Ready" charging spaces and infrastructure; and major multifamily building retrofits to install the minimum number of EV chargers based on Tier 2 requirements (i.e., 20 percent of total parking spaces).[83] **Action T-4b** will work to increase private EV chargers in new buildings. The City has a Level 2 EV Charger Rebate program in place,[84] and **Action T-4a** directs the City to identify funding opportunities for multifamily residential vehicle charger installations. These funding options, along with federal and State funding will help cover the upfront costs to purchasing an EV and installing the equipment or infrastructure upgrades needed to charge the EV at home as high costs are one of the barriers to EV adoption for low-income households.[85] **Action T-4a** also directs the City to identify opportunities for accelerated fleet ZEV adoption, supporting commercial vehicle conversions, as regulated by the ACF requirements. These Actions will enable the City to install as many privately owned EV chargers in existing buildings and new developments as practical to support a 30 percent passenger ZEV adoption and a 25 percent commercial ZEV adoption by 2030 and a 100 percent ZEV adoption by 2045. For the purpose of estimating GHG reductions, these percentages are made under the conservative assumption that the VMT reduction from ZEV adoption actions would occur after the active transportation and public transit actions with diminishing returns rather than have an aggregated effect on total VMT.

Table 19 shows the parameters and data sources that support GHG emissions reduction from the zero-emission vehicle adoption and Table 20 shows the calculations as outlined in Equations 7 through 7.2.

Zero-emission Vehicle Adoption Equations

Equation 7 $CO_2e\ Reduction_{VMT,i,y}=(VMT\ Reduced_{ICE,i,y}*EF_{VMT,i,y})-(Elec\ Converted_{i,y}*EF_{elec,i,y}*(1+L_{T\&D}))$

Equation 7.1 $Elec\ Converted_{i,y}=VMT\ Reduced_{ICE,i,y}*EPM_{ZEV,i,y}$

Equation 7.2 $VMT\ Reduced_{ICE,i,y}=(VMT_{i,y}-VMT_{alt,i,y})*(ZEV\ Adoption_{i,y}-ZEV\ Adoption\ Baseline_{i,y})$

Table 19 Zero-emission Vehicle Adoption Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 7				
$CO_2e\ Reduction_{VMT,I,y}$	VMT GHG emissions reduction	See Table 20	MT CO_2e	Calculated
$VMT\ Reduced_{ICE,I,y}$	Internal combustion engine VMT reduced	See Table 20	miles	Calculated
$EF_{VMT,I,y}$	Forecasted VMT emission factor	See Table 20	MT CO_2e/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report

[83] Major commercial retrofits include retrofits to commercial buildings with a square footage larger than 10,000 square feet or retrofits with modifications to electric service panels.

[84] City of Ukiah. Electric Vehicle Offers & Information. Accessed at: https://ukiah.chooseev.com/promos/

[85] Gaillard, Isa. Ingredients for Equitable Electrification: Analyzing Equity in Statewide Electric Vehicle Rebate Programs (2022). Accessed at: https://greenlining.org/wp-content/uploads/2022/10/Greenlining-Ingredients-Equitable-Transportation-WebFINAL.pdf

Variable	Definition	Value	Unit	Data Source
$Elec\ Converted_{i,y}$	Electricity from zero-emission vehicle conversion	See Table 20	kWh	Calculated
$EF_{elec,l,y}$	Forecasted residential electricity emission factor	See Table 20	MT CO_2e/kWh	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$L_{T\&D}$	Electricity transmission and distribution loss percentage	4.12%	Percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
i	VMT type	Passenger, commercial	–	–
y	Year	2030 or 2045	–	–
Equation 7.1				
$EPM_{ZEV,l,y}$	Forecasted electricity usage per mile of zero-emission vehicles	See Table 20	kWh/mile	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
Equation 7.2				
$VMT_{i,y}$	Forecasted total VMT	See Table 20	miles	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$VMT_{alt,i,y}$	VMT reduction from alternative transit methods	See Table 20	miles	See Measures T-1 and T-2
$ZEV\ Adoption_{i,y}$	Zero-emission vehicle adoption target	—	—	—
$ZEV\ Adoption_{pass,2030}$	—	30.00%	percentage	Measure T-4 target
$ZEV\ Adoption_{pass,2045}$	—	100.00%	percentage	Measure T-4 target
$ZEV\ Adoption_{com,2030}$	—	25.00%	percentage	Measure T-4 target
$ZEV\ Adoption_{com,2045}$	—	100.00%	percentage	Measure T-4 target
$ZEV\ Adoption\ Baseline_{i,y}$	Zero-emission vehicle adoption baseline	See Table 20	percentage	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

Table 20 Zero-emission Vehicle Adoption GHG Emission Reduction Calculations

Variable	Definition	Units	VMT Type	2030	2045
Equation 7.2					
$VMT_{i,y}$	Forecasted total VMT	miles	Passenger	150,757,738	197,679,597
			Commercial	18,643,436	24,622,799
$VMT_{alt,l,y}$	VMT reduction from alternative transit methods	miles	Passenger	4,614,196	29,002,491
			Commercial	0	0
$ZEV\ Adoption_{i,y}$	Electric vehicle adoption target	percentage	Passenger	30.00%	100.00%
			Commercial	25.00%	100.00%
$ZEV\ Adoption\ Baseline_{i,y}$	Electric vehicle adoption baseline	percentage	Passenger	6.58%	9.52%
			Commercial	4.73%	24.62%
$VMT\ Reduced_{ICE,l,y}$	Internal combustion engine VMT reduced	VMT	Passenger	34,226,818	168,677,106
			Commercial	3,779,024	24,622,799
Equation 7.1					
$EPM_{ZEV,l,y}$	Forecasted electricity usage per mile of electric vehicles	kWh/mile	Passenger	0.3681	0.3690
			Commercial	1.2227	1.1606
$Elec\ Converted_{i,y}$	Electricity from electric vehicle conversion	kWh	Passenger	12,599,302	62,248,262
			Commercial	4,620,477	28,576,654
Equation 7					
$EF_{elec,l,y}$	Forecasted electricity emission factor	MT CO_2e/kWh	Passenger	0.0001501	0.0000000
			Commercial	0.0001501	0.0000000
$EF_{VMT,l,y}$	Forecasted VMT emission factor	MT CO_2e/mile	Passenger	0.0002970	0.0002580
			Commercial	0.0011570	0.0009400
CO_2e ReductionVMT	**VMT GHG emissions reduction**	**MT CO_2e**	**Passenger**	**8,196**	**43,519**
			Commercial	**3,650**	**23,145**

Measure T-5: By 2030, electrify or otherwise decarbonize 12% of applicable SORE off-road equipment and replace 35% of fossil diesel consumption with renewable diesel in alignment with EO N-79-20.

Measure T-5 aims for Ukiah to decarbonize 12 percent of small off-road engine (SORE) use in the community by 2030 and 100 percent by 2045 in alignment with CARB's SORE Regulation. The measures also seek to substitute 35% of off-road diesel consumption with renewable diesel by 2030 in compliance with EO N-79-20. The primary Actions that enable this Measure include:

- **Action T-5a** which directs the City to offer education and incentives for replacement of fossil-fuel based equipment with SORE zero emissions alternatives;
- **Action T-5b** which commits the City to align with and support CARB's regulations requiring new sale small off-road equipment to be zero emission starting in 2024, and phase 2 of the regulation affecting the manufacture and sale of larger scale equipment such as generators and pressure washers by 2028; and
- **Action T-5c** which directs the City to develop an outreach strategy to notify affected fleets, identify pathways to enforce and track compliance with the requirement for diesel vehicles over 25 horsepower to use R99 or R100 renewable diesel, such as through reporting requirements, and partner with regional fuel suppliers to procure renewable diesel.

Action T-5b directs the City to align with and support CARB's regulations requiring that new sales of SORE be zero emission by 2024, in compliance with AB 1346. As defined by CARB, SORE are those equipment types with rated power at or below 19 kilowatts (i.e., 25 horsepower). Typical off-road vehicle and equipment types that use these engines include lawn and garden equipment, portable generators, and pressure washers.[86] To track compliance with AB 1346 requirements and meeting goals established by Measure T-5, the City will monitor the public's participation in the City's SORE education and incentive program.

In 2030, gasoline and diesel used by these SOREs will comprise over 38 percent of the off-road vehicle and equipment fuel used throughout Ukiah.[87] SORE equipment have a median lifespan of 5 years or less, which means the majority of SORE equipment in Ukiah will likely need to be replaced by 2030.[88] By providing education supporting compliance with AB 1346 (**Action T-5b**), the City will support the electric conversion of SORE off-road equipment at time of replacement. Additionally, the City will provide incentives for residents and businesses to replace their existing SORE equipment to further promote the transition to ZEV equipment alternatives (**Action T-5a**). Given the population of SORE equipment in the community, their median lifespan, and the expectation that only ZEV options will be available for purchase by 2030, a conservative goal of a 12% reduction in SORE fuel consumption is established for Measure T-5. This quantification focuses on 12 percent of applicable SORE rather than the full 38 percent that SORE comprises, to reflect that Action T-5b targets new sales rather than existing equipment across Ukiah.

In 2022, CARB also approved amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation that incorporates new requirements to use renewable diesel. Beginning January 1, 2024, all

86 California Air Resources Board (CARB). (2021) SORE Applicability Fact Sheet. Accessed at: https://ww2.arb.ca.gov/resources/fact-sheets/sore-applicability-fact-sheet.

87 Ukiah's SORE fuel usage in 2030 was estimated by filtering CARB OFFROAD2021 model outputs (for Mendocino County in 2030) for horsepower ratings less than or less than 25 and attributing the resulting County-level annual fuel usage to Ukiah based on the attribution methodology used in the GHG inventory and forecast. The results were divided by the total estimated off-road fuel usage in Ukiah in 2030 to estimate the share, or percentage, of fuel usage attributable to SOREs.

88 CARB. 2020 Emissions Model for Small Off-Road Engines – SORE2020 (2020). Table 16. Accessed at: https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf

California fleets subject to this regulation are required to procure and only use R99 or R100 renewable diesel fuel in all vehicles subject to the Off-Road Regulation, with some limited exceptions. This regulation applies to all self-propelled off-road diesel vehicles 25 horsepower or greater used in California and applies to vehicles that are rented or leased. Exceptions to the regulation include locomotives, commercial marine vessels, marine engines, recreational off-highway vehicles, combat and tactical support equipment, stationary equipment, portable engines, equipment used exclusively for agricultural operations, implements husbandry, and off-road diesel vehicles owned and operated by an individual for personal, non-commercial and non-governmental purposes.[89] To align with the regulation, the City will monitor the retail supply of R99 and R100 as the performance standard for Measure T-5. As part of compliance tracking outlined in Action T-5c, the City may also partner with CARB to verify fleet compliance, leveraging CARB's requirement for fleets to affirm their adherence to the regulation. To further support fleet compliance, the City will develop an education campaign to provide fleets with resources for procuring drop-in renewable diesel fuel (**Action T-5c**).

As the In-Use Off-Road Diesel-Fueled Fleets Regulation is dependent on the availability of renewable diesel and does not require equipment turn-over, and the City will monitor retail supply to ensure only R99/R100 is available locally, it is anticipated that Measure T-5 will transition all of off-road diesel consumption subject to the regulation to the renewable alternative by 2030, or 35% of Ukiah's total off-road diesel consumption. Renewable diesel that meets the required standards has an emissions factor that is approximately 70 percent lower than fossil-fuel diesel.[90] As renewable diesel has a lower emissions factor, the increased use required by CARB will further help drive down off-road emissions in the Ukiah community.

Table 21 shows the parameters and data sources that support off-road ordinance GHG emissions reduction and Table 22 shows the calculations as outlined in Equations 8through 8.3.

Off-road Decarbonization Equations

Equation 8	$CO_2e\ Reduction_y = Fuel\ Avoided_{SORE,y} * Weighted\ Efy$
Equation 8.1	$Weighted\ EF_y = CO_2e\ Emissions_y/(Fuel_{Gas,\ y} + Fuel_{Diesel,\ y} + Fuel_{NG,\ y})$
Equation 8.2	$Fuel\ Avoided_{SORE,y} = (Fuel_{Gas,\ y} + Fuel_{Diesel,\ y} + Fuel_{NG,\ y}) * Prop_{SORE} * Target_{SORE,y}$
Equation 8.3	$Fuel\ Replaced_{Diesel,y} = (Fuel_{Diesel,\ y} * (1-Target_{SORE,y})) * Target_{Diesel,y}$

[89] California Air Resources Board (CARB). (2022). Final Regulation Order Amendments to Sections 2449, 2449.1, and 2449.2 Title 12, California Code of Regulations. Accessed at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/off-roaddiesel/froa-1.pdf

[90] As of February, 2023, CARB staff identified renewable diesel produced by Neste meets the regulatory requirements and standards for diesel quality (https://ww2.arb.ca.gov/resources/fact-sheets/chc-factsheet-renewable-diesel-r100-or-r99). Estimates in GHG emission reductions based on emission factors provided by Neste accessed at: https://www.neste.com/en-us/products-and-innovation/neste-my-renewable-diesel/product-information

Table 21 Off-road Decarbonization Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 8				
$CO_2e\ Reduction_{offroad,y}$	Offroad fuel GHG emissions reduction	See Table 22	MT CO_2e	Calculated
$Fuel\ Avoided_{SORE,y}$	Off-road fuel avoided from applicable SORE equipment	See Table 22	gallons	Calculated
$Weighted\ EF_y$	Weighted emission factor for all off-road fuels	See Table 22	MT CO_2e/gallon	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel\ Replaced_{Diesel,y}$	Off-road diesel replaced from applicable diesel equipment >25 hp	See Table 22	gallons	Calculated
$EF_{RDiesel}$	Emissions factor of renewable diesel	0.00308	MT CO_2e/gallon	Neste (as recommended by CARB)[6]
$Weighted\ EF_{Diesel}$	Emissions factor of fossil fuel diesel	0.01047	MT CO_2e/gallon	Inventory
Equation 8.1				
$CO_2e\ Emissions_y$	Forecasted off-road GHG emissions	See Table 22	MT CO_2e	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel_{Gas,y}$	Forecasted gasoline use	See Table 22	gallon	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel_{Diesel,y}$	Forecasted diesel use	See Table 22	gallon	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Fuel_{NG,y}$	Forecasted natural gas use	See Table 22	gallon	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
Equation 8.2				
$Prop_{SORE}$	Proportion of fuel attributable to SORE equipment	38%	percentage	OFFROAD2021[1,2]
$Target_{SORE,y}$	Fuel use reduction target for all off-road fuels	–	–	–
$Target_{SORE,2030}$	Fuel use reduction target (2030)	12%	percentage	OFFROAD2021[1,2] and direction of state goals (i.e., EO N-79-20).[3]
$Target_{SORE,2045}$	Fuel use reduction target (2045)	100%	percentage	Based on compliance with state goals established by EO N-79-20.
Equation 8.3				
$Target_{Diesel,y}$	Fuel reduction target for diesel off-road fuels	–	–	–
$Target_{Diesel,2030}$	Fuel reduction target (2030)	35%	percentage	OFFROAD2021[1,4] and CARB applicable regulations requiring renewable diesel fuel use (i.e., In-Use Off-Road

Variable	Definition	Value	Unit	Data Source
				Diesel-Fueled Fleets Regulation)[5]
$Target_{Diesel,2045}$	Fuel reduction target (2045)	0%	percentage	Based on compliance with state goals established by EO N-79-20.

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. California Air Resources Board (CARB). 2024. Off-Road Emissions Inventory (OFFROAD2021). Available at: https://arb.ca.gov/emfac/offroad/emissions-inventory/3f377c1f45fef7c154509eac6354b9086be9cdd9
2. Ukiah's SORE fuel usage in 2030 was estimated by filtering CARB OFFROAD2021 model outputs (for Mendocino County in 2030) for horsepower ratings less than or less than 25 and attributing the resulting County-level annual fuel usage to Ukiah based on the attribution methodology used in the GHG inventory and forecast. The results were divided by the total estimated off-road fuel usage in Ukiah in 2030 to estimate the share, or percentage, of fuel usage attributable to SOREs.
3. California Air Resources Board (CARB). SORE Applicability Fact Sheet (2021). Accessed at: https://ww2.arb.ca.gov/resources/fact-sheets/sore-applicability-fact-sheet.
4. Ukiah diesel fuel usage in 2030 was estimated based on attributions established in the Ukiah 2022 GHG Inventory and by filtering CARB OFFROAD2021 model outputs for horsepower ratings greater than or equal to 25 and for equipment categories subject to the In-Use Off-Road Diesel-Fueled Fleets Regulation. The results were divided by the total estimated off-road diesel usage in Ukiah in 2030 to estimate the share, or percentage, of fuel usage subject to the In-Use Off-Road Diesel-Fueled Fleets Regulation which accounted for 35% of all diesel fuel use.
5. California Air Resources Board (CARB). (2022). Final Regulation Order Amendments to Sections 2449, 2449.1, and 2449.2 Title 12, California Code of Regulations. Accessed at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/off-roaddiesel/froa-1.pdf

Table 22 Off-road Decarbonization GHG Emission Reduction Calculations

Variable	Definition	Units	2030	2045
Equation 8.1				
$CO_2e\ Emissions_y$	Forecasted off-road GHG emissions	MT CO_2e	3,639	4,108
$Fuel_{Gas,y}$	Forecasted gasoline use	gallons	202,942	232,457
$Fuel_{Diesel,y}$	Forecasted diesel use	gallons	170,014	189,030
$Fuel_{NG,y}$	Forecasted natural gas use	gallons	-	-
*Weighted EF*y	Weighted fuel emission factor	MT CO_2e/gallon	0.009756	0.009747
Equation 8.2				
$Prop_{SORE}$	Proportion of fuel attributable to SORE equipment	percentage	38%	38%
$Target_{SORE,y}$	Fuel use reduction target for all off-road fuels	percentage	12%	100%
$Fuel\ Avoided_{SORE,y}$	Off-road fuel avoided from applicable SORE equipment	gallons	16,787	158,100
Equation 8.3				
$Target_{Diesel,y}$	Fuel use reduction target for all off-road fuels	percentage	35%	0%
$Fuel\ Replaced_{Diesel,y}$	Off-road fuel replaced from applicable diesel equipment >25 hp	gallons	59,811	0
Equation 8				
$CO_2e\ Reduction_{Fuel}$	**Fuel GHG emissions reduction**	**MT CO_2e**	**606**	**1,541**

Measure T-6: Decarbonize the municipal fleet in compliance with the California Advanced Clean Fleet Rule and EO N-79-20 off-road requirements.

Measure T-6 aims to electrify or otherwise decarbonize Ukiah's municipal fleet in line with the State's Advanced Clean Fleet Rule. To lead by example and align with State requirements, the City will implement its Sustainable purchasing policy by 2025 requiring all new and replacement municipal fleet vehicle purchases to be electric vehicles (EVs) or ZEVs, where commercially viable. The City will also conduct an audit of existing vehicles and their uses to design and implement a replacement schedule to comply with the California Advanced Clean Fleet rule, ensuring that 50% of medium- and heavy-duty vehicle purchases are ZEVs beginning in 2024, and 100% by 2027. Additionally, the City will evaluate opportunities to procure renewable diesel for applicable jurisdiction-owned equipment and replace end-of-life off-road equipment with zero-emission alternatives where feasible in alignment with EO N-79-20 requirements. The City also recognizes the need to provide the necessary infrastructure to support this transition. It plans to obtain resources to install additional ZEV chargers and renewable fueling stations in municipal parking lots for use by the fleet, employees, and the public.

This measure will reduce GHG emissions from municipal operations and demonstrate the feasibility and benefits of transitioning to clean transportation technologies. While the strategies to decarbonize fleet vehicles will reduce GHG emissions, these emissions are already included as a subset of transportation sector emissions within the Ukiah Community GHG Inventory. This means the associated GHG emissions reduction are included within the community mitigation Measures (i.e., T-4 through T-5). Thus, to avoid potential double counting, this municipal mitigation measure is not counted towards the 2030 and 2045 targets.

4 Sector WR: Water Resources

The City of Ukiah's Water Resources strategy aims to optimize Ukiah's water resources through sustainable practices in wastewater recycling, water conservation, and water use reduction. This approach includes ongoing updates to the Urban Water Management Plan, where the City's water utility department and the Ukiah Valley Basin Groundwater Sustainability Agency (UVBGSA) will outline demand reduction measures in compliance with the State's Urban Water Management Planning Act established in the California Water Code.[91] As part of this strategy, the City will expand on existing water management policies, collaborate with large water users, enforce landscape irrigation efficiency standards, and engage residents and businesses in sustainable water practices. Through these efforts, the City aims to strengthen water resource resilience and reduce per capita water consumption, ensuring sustainable water access for current and future generations.

Based on this approach, the CAP's Water Resources Sector consists of the following Measure presented in Table 23. The Measure is supportive (i.e., no GHG emissions reductions have been attributed) due to the potential for double counting of indirect GHG emissions reductions with the Building Energy Sector Measures. Energy is used at multiple stages of the water cycle, including extraction, treatment, distribution, and end-use activities like heating. Because of this interconnected relationship, conserving water can indirectly reduce energy demand, offering opportunities for resource efficiency and GHG emissions reductions. However, electricity consumption from residential and commercial building operations in the community is already accounted for under the Building Energy Sector, which will see efficiency upgrades (Measures BE-2 and BE-3) and emissions reductions from cleaner electricity generation and increased renewable energy procurement under Measure BE-1. Attributing GHG reductions from water conservation to the Water Resources Sector would risk double counting reductions already included under the Building Energy Sector. To avoid this overlap, GHG emissions associated with the Water Resources Sector are not quantified. The following subsection details the role of this supportive Measure.

Table 23 Sector WW: Water Resources GHG Emissions Reduction Summary

Measure ID	Measure	2030 GHG Emissions Reduction (MT CO_2e)	2045 GHG Emissions Reduction (MT CO_2e)
Measure WR-1	Continue to implement wastewater recycling and water conservation projects and reduce per capita potable water consumption.	Supportive	Supportive
Total		**0**	**0**

[91] California Department of Resources. 2024. Urban Water Management Plans. Available at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans

Measure WW-1: Continue to implement wastewater recycling and water conservation projects and reduce per capita potable water consumption.

Measure WW-1 focuses on advancing Ukiah's water conservation and wastewater recycling efforts to reduce per capita potable water consumption. Actions to achieve this goal focus on updating the Urban Water Management Plan (UWMP) every 5 years to align with California's Urban Water Management Planning Act,[92] as well as continuing to require low-impact-development (LID) strategies for new development.

The updated UWMP will include demand reduction measures and, as needed, new actions to meet state requirements. Updating the UWMP may also include enhancing regional Water Shortage Contingency Plans[93] to enforce water waste restrictions, partnering with large water users to develop on-site reuse plans, and updating the Model Water Efficient Landscape Ordinance (MWELO)[94] in collaboration with builders and developers. Additional strategies involve encouraging dual-plumbing systems in new construction to utilize greywater or recycled water for irrigation, engaging with the community—particularly low-to-moderate-income residents—to promote water-saving incentives and programs, and adjusting water and wastewater rates to promote financial sustainability. Through these comprehensive efforts, Measure WW-1 aims to establish a sustainable approach to water use that supports the City's conservation goals and water security.

Since Ukiah's wastewater treatment plant is located within City limits and all its water comes from local sources, GHG emissions reductions are not quantified under this Measure due to the risk of double counting with Building Energy Sector GHG reductions from renewable and carbon-free electricity. Energy is used at multiple stages of the water cycle—such as treatment, distribution, and end-use—which creates an interconnected relationship where water conservation can reduce energy demand. However, GHG emissions and reductions from water energy consumption and conservation are anticipated to be partially captured through the Building Energy Sector Measures, which address energy efficiency and cleaner electricity procurement. This Measure still directly supports BE 1 – 3 by reducing energy consumption for water distribution and wastewater treatment.

[92] California Department of Resources. 2024. Urban Water Management Plans. Available at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans

[93] California Department of Water Resources. 2025. Countywide Drought and Water Shortage Contingency Plans. Available at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/County-Drought-Planning

[94] City of Ukiah. 2024. ARTICLE 6. MODEL WATER EFFICIENT LANDSCAPE ORDINANCE ADOPTION. Available at: https://www.codepublishing.com/CA/Ukiah/html/Ukiah03/Ukiah0301-0600.html

5 Sector SW: Solid Waste

The City of Ukiah's Solid Waste strategy focuses on increasing diversion to reduce the amount of organic waste[95] sent to the landfill and effectively using those diverted resources across the community. The Strategy aims to accomplish these goals by focusing on organic materials, along with the finished end products. In the landfill, organic waste decays without access to light or oxygen and produces methane (CH_4) gas. In wildfire scenarios and/or when left unmanaged, woody and green waste produces carbon monoxide (CO), carbon dioxide (CO_2), sulfur oxides (SOx), and nitrogen oxides (NOx). Diverting organic waste from the landfill reduces the occurrence of this anaerobic decomposition, providing Ukiah with an important opportunity to reduce solid waste GHG emissions. Proper management of Ukiah's natural resources from a land use and renewable energy perspective, reduces the occurrence of emissions and can contribute to carbon sequestration goals. After diverting and recycling this organic waste, the resulting finished end products (e.g. biochar, compost, blended soil amendments, biogas & digestate) can be utilized throughout the community to sequester carbon and/or provide renewable power. Thus, properly managing organic waste provides an important opportunity to develop Ukiah's circular economy, reduce GHG emissions, and sequester carbon. Based on this approach, the CAP's Solid Waste Sector consists of the Measures presented in Table 24. The following subsections detail the substantial evidence and calculation methodologies of the quantitative Measures.

Table 24 Sector SW: Solid Waste GHG Emission Reduction Summary

Measure ID	Measure	2030 GHG Emissions Reduction (MT CO_2e)	2045 GHG Emissions Reduction (MT CO_2e)
Measure SW-1	Achieve and maintain SB 1383 requirements to reduce organic waste sent to landfills by 75% by 2030.	3,511	4,646
Measure SW-2	Achieve SB 1383 procurement requirements (0.08 tons recovered organic waste per person) by 2030.	190	228
Total		**3,701**	**4,874**

[95] Organic waste, for the purposes of this CAP, includes food waste, green material, landscape and pruning waste, organic textiles and carpets, lumber, wood, paper products, printing and writing paper, manure, biosolids, digestate, and sludges. Accessed at: https://calrecycle.ca.gov/organics/slcp/collection/#:~:text=Beginning%20in%202022%2C%20SB%201383,biosolids%2C%20digestate%2C%20and%20sludges.

Measure SW-1: Achieve and maintain SB 1383 requirements to reduce organic waste sent to landfills by 75% by 2030.

Measure SW-1 aims for Ukiah to meet SB 1383 requirements to recover 20 percent of disposed edible food for human consumption and reduce landfilled organic waste—and its associated GHG emissions—75 percent from current levels by 2030. The primary Actions that enable this Measure include:

- **Action SW-1a** which commits the City to meeting the requirements of SB 1383 to reduce organics in the waste stream by 75% by 2030 through activities such as:
  - Implementing enforcement and fees for incorrectly sorted materials;
  - Confirming adequate bin signage across commercial and residential areas of acceptable landfill, recyclable, and compostable materials;
  - Identifying public areas for adding organics collection and recycling bins where needed;
  - Working with C&S Waste Solutions and MSWMA to conduct free food scrap collection pail giveaways and promote curbside organics collection service; and,
  - Identifying long-term and alternate solutions for wastewater bio-solids and develop local, beneficial reuse, as well as obtaining resources to fund MSWMA staffing and capacity.

These Actions encompass the activities the California Department of Resources Recycling and Recovery (CalRecycle) requires jurisdictions to conduct to comply with SB 1383.[96] To monitor the progress toward compliance with SB1383 diversion requirements, the City will track the amount of funding acquired to increase staffing and capacity, as well as work with C&S Solutions and MSWMA to track organics diversion rates.

Currently, Ukiah is working with Cal Recycle to ensure communitywide compliance with SB 1383 requirements. The City of Ukiah, in partnership with its enterprise solid waste hauler, is already incorporating edible food recovery strategies and landfill/organics/recycling collection systems.[97] Between now and 2030, the City needs to expand funding, staff, enforcement and keep developing their current programs. The City intends to identify funding solutions to support implementation of **Action SW-1a**, which aims to increase and expand upon the solutions already in place. Continuing and completing these activities is thus expected to provide the levels of diversion, composting, and food donations needed to reduce Ukiah's landfilled organic waste 75 percent by 2030.[98] This level of landfilled organic waste reduction is expected to directly reduce solid waste disposal GHG emissions 75 percent because nearly all GHG emissions from the natural decay of solid waste in landfills come from organic waste.[99]

Table 25 shows the parameters and data sources that support the landfilled organic waste reduction GHG emissions reduction and Table 26 shows the calculations as outlined in Equation 9.

[96] CalRecycle. SB 1383 Jurisdiction Responsibilities. Accessed at: https://www2.calrecycle.ca.gov/Docs/Web/119160#:~:text=Beginning%20in%202022%2C%20SB%201383,is%20automatically%20provided%20the%20service.

[97] C&S Waste Solutions. Ukiah Waste Solutions. Accessed at: https://candswaste.com/locations/california/mendocino-county/ukiah-waste-solutions/

[98] While SB 1383 technically mandates jurisdictions to reduce 75 percent of organics waste sent to landfills form 2014 levels by 2025, setting Measure SW-1 to 2030 gives the City time to develop and increase the necessary programs and initiatives to meet compliance.

[99] According to the Local Governments for Sustainability (ICLEI) U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Appendix E – Solid Waste Emission Activities and Sources, GHG emissions are generated by non-biologic wastes only if they are combusted.

Landfilled Organic Waste Reduction Equations

Equation 9 $CO_2e\ Reduction_{LOW,y} = CO_2e\ Emissions_y * Reduction\ Target_{LOW,y}$

Table 25 Landfilled Organics Reduction Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 9				
$CO_2e\ Reduction_{LOW,y}$	Landfilled organic waste GHG emissions reduction	See Table 26	MT CO_2e	Calculated
$CO_2e\ Emissions_y$	Landfilled organic waste GHG emissions	See Table 26	MT CO_2e	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Reduction\ Target_{LOW,y}$	Landfilled organic waste reduction percent	75	percentage	Estimated based on compliance with CalRecycle's required activities for SB 1383 compliance and GHG emission factors for solid waste.[1, 2]
y	Year	2030 or 2045	–	–

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. CalRecycle. SB 1383 Jurisdiction Responsibilities. Accessed at: https://www2.calrecycle.ca.gov/Docs/Web/119160#:~:text=Beginning%20in%202022%2C%20SB%201383,is%20automatically%20provided%20the%20service
2. According to the ICLEI U.S. Community Protocol, Appendix E, GHG emissions are generated by non-biologic wastes only if they are combusted.

Table 26 Landfilled Organics Reduction GHG Emission Reduction Calculations

Variable	Definition	Units	2030	2045
Equation 9				
$CO_2e\ Emissions$	Landfilled organic waste GHG emissions	MT CO_2e	4,681	6,195
$Reduction\ Target_{LOW,y}$	Landfilled organic waste reduction percent	percentage	75%	75%
$CO_2e\ Reduction_{LOW}$	**Landfilled organic waste GHG emissions reduction**	**MT CO_2e**	**3,511**	**4,646**

Measure SW-2: Achieve SB 1383 procurement requirements (0.08 tons recovered organic waste per person) by 2030.

Measure SW-5 puts Ukiah on a path to meet Ukiah's SB 1383 procurement target by 2030 and maintain it thereafter. SB 1383 requires each jurisdiction in California to procure recovered organics waste products to meet annual procurement targets developed by CalRecycle.[100] Recovered organic waste products include compost, mulch, renewable energy generated from anaerobic digestion (e.g., transportation fuel, electricity, and gas for heating), and electricity generated from biomass conversion. While a jurisdiction has the option to procure any combination of recovered organic waste products to fulfill 100 percent of its procurement target, Ukiah aims to meet their procurement target primarily through the procurement of compost to leverage the carbon sequestration benefits it provides when applied to community lands. The primary Actions that enable this Measure include:

- **Action SW-2a** which directs the City to establish an implementation plan for meeting procurement requirements through:
  - Enforcing compliance with SB 1383, aiming to exceed baseline requirements by establishing a minimum annual level of compost or mulch application on appropriate land throughout the region;
  - Maintaining procurement policies to purchase recovered organic waste products in accordance with SB 1383 requirements; and,
  - Expansion/creation of community composting programs paired with community gardens.

This Action will allow the City to establish the supply and procurement of compost to meet their annual procurement targets. To monitor progress toward this goal and determine compliance with SB 1383 requirements, the City will continue to monitor the tons of organics procured and distributed to the community. Table 27 shows the parameters and data sources that support the annual procurement targets and landfilled organic waste reduction GHG emissions reduction associated with this Measure. Table 28 shows the calculations as outlined in Equation 10 through 10.1.

Compost Procurement Equations

Equation 10 $CO_2e\ Sequestration_y = (Compost_y * CSF_{Compost}) * Compliance\ Target_y$

Equation 10.1 $Compost_y = Population_y * (Ratio_{procure} * CF_{compost})$

Table 27 Compost Procurement Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 10				
$CO_2e\ Sequestration_y$	Carbon sequestered from compost procurement and application	See Table 28	MT CO_2e	Calculated
$Compost_y$	Compost procurement required to meet organic waste procurement target	See Table 28	compost tons	Calculated

[100] CalRecycle. Procurement Targets and Recovered Organic Waste Products. Accessed at: https://calrecycle.ca.gov/organics/slcp/procurement/recoveredorganicwasteproducts/.

Variable	Definition	Value	Unit	Data Source
$CSF_{compost}$	Carbon sequestration factor for mixed organic compost application	0.23	MT CO_2e/ feedstock ton	CARB[1]
$Compliance\ Target_y$	Compliance target with procurement requirement	100%	percentage	State required compliance with SB 1383[2]
y	Year	2030 or 2045	–	–
Equation 10.1				
$Population_y$	Forecasted population	See Table 28	persons	See references in Appendix GHG Inventory, Forecast, and Targets Technical Report
$Ratio_{procure}$	Organic waste procurement required per capita	0.08	feedstock tons/person	CalRecycle's Procurement Calculator Tool[3]
$CF_{compost}$	Conversion factor of organics to compost tons	0.58	compost tons/organic waste tons	CalRecycle's Procurement Calculator Tool[3]

Notes: "-" means either reference not applicable or see references for disaggregated parameter in the following table rows

1. CARB. Method for Estimating Greenhouse Gas Emission Reductions from Diversion Of Organic Waste from Landfills to Compost Facilities (2017). Accessed at: https://ww2.arb.ca.gov/sites/default/files/classic/cc/waste/cerffinal.pdf.
2. CalRecycle. Procurement Targets and Recovered Organic Waste Products. Accessed at: https://calrecycle.ca.gov/organics/slcp/procurement/recoveredorganicwasteproducts/.
3. CalRecycle. Procurement Calculator Tool. Accessed at: https://calrecycle.ca.gov/organics/slcp/reporting/.

Table 28 Landfilled Organics Reduction GHG Emission Reduction Calculations

Variable	Definition	Units	2030	2045
Equation 10.1				
$Population_y$	Forecasted population	people	17,834	21,407
$Ratio_{procure}$	Organic waste procurement required per capita	tons/people	0.08	0.08
$CF_{compost}$	Conversion factor of organics to compost tons	compost ton/organic waste ton	0.58	0.58
$Compost_y$	Compost procurement required to meet organic waste procurement target	ton	828	993
Equation 10				
$Compliance\ Target_y$	Compliance target with procurement requirement	percentage	100%	100%
$CSF_{compost}$	Carbon sequestration factor for mixed organic compost application	MT CO_2e/ton	0.23	0.23
$CO_2e\ Sequestration_y$	**Carbon sequestered from compost procurement and application**	**MT CO_2e**	**190**	**228**

6 Sector CS: Carbon Sequestration

The City of Ukiah's Carbon Sequestration strategy focuses on enhancing Ukiah's ability to capture and store carbon through natural solutions and community-driven economic development. This includes preserving existing trees and planting at least 200 new trees annually, guided by an Urban Forest Master Plan and regular urban tree canopy studies. Additional efforts involve regenerative land and water management practices to optimize natural carbon storage, restore ecosystems, and conserve biodiversity, alongside pilot projects in carbon farming. To support sustainable economic growth, the strategy integrates climate action with local economic planning, fostering a resilient, circular economy and green job creation. A feasibility study on forest biomass-to-energy will evaluate opportunities for carbon sequestration, wildfire risk reduction, and regional economic benefits. Through this integrated approach, Ukiah strengthens its natural carbon sink capacity while promoting a sustainable, self-sufficient local economy. Based on this approach, the CAP's Carbon Sequestration Sector consists of the Measures presented in Table 29. The table also indicates which Measures are quantitative and which Measures are supportive. The following subsections detail the substantial evidence and calculation methodologies of the quantitative Measures and the role of the supportive Measures.

Table 29 Sector CS: Carbon Sequestration GHG Emissions Reduction Summary

Measure ID	Measure	2030 GHG Emissions Reduction (MT CO_2e)	2045 GHG Emissions Reduction (MT CO_2e)
Measure CS-1	Preserve existing trees and plant at least 200 new trees per year or an equivalent amount of high-emissions reduction potential land cover throughout the community, beginning in 2025 and through 2045.	149	1,635
Measure CS-2	Pursue opportunities to support the City's sustainable economic development goals with an emphasis on circularity and creating green jobs within the region.	Supportive	Supportive
Total		**149**	**1,635**

Measure CS-1: Preserve existing trees and plant at least 200 new trees per year or an equivalent amount of high-emissions reduction potential land cover throughout the community, beginning in 2025 and through 2045.

Measure CS-1 aims for Ukiah to preserve existing trees and plant at least 200 new trees per year, beginning in 2025 and through 2045. The primary Actions that enable this measure are:

- **Action CS-1a** which directs the City to prepare an Urban Forest Master Plan, update the Tree Management Guidelines and create a Tree Protection Plan to promote public tree health, enhancing resiliency, and increasing the environmental benefits and co-benefits of street trees and shading;
- **Action CS-1b** which directs the City to optimize natural carbon sequestration through regenerative land and water management; and,
- **Action CS-1c** which commits the City to conduct carbon sequestration farming pilot projects within the community and across the City's area of interest.

The City will track progress toward tree planting goals established in this measure by annual monitoring of the number of trees planted and removed from urban tree stock. The City is already making progress toward these goals, as it has recently received a $1.4 million grant to plant 722 trees.[101]

While the measure also includes initiatives to increase and maintain carbon sequestration potential on natural and agricultural lands in addition to urban forestry, carbon sequestration quantification and tracking is a relatively new field of study with extensive science to be done. Therefore, even though carbon sequestration will play large role in meeting state and Ukiah's carbon neutrality goals, communities are taking a conservative approach to carbon sequestration quantification as a starting point while the state develops more specific goals and guidance. Passed in 2022, AB 1757 directs the California Natural Resource Agency to determine carbon sequestration reduction targets by 2024 and develop a methodology to track them by 2025.[102] Once that is completed, the City will integrate those goals and tracking methods within this measure and its associated actions and update them as needed. Until the State provides clear guidance on assessing carbon sequestration from natural and working lands, the GHG reduction potential of this measure is estimated based on the number of urban trees planted.

In the quantification for this Measure, a cumulative benefit of the planted trees was assumed. This is applicable to this Measure specifically, as **Action CS-1a** emphasizes not only the planting of trees, but also the maintenance and retention of the trees (i.e., Urban Forest Master Plan, Tree Management Guidelines, Tree Protection Plan). This Action manages Ukiah's carbon stock, with carbon sequestration benefits increasing cumulatively as more trees are planted each year. Table 30 shows the parameters and data sources that support GHG emissions reduction from the zero-emission vehicle adoption and Table 31 shows the calculations as outlined in Equations 11 through 11.2.

---

[101] Cal-Fire. 2024. Cal Fire Urban and Community Forestry, 2024 Inflation Reduction Act Awards Summary. Available at: https://34c031f8-c9fd-4018-8c5a-4159cdff6b0d-cdn-endpoint.azureedge.net/-/media/calfire-website/what-we-do/grants/urban-and-community-forestry/grant-awards/ira_award-summary_9-20--2024_final.pdf?rev=fa68cc4f1e694240ba4b193fd9893b32&hash=82BA6A98AC24F7EEC5E480BA16A9DC9C

[102] CARB. Assembly Bill 1757 (2022). Accessed at: https://ww2.arb.ca.gov/2022-assembly-bill-1757-garcia-cristina-california-global-warming-solutions-act-2006-climate-goal

Tree Plantings Equations

Equation 11 $CO_2e\ Sequestration = Rate_{trees} * CSF_{Tree} * N_e$

Equation 11.1 $N_e = (Y_n * (Y_n + 1))/2$

Equation 11.2 $Y_n = (Year_T - Year_b) + 1$

Table 30 Tree Plantings Parameters and Data Sources

Variable	Definition	Value	Unit	Data Source
Equation 11				
$CO_2e\ Sequestration_y$	Carbon sequestered from tree plantings	See Table 31	MT CO_2e	Calculated
$Rate_{trees}$	Rate of trees planted per year	200	trees/year	Measure CS-2
CSF_{Tree}	Carbon sequestration factor for tree seedlings	0.035	MT CO_2e/tree/ year	CAPCOA[1]
Equation 11.1				
N_e	Effective number of years carbon is being sequestered[2]	See Table 31	years	Calculated
Equation 11.2				
Y_n	Total number of years in which trees are planted	See Table 31	years	Calculated
$Year_b$	Baseline tree planting year	2025	year	Measure CS-1
$Year_T$	Target emissions reduction year	See Table 31	year	–

Notes: MT CO_2e = metric tons of carbon dioxide; "–" means either reference not applicable or see references for disaggregated parameter in the following table rows.

[1] Default annual CO_2e sequestration per tree per year with a maximum lifespan of 20 years per tree is 0.0354 MT CO_2e/tree/year was obtained from CAPCOA. 2010. Quantifying Greenhouse Gas Mitigation Measures.

[2] The effective number of years of carbon sequestration represents the total cumulative years during which a given number of trees sequester carbon. Since the goal is based on the number of trees planted annually, this metric captures the cumulative sequestration time for each annual planting cohort. This calculation leverages the Gaussian summation principle, which simplifies summing sequences by recognizing patterns or symmetry, enabling efficient calculation of consecutive or structured series.

Table 31 Tree Plantings Reduction GHG Emission Reduction Calculations

Variable	Definition	Units	2030	2045
Equation 11.2				
Y_n	Total number of years in which trees are planted	years	6	21
Equation 11.1				
N_e	Effective number of years carbon is being sequestered	years	21	231
Equation 11				
$Rate_{trees}$	Rate of trees planted per year	trees	200	200
CSF_{tree}	Carbon sequestration factor for tree seedlings	MT CO_2e/tree	0.0354	0.0354
CO_2e Sequestration	**Carbon sequestration from tree plantings**	**MT CO_2e**	**149**	**1,635**

Measure CS-2: Pursue opportunities to support the City's sustainable economic development goals with an emphasis on circularity and creating green jobs within the region.

Measure CS-2 seeks to support Ukiah's sustainable economic development by fostering a circular economy and creating green jobs in the region. This measure emphasizes integrating climate action strategies into Ukiah's long-term economic development goals to build a more resilient, self-sufficient local economy. Actions under Measure CS-2 include conducting a feasibility study to assess the potential of converting organic materials such as food and yard waste, woody biomass, and wastewater sludge to energy. The measure also calls for the development of a sustainable purchasing policy for municipal operations to prioritize local products, along with partnerships with businesses, community organizations, and nearby jurisdictions to establish reuse, refill, and repair programs that maximize resource use and reduce waste. While this Measure combines environmental responsibility with economic resilience, helping Ukiah achieve both climate and economic goals, it will not result in direct GHG emissions reduction, and therefore cannot be quantified. This Measure does still, however, directly support Ukiah's CAP in increasing community responsibility and awareness.