APPENDIX I.

GHG Reduction Strategies Quantification Methodology & Findings

LOS ALAMOS CLIMATE ACTION PLAN

GHG Reduction Strategies Quantification Methodology & Findings

October 2024

Executive Summary

This document summarizes findings from a quantitative assessment of proposed draft Los Alamos Climate Action Plan actions. The quantitative assessment provides high-level estimates of the **costs** and **emission reductions** associated with select proposed actions to provide information regarding a potential pathway for meeting the County's emission reduction goals. Note that this analysis was conducted prior to finalization of the Climate Action Plan, and thus reflects the suite of proposed actions at that point in the planning process, and not the final list of CAP actions. Key findings of the analyses include:

- Modeling suggests that implementation of the select proposed CAP measures could reduce emissions by **29% by 2030, 87% by 2040, and 88% by 2050**. The following proposed CAP strategies and actions were the highest contributors of GHG emission reductions through 2050:
    - Electric equipment replacement at burnout
    - Adopt green building standards
    - Promote EV adoption
    - Promote urban forest stewardship and tree preservation
- Modeling suggests that implementation of select key climate actions, including adopting green building standards and incentivizing electrification retrofits, will result in an average **net community cost of $3 per Los Alamos County resident per year** over the 25-year life of the plan. Community costs are largely driven by current and projected electricity and natural gas energy prices. These costs are largely offset by savings from available rebates and incentives and anticipated reductions in energy consumption/costs.

This document is organized as follows:

- The **Overview** introduces the approach and key assumptions that drove the analysis.
- The **Findings Summary** provides the emissions reductions, County staff time, Net Present Value , and cost-effectiveness for proposed CAP actions.
- The remaining sections detail emissions reduction and cost results by sector**:**
    - **Buildings & Energy**
    - **Materials & Consumption**
    - **Natural Systems & Water Resources**
    - **Transportation & Land Use**
    - **Community Resilience, Adaptation & Wellbeing**
    - **Cross-Cutting**
- A detailed **References** list documents the sources used to conduct the analyses.
- For more details, contact the County; the analysis workbook in Excel is available upon request.

Overview

This document summarizes findings from a quantitative assessment of proposed actions for inclusion in the draft Los Alamos CAP. The quantitative assessment provides high-level estimates of the **costs** and **emission reductions** associated with select proposed actions (detailed below) to provide information regarding a potential pathway for meeting the County's emission reduction goals. Note that this analysis was conducted prior to finalization of the Climate Action Plan, and thus reflects the suite of proposed actions at that point in the planning process, and not the final list of CAP actions.

Some climate actions are directly **quantifiable**, while others are not. Many climate actions may not be readily quantifiable, may result in inconsequential GHG reductions, or may have indirect benefits that do not result in emissions reductions as calculated in the County's inventory. These actions, often defined as "**supportive**," may be critical for implementation success even if they are not quantified. For example, actions to enhance energy battery storage are crucial for large-scale implementation of renewable energy and electrification, but do not themselves reduce GHG emissions. Another example is education and incentive programs, which can encourage reductions but may be difficult to quantify depending on the reach, efficacy, and permanence of the implemented changes. In contrast, an ordinance to require all-electric new construction is a quantifiable action that carries a very high and defensible likelihood of significant and measurable emissions reductions.

Some proposed climate actions are focused on improving community resiliency to climate change impacts rather than reducing GHG emissions. While the resilience benefits of these **"climate adaptation" actions** were not quantified, taking action to build climate resiliency and preparedness are nonetheless critical for addressing climate change in the Los Alamos community and should be considered as an important part of Los Alamos's climate action strategy.

The project team took an action quantification approach in line with that taken by other local climate action plans across the country. Action impact was explicitly modelled based on **available information** and **case studies**, including data on historic and projected energy usage, population and development trends, and technology and policy impact. The consultant drew from literature and expert opinion—including studies done by the U.S. Department of Energy and California Air Resources Board—as well as from available County data and staff input.

Actions were analyzed based on predetermined, draft implementation **timeframes**, which were categorized as follows. Note that these draft timeframes do not reflect the final implementation timeframes reflected in the final Climate Action Plan:

- Ongoing; a continuation of County or regional initiatives without significant changes.
- Near-term (1-5 years); 2025 to end of 2030.
- Mid-term (6-10 years); 2030 to end of 2035.
- Long-term (11-25 years); 2036 to end of 2050.

Cost Estimation

Action implementation costs were estimated for both costs to the County government and community:

- **Community costs** estimate how much it will cost an average resident, business, or developer to implement the measure as compared to a business-as-usual scenario.
- **County government costs** estimate costs related to County staff time, capital expenditures, consultant services, and procurement.

Cost estimations were based on consultant experience, available literature, consultation with peer cities, and County staff input, and included the following cost elements:

- **Initial start-up costs**, in the form of consultant and capital expenses.
- **Ongoing costs** through 2050 over a 25-year timeframe, including continued labor expenses, maintenance, and monitoring/evaluation of resource needs.

County staff reviewed the cost estimations—especially the County cost element (e.g., estimated FTE requirements). To the extent possible, the consultant provided citations for consulted literature and case studies, although information on climate action costs is very limited at this time.

Where known, the analysis includes consideration of partnerships. Also, available incentives, grants, and rebates were included in the analysis. If sourced by the County, costs to fund these incentives are noted as a *cost to the County* (e.g., County subsidizes cost of publicly available EV chargers). If sourced externally (e.g., from federal or state government), those costs are only noted as a local *community cost savings*, not as a cost incurred to the Los Alamos County government or community (though these rebates could be indirectly supported by the Los Alamos community through state or federal tax contributions). Funding options for each action in the final Climate Action Plan are presented in the implementation matrix of the Climate Action Plan.

Generally, the consultant aimed to estimate the costs to fully implement the policies and achieve their intended impact. For example, in estimating the costs to develop and implement an EV infrastructure plan, the costs represent both the costs to develop the plan as well as to implement the plan. Implementation costs were estimated using assumptions used for the GHG emission reduction model as well as best estimates based on County staff input and other similar climate plans.

Emission Reduction Estimation

The consultant explicitly modelled emissions reductions associated with proposed CAP actions. Modeling built from the emissions forecast and considered interacting actions to avoid double counting, such as impacts of EV vehicle use on community electricity consumption. All assumptions are provided for transparency and County/stakeholder review and outcomes are visualized in both table and graphical format.

Findings Summary

Results from the cost and impact analysis are summarized in the table below. The "Summary At-a-Glance" table on the subsequent page includes the following information associated with each proposed CAP action:

- **Net Present Value (NPV) cost to the County and community:** The anticipated net cost of the action for the County government and Los Alamos community, considering current and future costs and cost savings benefits (through 2050). Negative NPV values represent cost savings.
- **GHG savings:** Estimated cumulative GHG emission reduction benefits resulting from action implementation (through 2050).
- **Cost effectiveness:** Estimated cost effectiveness of the action (cost per unit GHG emission reduction achieved).

The Summary At-a-Glance table is followed by the following additional summary sections:

- **GHG Reductions** highlights the combined impact of all strategies and actions in reaching Los Alamos County's overall and per capita emissions reduction targets. It also summarizes which strategies and actions contribute most to emissions reduction.
- **Cost** details the estimated County staff time, in FTE, required to implement key actions of the Los Alamos CAP. It also includes the NPV cost by strategy and by action, organized by sector.
- **Cost effectiveness** includes the overall cost-effectiveness of CAP implementation for the County and community, highlights the most cost-effective actions, and summarizes cost effectiveness for every action.

Summary At-a-Glance

Acronym/Abbreviation Key		
GHG	Greenhouse gas	Methane, carbon dioxide, and nitrous oxides that contribute to climate change
$MTCO_2e$	Metric tons carbon dioxide equivalent	Common unit for quantifying GHG emissions
	Denotes actions with notable direct or indirect GHG savings that were not quantified due to measurement constraints.	
(blank)	Blank cells denote actions that do not have a direct or quantifiable GHG emissions reduction.	

		GHG savings (MTCO2e)
ID	Proposed Action	Cumulative Savings - to 2050
BE1.1	Establish an energy benchmarking program for commercial buildings	
BE1.2	Establish an energy benchmarking program for County-owned buildings	
BE1.3	Encourage community energy efficiency and electrification retrofits	110,581
BE1.4	Adopt green building standards	145,656
BE1.5	Develop a contractor training program	18,938
BE1.6	Require electric equipment replacement at burnout	407,200
BE2.1	Promote local renewable energy	5,030
BE2.2	Expand electric energy resiliency	
CC1.1	Develop a sustainable business certification	275
CC2.1	Facilitate equitable public participation in planning	
CC2.2	Monitor and share climate action progress	
CC2.3	Collaborate with local Pueblos	
CC2.4	Expand community partnerships	
CR1.1	Conduct a vulnerability assessment	
CR1.2	Invest in public climate education campaigns	
CR1.3	Support the local food system	
CR2.1	Encourage adaptation upgrades	
MC1.1	Promote circular economy practices	
MC1.2	Expand and refine waste data tracking, reporting, and goals	
MC1.3	Implement food waste prevention and diversion program	20,835
MC1.4	Promote C&D recycling and reuse	2,040
MC1.5	Conduct recycling and composting outreach and education	
MC1.6	Implement the zero waste strategy	
NS1.1	Promote urban forest stewardship and tree preservation	65,946
NS2.1	Promote green stormwater infrastructure and low-impact development	
NS2.2	Develop a water security strategy	
NS2.3	Encourage sustainable landscaping and water conservation	
NS2.4	Provide greywater reuse education	
T1.1	Promote EV adoption	58,923
T1.2	Develop EV infrastructure plan	10,236
T1.3	Implement codes requiring EV infrastructure	
T1.4	Transition County fleet to EVs	
T2.1	Expand mixed-use, transit oriented development policies	17,986
T2.2	Continue public transit education campaign	
T2.3	Advocate and partner regionally to improve transit network	
T2.4	Encourage multimodal transportation	
T2.5	Expand non-motorized transportation options and accessibility	372
T2.6	Develop a CTR program	
TOTAL		865,603

GHG Reductions

Modeling suggests that implementation of proposed draft CAP measures could reduce emissions by **29% by 2030, 87% by 2040, and 88% by 2050**. The following CAP strategies and actions are the highest contributors of GHG emission reductions through 2050:

- Electric equipment replacement at burnout
- Adopt green building standards
- Encourage energy efficiency and electrification retrofits
- Promote EV adoption
- Promote urban forest stewardship and tree preservation

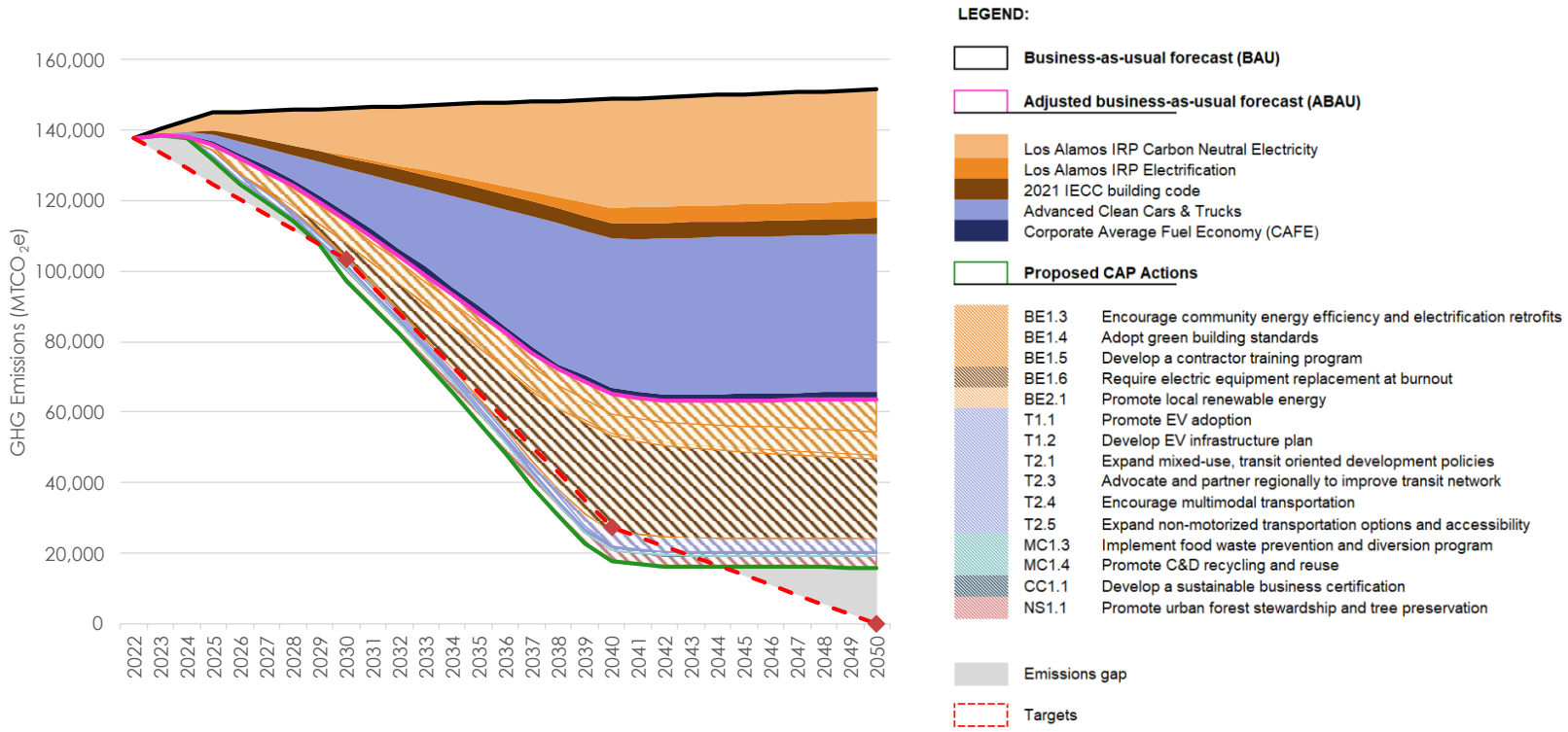

Figure 1. Modeled GHG reductions

Table 1. Proposed CAP Actions and Modeled GHG Reductions

			Cumulative Reductions ($MTCO_2e$)		
			2030	2040	2050
	BE1.3	Encourage community energy efficiency and electrification retrofits	2,650	35,515	110,581
	BE1.4	Adopt green building standards	25,545	84,488	145,656
	BE1.5	Develop a contractor training program	597	6,884	18,938
	BE1.6	Require electric equipment replacement at burnout	5,856	165,700	407,200
	BE2.1	Promote local renewable energy	3,072	5,030	5,030
	T1.1	Promote EV adoption	1,878	18,248	58,923
	T1.2	Develop EV infrastructure plan	1,878	10,236	10,236
	T2.1	Expand mixed-use, transit oriented development policies	8,255	15,112	17,986
	T2.3	Advocate and partner regionally to improve transit network	244	376	376
	T2.4	Encourage multimodal transportation	244	1,208	1,208
	T2.5	Expand non-motorized transportation options and accessibility	243	372	372
	MC1.3	Implement food waste prevention and diversion program	4,702	12,682	20,835
	MC1.4	Promote C&D recycling and reuse	460	1,242	2,040
	CC1.1	Develop a sustainable business certification	91	196	275
	NS1.1	Promote urban forest stewardship and tree preservation	3,140	34,543	65,946

Table 2. Emissions trajectories under examined scenarios.

		2030	2040	2050
	TARGET (% reduction compared to 2022)	**25%**	**80%**	**100%**
	BAU (MTCO2e)	146,140	148,793	151,456
	BAU (% reduction compared to 2022)	6%	8%	10%
	ABAU (MTCO2e)	114,611	65,173	63,629
	ABAU (% reduction compared to 2022)	-17%	-53%	-54%
	Proposed CAP Actions (MTCO2e)	97,339	17,635	15,973
	Proposed CAP Actions (% reduction compared to 2022)	-29%	-87%	-88%

Cost

Modeling suggests that the total net present value (NPV) community cost of implementing select CAP actions are equivalent to an average cost of about $3 per resident per year. Much of these savings to the community are in the form of rebates/incentives and energy/fuel cost savings.

Table 3. Net costs associated with select CAP actions therein (negative values are net cost savings).

ID	Action	NPV Costs to Gov't	NPV Costs to Community	Total NPV Costs	Public Benefit (PV Avoided Climate Costs)	Net Public Cost (NPV)	Per-Capita NPV Community Costs	Ongoing FTE
BE1.3	Incentivize electrification retrofits	$166,971	$25,682,186	$25,849,157	($5,850,484)	$19,998,673	$1,294	0.09
BE1.4	Adopt green building standards	$593,664	($14,446,531)	($13,852,867)	($8,298,132)	($22,150,999)	($728)	0.33
BE1.2	Establish an energy benchmarking program for municipal buildings	$1,402,718	$0	$1,402,718	($944,586)	$458,132	$0	1.00
T1.2	Develop EV infrastructure plan	$895,346	($37,445)	$857,901	($624,417)	$233,483	($2)	0.20
T1.4	Transition County fleet to EVs	($1,974,747)	$0	($1,974,747)	($3,613,425)	($5,588,173)	$0	0.00
T2.5	Expand non-motorized transportation options and accessibility	$17,146,368	$198,802	$17,345,170	($24,477)	$17,320,693	$10	0.50
T2.6	Develop a CTR program	$447,518	$0	$447,518	($195,949)	$251,569	$0	0.30
CR1.3	Support the local food system	$372,931	($578,890)	($205,959)	$0	($205,959)	($29)	0.25
	Total	**$19,050,768**	**$10,818,122**	**$29,868,891**	**($19,551,471)**	**$10,317,419**	**$545**	
	Average	**$2,381,346**	**$1,352,265**	**$3,733,611**	**($2,443,934)**	**$1,289,677**	**$68**	
	Total, per person per year						**$22**	
	Average, per person per year						**$3**	

Cost Effectiveness

With the GHG reductions and overall costs estimated, we can estimate the cost effectiveness of proposed CAP actions (in $/MTCO$_2$e reduced; see Table 6). Highly cost-effective actions include adopting green building standards, transitioning County fleet to EVs, and developing an EV infrastructure plan. Less cost-effective actions include incentivizing electrification retrofits (largely due to natural gas and electricity prices) and expanding non-motorized transportation options and accessibility.

Table 4. Cost effectiveness of select CAP actions.

ID	Action	$/MTCO2e (Gov't)	$/MTCO2e (Community)
BE1.3	Incentivize electrification retrofits	$2	$232
BE1.4	Adopt green building standards	$4	-$99
BE1.2	Establish an energy benchmarking program for municipal buildings	$89	$0
T1.2	Develop EV infrastructure plan	$87	-$4
T1.4	Transition County fleet to EVs	-$31	$0
T3.4	Expand non-motorized transportation options and accessibility	$46,035	$534
T3.5	Develop a CTR program	$131	$0

GHG Analysis Assumptions

Inputs and assumptions used for the Adjusted Business-as-Usual scenario are summarized below.

Key	Policy	Description	Value	Milestone Year	Definition	Source(s)
	Los Alamos IRP (2022)	The IRP addresses near-term and long-term resource strategies for the Los Alamos Power Pool from 2022-2041. The IRP states that the Los Alamos Public Utility will be carbon-neutral by 2040. Additionally, the IRP outlines a low care for 10% of natural gas to be electrified by 2041.	100%	2040	% reduction in electricity emissions factor by 2040.	2022 Los Alamos Public Utility IRP
			10%	2041	% of natural gas to be electrified	
	IECC building code (2021)	The IECC building code requires greater energy efficiency in buildings. The Department of Energy estimates that commercial buildings will save 4.7% and residential buildings will save 9.38% of site energy.	5%	2025	% reduction in energy emissions in new commercial buildings	2021 International Energy Conservation Code
			9%	2025	% reduction in energy emissions in new residential buildings	
	Advanced Clean Car and Truck Rules (adopted 2023)	Advanced Clean Car and Truck rules require automakers to deliver an increasing percentage of new zero-emissions vehicles for sale in NM each year. -By 2031 82% of new cars delivered by the automakers to New Mexico will be zero-emissions cars -By 2034 57% of new heavy trucks delivered by the automakers to New Mexico will be zero-emissions trucks -By 2031 40% of new transit buses delivered by the automakers to New Mexico will be zero-emissions transit buses -Excludes motorcycles - Use same turnover rate as cars and light trucks	43%	2026	% of passenger car and light truck vehicle sales that are electric by 2026.	New Mexico Environment Department
			51%	2027	% of new passenger car and light truck vehicle sales that are electric by 2027.	
			59%	2028	% of new passenger car and light truck vehicle sales that are electric by 2028.	
			68%	2029	% of new passenger car and light truck vehicle sales that are electric by 2029.	
			76%	2030	% of new passenger car and light truck vehicle sales that are electric by 2030.	
			82%	2031	% of new passenger car and light truck vehicle sales that are electric by 2031.	
			12	Years	The number of years that a vehicle owner is assumed to have the vehicle for before replacing it - for light trucks/passenger. (cell name: CarLTTurnover)	
			17%	2026	% of heavy truck vehicle sales that are electric by 2026.	
			23%	2027	% of heavy truck vehicle sales that are electric by 2027.	
			30%	2028	% of heavy truck vehicle sales that are electric by 2028.	
			37%	2029	% of heavy truck vehicle sales that are electric by 2029.	
			42%	2030	% of heavy truck vehicle sales that are electric by 2030.	
			47%	2031	% of heavy truck vehicle sales that are electric by 2031.	
			50%	2032	% of heavy truck vehicle sales that are electric by 2032.	

Key	Policy	Description	Value	Milestone Year	Definition	Source(s)
			53%	2033	% of heavy truck vehicle sales that are electric by 2033.	
			57%	2034	% of heavy truck vehicle sales that are electric by 2034.	
			15	Years	The number of years that a vehicle owner is assumed to have the vehicle for before replacing it - for heavy trucks (cell name: HTTurnover)	
			15%	2026	% of transit bus sales that are electric by 2026.	
			20%	2027	% of new transit bus sales that are electric by 2027.	
			25%	2028	% of new transit bus sales that are electric by 2028.	
			30%	2029	% of new transit bus sales that are electric by 2029.	
			35%	2030	% of new transit bus sales that are electric by 2030.	
			40%	2031	% of new transit bus sales that are electric by 2031.	
			7	Years	The number of years that a vehicle owner is assumed to have the vehicle for before replacing it. (cell name: BusTurnover)	
	Corporate Average Fuel Economy (CAFE) (2023 update)	Corporate Average Fuel Economy (CAFE) standards are regulated by the Federal Department of Transportation and supported by the EPA. These standards incrementally increase average fuel economy levels for manufacturers and set related GHG standards. The assumptions made for MPG increase for each vehicle type are based on actual MPG increases since 2010 to understand a realistic increase in overall vehicle MPG's.	0.20	Annually	Annual increase in average MPG for passenger cars	US Environmental Protection Agency (EPA)
			0.10	Annually	Annual increase in average MPG for light trucks	
			0.03	Annually	Annual increase in average MPG for heavy trucks and transit buses	

Inputs and assumptions used for the CAP action-specific GHG analysis are summarized below.

CAP Action ID	Action Short Name	Value	Unit	Source(s)
BE1.3	Encourage energy efficiency and electrification retrofits	39%	energy savings from efficiency upgrades	BE2.1_BE2.2_BE1.3_Efficiency savings.pdf (for 0.5% buildings retrofit estimate); NatGasUseAssumption.pdf ("National site energy savings are also substantial, with average savings of 31%–47%, depending on ASHP performance level, and 41%–52% when combined with envelope upgrades.") ("According to RECS, of the natural gas used in the residential sector 63% goes toward space heating and 26% toward water heating.")
		0.5%	buildings retrofit per year	
		89%	natural gas transitioned to electricity per retrofit	
BE1.4	Adopt green building standards	21%	energy savings in NEW residential homes from efficiency standards	BE1.4_HERSrating.html BE1.4_SBPS.pdf
		22%	energy savings in NEW and EXISTING commercial buildings by 2050	
CC1.1	Develop a sustainable business certification	2%	participation rate	CC1.1_Census_Employers.pdf
		2%	increase in energy efficiency	2020 City of Dublin CAP (Appendix C, page 12); County staff
BE2.1	Incentivize electrification retrofits	0.50%	electrification increase beyond action BE 1.3	2018 Energy Efficiency Study; DublinCAP_2020.pdf (Appendix C, page 12) [NOTE THAT THIS ACTION WAS COMBINED WITH BE1.3]
BE2.2	Develop a contractor training program	39%	energy savings from efficiency upgrades	Same as BE1.3
		0.25%	buildings retrofit per year	
		89%	natural gas transitioned to electricity per retrofit	
BE2.3	Electric equipment replacement at burnout	7%	annual reduction in natural gas usage for residential/commercial buildings, summing to 100% after 15 years	Assume 15-year equipment life
BE3.1	Promote local renewable energy	2%	households retrofit with rooftop solar annually	NREL benchmark of 8 kW PV system: https://www.nrel.gov/docs/fy23osti/87303.pdf, assume 5 hours of full daylight
		14	MWh achievable per household	
T2.1	Expand mixed-use, transit oriented development policies	2.7%	annual reduction in overall VMT	2021 California Air Pollution Control Officers Association's Guide for GHG Emissions Reductions (CAPCOA) (T-3) Transportation_EDLVMTModel.xlsx
T3.2	Advocate and partner regionally to improve transit network	0.2%	annual reduction in passenger vehicle VMT	2021 California Air Pollution Control Officers Association's Guide for GHG Emissions Reductions (CAPCOA) (T-24; T-25) Transportation_EDLVMTModel.xlsx
T3.3	Encourage multimodal transportation	1.47%	annual reduction in passenger vehicle VMT	2021 CAPCOA (T-9)
T3.4	Expand non-motorized transportation options and accessibility	0.2%		EcoDataLab's Vehicle Miles Traveled Model
T1.1	Promote EV adoption	5%	higher new EV adoption than statewide average	Consultant assumption

CAP Action ID	Action Short Name	Value	Unit	Source(s)
T1.2	Develop EV infrastructure plan	5%	higher new EV adoption than statewide average	Consultant assumption
MC1.3	Implement food waste prevention and diversion program	5%	residential efficiency	Tacoma's Sustainable Materials Management Plan Diversion Efficiency; County staff
		50%	residential participation	
		80%	commercial efficiency	
		100%	commercial participation	
MC1.4	Promote C&D recycling and reuse	30%	efficiency (residential and commercial)	2010 New Mexico State Solid Waste Assessment; Tacoma's Sustainable Materials Management Plan Diversion Efficiency
		25%	participation (residential and commercial)	
CC1.1	Develop a sustainable business certification	2%	business participation	Tacoma's Sustainable Materials Management Plan Diversion Efficiency; 2021 Los Alamos County U.S. Census Quick Facts
		10%	increase in waste diversion	
NS1.1	Promote urban forest stewardship and tree preservation	0.05%	new acres of tree cover annually (equivalent to an increase of .5% from the County's existing tree cover)	2020 New Mexico GHG Inventory and Forecast Los Alamos' ICLEI LEARN Report

Cost Analysis Inputs & Assumptions

Inputs and assumptions used for the cost analyses are summarized below. Referenced sources are cited in the "References" section of this appendix. All calculations are detailed in the "LACAP_ActionAnalysisWorkbook.xlsx" document.

Universal cost analysis assumptions:

- Real discount rate: 3%
- County staff labor cost: $83,445/year
- Average energy rate over implementation timeframe (average monthly current rates from Los Alamos DPU; projected future trends from U.S. Energy Information Administration):
    - Residential electricity: $0.11/kWh
    - Commercial electricity: $0.08/kWh
    - Residential natural gas: $0.73/therm
    - Commercial natural gas: $0.75/therm

ID	Action	Gov't Cost Assumptions/Comments	Community Cost Assumptions/Comments
BE2.1	Incentivize electrification retrofits	**General** - Assuming the County can incorporate the following tasks into existing positions. **Engage in Community Outreach & Education** <u>Develop a Formal Ed & Outreach Plan</u> *One-time Costs* - 200 hours to develop this plan (Consultant estimate) <u>Develop & Share Resources</u> *One-time Costs* - 400 hours to update County website, update utility bill inserts, develop pamphlets, and develop other resources (Consultant estimate) *Annual Costs* - Staff time to table at events (6 hours to prep + table, 2 staff, once a month) (Consultant estimate) - $250 budget for material/technological resources <u>Stay Updated on Financing Options</u> *Annual Costs* - 50 hours to research and incorporate novel clean energy financing options into education and outreach resources (Consultant estimate) **Savings** - No identified savings for the County	**Costs** *Annual Costs* - Includes increased electricity costs and installation costs, including the following average cost differentials compared to conventional versions: -- Residential heat pump: +$1,250 (Heat Pump Cost; Gas Furnace Cost) -- Residential water heather: +$768 (Water Heat Pump Cost; Gas Water Heater Cost) -- Residential stove top: -$395 (Electric Cooktop Cost; Gas Stovetop Cost) -- Commercial heat pump: +$7,200 (Commercial Heat Pump Cost; Commercial HVAC Replacement Cost) - Includes federal rebates available from the High-Efficiency Electric Home Rebate Act (HEEHRA). **Savings** *Annual Savings* - Includes energy cost savings (reduced natural gas costs).
BE1.4	Adopt green building standards	**Develop & Adopt Green Building Performance Standard** *One-time Costs* - 150 hours to research & develop a standard (Shoreline Cost Assessment) *Annual Costs* - 175 hours to implement and enforce the standard (Shoreline Cost Assessment) **Educate Community on the Value of a GBPS** *Annual Costs* - 0.25 FTE to develop a community education plan and implement it. Implementation includes activities to educate the community, provide transition assistance and conduct outreach (Lake Stevens Cost Assessment) - $5,000 budget (Consultant Estimate)	**Costs** *Annual Costs* - Assume cost of $1.83 per sq ft to comply with standards, after available tax incentives (Green Building Cost, Green Building Tax Incentives). Used Impact Analysis data to determine number of sq ft upgraded per year. - Assume average house size of 2,087 square feet.[1] **Savings** *Annual Savings* - Includes energy cost savings from reduced consumption.

[1] https://www.fool.com/the-ascent/mortgages/articles/how-big-is-your-home-here-is-the-average-home-size-by-state/

ID	Action	Gov't Cost Assumptions/Comments	Community Cost Assumptions/Comments
BE1.2	Establish an energy benchmarking program for municipal buildings	**Establish Benchmarking Criteria** *One-time Costs* - 140 hours of staff time to research and establish criteria (Consultant estimate) **Perform ROI Analysis** *One-time Costs* - 240 hours to conduct the analysis; this includes collecting the data and cost estimates (80 hours), analyzing them (80 hours), and reporting results (80 hours) (Consultant estimate) **Earmark Recurring Funding** *Annual Costs* - 2 hours monthly to research, track, and keep up-to-date on funding opportunities (Consultant Estimate) **Implement and Maintain Building Performance Dashboards** *One-time Costs* - 240 hours to implement an internal dashboard; this includes collecting and processing data (80 hours), building visuals (80 hours), writing documentation (40 hours), and training (40 hours) (Consultant estimate) - 100 hours to implement an external, public-facing dashboard (80 hours) and market it to the community (20 hours) (Consultant estimate) *Annual Costs* - 150 hours to maintain the dashboards (Consultant estimate) **Implementing Efficiency Upgrades** *Annual Costs* - Costs and savings of an energy retrofit include the following assumptions: - 623,919 square feet of county-owned buildings (County staff). - County facility energy consumption as sourced from municipal GHG inventory. - 30% reduction in energy use for retrofit that costs $2.50/sqft in 2010 dollars (Energy Efficiency Retrofits for Commercial and Public Buildings). - 1 FTE to manage the retrofit process (Consultant Estimate).	- No estimated community savings from this action

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T1.2	Develop EV infrastructure plan	**General/Background** In Los Alamos, installation of three Level 1 chargers is underway – the County is waiting on supply chain. Others are Level 2 and Level 3, some are free, have rates, are on public property, and are located at businesses. A few apartment complexes have and are beginning to install more chargers for their residents. Assume charger installation and revenue generation begins in year 3 (After EV Infrastructure Plan developed). **Develop & Implement EV Infrastructure Plan** *One time costs* Developing an EV infrastructure plan is anticipated to be one time cost of $200,000 (Consultant estimate based on past work). *Annual costs* - Assume County installs 5 new chargers every year over implementation timeframe. (Assumption based on 70-80 chargers installed over 3 years - as indicated in CFI grant application - and that County pays for 25% of these chargers), with an average maintenance costs of up to $400 annually (Alternative Fuels Data Center). - Includes costs to the County to install and maintain publicly available charging infrastructure after tax credits and CPI adjustment. - Assume 25% of new chargers will be on County gov't-owned spaces (and thus they incur the costs if providing free charging) and 75% will be owned and operated by private entities (revenues go to charging companies). Assume County pays $0.49/kWh (Federal Workplace Charging Fee). - Used Impact Analysis to calculate increased kWh that will be used for EVs under the action. Assume by 2030, 30% of charging will occur at public chargers (Public EV Charging Trends). *FTE* Assume 0.1 (0.1 for Woodinville) dedicated to implementing this plan and another 0.1 FTE (0.1 FTE for Woodinville) for outreach and partnership efforts. *Annual Savings* *- Assumed no annual savings because County provides free EV charging for the stations they own.* *- Calculation can be adjusted to provide County revenue for charging at County-owned stations.*	**Costs** - EVs are, on average, $10k more expensive than traditional vehicles. Given current $7k federal rebate, this is lowered to $3k. - Assume increased kWh cost from impact analysis, assuming 30% of charging occurs at public chargers at $0.49/kWh and the rest occurs at home using residential electricity rates. **Savings** - EV owners save on average $300 annually on repairs when compared to ICE vehicle owners (assume over 5 year car ownership per vehicle) (Woodinville Cost Analysis, Consumer Reports). - Assume reduced gasoline/diesel costs from impact analysis, using standard gasoline/diesel per-gallon rates.

ID	Action	Gov't Cost Assumptions/Comments	Community Cost Assumptions/Comments
T1.4	Transition County fleet to EVs	**Prioritize Vehicles by Retirement & EV Viability** *One-time Costs* - Staff hours to prioritize vehicles and understand EV viability for various vehicle types: 25 staff hours. Assume this is a one-time cost (Consultant estimate). **Explore EV Replacement Options & Budget** *One-time Costs* - Includes staff hours to explore various EV replacement options and integrate into budget planning. Calculated an average hours per vehicle type and spread across the implementation timeline as a yearly cost (Consultant estimate). Assume average of 25 staff hours per vehicle type (14 vehicle types). **Purchase Electric Alternatives** *Annual Costs* - Calculated difference in cost between an electric and conventional vehicle for each type, including consideration of available rebates. Calculated cost differential for all types of County vehicles (pickups, SUVS, police cars, buses, vans, garbage trucks, etc.) to determine how many of each vehicle type will need to be replaced and what replacement cost would be for the County. *Savings* - EVs save on average $300 annually on repairs when compared to ICE vehicles (Consumer Reports (2020)). - Average annual fuel savings estimated using a Ford Lightning truck as an indicator (and then scaled to the total number of vehicles replaced).	- No identified costs/savings to the community

ID	Action	Gov't Cost Assumptions/Comments	Community Cost Assumptions/Comments
T3.4	Expand non-motorized transportation options and accessibility	**General** The Bicycle Transportation Plan from 2017 outlines several aspects of improving ped/bike infrastructure, including information on completed and planned projects. Use this study to estimate number of miles and potential cost. **Supporting Relevant Plans** *Costs* - Assume 0.5 FTE for supporting relevant plans and overseeing ped/bike improvement (Pleasanton CAP, Sedona CAP). **Improving Infrastructure** *Annual Costs* Assume one major ped/bike infrastructure project every 5 years - using County project estimates. Additional infrastructure per year - 1 miles of additional bike infrastructure (Consultant estimate). Designated bike routes cost $10k/mile as of 2019 in California (Bike Infrastructure Estimated Costs), which may be somewhat less expensive in New Mexico. - 1 miles of additional pedestrian infrastructure (Consultant estimate). Concrete sidewalks cost $8.63/sq ft as of 2023 (Concrete Sidewalk Costs). *Savings* - Note that no County savings included from grants, taxes, existing funds/budgets, etc.	**Savings** - Assume reduced vehicle fuel costs from reduced VMT (from impact analysis).
T3.5	Develop a CTR program	**General** Los Alamos has promoted the "Drive Less Los Alamos" Walk, Bike, Ride, Carpool Initiative since 2022. This initiative provides resources on the Los Alamos County Trail Network, cycling safety measures, Atomic City Transit and Afternoon Express routes and schedules, New Mexico Park & Ride operations, and other commuting measures to reduce community VMT. In addition, a flexible work schedule policy is currently in development. **Developing the CTR Program** *Annual Costs* - Estimate 0.3 FTE needed to provide resources to employees, create outreach materials, partner with local employers, and track progress (Consultant estimate).	- No identified costs/savings to the community
CR1.3	Support the local food system	**Staff time to support the local food system** **Costs** *Annual Costs* - Estimate 0.25 FTE to provide outreach, education, and foster relationships with local businesses/organizations and regional groups (Consultant estimate). *Annual Savings* - Savings for County not determined. Savings will likely go to businesses and community members.	**Costs** - Only savings identified. **Savings** - Estimated 10% price difference between shopping at farmers markets/Cooperative Market and non-local grocery stores (10% cheaper to buy local) (Buying Local Price). - Estimate 0.19% percent of consumers will buy more locally sourced food per year.

References

GHG Analysis

Source Name	Description
2022 Los Alamos Public Utility IRP	The IRP addresses near-term and long-term resource strategies for the Los Alamos Power Pool from 2022-2041. The IRP states that the Los Alamos Public Utility will be carbon-neutral by 2040. Additionally, the IRP outlines a low care for 10% of natural gas to be electrified by 2041.
2021 International Energy Conservation Code	The IECC building code requires greater energy efficiency in buildings. The Department of Energy estimates that commercial buildings will save 4.7% and residential buildings will save 9.38% of site energy.
Consultant Assumptions Document	Consultant document that lays out ABAU assumptions across sectors.
Corporate Average Fuel Economy (CAFE) Standards	Corporate Average Fuel Economy (CAFE) standards are regulated by the Federal Department of Transportation and supported by the EPA. These standards incrementally increase average fuel economy levels for manufacturers and set related GHG standards. The assumptions made for MPG increase for each vehicle type are based on actual MPG increases since 2010 to understand a realistic increase in overall vehicle MPG's.
2018 Energy Efficiency Study	A research study that investigated estimated energy savings from energy efficiency upgrades.
2020 City of Dublin CAP	A CAP that performed an impact analysis and detailed assumptions in Appendix B.
HERS Efficiency Standards	Provides an estimate of energy savings for HERS rated homes.
Seattle's New Building Emissions Performance Standard	Provides emissions reduction estimates associated with Seattle's Building Emissions Performance Standards for new commercial and residential buildings.
2021 Los Alamos County U.S. Census Quick Facts	U.S. Census quick facts. Provided an estimate of total number of employers.
2021 California Air Pollution Control Officers Association's Guide for GHG Emissions Reductions	A comprehensive handbook that provides emissions reduction estimates for various climate actions.
EcoDataLab's Vehicle Miles Traveled Model	Estimates reductions in VMT for transportation-related climate actions.
Tacoma's Sustainable Materials Management Plan Diversion Efficiency	Describes the diversion efficiency seen for Tacoma's waste diversion programs.
2010 New Mexico State Solid Waste Assessment	Provided estimate for amount of waste that is estimated to be construction and demolition.
2020 New Mexico GHG Inventory and Forecast	Provided estimate for amount of carbon sequestered per acre.
Los Alamos' ICLEI LEARN Report	Describes emissions and sequestration from land use changes in Los Alamos County.
U.S. Census Population Estimates	The U.S. Census' population estimates for Los Alamos County.
University of New Mexico Population Projection Estimates	The University of New Mexico's population projection estimates out to 2040 by county.
Detailed Inventory Data for Wedge	Provided inventory data needed for the wedge, including activity data, # of people served, and emissions factors.

2021 Los Alamos County U.S. Census Quick Facts	U.S. Census quick facts. Provided an estimate of total number of businesses.
Los Alamos County Employment Projections Out to 2025	Includes Los Alamos County employment projections based off of LANL employment growth projections.
Los Alamos County Commercial Square Footage	Los Alamos County commercial square footage excluding LANL.
Natural Gas Use Assumption	Energy efficiency estimates for heat pump conversion based on ACEEE study.

Cost Analysis

Source Short Name	Description	Link
Inflation Forecasts - Survey of Professional Forecasters	Provides the 1 year and 10 year inflation forecasts for each year up to 2023 Q2. Using the 10 year forecast from 2023 Q2.	https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/inflation-forecasts
Discount Rate Details	About discount rates from UW	https://faculty.washington.edu/zerbe/docs/discount_rates/
CPI Estimates	CPI estimates from the Federal Reserve Bank of Minneapolis starting from 1913	https://www.minneapolisfed.org/about-us/monetary-policy/inflation-calculator/consumer-price-index-1913-
Social Cost of Carbon Estimates	Provides the social cost of carbon estimates from the Washington Utilities and Transportation Commission	https://www.utc.wa.gov/regulated-industries/utilities/energy/conservation-and-renewable-energy-overview/clean-energy-transformation-act/social-cost-carbon
2020 RECS Survey Data	Provides data on total and average consumption of various forms of energy by state	https://www.eia.gov/consumption/residential/data/2020/index.php?view=state#ce
EIA Electricity Rates by State	Contains the rate per kWh for each state. Includes the commercial and residential rates for Feb 2023.	https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a
EIA Natural Gas Cost Data	Natural gas cost data for the most recent months and by state.	https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm
EIA Petrol/Diesel Cost Data	Petroleum cost data by state and time period	https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_a.htm
Avg MPG for Passenger Vehicle	Average fuel economy for a passenger vehicle in the US	https://afdc.energy.gov/data/10310
Avg Range of an EV	Average range of an EV	https://www.energysage.com/electric-vehicles/buyers-guide/mpg-electric-vehicles/
Avg EV miles per kWh	Average miles per kWh for an EV	https://www.inchcalculator.com/convert/mile-per-gallon-equivalent-to-mile-per-kilowatt-hour/
Avg MPG for Light/Heavy Duty Vehicle	Average fuel economy for a light or heavy duty vehicle	https://afdc.energy.gov/data/10310
EIA Housing Unit Square Footage CO	EIA Highlights for square footage in U.S. homes by state, 2020	State Square Footage.pdf (eia.gov)
ICCT EV Charging Cost	T1.2	Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas (theicct.org)
Alternative Fuels Data Center	T1.2 Alternative Fuels Data Center: Charging Infrastructure Operation and Maintenance	https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html#:~:text=While%20actual%20maintenance%20costs%20vary,for%20an%20additional%20annual%20fee.
Alternative Fuels Data Center: New Mexico	T1.2 Alternative Fuels Data Center: Charging Infrastructure Operation and Maintenance	Alternative Fuels Data Center: New Mexico Laws and Incentives (energy.gov)
Public EV Charging Trends and Costs	T1.2	Can public EV fast-charging stations be profitable in the United States? | McKinsey
Federal Workplace Charging Fee	T1.2	femp-workplace-charging-fee-calculator.xlsx (live.com)
EV Market Share		EV Market Share by State | EVAdoption
Concrete Sidewalk Costs	T3.4 Information on the costs of various types of concrete sidewalks as of 2023, includes an average as well.	https://www.lawnstarter.com/blog/cost/concrete-sidewalk-price/
Bike Infrastructure Estimated Costs	T3.4 Some estimates gathered by Streetsblog Cal from various planners for bike infrastructure in California as of 2019.	https://cal.streetsblog.org/2019/08/30/breaking-down-caltrans-cost-estimate-of-the-complete-streets-bill
Conventional Diesel Loader Cost Range	T1.4 Mentions the cost range of various loader sizes.	https://www.linkedin.com/pulse/how-much-does-cost-buy-track-loader-landscaping-beacon-funding
Dump Truck Cost	T1.4 About the average cost of ownership for a dump truck	https://www.truxnow.com/blog/how-much-does-a-dump-truck-cost
Ford F150 Lightning Details	T1.4 Details about the Ford F150 Lightning pick up truck.	https://www.ford.com/trucks/f150/f150-lightning/models/f150-pro/
2023 Electric SUV Price Range	T1.4 2023 prices for various electric SUVs available in the US today.	https://www.roadandtrack.com/rankings/g43920664/cheapest-electric-suvs/
Oakdale Police Adds EVs	T1.4 Oakdale Police department added a couple Ford Mach-Es to their fleet. Also has an estimate for the cost of building out the police modifications.	https://www.police1.com/police-products/vehicles/articles/calif-police-department-to-add-two-electric-vehicles-to-its-fleet-MWY0gfAICfWEIBwu/

South Pasadena Police Transition to EVs	T1.4 South Pas Police department completely transitioned their fleet to EV, purchasing Tesla model 3 and Ys.	https://gvwire.com/2023/05/09/california-citys-police-car-fleet-going-all-electric/
Ford Mach E Cost	T1.4 Cost of a base model Ford Mach E	https://www.ford.com/suvs/mach-e/
Tesla Model 3 Cost	T1.4 Cost of a base model Tesla Model 3	https://www.edmunds.com/tesla/model-3/
LADOT Zero Emission Bus Rollout Plan	T1.4 Details on LADOT's transition to a zero emission bus fleet. Has estimates on the cost of various types of electric buses in various years.	https://ww2.arb.ca.gov/sites/default/files/2020-12/LADOT_ROP_Reso_ADA12172020.pdf
Ford Commercial EV Van Pricing	T1.4 Pricing details on various types of commercial EV trucks/vans from Ford.	https://www.ford.com/commercial-trucks/e-transit/pricing-and-incentives/?gnav=shopnav-io
Mullen Electric Cargo Van Pricing	T1.4 Pricing details on Mullen's electric cargo van and truck.	https://www.automotive-fleet.com/10198178/mullen-announces-pricing-for-electric-cargo-van-cab-chassis-truck
Electric Fire Truck Cost	T1.4 Pricing details on electric fire truck.	https://electrek.co/2022/05/17/electric-fire-truck-deployed-us-lafd/
Conventional Fire Truck Cost	T1.4 Pricing details on conventional fire truck.	https://www.firerescue1.com/fire-products/fire-apparatus/articles/1-million-dollars-for-a-fire-truck-yup-and-heres-why-miZF81kYVmcMxoZ0/
Electric vs Conventional Bus	T1.4 Pricing details on ZE buses.	https://www.sierraclub.org/sites/www.sierraclub.org/files/sce/new-jersey-chapter/Handouts/VW_Zero_Emission_Bus_Factsheet.pdf
Conventional Bucket Truck Cost Range	T1.4 Pricing details on bucket truck.	The Ultimate Guide On Boom & Bucket Trucks | TLC Auto & Truck Repair Service Center (tlcautotruck.com)
Conventional Semitruck Cost	T1.4 Pricing details on semitruck.	How Much Does a Semi Truck Cost? Your 2022 Guide - Durabak | Durabak (durabakcompany.com)
2023 Dodge Charger Cost	T1.4 Cost for a 2023 Dodge Charger	https://www.dodge.com/charger.html
Mower Cost	T1.4 Pricing details on electric vs gas mower.	Electric vs. Gas Lawn Mowers (lawnlove.com)
Electric ATV/UTV Cost	T1.4 Pricing details on electric ATV.	https://www.atv.com/products/electric-atvs-a-consumers-guide-1625.html
Conventional ATV/UTV Cost	T1.4 Pricing details on gas-powered ATV.	https://www.superatv.com/offroad-atlas/how-much-does-a-side-by-side-cost/
Farmers Market Local Economy	T3.4	Farmers Market Facts & Figures 2022 (farmersmarketcoalition.org)
New Mexico Grocery Price	T3.4 Determine how much community members spend on groceries	These states spend the most on groceries in America: study (thehill.com)
Buying Local Price	T3.4 Used to calculate difference between local food and non local food	Is Buying Local Less Expensive? Debunking a Myth—Assessing the Price Competitiveness of Local Food Products in Canada - PMC (nih.gov)
Local Food Sales	T3.4	USDA ERS - Local Food Sales Continue to Grow Through a Variety of Marketing Channels
Building Retrofits RMI	BE2.3	https://rmi.org/wp-content/uploads/2017/04/Pathways-to-Zero_Bldg-Case-for-Deep-Retrofits_Report_2012.pdf
Energy Efficiency Retrofits for Commercial and Public Buildings	BE1.2 Has cost estimates on a per square foot basis for energy efficiency retrofits for commercial and public buildings	https://paceworx.com/wp-content/uploads/srm/pdf/whitepapers/Energy_Efficiency_Retrofits_Jul10.pdf
About Heat Pumps for Southwest Homes	BE2.1 Has estimates on average annual energy usage of various types of heat pumps for the southwest region of the US	https://www.swenergy.org/wp-content/uploads/southwest-heat-pump-study-2022.pdf
Electric Oven Energy Usage	BE2.1 Estimates the average annual energy usage for an electric stovetop + oven	https://www.energysage.com/electricity/house-watts/how-many-watts-does-an-electric-oven-and-stove-use/
Heat Pump Cost	BE2.1 average cost of purchasing and installing a heat pump	https://www.forbes.com/home-improvement/hvac/heat-pump-installation-cost/
Water Heat Pump Cost	BE2.1 average cost of purchasing and installing a water heat pump	https://www.energystar.gov/products/ask-the-experts/what-goes-into-the-cost-of-installing-a-heat-pump-water-heater
Electric Cooktop Cost	BE2.1 average cost of purchasing and installing an electric cooktop	https://www.housedigest.com/924631/how-much-does-it-cost-to-put-in-an-electric-stovetop/

Commercial Heat Pump Cost	BE2.1 average cost of purchasing and installing a commercial heat pump	https://www.novakheating.com/how-much-does-it-cost-to-install-commercial-hvac-systems/
Gas Furnace Cost	BE2.1 average cost of purchasing and installing a gas furnace	https://www.forbes.com/home-improvement/hvac/how-much-does-a-gas-furnace-cost/
Gas Stovetop Cost	BE2.1 average cost of purchasing and installing a gas stovetop	https://www.angi.com/articles/how-much-should-it-cost-install-gas-stove-home-already-has-gas.htm
Commercial Gas HVAC Replacement Cost	BE2.1 average cost of replacing a gas HVAC	https://capitalimprovement.org/commercial-hvac-cost-calculator/
HEEHRA Rebates	BE2.1 electric home rebates	High-Efficiency Electric Home Rebate Act (HEEHRA) — Rewiring America
Green Building Cost	BE1.4 cost of green building performance upgrades	Rules of Thumb (epa.gov)
Green Building Tax Incentives	BE1.4 green building tax incentives	IRA update: It's a go for green building tax incentives | U.S. Green Building Council (usgbc.org)
Federal EV Rebate	T1.4 federal rebates for EVs	Electrification Coalition - Inflation Reduction Act Impacts on Electric Vehicles
2022 Electricity Rates	2022 electricity rates for Los Alamos County	
2022 Gas Rates - Average	2022 natural gas rates for Los Alamos County	