Pathway to Zero Natural Gas: Understanding the Transition from Natural Gas to Electric Appliances in LADPU Households

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Project Duration:
01/01/2025 - 06/30/2026

Budget:
$130,109 (LADPU: $102,746, UNM cost-share: $27,363)

Project Narrative

As the urgency to combat climate change intensifies, utilities and policymakers are increasingly recognizing the need to transition away from fossil fuels toward cleaner energy sources. In line with this trend, the Los Alamos Department of Public Utilities (LADPU) has established an ambitious goal to achieve zero natural gas usage by 2070. This target reflects a growing commitment to reduce greenhouse gas emissions and support a sustainable energy future. However, despite the clear directive to electrify households and move away from natural gas, there remains a significant gap in understanding the practicalities of this transition, particularly regarding the electrification of household appliances and the subsequent impact on electricity demand.

The relevance of this research stems from the pressing need to elucidate the current stock of natural gas appliances in households and the willingness of consumers to adopt electric alternatives. With limited knowledge of the existing appliance landscape and household readiness for electrification, utilities and policymakers may struggle to formulate effective strategies to facilitate this transition. Furthermore, understanding the pace at which

households are willing to switch to electric appliances is crucial for accurate forecasting of electricity demand growth.

In addition, as households transition to electric appliances, it is vital to assess the necessary pre-switching upgrades, such as weatherization, roof changes, and electric panel upgrades, that may be required to accommodate increased electrical loads and ensure the electrical appliances' efficiency. This research will provide insights into how electricity consumption patterns may shift as households make the transition, enabling utilities to better plan for future energy needs.

By systematically exploring these dynamics through surveys and discrete choice experiments (DCE) and combining them with rich natural gas and electricity consumption data, this study aims to contribute critical knowledge to the understanding of household electrification decisions. The findings will not only support the utility's zero natural gas goal but will also inform strategies to optimize energy use, enhance grid reliability, and ensure a smooth transition for consumers toward a sustainable energy future.

Research Questions

This project seeks to answer the following questions that are critical to understanding household preferences for appliances electrification:

1. What is the current stock of natural gas appliances in households?
2. Are households willing to convert to electric appliances, and at what pace/time?
3. What pre-switching upgrades (e.g., weatherization, roof change, electric panel upgrade) are needed to facilitate fuel switching?
4. What are the levels of incentives (e.g., tax credits, rebates) that can induce fuel switching?
5. How would electricity load change as a result of the transition to electric appliances?

Methodology

This research will utilize a two-step approach, combining a comprehensive survey and a DCE with historical natural gas and electricity consumption data to analyze household energy use and the potential impact of transitioning from natural gas to electric appliances.

Step 1: Survey Design and Implementation

A detailed **survey** will be administered to all LADPU customers. The survey will contain two components: a questionnaire designed to capture key consumer information and a DCE to elicit consumer willingness to switch from natural gas to electric appliances.

Part 1: Questionnaire

The questionnaire is designed to capture consumer information about:

- **Current appliance stock**: Respondents will be asked to provide data on the types of natural gas appliances they currently use, such as heating systems, water heaters, stoves, and other gas-powered appliances. Additionally, we will collect information on the age and efficiency of these appliances.
- **Household characteristics**: Information on household demographics (e.g., family size, income level, home ownership status) and dwelling characteristics (e.g., size, age, insulation status) will be gathered to understand the factors that influence appliance usage and energy needs.
- **Attitudinal questions**: The survey will also include questions to capture consumer attitudes toward electrification and renewable energy. These questions will explore household awareness of climate policies, perceived barriers to switching, and overall attitudes toward the environmental and financial impacts of using electric appliances over natural gas appliances.

Part 2: Discrete Choice Experiment

The DCE will present respondents with a series of hypothetical scenarios, each involving different choices about appliance replacement. Potential attributes that will be varied in the scenarios include:

- Cost of electric appliances, including installation fees and available financial incentives (rebates or subsidies).
- Energy efficiency of electric appliances compared to natural gas options.
- Necessary pre-switching upgrades, such as electric panel upgrades or weatherization, and the associated costs.
- Environmental impact and potential savings on future energy bills due to increased efficiency.

The DCE will enable the estimation of willingness to pay for electric appliances and the relative importance of different factors influencing a household's decision to adopt these technologies. This analysis will help determine which incentives or policy interventions are likely to accelerate the switch to electric appliances.

Step 2: Data Integration and Empirical Analysis

Once the survey and DCE data are collected, the results will be integrated with household-level hourly natural gas and electricity consumption data provided by LADPU. This integration allows for an empirical analysis of:

- **Current consumption patterns** of natural gas for different household functions (e.g., heating, cooking, water heating), considering variations across seasons and peak demand times.
- **Projected changes in electricity load** that would result from switching to electric appliances for the same functions. The analysis will focus on how different adoption scenarios (e.g., slow, moderate, or rapid electrification) would increase household electricity demand and impact overall grid stability.

Using this combined dataset, we will develop load forecasting models that account for both the pace of electrification and variations in household energy consumption patterns. By comparing households that switch with those that do not, and analyzing energy use before and after switching, we can estimate how transitioning from gas to electric appliances would affect peak electricity demand, daily load profiles, and seasonal variations in energy use. Additionally, we will assess the need for grid upgrades or investments to accommodate increased electricity demand.

Project Timeline

January 2025 - June 2026

Task	Timeline
Apply for Institutional Review Board (IRB) approval	January 2025
Survey Design	January - March 2025
Focus Groups	March - May 2025
Survey Implementation	May 2025
Data Collection	June - July 2025
Data Analysis	August - December 2025
Drafting Report	January - May 2026
Reporting and Dissemination	Summer 2026

Project Deliverables

- **Primary Data Set:** The project will produce a detailed data set on household natural gas appliance stock, usage patterns, and household characteristics. It will also include hourly natural gas and electricity consumption data.
- **White Paper:** A white paper summarizing the study's findings will be prepared, focusing on household willingness to switch to electric appliances, barriers to transition, and the potential impact on electricity load. The paper will also provide policy recommendations for supporting the shift to electric appliances.
- **Presentation to the Public Utility Board:** A presentation will be delivered to the utility board, outlining key insights from the project.

Budget & Budget Justification

Component	Budget	Comments
Senior Salary	$8,358.22	0.5 month's summer salary for Dr. Jamal Mamkhezri with 22% fringe benefits
Course Buyout	$21,388.3	One course buyout for Dr. Jamal Mamkhezri with 38.75% fringe benefits
Senior Salary	$8,066.48	0.4 month's summer salary in AY2024-2025, and 0.1 month in AY2025-2026 for Dr. Yuting Yang with 25.96% fringe benefits
UNM Graduate Research Assistant 0.25 FTE	$22,510	A 10-hour Graduate Assistant for Fall 2025 & Spring and Summer 2026
Total Direct Cost	**$60,323**	
UNM F&A*	**$28,161**	
NMSU F&A*	**$10,255**	
Sub Total	**$102,746**	
UNM Contribution		
UNM Graduate Research Assistant	$20,195	A 10-hour Graduate Assistant for Fall 2025 & Spring 2026
Course Release	$7,168	One course release for Dr. Yuting Yang
TOTAL	**$130,109**	

Budget Justification

Yuting Yang, PhD, PI (0.5 summer month effort + course release). Support is included for the PI at a total cost of $15,234. Dr. Yang will oversee every stage of the work, supervise the graduate assistant, and prepare the final report.

Jamal Mamkhezri, PhD, PI (0.5 summer month effort + course buyout). Support is included for the PI at a total cost of $38,104. Dr. Memkhezri will lead the DCE design, implementation, and analysis, as well as prepare the final report.

Graduate Students, TBD. Funds requested for one graduate student will be hired to work 12 calendar months at 0.50 FTE with a monthly stipend of $2,602, 18 credit hours, health insurance, and mandatory student fees for a total of $42,705. UNM students will work with the PI on literature review, survey design and implementation, data collection, and analysis.

***Per UNM guidelines, there are no modifiers on budgets with reduced F&A unless otherwise stated in the solicitation. The reduced F&A rate must be applied to total direct costs.**