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Comparing Travel Behavior and Opportunities to Increase Transportation Sustainability in Small Cities, Towns and Rural Communities

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ABSTRACT
The vast majority of travel behavior and sustainable transportation research has focused on urban areas. A rural perspective is lacking. This paper aims to dive deeper into understanding how people travel and their perceptions and opinions about various components of travel in a majority rural state. By speaking directly with Vermonters through in-person interviews, uniquely personal points of view were discovered and analyzed to find commonalities and differences between urban, suburban, and rural Vermonters. Questions on day-to-day challenges of traveling, suggestions for reducing greenhouse gas emissions, responses to fuel prices, and opinions on electric vehicles were asked. Some key findings were illuminated over the interview and analysis processes. Rural areas struggle most with traveling long distances to reach services, while urban areas are more concerned with traffic, opinions on EV ownership were consistent across the state, with people being likely to consider owning an EV if costs of ownership were to decrease. These interviews highlighted additional questions that need to be answered so that states can develop practical and effective policies aimed at reducing greenhouse gas emissions in rural areas. Further in-depth surveys are recommended coming out of this study so that a more complete picture of potential behavioral shifts can be attained. A reduction in GHG emissions is paramount to the world's survival and this research will add to the body of knowledge in a historically understudied population so that we can work more closely with small and rural communities to help combat climate change through widespread emission reduction.

INTRODUCTION

The need to better understand rural travel behavior has never been greater or more urgent. Transportation is the largest source of greenhouse gas (GHG) emissions in the US, and transportation GHGs are particularly significant in small and rural (S&R) communities where 30% of U.S. auto-travel occurs, according to highway statistics collected by the US Department of Transportation and the average person travels 40% farther that their urban counterparts according to data tabulated in the Transportation Energy Data Book (*1*). A significant body of travel behavior research seeks to predict how infrastructure investments, technology and policies can reduce GHG emissions from transportation, however the vast majority of this research has been conducted in urban areas. As a result, very little is known about how people and households in S&R communities make travel decisions and how they respond to changes in transportation infrastructure, technology, and policies. Strategies that have been found to reduce GHGs in urban areas are likely to be ineffective in S&R communities due to differences in transportation options, the built environment, socioeconomics, values and norms, attitudes, and beliefs. This research aims to begin addressing the need for a deeper understanding of travel behavior in S&R communities by conducting exploratory qualitative research in a wide range of small and rural communities in Vermont. Our objective is to develop an initial understanding of potential barriers to travel behavior change in S&R communities that would support more sustainable transportation.

We focus on Vermont because of our location and knowledge of the state, its history of aggressive GHG emission reduction targets, and the lack of mitigation achieved so far. Vermont is unique in the amount of political support for widespread GHG mitigation but general lack of progress in reducing emissions. Vermont first adopted GHG mitigation targets in 2005 (10 V.S.A. § 578), requiring reductions of 50% below 1990 levels by 2028 and 75% below 1990 levels by 2050. In 2016, the state's comprehensive energy plan established additional goals to meet 25% of energy demand with renewable resources by 2025, 40% by 2035 and 90% by 2050 (*2*). Then, in 2020 the state adopted a new set of legally binding GHG mitigation targets (Act 153) requiring reductions of 26% below 2005 levels by 2025, 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. Despite these goals and a wide range of related policy and planning initiatives undertaken to achieve them, Vermont's GHG emissions have been increasing since 2011 (*3*). Transportation is the largest source of Vermont's GHG emissions, accounting for nearly 40% of the state's emissions (*4*). Many states in the northeastern United States face similar challenges in reducing transportation sector emissions and some have considered signing on to the Transportation and Climate Initiative (TCI). TCI aims to create a collaboration among northeastern and mid-Atlantic states to cut GHG emissions from transportation through a regional carbon cap and invest program. TCI would place a cap on GHG emissions from on-road gasoline and diesel and invest the proceeds from the auction of emission allowances to incentive households to reduce their driving or to purchase lower emitting vehicles.

An important concern for Vermont where 61% of the population resides in a rural area according to the 2010 US Census, and other states with large rural populations, is that market-based climate policies like TCI may disproportionately impact the welfare of low income and rural households because they may be more automobile dependent, less able to afford alternatives, and transportation costs may be a higher share of their household expenditures (*4–10*). While the proceeds from GHG emission allowance auctions can be used to increase the effectiveness of policies like TCI and offset inequities (*3*, *11*), data to understand welfare impacts and investments decisions is lacking for rural communities (*6*, *12*). Similar gaps exist with respect to the effectiveness of programs and policies to encourage the use of electric vehicles (EV), such as rebate programs. While research on EV incentive programs generally find that they are associated with higher EV adoption rates, there is little evidence on their effectiveness in rural communities as prior research evaluates national and state-level data (*13*). Even in states with high EV adoption rates, adoption and incentive effectiveness may be lower in rural areas where range anxiety could be greater given longer trip distances, people may have preferences for different types of vehicles (e.g., trucks and four-wheel drive vehicles), and where incomes are often lower.

While travel behavior research and the knowledge it has produced is extensive, this field of scholarship has its roots in trying to solve urban transportation problems with little attention given to rural areas. The lack of rural transportation GHG mitigation research is perhaps best summarized in the concluding remarks of a TRB 2nd Strategic Highway Research Program (SHRP 2) study on GHG mitigation decision making that states "By far, and not surprisingly, most of the research on GHG emissions reduction strategies has focused on metropolitan areas or at the national and state levels." and that "…very little attention has been given to nonurban areas." (*14*). Most of what we currently know about travel behavior, including theories of travel demand, mode and destination choice, vehicle and housing location choice, price elasticities, and technology adoption has come from research collecting data in urban areas to address urban transportation problems such as traffic congestion and regional air quality concerns, and more recently urban GHG mitigation strategies. However, climate change and GHG mitigation policies will also affect, and require robust participation from, small and rural communities. New data and knowledge are required to understand the interactions between individual and household attributes, contextual factors and travel behavior in S&R communities and ultimately identify effective, efficient and equitable transportation GHG mitigation strategies.

Evidence that travel behavior in S&R communities differs from behavior in more urbanized areas is starting to emerge from research on gasoline price responsiveness (elasticity). Hundreds of fuel price elasticity studies have been conducted (*15*), but only a few have attempted to also understand price responses in S&R communities (*16–18*). Perhaps counterintuitively, some of these studies suggest that rural households may be more responsive to changing fuel prices than their urban counterparts, challenging the findings of earlier studies that use more aggregate data (*17*, *19*). While more spatially refined gasoline price elasticities would be useful for estimating the impacts of market-based GHG mitigation policies on S&R communities they are essentially a black box – they reveal how much a traveler changes their consumption of transportation-related goods, but they do not reveal how and why they do so. Insights about how and why travelers change their behavior is necessary to understand the role contextual factors such as transportation infrastructure and the attributes of households and individuals play in supporting or limiting travel behavior change.

Our research begins to address the lack of travel behavior research in S&R communities by conducting exploratory qualitative research through interviews in a wide range of S&R community types. Gathering data on the travel behavior and attitudes of a diverse cohort of people in rural places can be challenging. We address this challenge by going out to these communities and interviewing people in public places in a wide range of settings. Our recruitment approach of intercepting research subjects in public places and conducting our interviews on the spot, eliminates some of the bias inherent in telephone or internet surveys relating to access to internet or a smartphone, income, and/or age (*20*). The data we collect through these interviews are evaluated to identify factors, including attitudes and beliefs, that may create barriers to more sustainable travel behavior and choices and how they vary across different types of communities. The remainder of this paper discusses our interview and qualitative research methods in more detail, discusses what we learned about travel behavior and potential barriers to change in different types of Vermont communities and concludes with how the findings from this phase of our work can inform policy decisions and further research needs.

METHODS

We collected information on travel behavior, fuel price response, attitudes towards EVs, and opportunities and barriers to reduce GHG emissions from transportation from 173 in-person interviews conducted during the spring and summer of 2021 with individuals from 43 Vermont municipalities. Interviews were transcribed and coded to identify differences in the responses of individuals from different types of communities.

On-the-Street Interviews

To reach a diverse group of people in a variety of small and rural places, we choose to interview people in person in a range of frequently used public places. The semi-structured interviews included 20 questions with additional follow up questions depending on the respondents' answers (e.g. asking if they use public transportation after the respondent states that they have access). Topics of questioning included general travel questions about primary mode in a typical week, overall challenges and likes about travel in their community, travel changes related to the Covid-19 pandemic, responses to fuel price changes, predictions for fuel prices, opportunities and challenges to meeting statewide GHG emission reduction goals, and one question comparing their personal travel to others in their community. The full range of questions we asked and their themes are shown in Table 1. The audio of the interviews was recorded and a transcript was generated to be coded qualitatively. At the conclusion of the interview, an optional demographic questionnaire capturing town of residence, age, household size, number of household vehicles, gender, income, employment status, race, and ethnicity.

TABLE 1 Interview Questions by Theme

Theme	Interview Questions
Opening Questions	1. Do you live in an urban, suburban, or rural area? 2. How long have you lived in Vermont?
Covid-19 Effects on Travel	1. How has your travel changed since Covid-19? 2. During the initial stages of the pandemic quarantines, were you walking or biking more or less than usual? 3. Do you walk or bike more or less since the pandemic conditions have improved?
Responses to Fuel Prices	1. Has the increasing cost of gas has changed how you travel? 2. Has the increasing cost of gasoline changed the type of vehicle you now own or would consider purchasing in the future? 3. Do you think gas prices will stay about the same, increase, or decrease in the next 5 – 10 years? 4. If gas prices were expected to increase by 50% in the next year, how do you think this would impact how you travel?
Actual and Perceived Barriers to Change	1. What do you think could be done to reduce greenhouse gas emissions from transportation in your community so the State can meet its goals? 2. What are some of the largest challenges you see to reducing the amount of gas that people in your community use for transportation? 3. Are you aware of the rebates and incentive programs offered by the state and federal governments? 4. Do you feel that electric vehicles would work for you? 5. Do you think these incentives are helping people purchase electric vehicles?
Alternative Modes of Transportation	1. Do you have access to public transportation where you live and/or work? A. If yes, do you use it? a. If no, why? b. If yes, how do you use it? 2. Would you ever consider moving somewhere else to reduce or change the way you travel?
Range of Travel Behavior	1. What are your largest challenges you face while travelling?

	A. Are there things that you like, or you think work well for people traveling in your community? B. What suggestions or ideas do you have for improving how people travel in your community? 2. In a typical week, what mode of transportation do you usually use? 3. How do you feel your travel varies from people in your community? For example, do you feel like you travel more, less, or about the same? What about the different modes of transportation you use?

Over the course of the study, interviews were conducted in 16 towns at 26 locations. The towns and cities selected represented a range of population densities and distance to more metropolitan areas. Locations included public parks, beaches, recreation facilities, downtowns and village centers, boat launches, farmers markets, state parks, and general stores or supermarkets. These places were selected as they attract a wide variety of people and are open to the general public. Researchers conducted interviews between 10am and 1pm and again between 3pm and 7pm on both weekdays and weekends. In a given city or town, between 2 and 20 people were interviewed during a single session with each interview lasting approximately five minutes.

Interview participants were selected at random with a few considerations. To qualify as a research participant, the individual must be at least 18 years old and be a resident of Vermont. In sparsely populated parks and beaches, all individuals who were not actively preoccupied (i.e. on the phone, taking care of a child, etc.) were approached for an interview. In more populated public spaces, the area was subdivided and each person within a randomly selected subdivision was approached. When interviews were conducted outside of stores or on a downtown sidewalk, every third person to pass by was asked to participate in the study. We had an 74.6% acceptance rate for inclusion in the study with 173 completed interviews out of 232 attempted interviews.

Interview Analysis

The 173 audio recordings of the interviews were transcribed using computer software which was then manually verified by listening to the recordings and updating transcripts as needed. 19 of these recordings were inaudible due to windy conditions, leaving 151 usable interviews. After removing out of state interviews, 139 interviews remained for analysis. Transcriptions were then coded for attributes of the interviewee, their community, or their travel behavior using NVivo by three members of the research team. The coding scheme used by the coders was developed iteratively after initial attempts at coding a small portion of the interviews. The codes included 21 topics with numerous subcodes to be used in analysis. A brief description of the coding topics is provided in Table 2.

TABLE 2 Coding Scheme Description

Topic	**Number of Subcodes**	**Description**
Introductory Questions		
Primary Mode	4	Primary mode of transportation in a typical week
Length of Vermont Residence	5	Length of time the participant has lived in Vermont
Pandemic Travel Behavior		
Overall Travel After Pandemic	4	Overall amount of travel after pandemic conditions improved

Overall Travel During Pandemic	4	Overall amount of travel during pandemic
Walk-Bike Purpose During Quarantine	2	Recreational or essential travel by walking and/or biking during early pandemic quarantine
Travel Improvement Suggestions	15	Suggestions for improving local or regional travel
Walk-Bike-Vehicle Change During Pandemic	16	No change, increase, or decrease of walking, biking, public transportation, and/or vehicular travel during early pandemic quarantine
Responses to Fuel Prices		
Fuel Price Impact	11	Impact of fuel price increases since 2009
Future Fuel Price Impact	10	Anticipated impact from fuel prices if they were to increase by 50% in the next 1 – 2 years
Fuel Price Prediction	5	Prediction for fuel prices over the next decade
Actual and Perceived Barriers to Change		
GHG Reduction Suggestions	16	Strategies recommended for reducing GHG emissions to meet statewide goal
Reducing Gas Challenges	10	Challenges the participant sees to reducing the amount of gas used by members of their community
Electric Vehicles		
Electric Vehicle Rebate Awareness	3	Awareness of existing EV incentive program
Electric Vehicle Incentives	6	Opinion on the effectiveness of Vermont's EV incentive program
Electric Vehicle Ownership	11	Likelihood of owning an electric vehicle at some point
Modes of Transportation		
Public Transit Access	3	Access, or lack thereof, to public transportation and frequency of use
General Travel Behavior		
General Travel Challenges	12	Challenges expressed about general travel in the participants' community
General Travel Likes	8	Components of travel that work well in the participants' community
Travel Improvement Suggestions	15	Suggestions for improving local or regional travel
Move to Change Travel	11	Likelihood of participant moving to change or reduce their current travel
Travel Comparison	17	How the participant sees their travel compares to members of their community

Intercoder reliability (ICR) was evaluated to ensure reliability across the three coders coding the interview transcripts (*21*). Of the 151 usable interviews, 27 (18%) were tested using ICR. It is recommended to test between 15 and 25% of the total sample using ICR (*22*). By using the coding comparison query tool in NVivo, the percent agreement and disagreement and Cohen's kappa coefficient

are reported. The kappa coefficient is reported in NVivo for each code and file separately. In this report, the average kappa coefficient for each coding theme is reported. Research suggests that percent agreement or disagreement is not a sufficient reporting tool, whereas a kappa coefficient is more widely accepted as they are more likely to account for chance agreements or disagreements (*23*). The range of possible kappa values is from -1 to 1 with a value of 0 meaning agreement by chance, values below 0 meaning agreement less than chance, and values above 0 meaning some level of agreement. A value of 1 indicates perfect agreement that is not related to chance. The formula for calculating kappa is shown below in Equation 1. The kappa coefficients for each coding category across the 27 transcripts tested for ICR are presented in Table 3.

$$\kappa = \frac{A_0 - A_e}{1 - A_e} \quad (1)$$

Where:

A_0 = the observed agreement between coders;

A_e = the expected agreement as a result of chance

TABLE 3 Coding Scheme Kappa Coefficients

Code Category	Mean Kappa Coefficient
Electric Vehicle Incentives	0.903
Electric Vehicle Ownership	0.944
Electric Vehicle Rebate Awareness	0.903
Fuel Price Impact	0.929
Fuel Price Prediction	0.937
Future Fuel Price Impact	0.916
General Travel Challenges	0.952
General Travel Likes	0.986
GHG Reduction Suggestions	0.928
Length of Vermont Residence	0.936
Move to Change Travel	0.931
Overall Travel After Pandemic	0.972
Overall Travel During Pandemic	0.919
Primary Mode	0.832
Public Transit Access	0.866
Reducing Gas Challenges	0.958
Travel Comparison	0.961
Travel Improvement Suggestions	0.964
Walk-Bike Purpose During Quarantine	0.961
Walk-Bike-Vehicle Change After Pandemic	0.955
Walk-Bike-Vehicle Change During Pandemic	0.883

The coefficients shown in Table 2 show an overall very high level of agreement, with a minimum value of 0.832 and a mean of 0.926. Research suggests that values of 0.8 are generally accepted by most standards and all standards agree that values over 0.9 are acceptable (*22*). One of the most widely cited pieces of literature on measuring agreement between observers or coders states that kappa coefficients

between 0.81 and 1 represent almost perfect agreement (*24*). Based on these standards, the coding presented in this research is valid and can be used for analysis.

RESULTS

Demographic Survey

The optional demographic survey presented to participants was completed by 139 individuals who reside in 43 towns in Vermont. The cities and towns represented in our sample are shown in the map provided in Figure 1. The northwestern portion of the state, where most of the sample occurred, is home to the majority of the state's population and developed land. There are a wide range of land use patterns and covers all types of community on the urban-rural continuum. This survey was updated to include additional variables as the study progressed, so employment and gender were completed by fewer respondents than the other variables. The representation of gender mirrored that of the state, although it was based on a smaller sample as it was added to the demographic survey after some responses had already been collected. The sample demographics are presented in Table 4 and compared to 2019 American Community Survey (ACS) five-year average values for available demographic characteristics. Employment status information was collected from the US Bureau of Labor Statistics 2020 Employment Profile and is only available for employed or unemployed and eligible to be in the workforce. The sample collected in this research is representative of statewide US Census data for race, while our sample underrepresents high income households earning over $100,000. Employment status is not directly comparable as only those eligible for the workforce are shown for the statewide comparison

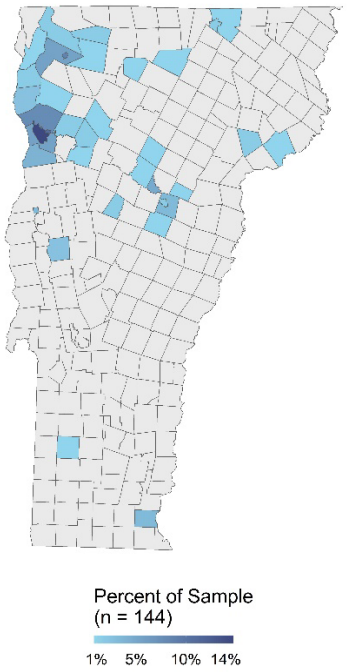

FIGURE 1 Sampled Cities and Towns by Proportion of Total Sample

TABLE 4 Sample Demographics Descriptive Statistics

Variable	Count	Study Sample	2019 ACS
Gender			
Female	26	54.2%	51.0%
Male	22	45.8%	49.0%
Other	0		

Race			
American Indian or Alaska Native	2	1.4%	0.5%
Asian or Asian American	3	2.1%	1.4%
Black or African American	3	2.1%	1.5%
White	131	93.8%	93.8%
Other	1	0.6%	2.8%
Income			
Less than $34,999	43	30.7%	26.6%
$35,000 – $49,999	16	11.4%	12.3%
$50,000 – $74,999	22	15.7%	19.0%
$75,000 – $99,999	24	17.1%	13.7%
Over $100,000	29	20.7%	28.4%
Prefer Not to Answer	6	4.4%	
Employment Status			
Employed (part-time or full-time)	78	63.9%	63.2%
Self-Employed	9	7.4%	7.6%
Retired	20	16.4%	
Student	3	2.5%	
Unable to Work	1	0.8%	
Unemployed	11	9.0%	2.2%
Number of Adults in the Household			
1	28	20.1%	31.6%
2	86	61.9%	39.2%
3	9	6.6%	13.5%
4 or more	16	11.4%	15.5%
Number of Children (under 18 years) in the Household			
0	92	66.2%	71.6%
1	17	12.2%	13.0%
2	19	13.7%	10.9%
3	5	3.6%	3.4%
4 or more	6	4.3%	1.1%
Number of Vehicles Available in the Household			
0	2	1.5%	6.9%
1	37	27.2%	35.9%
2	55	40.4%	39.5%
3	26	19.1%	12.5%
4 or more	16	11.8%	5.2%

Interview Responses

The responses provided by the participants are organized into themes that are reflected in the following sections. Of interest to this research are general attitudes towards rural travel behavior, including culture around vehicles and public transportation, attitudes towards EVs, and responses to transportation costs. As part of the interview, participants were asked to self-identify their town or city of residence as urban, suburban, rural or a village center. The community type of four respondents was unknown due to audio recording issues (background noise) or because the respondent was unsure how to describe their community type. The distribution of responses is shown in Table 5.

TABLE 5 Distribution of Self-Identification of Rurality

Classification	Count	Percent of Total Sample
Urban	45	32.4%
Suburban	24	17.3%
Rural	64	46.0%
Village Center	2	1.4%
Unknown	4	2.9%
TOTAL	139	100%

General Attitudes on Transportation and Means of Travel

A participant from a rural area articulated quite clearly the reason for this study and stated, "I think my general messages is pay closer attention to, you know, to rural areas…urban areas; that's where a lot of people, you know, a lot of the population is concentrated, but I think that there's a lot more attention that could be paid to rural communities". This response indicates that individuals residing in rural areas may feel overlooked when it comes to transportation planning and decision making. In this section we discuss how respondents in different community types travel and what their transportation challenges are.

One thing that comes with rural communities is a predominant culture around vehicles and automobile dependence, often as a result of isolation from services and lack of public transportation. The primary mode for the majority of respondents in all community types was a personal vehicle (Figure 2). Only a minor portion of suburban (20%) and rural (12%) respondents indicated another mode for their primary means of travel. Urban residents were more likely to report walking as their primary means of travel (29%) and transit (12%). Very few respondents in any community type use a bicycle as their primary means of travel (less than 5% in all community types).

Although public transportation is not the primary mode of transportation, all respondents from urban areas stated they have access to public transportation and 42% of them use it on some occasion (Figure 3). Most suburban respondents also have access to public transportation 80%) but very few use it (13%). Fewer rural respondents reported having access to public transportation (42%) than suburban respondents and they were even less likely to use it (4%). Reasons given for not using public transit, particularly in rural areas, were easier access to a vehicle or public transportation did not get them where they needed to go. A participant from a suburban area mentioned that there is a bus stop at the end of her street, but they do not even think to take it because getting in the car and driving "just because it's easiest". When examining these results shown in Figure 3 using a χ^2 test, a p-value of 0.01 was calculated, showing that the differences in responses across urban, suburban, and rural groups were statistically significant.

Most respondents did not indicate they face any significant transportation challenges (Figure 4). Traffic was the most frequently cited concern for urban (18%) and suburban (23%) residents while road conditions (13%) and distance to services (18%) were the primary concerns of rural residents. Affordability was also a concern for some urban (8%) and suburban (8%) residents in addition to a lack of travel options (12%) and safety (8%) for suburban residents. We also asked respondents what they thought worked well or what they liked about traveling in their community. Most respondents did not respond to this question, but those who did most frequently mentioned that they enjoyed Vermont's natural scenery (12%) with no apparent difference between community types (Figure 5). Other positive views were relatively infrequent were not statistically significant across community types.

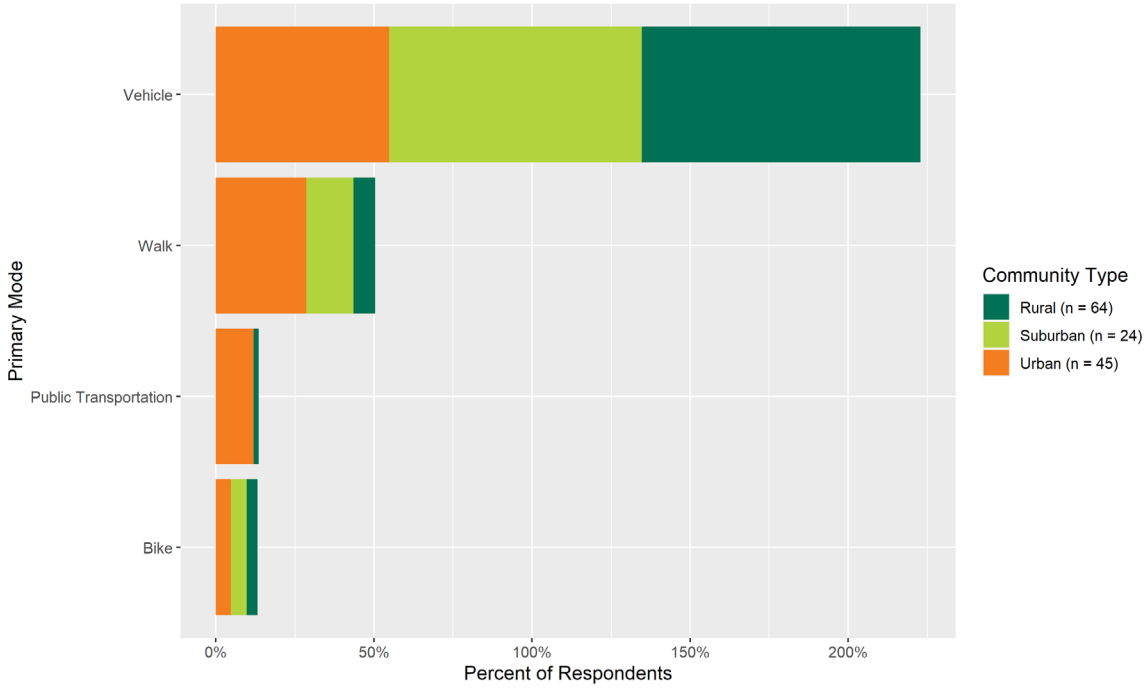

FIGURE 2 Primary Mode of Transportation

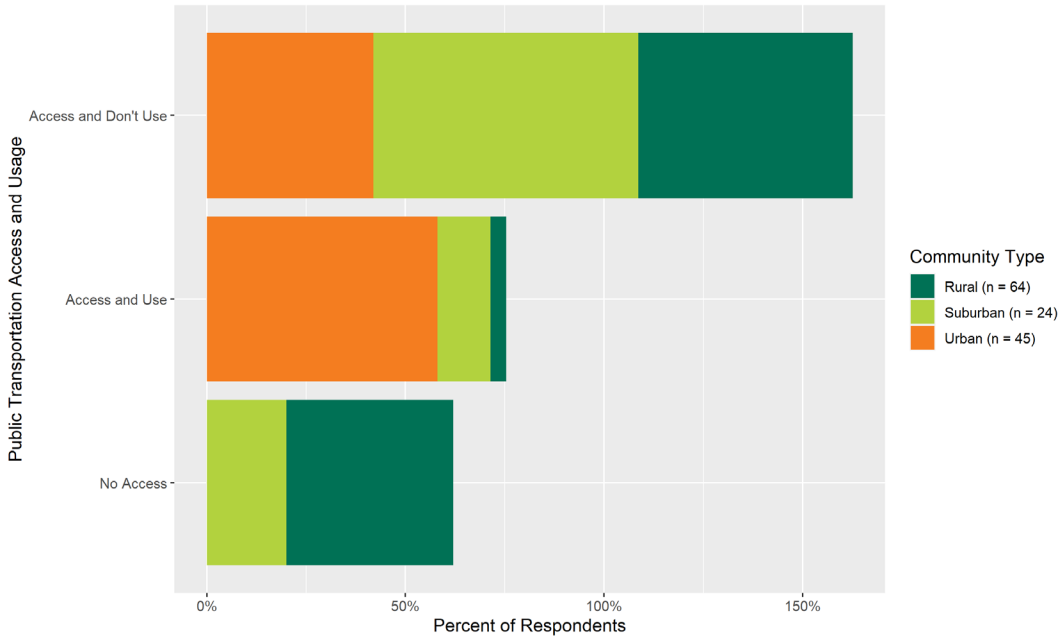

FIGURE 3 Public Transportation Access and Usage

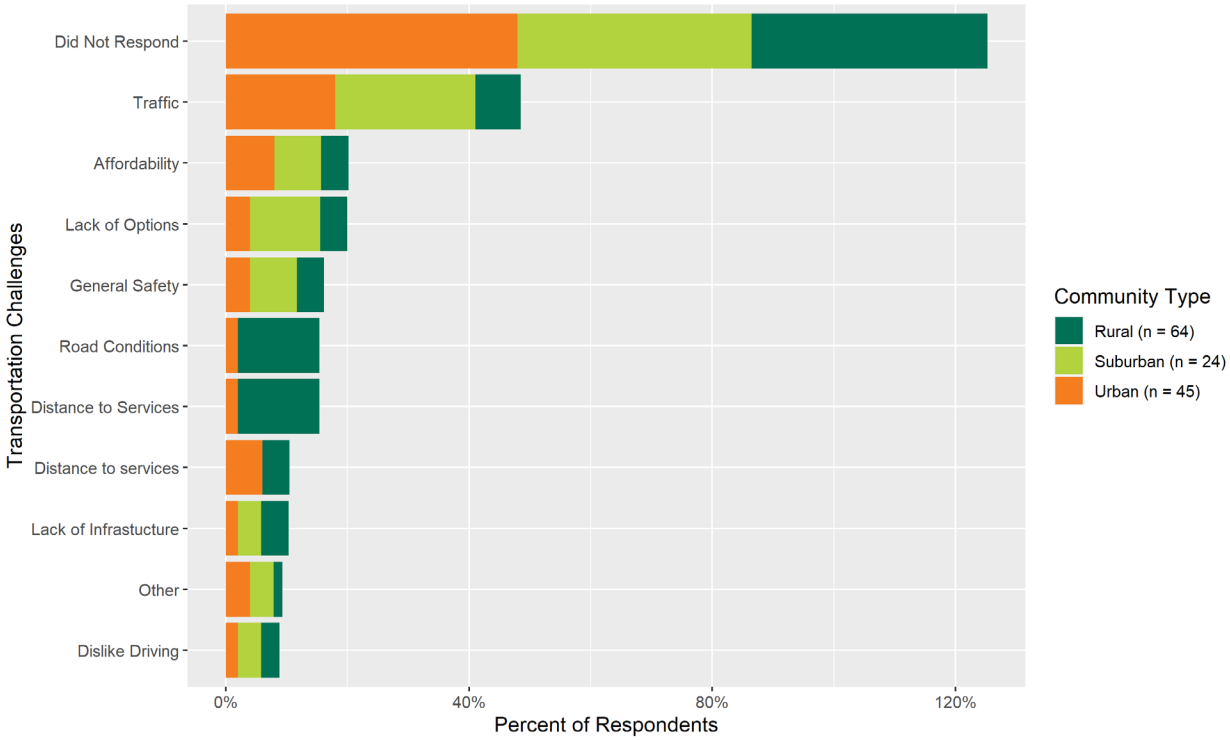

FIGURE 4 Travel Challenges in Vermont

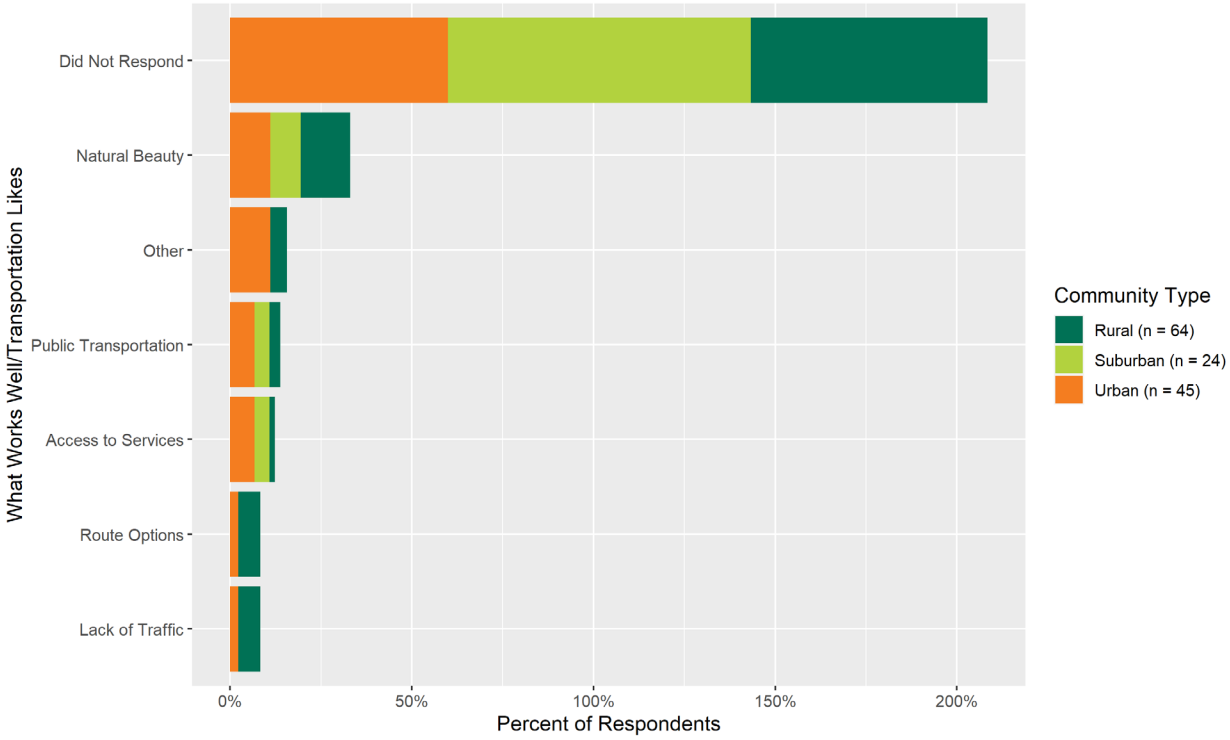

FIGURE 5 What Works Well or is Liked About Travel in Vermont

Attitudes on Electric Vehicles

Another component of the interview asked about knowledge of EV rebate programs offered by the state, if they think these rebates are effective, and if they would consider purchasing an EV. A recurring theme throughout our interviews was that most people (41%) were not aware of the rebates. Awareness of rebates was similar across community types with approximately 30% of respondents from each community type being aware (Figure 6). Many respondents stated that they wished they had known about EV incentives, that there should be more education and outreach to inform Vermonters about EV incentives, and that they would likely tell their friends and family about them. When asked about effectiveness of the EV rebates, most people were unsure or felt unqualified to answer. 25% of suburban participants and 20% of urban participants stated they were definitely effective whereas only 14% of rural participants saw them as being definitely effective.

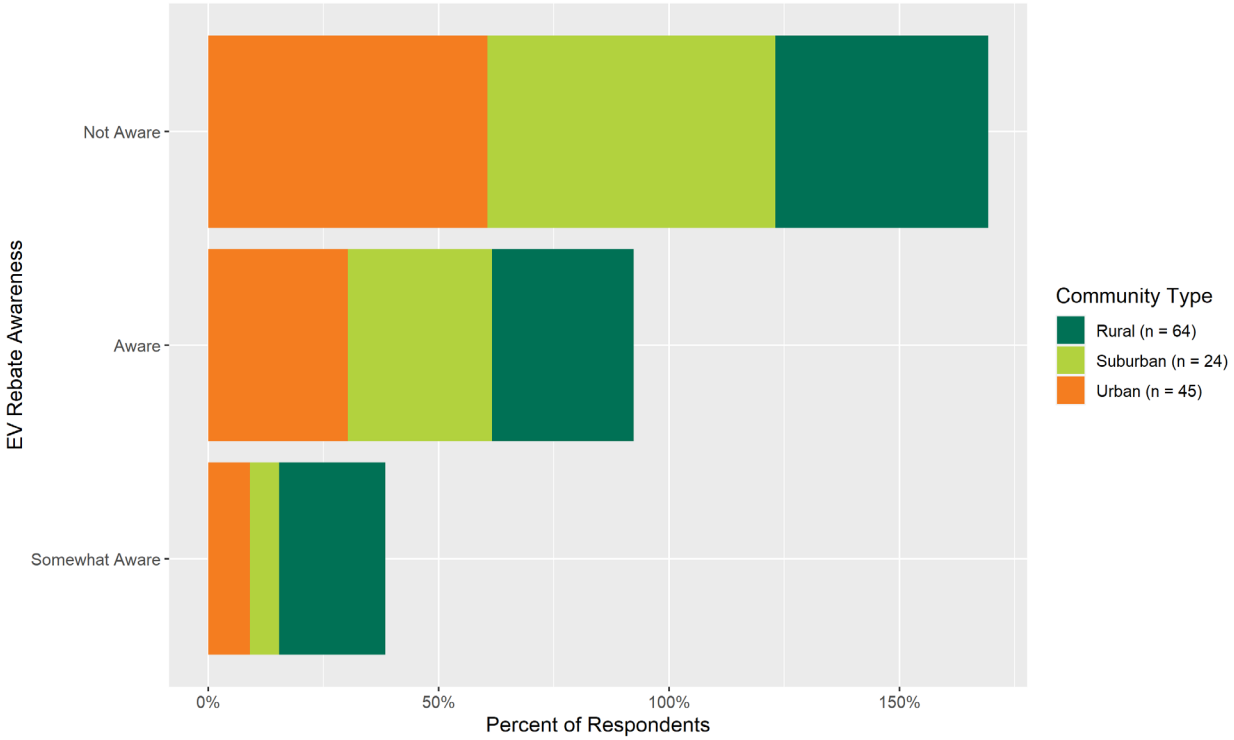

FIGURE 6 EV Rebate Program Awareness

Most respondents indicated that they would consider owning an EV (Figure 7). Rural residents were more resistant to considering an EV (15%), with relatively fewer suburban (11%) and urban (13%) residents stating they would not consider owning an EV. The largest share of those that would definitely own an EV were from suburban areas (47%). Cultural factors may play a role in greater EV resistance in rural areas. For example, one respondent from an urban community stated, “I think because there's such a culture here. I can't see people switching to tiny little electronic cars” and another rural responded stated, “a lot of people will still fight that image of being the Prius driving hippie”. For those considering EVs, costs and charging were the largest concerns. For example, a rural respondent said, “…my husband was just looking at them and my issue was the smaller ones are too small. I don't feel like they're safe enough for my kids. And then the SUVs are too expensive, so I can't afford them” and another respondent said, “I feel like electric vehicles are really targeted to a certain income bracket of people…whereas I would be choosing an electric vehicle over being able to pay the rest of my bills.” We also evaluated how EV consideration varied with knowledge of EV incentives, finding no apparent affect.

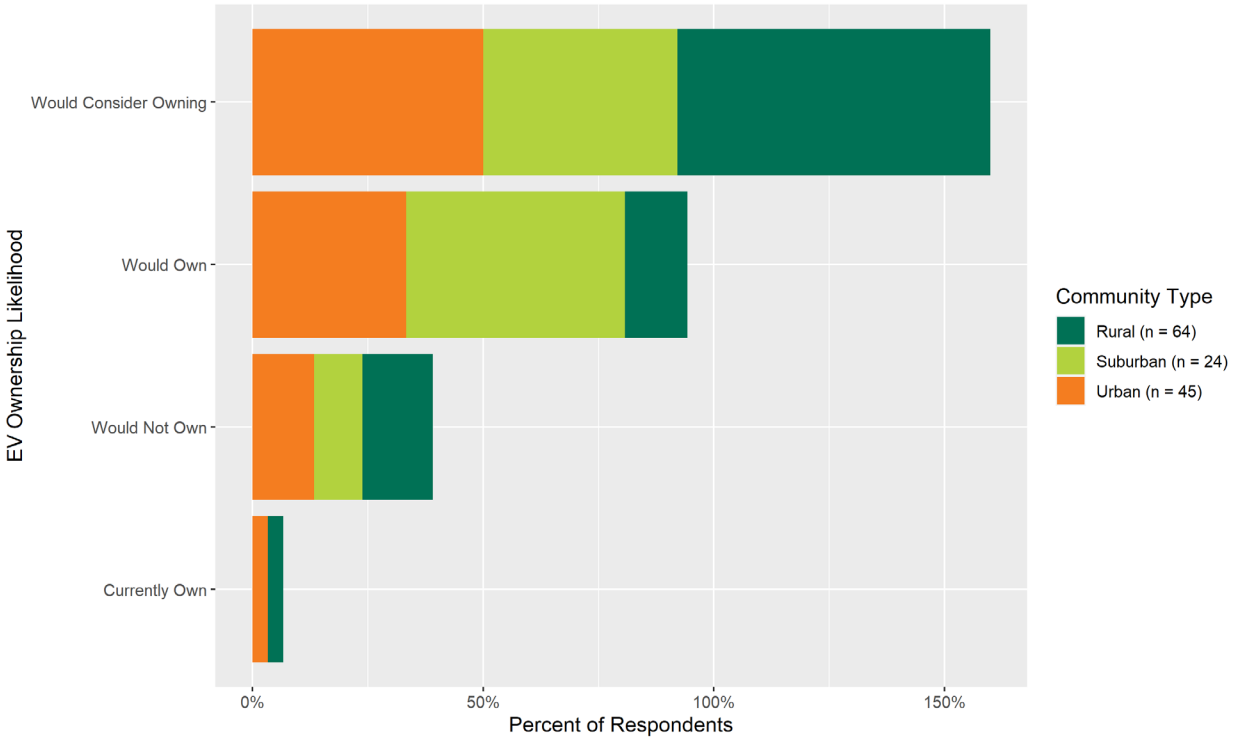

FIGURE 7 EV Ownership Likelihood vs. Rurality

Impacts of Fuel Prices

Interviewees were informed that between 2009 and 2011, gasoline and diesel fuel prices went up by about $1.00 per gallon and increased another $0.60 per gallon between 2014 and 2016. They were then asked if this had an any impact on how they travel behavior or the vehicle they use.

Overall, most respondents indicated that rising fuel prices had little impact on how they travel or their vehicle choice (Figure 8). Rural residents were most likely to report no effect on how they travel (66%), followed by urban (53%) and suburban (39%) residents. Some suburban residents (38%) indicated they had started to or were considering using more fuel-efficient vehicles, but few residents in any community type indicated they had or were considering reducing the amount they drive. These results agree with prior studies that have found travel to be inelastic to changes in fuel costs and point to high levels of automobile dependence in all community types in Vermont. One rural participant put it succinctly saying, “the price you have to pay is the price you have to pay”. A participant from a suburban area also stated, “We still go where we're going to go. We don't not go somewhere because price was going up”. One respondent from a rural area even mentioned that they would work additional hours just to pay for gasoline so that they could travel the way they wanted to with their family, even if gas prices were upwards of $6.00 per gallon. We also asked respondents if they have considered moving to change how they travel. Most indicated they would not (66%), with rural participants most frequently citing that they liked where they live, were close to their job or thought other places were not affordable. Respondents who indicated they would consider moving were motivated by avoiding traffic and being closer to services. Other factors including affordability and a desire to use other modes of travel were infrequently mentioned as reasons that one would move.

We also asked respondents if they thought fuel prices would go up, down, fluctuate, or stay the same over the next 5 – 10 years to understand if price expectations influence attitudes towards EVs and other behaviors that could reduce fuel use. Most respondents (63%) said they thought prices would increase, with little difference in this response across the three community types. We evaluated how responses

regrading EV adoption and moving to change how one travels varied with price expectations, finding little to no association. There were a few people expressed that they hoped gas prices would increase so that EVs would become more widely appealing. A rural respondent mentioned, “I hope they will increase as a way of encouraging people to seek alternative forms of transportation.”

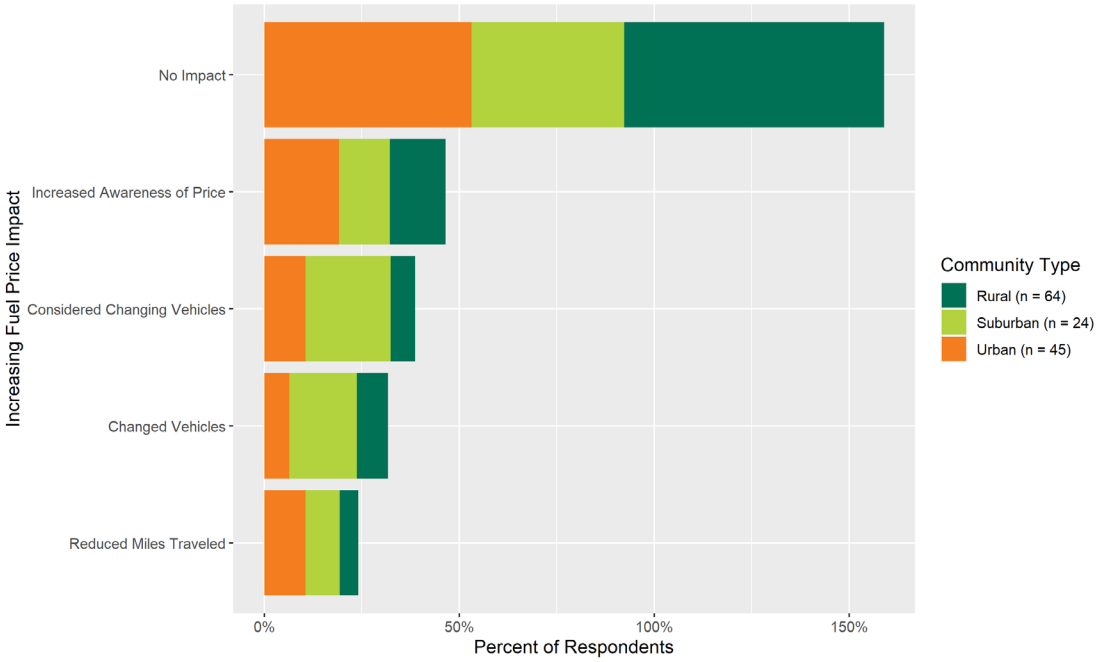

FIGURE 8 Increasing Fuel Price Impact vs. Rurality

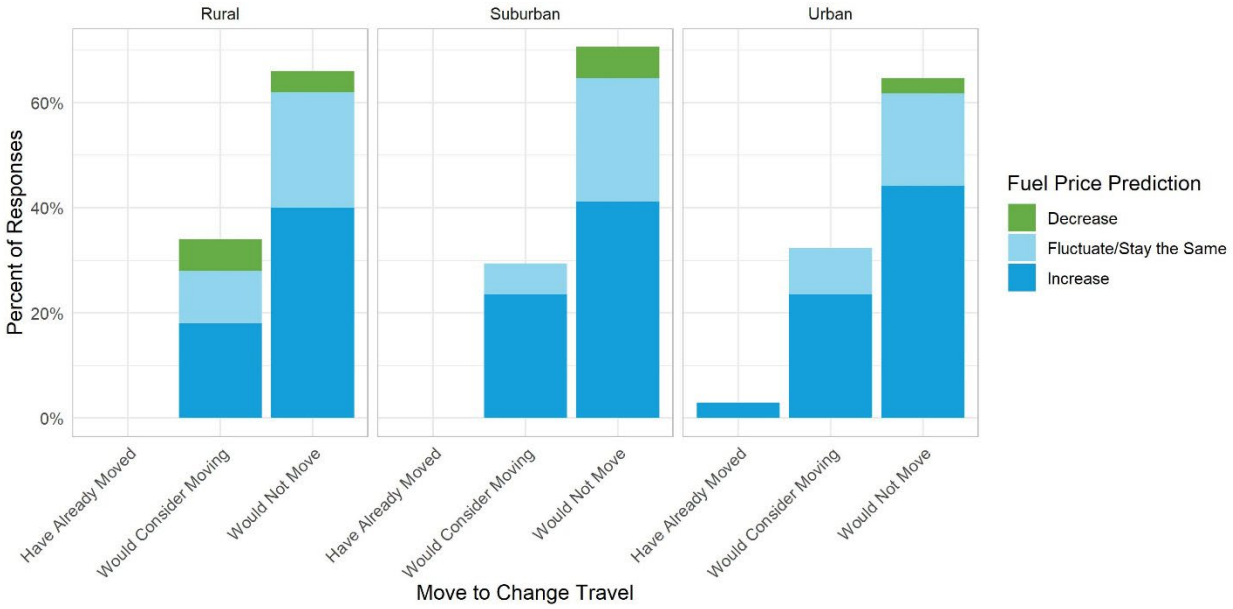

FIGURE 9 Moving to Change Travel vs. Fuel Price Prediction by Rurality

Attitudes on Reducing Greenhouse Gas Emissions

During the interviews we informed respondents about Vermont's climate goals and asked them what could be done in their communities to help meet this goal regardless of whether they though the goals were necessary or climate change was a problem. One of the most common answers was to increase access to public transportation. Responses around transit included recommending increasing frequency, the number of stops, and the number or routes. A participant from a suburban area stated, "I think buses are the answer…but I think it's just the reputation… wish somehow government could put the resources into changing public perception of taking the public bus.". The second most common response was to increase the number of EVs on the road. This was a more common answer in rural areas than urban areas. Another common answer in rural areas was to increase carpooling options. One rural respondent said, "I think there's a lot of opportunity for carpooling that doesn't happen", when referencing people traveling to their place of work. When asking rural participants what they see as the largest challenges to reducing gas use in their community, nearly 26% noted distances to services, 22% said lack of sustainable alternatives, and 16% thought there was general resistance to change. This aligns well with the challenges they see to reducing gas. It may be possible to draw the conclusion that if services are going to be far away in rural areas, there should more EVs making those trips or there should be public transportation to get them there. The complete range suggestions for GHG reductions organized by rurality is shown in Figure 10.

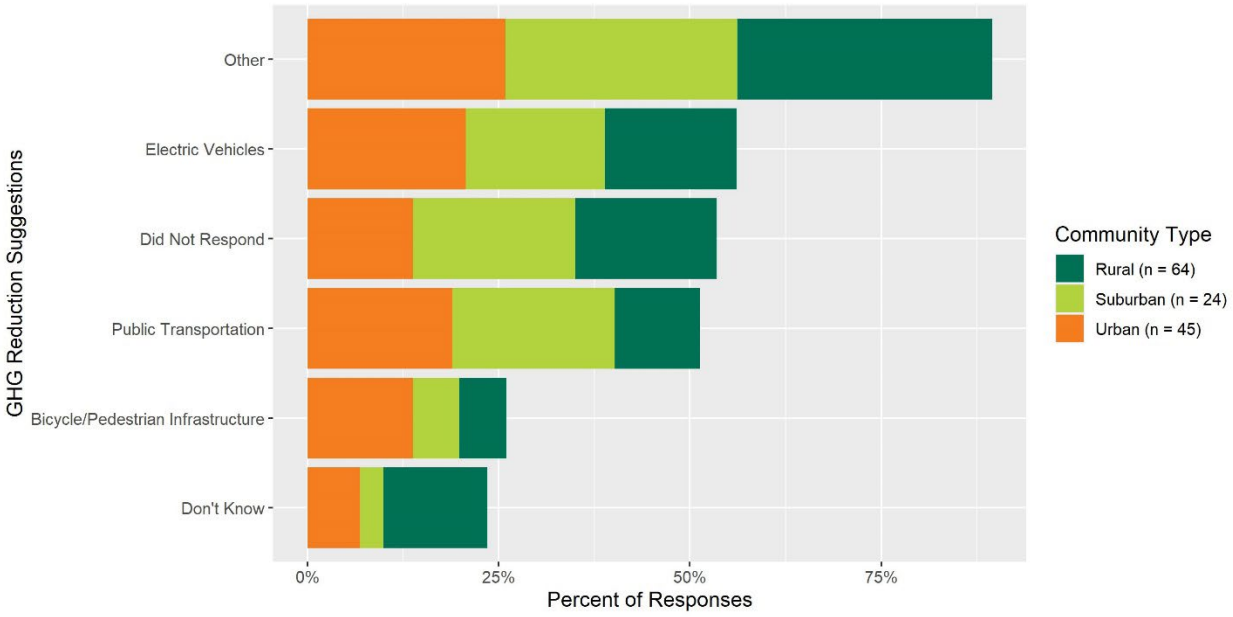

FIGURE 10 Greenhouse Gas Reduction Suggestions vs. Rurality

DISCUSSION

The main objective of this study was to collect new information about what barriers people living in a range of small and rural communities face when traveling and looking to reduce GHG emissions as well as their responses to increasing transportation fuel costs. The aim is to identify challenges deserving additional research attention since the travel behavior of people and households in smaller and rural communities has been studied much less than those in larger metropolitan areas. One hurdle to overcome when conducting research in smaller and rural communities is recruiting a diverse range of participants. We pivoted from an initial plan to conduct focus group meetings in various communities to interviews in public places as a response to COVID-19 restrictions on group meetings. By intercepting individuals in public places and conducing short interviews, we were able to collect information from a modest number

of individuals in many different types of communities that included participants with a range of socioeconomic characteristics that aligned reasonably well with Vermont's overall adult population. The interviews were relatively quick to complete, and most people agreed to be interviewed upon being approached. We think that in-person recruitment, whether an interview is conducted or not, offers an effective and efficient means to recruit individuals for place-based research, particularly where more difficult to research populations are of interest such as people living in rural communities.

This research showed some key differences between urban and rural areas which are relevant to understanding how we can shift to reduce GHG emissions. In this study, all urban-dwelling participants had access to public transportation, whereas less than half of rural-dwelling participants did not have access. Of those that had access in rural areas, they usually did not use it because the services were inadequate, or they preferred to use their vehicles. Increasing routes and frequency of public transportation in rural communities may make transit a more viable option for commuting and other travel needs. Another notable difference was in the daily challenges people faced in rural versus urban areas. In rural areas, people most frequently commented on the road conditions or the distance they must travel for services whereas in urban areas, the common challenge was traffic. The distances to services may be abated by the encouragement of denser, mixed-use village centers which can allow for closer access to basic needs like food and retail services. Density, even if in small clusters, provides opportunities for more active and public transportation (*25*).

While there are vast differences between urban and rural areas, there are shared characteristics, some of which can be leveraged to reduce GHG emissions from transportation whereas others create a barrier for change. Most people are satisfied with their travel and where they live. Most people did not indicate significant challenges or feel they would move to travel differently. For those who did indicate they would consider moving to change how they travel, this was generally to avoid traffic or increase accessibility rather than avoid costs or switch modes. Automobile dependence is high in all communities. Most people stated that higher fuel prices are unlikely to change the amount they travel. If anything, they would consider using a more efficient or electric vehicle. This aligns well with national level research on fuel price elasticities, but we cannot say if individuals in small and rural communities are more or less price sensitive than those in more urban places with the data we have collected.

Most participants indicated they have some level of transit access, yet few use it as their primary means of travel. Based on what we heard, unless transit can compete with the convenience and speed of private vehicles its unlikely to enjoy much use in Vermont since travel costs were infrequently mentioned as a concern. Traffic in urban areas and roadway conditions and distance to services in rural communities seem much more important than costs and it's unclear that better transit service would directly address these concerns, particularly in rural places. People did seem to walk and use transit more in urban areas, raising the potential that more compact development in rural and other small communities could result in some substitution of vehicle trips for walking and transit. Few people bike and there was little difference in attitudes towards bicycling across community types. Our sample size and the very low bicycle mode share in Vermont limits any meaningful conclusions about factors that could influence bicycling in different community contexts in Vermont.

The most common barrier to EV ownership is the cost, yet most people are unaware of the rebate and incentive programs offered by the state and for those that are aware, many do not think they are enough to counteract the cost of the vehicle. Even with awareness, it has been seen that cost is generally a barrier to entry into the EV market for consumers (*26*). Increasing education and awareness of these programs, while also bolstering them to provide larger incentives, may push many Vermonters to make the switch to an EV. If adoption of EVs becomes widespread, lifecycle emissions can be reduced by upwards of 10 – 20% per kilometer of travel (*27*). The transition to EVs will take time, an increase in supply of vehicles, a more diverse array of vehicle styles, increased infrastructure, and overall lower costs, but there are opportunities to encourage this transition through subsidies, incentives, and education.

Most people we spoke with indicated that increasing the use of EVs and transit were the most effective means to reduce GHG emissions and meet the state's climate goals. Active travel was also frequently cited. Notably, few people we spoke to use transit regularly, use active travel modes outside or urban areas or have purchased an EV which points to the challenges a rural state like Vermont may have in meeting its climate goals. Reducing the amount of travel was not something considered by most. In fact, many respondents indicated they would continue using their vehicle regardless of costs which one indicates that pricing policies may be costly Vermonters if their demand response is as inelastic as they state, and that pricing and other demand reduction strategies may receive little public support.

This study has shown that people living in urban, suburban, and rural areas in Vermont vary in terms of the daily challenges they face while traveling, but also share some notable attributes. This has impacts on current and future policy decisions aimed at changing behavior to reduce GHG emissions. Many researchers and policymakers have claimed that pricing policies are going to be effective in reducing emissions, and they are in some areas, but this may not be the case in rural communities. This research sought to further investigate this responsiveness to fuel prices. Many Vermonters expressed that they would do what they must do to pay for fuel, regardless of prices. This perceived inelasticity may have merit over the course of long-term price increases. When a sudden price shock hits, people tend to be more responsive, however these changes do not always withstand the test of time, even if prices do not go back down (*28*). This idea of dependence often leads people to be opposed to gas taxes because they say that they will pay whatever they have to in order to maintain their current travel patterns. Stated preference surveys have shown that people say they would seek alternative forms of transportation if gas prices were to reach six dollars per gallon (*29*). The relationship between stated preference and revealed data is often studied as humans do not always act in the ways in which they say they will, meaning their stated preferences do not align with the eventual revealed preferences. This is particularly prevalent when asked to perform valuations of public goods. In these cases, valuations are frequently overexaggerated (*30*, *31*).

Further research is suggested to examine this closer and analyze whether people truly maintain their behavior or if there are changes in behavior in response to increasing prices. We plan to use these study conclusions to launch more detailed studies in how to remove barriers to behavior change and better understand opportunities to reduce GHG emission from transportation in small and rural communities. Our present findings suggest that many individuals are receptive to using more efficient and electric vehicles. Reducing demand and shifting towards transit and active travel appear more challenging since this would generally require more compact development and encouraging individuals to move towards more compact places. Most people were very satisfied with where they currently live and how they currently travel (using a private automobile). This points to a need to further understand how attitudes and housing preferences could be modified.

We are using data from these interviews to implement a more comprehensive stated-preference survey to dig deeper into what it would take to change rural travel behavior and increase the sustainability of rural travel. The research presented here draws from a diverse, but small sample size. There were also limited questions asked to keep the interviews short and maximize participation. Future research aims to capture a larger sample of individuals across many small and rural communities. The lines of questioning may include scenarios with specific gas prices or distance to bus service to establish elasticities of individuals who may change their behavior. Additional research can help to establish a baseline of where people are at with their behavior and where they may change to reduce emissions from transportation. There is likely no silver bullet for reducing transportation emissions in small and rural communities, but through a deeper understanding of the challenges that people face and changes they are willing to make, a diverse suite of options for reducing GHG emissions can be developed and implemented over time. By using in-person interviews conducted in public places, this research provides a unique point of view in studying individuals who are often neglected in the current body of literature on travel behavior. This study has increased understanding of the barriers and opportunities in rural communities across Vermont,

and likely in similar regions, for changing behavior for the sake of reducing GHG emissions from transportation. Climate change is a global crisis that must be combatted and with over one third of emissions coming from transportation, we must act quickly and encourage behavior that is conducive to a world in which we can thrive sustainably. Behavior change is a complex thing to achieve, but it is only possible through continued study and close communication with the people that are directly impacted.

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AUTHOR CONTRIBUTION STATEMENT
The authors confirm contribution to the paper as follows: study concept: Gregory Rowangould, study design: Gregory Rowangould, data collection: Erica Quallen, Julia Clarke, and Clare Nelson, interview coding and analysis: Erica Quallen, Julia Clarke, and Clare Nelson, draft report preparation: Erica Quallen, Julia Clarke, and Clare Nelson, Gregory Rowangould. All authors reviewed the results and approved the final version of the manuscript.

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