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Pain at the Pump: The relationship between gas prices and transit ridership in urban and rural counties of Vermont

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An Environmental Studies Thesis Submitted in Partial Fulfillment of the Requirements of a Bachelor of Science Degree in the Rubenstein School of Environment and Natural Resources at The University of Vermont
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Abstract

I researched gas price and transit ridership data in the rural state of Vermont by county in the time period from January 1, 2004, to December 31, 2013. My research has addressed the topic of understanding transit ridership, specifically in rural or micropolitan areas. Previous literature shows a lack of research on the relationship between transit ridership and gas prices in rural areas. I have used SPSS Statistical software and Excel to determine the relationship between Vermont gas prices and monthly ridership data from the various transit authorities throughout Vermont. I have discovered a statistically significant correlation between public transit ridership and gas prices in the one urban county in Vermont. Additionally, I found a statistically significant relationship in one rural county of Vermont, with the correlation becoming more significant once I lagged the gas price data. Using population density and information about each transit authority, I have determined that there is a statistically significant relationship between gas prices and ridership in urban counties of Vermont. I recommend Vermont adjust its gas tax in order to incentivize the use of public transit in more urban counties where there is greater access to public transit.

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Thank you to Michael R. Kundrath, the Energy Policy & Program Analyst at the Vermont Department of Public Service, for providing me with regular gas prices in Vermont from 1992-2014. Additionally, thank you to Jon Moore, the Planning Manager of Chittenden County Transportation Authority, for providing me with CCTA and GMTA data, Stephanie Stearns, the Program Manager and Volunteer Coordinator at Addison County Transit Resources (ACTR), for providing me with ACTR data; to Randy Schoonmaker, General Manager and Vice Chair of Deerfield Valley Transit Association/Moover (DVTA), for providing DVTA data; to David Towle, Operations/Safety & Fleet Manager of Rural Community Transportation, Inc., for providing RCTI data; and to Rebecca Gagnon, General Manager of Connecticut River Transit, Inc. for providing CRTI data.

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Introduction

For those living in the United States, transportation is the second largest household expense. For every dollar, Americans spend an average of 18 cents on transportation, with the poorest fifth of families spending more than double that figure (Vermont Department of Public Service, 2011). And nearly 98 percent of what is spent on transportation goes to the purchase, operation, and maintenance of automobiles alone (Vermont Department of Public Service, 2011).

In rural states these costs dramatically increase due to less compact growth. The growth pattern found in rural states forces residents to travel further from home to work, school, and services. Vermont is a perfect example of this. In Vermont, approximately two-thirds of a household's total energy usage is for heating and transportation (Vermont Department of Public Service, 2011). The transportation sector remains the largest energy user in Vermont, with transportation making up 33.7 percent of its energy use, while nationally transportation only accounts for 28.6 percent (Sears & Glitman, 2011). While Vermont's total energy use is the lowest of any state, it is one of few with transportation playing such a large role- in most other states, the industrial sector is the largest energy user (Sears & Glitman, 2011). And transportation's contribution to greenhouse gas emissions has slowly increased. While the sector's contribution in 1990 was 39.6 percent, as of 2008, it has reached the largest source of greenhouse gas emissions in Vermont, at 47.1 percent, while nationally it only accounts for 27 percent (Sears & Glitman, 2011).

Land use in Vermont has led to automobile dependency. As of 2009, Vermont's per capita VMT (vehicle miles traveled) was 12,297—27.9 percent above the national average (Vermont Department of Public Service, 2011). And while Vermont's total energy use is the lowest, Vermont has the sixth highest per capita Vehicle Miles Traveled (VMT) in the U.S. (Vermont Department of Public Service, 2011).

Unfortunately, transportation in Vermont is subject to gas price volatility, especially because Vermont does not produce gasoline. This high consumption of gasoline drains the Vermont economy, and the costs will only continue to increase, especially as global supplies decrease worldwide. In order to reduce our dependence on the automobile and save the Vermont economy, environment, and citizens, it is necessary to move toward alternative modes of transportation. While we have acknowledged that gas prices will continue to increase, this thesis further explores the relationship in Vermont between these increasing gas prices and the consumers' choice to ride the most popular mode of mass transportation: the bus.

As of 2006, there were 1,500 mass transit agencies operating buses in the U.S., with the majority of transit passengers (59.6%) choosing the bus (American Public Transportation Association, 2014). The development of mass transportation in the United States can be traced back to the chartered ferry and horse cart services in Boston in 1630 (Thompson, 2008). Starting in the early 1800s, New York City, Boston, Chicago, and many other cities developed stagecoaches (Thompson, 2008). Starting in 1890, with the installation of light rail, many urban dwelling U.S. residents had access to some form of public transportation

(Miller, 2014). The number of modes has increased over time, with the addition of buses, trolleybuses, trains, trams, rapid transit, and ferries. For the most part, the early mass transportation systems were focused in the large urban areas, while the percent of the population dwelling in urban areas began to rise.

Mass transit ridership was believed to have peaked in 1956, due to the end of war time rationing, and the establishment of the Interstate Highway program in 1957, which enabled non wealthy people to afford both gasoline and automobiles and provided them with the infrastructure to use them (Miller, 2014; Thompson, 2008). While urban populations have continued to increase, so did the percentage of the population living in the suburbs.

Ridership on public transit has grown by nearly 3 billion trips since 1995 (American Public Transportation Association, 2014). This is due to constant investment in public transportation and renewed interest in central city living, and the efforts of cities to create transit-oriented environments and revitalize previously underdeveloped areas (American Public Transportation Association, 2014).

But ridership did not solely peak in 1956. In 2013 Americans took 10.7 billion trips on public transportation, "which is the highest annual public transit ridership number in 57 years" (Miller, 2014). The year 2013 marked "the eighth year in a row that more then 10 billion trips were taken on public transportation systems nationwide" (Miller, 2014). These increases were seen in public transportation systems in small, medium, and large communities, and specifically "bus ridership increased by 3.8% in cities with a population below 100,000," while nationally bus ridership remained stable (Miller, 2014). Surprisingly, the year 2013 also marked "the lowest [gas] price in three years," which seemed due to gasoline consumption "dropping on an annual basis in recent years as well" (Isidore, 2013).

The purpose of this study is to determine if there is a difference in the relationship between gas prices and public transit ridership throughout rural and urban counties in Vermont.

The relationship between gas prices and public transit ridership is important because Vermont is a rural state with limited public transit use, a high number of SOV (Single Occupancy Vehicle) commuters, and a high number of VMT (Vehicle Miles Traveled) per capita. If we can determine a way to decrease the amount of VMT or SOV commuters, then we will reduce pollution and greenhouse gas emissions, as well as save energy. The Vermont Comprehensive Energy Plan, released in 2011, stated that the goal of Vermont would be to achieve 90 percent of its energy from renewable sources by 2050 (Vermont Department of Public Service, 2011). Transportation is an important element in this puzzle, and is necessary to address if Vermont desires to achieve its goal.

Defining Public Transit

According to the American Public Transportation Association, **public transportation** is "transportation by a conveyance that provides regular and continuing general or special transportation to the public, but not including school buses, charter buses, or sightseeing services" (American Public Transportation Association, 2014).

A **transit agency**, or transit system, "is an entity (public or private) responsible for administering and managing transit activities and services. Transit agencies can directly operate transit service or contract out for all or part of the total transit service provided. When responsibility is with a public entity, it is a public transit agency" (American Public Transportation Association, 2014).

According to APTA, a **bus** is "a mode of transit service (also called motor bus) characterized by roadway vehicles powered by diesel, gasoline, battery, or alternative fuel engines contained within the vehicle. Vehicles operate on streets and roadways in fixed-route or other regular service. Types of bus service include local service, where vehicles may stop every block or two along a route several miles long. When limited to a small geographic area or to short-distance trips, local service is often called circulator, feeder, neighborhood, trolley, or shuttle service. Other types of bus service are express service, limited stop service, and Bus Rapid Transit (BRT)" (American Public Transportation Association, 2014).

As defined in Vermont legislation, public transportation refers to passenger transportation "by all means available to the general public," while public transit service is a subset of that which means "…any fixed route, paratransit, transportation brokerage, user-side subsidy, and or rideshare/ride-match program which is available to any person upon payment of the proper fare, and which is promoted to be available to all members of the public, including those with special needs" ("Vision, Mission & Goals | Public Transit," 2015).

Defining Urban and Rural

In order to fully discuss the findings of this thesis, there must first be agreement about the definition of urban versus rural. According to the Economic Research Service (ERS), there are nine definitions used to classify urban/rural areas in the U.S., but I will be using the Rural-urban commuting area (RUCA) system. The RUCA system "classifies census tracts following the same theoretical concepts and data used by OMB (Office of Management and Budget) to define metro and micro areas.

The RUCA system uses population density, urbanization, and daily commuting data to determine metropolitan, micropolitan, and small-town urban cores (Cromartie & Bucholtz, n.d.). Using this information from the U.S. Census Bureau, the ERS assigns a code to each county in the U.S., ranging from 1-3 (urban) or 4-10 (rural). Using the RUCA definition, the ERS found that 81% of U.S. land area is considered rural (Cromartie & Bucholtz, n.d.). When measured by RUCA, areas with the codes 1-3 are considered urban, while areas with codes 4-10 are considered rural. Using the RUCA data all of Chittenden County and some of Lamoille, Franklin, Washington and Addison Counties are coded 1-3. See Appendix A for a map of the RUCA codes in the U.S. and Vermont.

Literature Review

Gas Prices and Consumer Behavior

Gasoline is an inelastic product, which means the price has little effect on its demand (U.S. Energy Information Administration, 2014) The responsiveness of demand to changes in price is referred to as price elasticity. Almost all price elasticity are negative, which means an increase in price leads to lower demand (U.S. Energy Information Administration, 2014). Things purchased with disposable income- like air travel and vacations- are elastic, while necessary items like salt, tap water, and rail tickets are inelastic. Unfortunately, in places lacking public transit, consumers have no other choice but to pay the higher price for gasoline. When there is no available substitute for car travel, consumers are forced to pay the higher price for gasoline.

If price changes persist over time, there is a greater effect, as opposed to temporary shocks. Automobile travel in the U.S. is less elastic, and the price elasticity of motor gasoline is currently estimated to be in the range of -0.02 to -0.04 in the short-term, "meaning it takes a 25% to 50% decrease in the price of gasoline to raise automobile travel 1%" (U.S. Energy Information Administration, 2014).

Price elasticity is difficult to interpret, as demand can change for reasons other than fuel price, such as demographics, fuel efficiency, driver behavior, and income. There are many possible explanations for the decrease in elasticity, including the population migrations to urban areas (U.S. Energy Information Administration, 2014).

Many studies have researched the effects of gas prices on consumers' behavior (Anderson, Kellogg, & Sallee, 2013; Banerjee, 2003; Hughes, Knittel, & Sperling, 2008; Lahart, 2005). These studies have primarily been done at larger scales and use decades of data to determine how price affects social consumption (Anderson et al., 2013).

It is important to note that many studies have also focused on gasoline prices over shorter and more drastic periods of time, such as the fluctuations from 2004 to 2005(Lahart, 2005). Furthermore, many studies seek to analyze the sensitivity of gas prices in the 1970s and 1980s, around the time of high gas prices and increase in demand (Gately & Rappoport, 1988; Kerr, 1995; Levi & McNally, 2011). Additionally, researchers have used this information to back speculation about spending decisions regarding vehicles choices, retail decisions, and the impact on lower-income individuals (Lahart, 2005).

Using price asymmetry and demand reversibility, researchers have studied the effects of gas prices on consumer demand. Specifically, research on the price increases and increase in demand of the 1970s have been researched extensively, ultimately finding that oil has no exact substitute, thus when prices rise consumers have little choice but to pay more rather than buy less (Gately & Rappoport, 1988; Levi & McNally, 2011).

It is clear that gas prices and demand will continue to rise, and while there is current research on developing new technologies for alternative fuels, the U.S. should attempt to discourage consumption through gradually raising taxes on gasoline and diesel (Levi & McNally, 2011). It is clear that wild fluctuations in global oil prices will continue.

There has been a lot of research on price and income elasticity of gasoline demand specifically from 1975-1980 and 2001-2006 (Hughes et al., 2008). Other time periods of extensive interest in regards to the inelasticity of gasoline prices are the early 1990s and 2000s (S.-S. Chen & Chen, 2007; Narayan & Narayan, 2007; Yang, Hwang, & Huang, 2002).

It seems as though shocks, or severe changes in oil prices, have permanent effects, and asymmetric effects, on volatility; implying that the behavior of oil prices tends to change over short periods of time (Narayan & Narayan, 2007).

In 2002, Yang, among other economists, predicted that "the oil price is expected to increase unless the recession, if it exists, is severe"(Yang et al., 2002). Just as he predicted, there was a severe recession in 2007-2008. And the years after 2001 saw a steady increase that tripled the real prices by the middle of 2007 (Hamilton, 2009). Later that year oil prices steepened sharply, peaking at an all-time high on July 3, 2008, only to be followed by an even more spectacular price collapse (Hamilton, 2009).

While Yang successfully predicted the collapse of oil prices, the long-run relationship between oil prices and real exchange "demonstrate(s) greater predictability over longer horizons" (S.-S. Chen & Chen, 2007)

When studying gas prices and behavior in the four primary metropolitan areas of California, the Congressional Budget Office found a 20 percent increase in price would reduce weekday freeway traffic by an average of 0.4 percent, concluding that "it can be asserted with 95 percent confidence that higher gasoline prices are associated with increased [transit] ridership" (United States. Congressional Budget Office, 2008).

Overall, the price volatility and demand elasticity of oil in the United States and other major oil using nation-states has been studied extensively, but the focus tends to remain on the economics and large-scale issues, and not as many case studies in particular counties and states within the United States. While there has been a lot of research on the volatility of gas prices' effects on consumers in metropolitan areas and in the United States as a whole, there are many counties and states that are underrepresented. There is a lack of research on effects of gas prices on modal choices of citizens in more rural areas of the United States.

Effects of the Recession

Our economy is recovering from a long recession, but not all segments of the population have benefited (U.S. Department of Transportation, 2015). Unfortunately, since transportation is the second largest expense for most households after housing, this has major effects on the American population (Vermont Department of Public Service, 2011). On average, transportation accounts for nearly 20 percent of total household expenses and 12-15 percent of total household income (Vermont Department of Public Service, 2011). This burden is much greater for lower income households. Since 2009, Americans' incomes have declined for all but the wealthiest 10 percent (U.S. Department of Transportation, 2015). For consumers in the lowest 20 percent of income earners, transportation costs account for approximately 32 percent of their after-tax income (U.S. Department of Transportation, 2015).

Today, approximately half of all Americans live in the suburbs. Three quarters of all population growth since 1980 has occurred in the suburbs, and jobs have also moved to the suburbs (U.S. Department of Transportation, 2015). In 2010, the number of jobs in metropolitan areas located more than 10 miles from downtown was nearly double the number of jobs located fewer than three miles from downtown (U.S. Department of Transportation, 2015).

Gas Prices and Modal Choice

When it comes to public transit and gas prices, there have been attempts to provide free transit ridership or incentives in order to increase the use of public transit (Pack 1992, Zhou 2011) Many times these types of programs can only be reasonably implemented around the time of an increase in gas prices.

In a program called "Dump the Pump" in Los Angeles, California, Zhou (2011) found that drivers were more likely to try this sort of program "under conditions in which (1) gas prices were relatively high and (2) the travel time difference between driving and transit was relatively low" and that "after trying transit, participants remained on transit longer if they had no children, were unresponsive to lower gas prices, and had a bus schedule that matched their travel needs." In contrast, two decades earlier, Pack (1992) found that in the case of the Southeastern Pennsylvania Transportation Authority in Philadelphia, a commuter rail, drivers were unable to view the benefits of using public transit.

In "Does Gas Price Fuel Transit Ridership?" by Donnie Maley & Rachel Weinberger, data was separated into two divisions: regional rail (trains) and city transit (bus, subway, and trolley) of Philadelphia. Using ridership numbers, which are reported on a monthly basis, they have completed a scatter plot to determine the correlation between ridership and gas price, taking into account the fare increases and strikes events. I hope to use some of their approaches; however considering that the Philadelphia area is much different from Vermont, I will not be depending heavily on their paper and approach (Maley 2009).

In an analysis on gasoline prices on public bus ridership in Muncie, Indiana, an equation has been used, with gasoline prices from the Energy Information Administration and monthly ridership in fixed-route and demand-response systems from 2006 to 2011. Using an equation, they sought to determine the elasticity of ridership with respect to gasoline prices. Additionally, they studied whether or not the recession played a role in elasticity or demand of public transit. This study used multiple graphs to express the relationship between ridership and gasoline prices, including the normal gas prices from 2005-2011, a month-to-month percentage change in ridership and gasoline prices from 2006-2012, annual ridership on fixed route systems, and forecasts of fixed route service demand in Indiana from 2010-2013 (Hicks 2013).

According to the American Public Transportation Association, "regression analysis shows that 44% of the variation in ridership can be explained by changes in the price at the pump," which is considered a strong correlation, and is statistically significant (American

Public Transportation Association, 2012). Additionally, while only 54% of American households have access to public transit, "research since the fuel price spikes of 2005 through 2008 have consistently shown a larger elasticity between gas price increases and transit ridership than between gas price increases and roadway travel decreases" (American Public Transportation Association, 2012). When the price of regular gasoline per gallon went from $3.053 on December 31, 2007 to a peak of $4.114 on July 7, 2008 and then plummeted to $1.613 on December 29, 2008; the lowest price recorded since the 2008 peak," APTA reported that ridership increased 3.42% in the first quarter of 2008, and as motor gasoline prices increased in the second quarter, transit ridership rose 5.19% compared to the previous year (American Public Transportation Association, 2012). And when gasoline prices started to fall in the third quarter, transit ridership still increased 6.52%, due to the lag between price change and transit ridership change (American Public Transportation Association, 2012).

In fact, according to the American Public Transportation Association, when the average price of gasoline increased by 27% from 2010 to 2011, the Federal Highway Administration found that the total vehicle miles traveled in 2011 decreased 1.2% (American Public Transportation Association, 2012). Researchers at the University of California at Davis found that "for each 10 percent the price of gasoline increased, the amount of gasoline purchased decreased 0.34 percent to 0.77 percent" which is a decrease in the elasticity from earlier periods (American Public Transportation Association, 2012).

Gas Prices and Transit Use: Urban v. Rural

According to the American Public Transportation Association, only 54% of American households have access to public transit service; however, many of these households are in urban areas (American Public Transportation Association, 2014).

Thus, many people have studied the relationship between transit ridership and gasoline prices. Most of these studies, however, have been done in urban areas (C. Chen, Varley, & Chen, 2011; Lindsey, Schofer, Durango-Cohen, & Gray, 2010; Zhou & Schweitzer, 2011).

There tends to be much tension regarding rural drivers and gas prices, and "as a rural driver, [he] is part of the demographic that has felt the biggest financial squeeze from rising gas prices" (Rivoli 2007). In fact, "a study released earlier this month by the Consumer Federation of America shows that rural households drive 15 percent more miles and spend 20 percent more on gas than their counterparts in metropolitan areas" Generally, studies found that a rise in gasoline prices did amount in an increase in transit ridership short-term in urban areas (Rivoli 2007).

In particular, urban areas are studied because most urban areas have reliable transportation and accurate methods to measure vehicle trips and transit ridership. Additionally, urban areas are studied because those living in urban areas have many more public transit options than those living in rural areas. The Los Angeles Metropolitan Transit Authority's Blue line lost 5,000 riders after gas declined from close to $5 to close to $2 ("Have lower gas prices burst the urban transit bubble?," 2008).

One specific study looked at urban versus rural areas. Jeremy Mattson's research on "Effects of Rising Gas Prices on bus ridership for small urban and rural transit systems" found that "higher gasoline prices do lead to increased ridership, but the increases in fare revenues are not enough to cover higher fuel expenses for transit systems" (Mattson, 2008).

He came to this conclusion through using a "dynamic polynomial distributed lag model" which measures short-run and longer-run effects. This model is "applied to individual transit systems as well as aggregate data for cities grouped by size". Additionally, he used a panel data model, which uses data for eleven transit systems over a period of ten years. I would hope to use similar, if not the same, models, in order to analyze Vermont's small urban and rural transit.

First, Jeremy explored recent trends in transit ridership and gas prices, then a sampling of media reports on gas prices and transit ridership, then bus and rail ridership for select small urban transit systems in the North Dakota Upper Midwest and Mountain Region area, then annual growth in ridership. He then has a section on factors affecting ridership, one on short-run versus long-run effects, and previous research on the effect of gas prices on ridership. He went on to develop a polynomial distributed lag model, analysis of aggregate bus ridership, analysis of individual transit systems, panel data model, and changes in fare revenue and fuel expenses (Mattson, 2008).

Public Transit in Vermont

In 1973, Act 259 established a Transportation Advisory Board, whose duty it was "to assess the various organizations and financing alternatives for transportation within Vermont and to submit a ten-year plan to the 1975 general assembly" and in 1975 established the first Agency of Transportation, including a Bus, Rail, Waterways and Motor Carrier services department ("VTrans 2014 Fact Book and Annual Report," 2014). Today, Vermont has 392 vehicles that provide public transit in the state ("VTrans 2014 Fact Book and Annual Report," 2014).

Today, Vermont has a total of 10 public transit providers ("Transit Providers | Public Transit," 2015):

- Advance Transit, serving the Upper Valley including Hanover and Lebanon
- Addison County Transit Resources, serving the Middlebury Area
- Chittenden County Transportation Authority, serving Chittenden County
- Connecticut River Transit, serving Windham and Southern Windsor County
- Deerfield Valley Transit Association, serving Wardsboro, Wilmington, Whitingham, Halifax, Dover and Readsboro
- Green Mountain Community Network Inc, serving Bennington County
- Green Mountain Transit Agency, serving Central Vermont and the Franklin/Grand Isle region
- Marble Valley Regional Transit District, serving Rutland County and Manchester (Bennington County)
- Rural Community Transportation, serving the Northeast Kingdom

- Stagecoach Transportation Services, Inc, serving 29 towns in Northern Windsor and Orange Counties

Additionally, Vermont is served by six commercial bus services (Vermont Translines, Greyhound Lines, Inc., Megabus, Yankee Trails, Dartmouth Coach, Concord Coach); three rail services (Ethan Allen Express, Vermonter, Amtrak); one paratransit provider (Special Services Transportation Agency); and two ferry services (Lake Champlain Ferries, Ticonderoga Ferry).

Gas Prices in Vermont

In Vermont, approximately 85% of the fuel sold was gasoline, most of which is used for personal travel ranging from work trips to running errands (Sears & Glitman, 2011). Gasoline prices spiked in Vermont in the summer of 2008, just like national gas prices did. And in 2010, while gasoline prices fluctuated less dramatically, gasoline sales continued to drop (Sears 2011). For the most part, gasoline prices in Vermont hovered slightly below the national average prior to 2010, whereas in 2010 diesel prices remained consistently above the national average (Sears & Glitman 2011). While there is little relevant information regarding gasoline prices, there is extensive information comparing the national and state prices. However, this information is unrelated to the research in this thesis.

Vermont Transit Use

Three hundred and ninety two vehicles provide public transit in the state of Vermont, while there are still 414,914 personal cars and 144,886 trucks (2014 Fact Book and Annual Reports). The Transportation Budget has put aside $29.8 million for public transit, which is a 5% increase due to the 5% increase in ridership this past year, however it is only 4% of the total Transportation Budget (FY 2015 Transportation Budget). Vermont has slowly increased public funding for public transit, attempting to catch up to the trend of increasing ridership.

Specifically on Marble Valley Regional Transit buses, route cuts are believed to account for reduced ridership between 2006 and 2010, because most transit providers in Vermont ridership experienced an increase in ridership between 2006 and 2010 (Sears & Glitman, 2011). There are many factors affecting ridership on Vermont transit, however this thesis specifically looks at the effect of gas prices.

Vermont's Urban and Rural Populations

A large number of Vermonters live in what is considered a rural area. Of the total population of 625,741 Vermonters, 243,385 live in urban areas (38.9%), while 382,256 (61.1%) live in rural areas. According to the 2010 Census, the only urbanized area in Vermont is the Burlington, VT urbanized area; which includes Burlington city, Essex Junction village, Jericho village, Shelburne CDP (census designated place), South Burlington city, and Winooski city (U.S. Department of Commerce, 2012).

State County/County Equivalent	Population (2010 Census Data)	% of Population	Population Density per square mile of land (2010)
Addison County	36,821	5.88%	48
Bennington County	37,125	5.93%	55
Caledonia County	31,227	4.99%	48.1
Chittenden County	156,545	25.02%	291.7
Essex County	6,306	1.01%	9.5
Franklin County	47,746	7.63%	75.3
Grand Isle County	6,970	1.11%	85.2
Lamoille County	24,475	3.91%	53.3
Orange County	28,936	4.62%	42.1
Orleans County	27,231	4.35%	39.3
Rutland County	61,642	9.85%	66.3
Washington County	59,534	9.51%	86.6
Windham County	44,513	7.11%	56.7
Windsor County	56,670	9.06%	58.5
Total Population	**625,741**	**100.00%**	

Methodology

My research answers the research question: What is the relationship between gas prices and ridership in Vermont, and is there a difference between urban and rural counties?

To answer this research question, I completed the research in five objectives:

1. Determine gas prices in Vermont for a ten year period;
2. Determine public transportation ridership in urban and rural areas of Vermont for the same ten year period;
3. Assess the relationship between gas prices and ridership in each of the identified areas of Vermont over the ten year period;
4. Compare urban and rural areas to assess whether differences exist in the relationship between gas prices and ridership; and
5. Assess the implications of the data analysis.

I. Determine gas prices in Vermont for a ten-year period

I contacted Michael Kundrath, the Energy Policy & Program Analyst at the Vermont Department of Public Service, and he provided me with monthly statewide gas prices from January 2004-December 31, 2013.

II. Determine public transportation ridership in urban and rural areas of Vermont for the same ten-year period

I emailed and called each member of the Vermont Public Transportation Association, and of the ten public service providers, I was able to obtain five sets of data from five of Vermont's public transit providers. When possible, I did not include the Dial-a-Ride data or the volunteer van service data. Four sets of data are for the full period of time from January 2004-December 31, 2013, while the GMTA data is partial: FY08-December 31, 2013. Below is a list of the public transit providers, the contacts, and the information provided:

Public Transit Provider	**Contact**	**Information Provided**
Chittenden County Transportation Authority (CCTA)	Jon Moore, Planning Manager, CCTA	Monthly ridership for each route
Green Mountain Transit Agency (GMTA)	Jon Moore, Planning Manager, CCTA	Partial data-- FY08-Present for each route
Addison County Transit Resources (ACTR)	Stephanie Stearns, Program manager and Volunteer Coordinator, ACTR	Monthly data for each route: MSB, TTSB, SBSB, Sat Link, Rutland Connector, and the 116 commuter
Deerfield Valley Transit Association/Moover (DVTA)	Randy Schoonmaker, General Manager and Vice Chair of DVTA	Daily ridership data for each route
Rural Community	David Towle,	Monthly ridership data for

Transportation, Inc. (RCTI)	Operations/Safety & Fleet Manager of RCTI	each route: the Jay-Lyn shuttle and the Highlander shuttle
Connecticut River Transit, Inc. (CRTI)	Rebecca Gagnon, General Manager of CRTI	Monthly ridership data for each route from January 2011-Present: DHMC Rte 71, DHMC Rte 72, Hanover Rte 73, VA Rte 74, BF-Brattleboro Rte 53, BF-Springfield Rte 55, BF-Ludlow CMAQ, Okemo Seasonal, Springfield In-Town Rte 1, Bellows Falls In-Town Rte 2, Redline, Blueline, Bratt Weekend, Shopper Special Rte 1010

III. Assess the relationship between gas prices and ridership in each of the identified areas of Vermont over the ten-year period

Using secondary analysis of the data, I assessed the relationship between gas prices and ridership. I entered the monthly ridership and gas price data for each public transit provider into Excel and created a chart for each public transit provider showing ridership and gas prices over time. Additionally, I entered these data into IBM's Statistical Package for the Social Sciences (SPSS) software to determine the Pearson correlation coefficient for each public transit provider

Considering many people do not change their consumptive behaviors unless there is a long-term change, I also calculated the correlation between public transit ridership and a three-month lag of gas prices. This is based on prior knowledge that humans' consumption may be more affected after three months (or one quarter) rather than immediately. Using SPSS software, I lagged the gas price data by one, two, and three months, and calculated the Pearson correlation coefficient for each set of lagged data.

IV. Compare urban and rural areas to assess whether differences exist in the relationship between gas prices and ridership

To determine whether there is a different relationship between gas prices and ridership in urban and rural counties in Vermont, I divided the public transit authorities by urban and rural according to the most recent 2010 Census information and the Economic Research Service's RUCA definition.

Using the rural-urban commuting area (RUCA) codes for classifying rural and urban areas that was discussed earlier, I divided the public transit authorities of Vermont into urban and rural. The RUCA system uses population density, urbanization, and daily commuting data to differentiate rural and urban areas. A map of Vermont using these codes can be found in Appendix A. The RUCA system was used because it allows for stricter or looser delimitation of metropolitan, micropolitan, and small-town commuting areas. Additionally, it was used because its primary focus is on commuting, and the focus of this thesis is methods of transportation.

Once differentiating the data, I compared the urban data (CCTA) with the rural data (GMTA, CRTI, RCTI, DVTA, ACTR) to assess whether gas prices have more of an effect on ridership in urban as compared to rural areas of Vermont.

V. Assess the implications of the results

Using the Pearson correlation coefficients, census data, and bus route information, I was able to further assess the implications of the results.

To better understand the results, I had to do additional research on specific bus frequencies and bus routes, as well as any changes in fare pricing. There are many providers who run extra services in the winter rather than in the summer, and that accounts for how the ridership increases.

Results

The results show that there is a high positive correlation between gas prices and ridership in Vermont in the urban area served by Chittenden County Transit Authority, as well as the area served by Addison County Transit Resources. However, the rest of the rural areas (Deerfield Valley transit Association, Rural Community Transportation Inc., and Green Mountain Transit Authority) did not show a significant correlation between gas prices and ridership. Unfortunately Connecticut River Transit, Inc. only provided

Correlations

		CCTA	RCT	ACTR	DVTA	GMTA
Gas prices	Pearson Correlation	.643**	.043	.682**	-.053	.055
	Sig. (2-tailed)	.000	.645	.000	.569	.631
	N	120	120	120	120	78
Lag1GasPrices	Pearson Correlation	.650**	.047	.676**	-.046	.012
	Sig. (2-tailed)	.000	.609	.000	.621	.918
	N	119	119	119	119	78
Lag2GasPrices	Pearson Correlation	.651**	.116	.682**	.028	.036
	Sig. (2-tailed)	.000	.211	.000	.767	.756
	N	118	118	118	118	78
Lag3GasPrices	Pearson Correlation	.679**	.205*	.704**	.121	.107
	Sig. (2-tailed)	.000	.026	.000	.192	.350
	N	117	117	117	117	78

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Urban County: CCTA

Chittenden County Transit Authority (CCTA)

The Pearson correlation coefficient for CCTA is 0.643**, which is significant at the 0.01 level. The data from January 2004 to December 2013 shows that there is a high positive correlation between ridership and gas prices in the area served by Chittenden County Transit Authority. The coefficient when gas data is lagged behind ridership increases each month; 0.650** at one month, 0.651** at two months, and 0.679** at three months. Scatter plot graphs showing the relationship can be found in Appendix B.

Rural Counties: ACTR, DVTA, CRTI, RCTI, GMTA

Overall, of all the rural transit authorities, Addison County Transit Resources is the only one with a statistically significant correlation between gas prices and ridership.

Addison County Transit Resources (ACTR)

The Pearson correlation coefficient for ACTR is 0.682**. The data from January 2004 to December 2013 shows that there is a high positive correlation between ridership and gas prices in the area served by Addison County Transit Resources. The coefficient when gas data is lagged behind ridership by one month is 0.676**, two months is 0.682**, and three months is 0.704**, which is even more significant. Scatter plot graphs showing the relationship can be found in Appendix B.

Deerfield Valley Transit Association (DVTA; MOOver)

The Pearson correlation coefficient for DVTA is -0.053. The results show that there is a very low negative correlation between ridership and gas prices in the area served by Deerfield Valley Transit Association. The coefficient when gas data is lagged behind ridership by one month is -0.046, two months is 0.028, and three months is 0.121, which are all statistically insignificant. Scatter plot graphs showing the relationship can be found in Appendix B.

DVTA offers an Elderly and Disabled Transportation Program in which it provides demand-response service for seniors age 60 and over and ADA eligible persons with disabilities, as well as organizes volunteer drivers to be available to provide seniors and persons with disabilities with rides to medical appointments; however, this data was not included in the analysis (KFH Group, Inc., 2012).

Connecticut River Transit, Inc. (CRTI)

Connecticut River Transit, Inc, provided data from January 2011 to December 2013. Due to this lack of data, it is difficult to accurately determine the relationship between gas prices and ridership in the area served by Connecticut River Transit, Inc.

Rural Community Transportation, Inc. (RCTI)

The Pearson correlation coefficient is 0.043. The results show that there is a very low positive correlation between ridership and gas prices in the area served by Rural Community Transportation, Inc. The Pearson correlation coefficient when gas data is lagged behind ridership by one month is 0.047, two months is 0.116, and three months is 0.205. Only when lagged by three months, or one quarter, is the correlation coefficient significant at the 0.05 level. Scatter plot graphs showing the relationship can be found in Appendix B.

Green Mountain Transit Agency (GMTA)

The correlation coefficient is 0.055. The results show that there is a very low positive correlation between ridership and gas prices in the area served by Green Mountain Transit Agency. However, GMTA only provided data for the period FY08-December 2013. There is no significant correlation between ridership and gas prices in the area served by GMTA. The Pearson correlation coefficient when gas data is lagged behind ridership by one month is 0.012, two months is 0.036, and three months is 0.107. Each of these numbers is insignificant and thus gas prices and ridership are not correlated in GMTA's territory. Scatter plot graphs showing the relationship can be found in Appendix B. While GMTA provides

ADA paratransit services for eligible persons with disabilities who cannot use GMTA fixed-route buses in the Town of Stowe, this information was not included in the analysis (KFH Group, Inc., 2012).

Discussion

In the areas served by CCTA and ACTR, there is a statistically significant relationship between gas prices and transit ridership, whereas there is only a statistically significant relationship in RCTI when gas price data is lagged by three months. Ultimately, GMTA and DVTA did not reveal statistically significant relationships, and there was not enough data to determine the relationship in the area served by CRTI.

Urban Public Transit Ridership and Gas Prices in Vermont: CCTA

The correlation coefficient of 0.643 shows that there is a high positive correlation between ridership and gas prices in the area served by Chittenden County Transit Authority. This is statistically significant, and most likely due to the urban makeup of Chittenden County, as well as the overwhelming number of public transit options in compared to other counties of Vermont. Vermont has a total population of 625,741, and roughly 25% of Vermont's population live in Chittenden County (U.S. Department of Commerce, 2012). Founded in 1787, Chittenden County is "estimated to be home to 158,500 residents living in 19 municipalities that range in size from 30 to approximately 42,000 residents" (National Association of Development Organizations, 2013). Since 2005, there has been a decrease in residential development in rural areas (National Association of Development Organizations, 2013). CCTA operates the largest transit area in the state, and as of June 30, 2011, GMTA was officially dissolved into CCTA (Birkett, 2011).

The density of Chittenden County is what makes it the most urban area of Vermont. Chittenden County has an average population density of 291.7 per square mile of land, while the average in Vermont is 67.9 (U.S. Department of Commerce, 2012). Additionally, in Chittenden County the housing unit density per square mile of land is 122.5, while in Vermont it is 35.0 (U.S. Department of Commerce, 2012). This compact land use results in more accessibility to public transit than in other areas of the state; however, housing and transportation costs exceed the target of 45% of income spent on housing & transportation, suggesting residents in Chittenden County must choose between household and travel costs (National Association of Development Oragnizations, 2013).

Despite a 2-year decline, the average income in Chittenden County is higher than both Vermont and the U.S., suggesting that those with higher incomes may not change their behavior depending on gas prices, but instead that those with lower incomes may be more eager and able to change their travel patterns due to the availability of buses in Chittenden County (National Association of Development Oragnizations, 2013).

Public transit in Vermont, much like other states, is funded through fares, donations, local communities, agency-contracted services, and federal and State transit subsidy programs (KFH Group, Inc., 2012). While CCTA is a direct recipient of FTA Section 5307 transit operating/capital funds for small urbanized areas, much of the federal funds flow through VTrans to rural transit operators (KFH Group, Inc., 2012). Funding for Urban Transit areas goes to areas with a population of 50,000-200,000 (KFH Group, Inc., 2012).

All of Chittenden County, as can be seen in Appendix A, is considered an urban area in the Economic Research Service rural-urban commuter area (RUCA) definition of urban. Chittenden County is also considered urban according to the Census Bureau's list of places, Census Bureau's list of urban areas, and the Office of Management and Budget's metropolitan areas.

Rural Public Transit Ridership and Gas Prices in Vermont: ACTR, DVTA, CRTI, RCTI, GMTA

While the Addison County Transit Resources (ACTR) correlation coefficient revealed a high positive correlation between ridership and gas prices, the remaining rural counties; DVTA, RCTI, and GMTA, had statistically negligible correlations, with too little data from CRTI to determine a statistically significant relationship.

Addison County Transit Resources (ACTR)

The Pearson correlation coefficient for ACTR is 0.682**. This shows that there is a high positive correlation between ridership and gas prices in the area served by Addison County Transit Resources. ACTR primarily provides public transit services in Addison County, which has a population of 36,821 and a population density of 48.0, while Vermont's average population density is 67.9 (U.S. Department of Commerce, 2012).

ACTR also serves the towns of Hancock and Granville, with populations of 323 and 298, respectively (U.S. Department of Commerce, 2012). ACTR also runs commuter connections to Chittenden and Rutland Counties. ACTR is the only one of the rural public transit providers with a positive correlation, and this can be attributed to its commuter buses. In FY04, the Middlebury Shuttle Bus was the only bus route in FY04, which only runs in Middlebury, which has a population of 8,494, and is considered an urban cluster (U.S. Department of Commerce, 2012). Adding to the appeal, the Middlebury Shuttle Bus is free to use. Middlebury is also a highly popular among tourists and contains Middlebury College, with 2,450 students ("About Middlebury," n.d.). In FY05, the Tri-Town Shuttle Bus (TTSB) and Snow Bowl Shuttle Bus (SBSB) were added. The Tri-Town Shuttle Bus connects Middlebury, Vergennes, New Haven, and Bristol, and only runs Monday-Friday 5:30-10:00 am and 1:30-6:00pm. The Snow Bowl Shuttle Bus operates Thursdays, Friday and Saturdays in the spring, summer and fall, and every day from December 22-February 27 (in 2015). The Snow Bowl Shuttle serves the Middlebury Snow Bowl in the winter and the Long Trail in the summer. In FY06 the Sat Link and Rutland Connector were added. The Rutland Connector, which connects to Rutland via Rte 7, and is a partnership between ACTR and MVRTD, operates Monday-Friday with only six routes, and two routes on Saturday and Sunday. Since the Rutland Commuter is a partnership between ACTR and MVRTD, the two transit providers alternate buses. The Rutland Commuter had a very low ridership both FY06 and FY07, due to the lack of connections available to riders. The 116 Commuter, added in FY08, is a connection to Burlington Monday-Friday and is a partnership between ACTR and CCTA.

Because of the small number of bus routes, and the fact that the city of Middlebury is an urban cluster, it is expected that the relationship between ACTR ridership data and gas prices would be similar to that of CCTA and Chittenden County. Additionally, parts of Addison County are classified as urban according to the Economic Research Service's rural-urban commuting areas (see Appendix A).

Since a large majority of ACTR bus routes market to commuters, and a large percentage of trips on public transit are trips to work, the success of ACTR is expected.

Additionally, ACTR offers Dial-a-Ride services for older adults, persons with disabilities and low-income families and individuals; however, the ridership for the Dial-a-Ride service was not included in the calculations (KFH Group, Inc., 2012).

Deerfield Valley Transit Association (DVTA; Moover)

The Pearson correlation coefficient for DVTA is -0.053. This shows a statistically insignificant relationship between gas prices and transit ridership trends in the area served by DVTA. The area served by DVTA, as can be seen in Appendix A, is considered a rural area in the Economic Research Service rural-urban commuter area (RUCA) definition of urban. DVTA operates a public transit system, known as the "MOOver" for the communities and resorts in Deerfield Valley, which claims to be the best resort community transit system in Vermont, and costs nothing to ride. DVTA serves the towns of Dover, Wilmington, Whitingham, and Readsboro, with a connection to Brattleboro (KFH Group, Inc., 2012). DVTA only operates five routes in the summer, whereas it runs thirteen routes in the winter, accounting for the annual spike in ridership in December of each year.

However, just because this research did not find a relationship between ridership and gas prices in the area served by DVTA does not mean that a relationship does not exist. There are a substantial number of people that are not affected by gas prices, as they are simply taking the bus due to lack of parking, or because they are resort-specific, like much of DVTA's ridership. Further research could be done analyzing each route and determining if there is a relationship between commuter ridership and gas prices.

Connecticut River Transit, Inc. (CRTI)

CRTI only provided data from 2011-2014, which unfortunately did not provide enough of a picture to determine a relationship between gas prices and ridership in this region. CRTI operates transit service in SE Vermont as "The Current"—provides several fixed-route services, including commuter and local routes in Windham and Windsor Counties. CRTI allows deviations of up to three-quarters of a mile from the fixed-route are by request, also provides Dial-a-Ride, and is open to anyone in more than 30 towns within Windham and Windsor Counties (KFH Group, Inc., 2012).

CRTI also operates the Brattleboro BeeLine, serves the Town of Brattleboro in SE Windham County, provides complementary ADA paratransit service, curb-to-curb transportation for eligible persons with disabilities (KFH Group, Inc., 2012).

Rural Community Transportation, Inc. (RCTI)

The Pearson correlation coefficient is 0.043. While this is not statistically significant, when the gas price data was lagged by three months it was found that the correlation coefficient was 0.205*, which is significant at the 0.05 level, this means that three months after gas prices rise, ridership also increases. This must be due to the necessity of transit in the area served by RCTI. RCTI provides public transit in the Northeast Kingdom, including Caledonia, Essex, and Orleans Counties, as well as Lamoille County. According to the Vermont Public Transit Policy Plan "the Northeast Kingdom, Lamoille, and Orange Counties have areas with high relative transit needs, but limited fixed-route transit service; these areas also have lower population densities, which make fixed-route or deviated fixed-route transit service less feasible" (KFH Group, Inc., 2012). Unfortunately, due to the low population density of the area, RCTI bus routes are less accessible, thus making it harder for consumers to choose the bus over alternative forms of transportation. Despite this, RCTI operates two deviated fixed-route services, which will deviate up to a quarter-mile from the published routes. This addresses the issue that people will not walk more than one-half mile to a transit stop (Guerra, Cervero, & Tischler, 2011).

One of the main reasons people in this area may choose to ride the bus could be to get to work. APTA found that over 55% of trips are commuter trips to work, with nearly six million commuters using transit as their primary travel mode. It seems like even in Vermont, commuter transit ridership has risen significantly (American Public Transportation Association, 2012, "VTrans 2014 Fact Book and Annual Report," 2014). RCTI partners with GMTA in providing a commuter service between Montpelier and St. Johnsbury, along with the US 2 corridor, as well as five "Green Express" shuttles that serve outlying villages and towns, primarily transporting riders for shopping trips (KFH Group, Inc., 2012). The large number of buses serving commuters in this area is one of the reasons ridership and gas prices correlate after three months.

This is most likely due to the fact that RCTI has completely dissolved the cost of riding the bus. In July 2004, RCTI increased their fares from $1.50/ride to 2.00/ride, resulting in a severe drop in ridership. However this did not last long, and the next year, in July 2005, ridership was reduced to $0.25/ride. Ridership increased significantly after this change in fare price, and in May 2008 RCTI eliminated the cost of ridership. The statistically significant relationship between gas prices and public transit ridership in the area served by RCTI can be attributed to the ability of the transit authority to decrease other factors affecting ridership. RCTI eliminated the cost of ridership, increasing access to low-income communities, and making public transit more appealing, especially as gas prices increased. RCTI also increased physical accessibility of ridership by operating two deviated fixed-route services, which deviate up to a quarter-mile from the published routes for rider accessibility.

Green Mountain Transit Agency (GMTA)

The Pearson correlation coefficient is 0.055, meaning there is very low positive correlation between gas prices and ridership in the area served by GMTA. However, there was only data from 2008-2014, which is partially due to the change in ownership when

CCTA took over GMTA. GMTA has been operated by CCTA since June 30, 2011 (Birkett, 2011). The low positive correlation is understandable and expected due to the makeup of the GMTA fleet. GMTA provides various forms of public transit in Grand Isle, Franklin, and Washington Counties; the towns of Orange, Williamstown, and Washington in Orange County; and the towns of Stowe and Morrisville in Lamoille County (KFH Group, Inc., 2012). Most services are deviated fixed routes, with deviations of up to three-quarters of a mile available with 24-hour advanced notice, allowing for more flexibility among riders. This addresses the issue that people will not walk more than one-half mile to a transit stop, and allows for more consumers to have access to the bus (Guerra, Cervero, & Tischler, 2011).

GMTA's services are differentiated by region: Capital District, Mad River Valley, Stowe/Lamoille Valley, and Franklin/Grand Isle Region, and there is different branding depending on the service area, "Mad Bus" in Mad River Valley, incorporates Stowe, VT logo on marketing materials for transit services in the Stowe/Lamoille Valley area (KFH Group, Inc., 2012).

However, just because this research did not find a relationship between ridership and gas prices in the area served by GMTA does not mean that a relationship does not exist. There are a substantial number of people that are not affected by gas prices, as they are simply taking the tourist specific buses, such as the "Mad Bus" that runs to the mountain, or buses that supplement the lack of parking in a town. Further research could be done analyzing each route and determining if there is a relationship between commuter ridership and gas prices.

Conclusion & Recommendations

In the 2011 Comprehensive Energy Plan (CEP), Vermont vowed to achieve 90 percent of its energy from renewable sources by 2050, statewide (Vermont Department of Public Service, 2011). Transportation is a large piece of this puzzle. According to the CEP, 46% of Vermont's greenhouse gas emissions were from transportation, which is a drastically large percentage compared to other states. It is incredibly important for the state as a whole to reduce greenhouse gas emissions and ultimately reach the goals outlined by the CEP. Much like how Chittenden County has asked other more rural regions of the state to help out with the Lake Champlain clean up, it is important that Chittenden County and the more urbanized region of the state take more responsibility, as they are able to off-set the increase in gas prices with the availability of public transit in their area.

Understanding the relationship between mass transit ridership and gas prices is not only important to the economy, environment, and health of Vermonters, but also to state legislation and town or city planning. This research shows a significantly correlated relationship between gas prices and transit ridership in the urban county (Chittenden County) of Vermont, and an insignificant relationship in the rural counties of Vermont, except for Addison County. From this research, it is clear that eliminating outside costs and making public transit more accessible to the population will allow ridership to flourish. Consumers are not only motivated by the rising and falling of gas prices, but also the cost and availability of bus routes. This is clearly seen in the two counties in which the relationship between gas prices and ridership was statistically significant. CCTA, which operates in the dense population of Burlington and its surrounding area, has a statistically significant relationship between its ridership and gas prices—when gas prices rose, more consumers chose to ride the bus, and vice versa. This can be attributed to the density of the population in the area served by CCTA, as the accessibility of the bus route is not something CCTA has to compensate for. Additionally, the area served by ACTR is considered an urban cluster due to its higher than average (for Vermont) population density, which means there is more accessibility to public transit then in more rural areas, thus consumers have the option to choose public transit rather than personal automobiles.

While ACTR and CCTA are the only two with a clear and significant relationship between gas prices and ridership in Vermont, when the gas prices were lagged by one, two, and three months, the data showed that in the area served by RCTI, there is a somewhat statistically significant relationship between gas prices and ridership. This is most likely due to the fact that RCTI has eliminated the cost of ridership completely for its riders.

It is clear that decreasing or eliminating the cost of ridership allows for an increase in ridership when gas prices spike. When gas prices increase, those who have access to public transit, both financially and physically, will choose to use it.

However, we need to find funding for these public transit providers, especially in rural areas where the ridership numbers are so dependent upon the cost of ridership and accessibility of bus routes.

I suggest that Vermont introduce a higher gas price in the urban county served by CCTA and use that money to further fund rural public transit in other counties. Since those who live in Chittenden County have more access to public transit than those who live in more rural counties, they will be able to adapt to the increase in gas prices and utilize the bus services. This increase in funds could them be used to make service more accessible around the state. Using this increase in gas prices, rural public transit authorities, much like RCTI, could decrease or eliminate the cost of ridership, increase the frequency of buses, or add bus routes, thus allowing for those who live in rural and potentially low-income areas to have more access to public transit. In Chittenden County, as gas prices rise, demand for buses have as well, which proves that those in Chittenden County have more access to public transit than those in more rural counties. I suggest Vermont gradually raise the gas tax in Chittenden County and other urbanized clusters of Vermont to better prepare the state for future spikes in gas prices. While citizens of Chittenden County and other urban areas may be opposed to subsidizing public transit for the more rural regions of the state, it is important to remember the CEP goal of 90% renewable energy by 2050 is a statewide goal. Steps to achieve this goal must be taken differently by different regions throughout the state, considering the diverse land use patterns. There are more steps that must be taken, and a gradual increase in the gas tax is not sufficient on its own to solve the problem, but it can be part of the solution. In combination with other initiatives, a gas tax can help Vermont to move forward. Therefore, a gradual increase in gas taxes among the urbanized regions will be one more step toward less greenhouse gas emissions and more renewable energy. It is necessary to start taking bold steps to better improve the state and allow it to reach its energy-related and environmental goals. Vermonter's environment, health and future depend on it.

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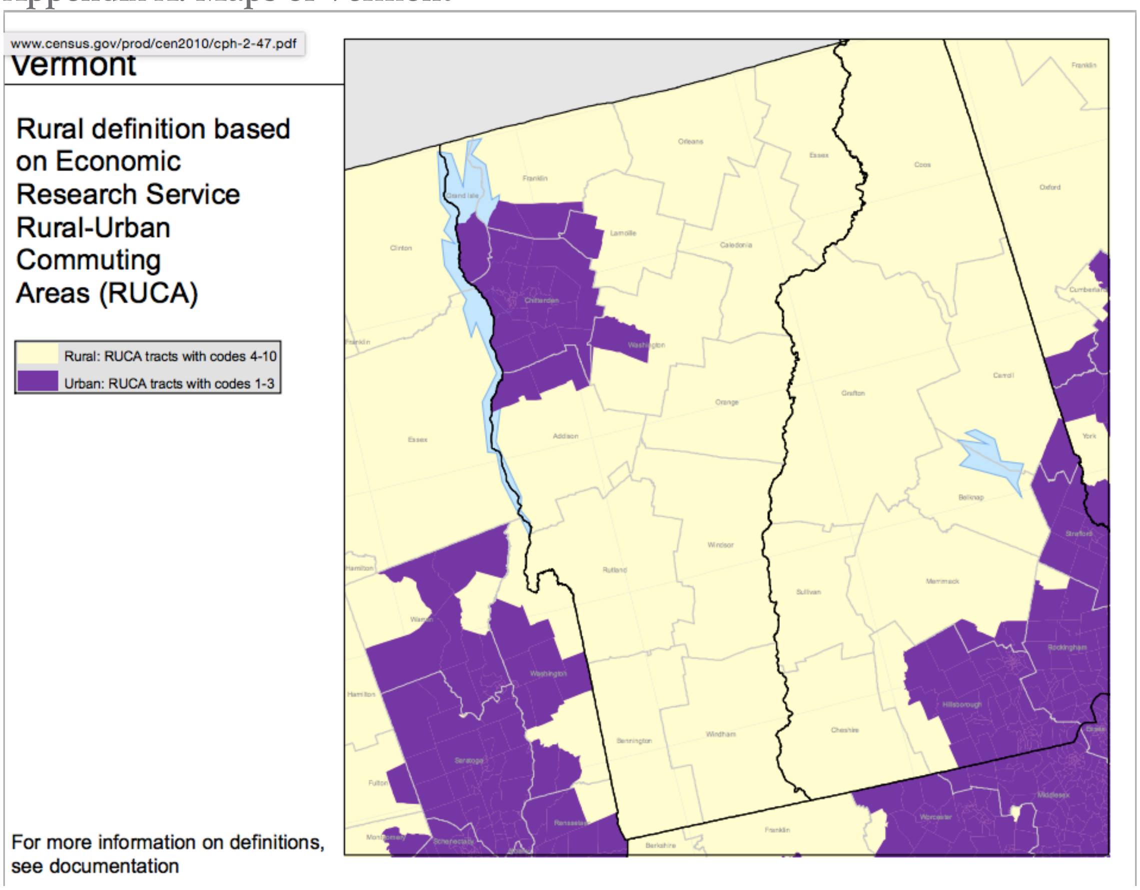
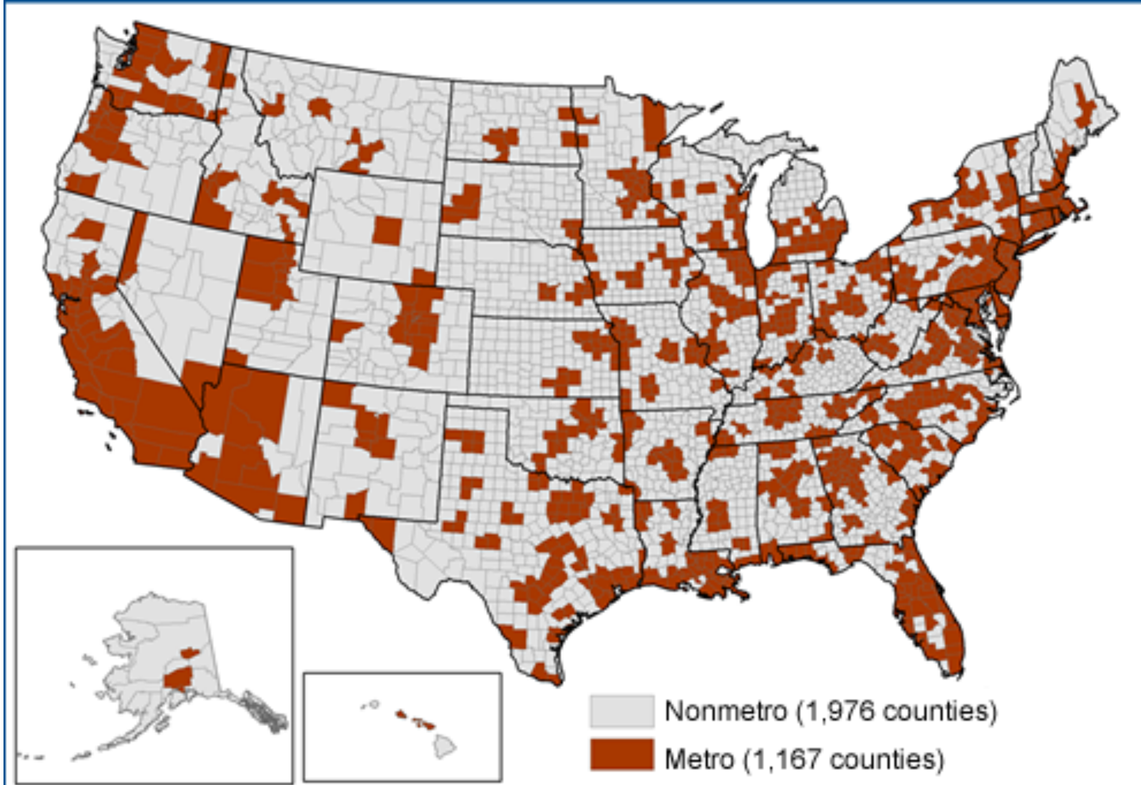
Appendices

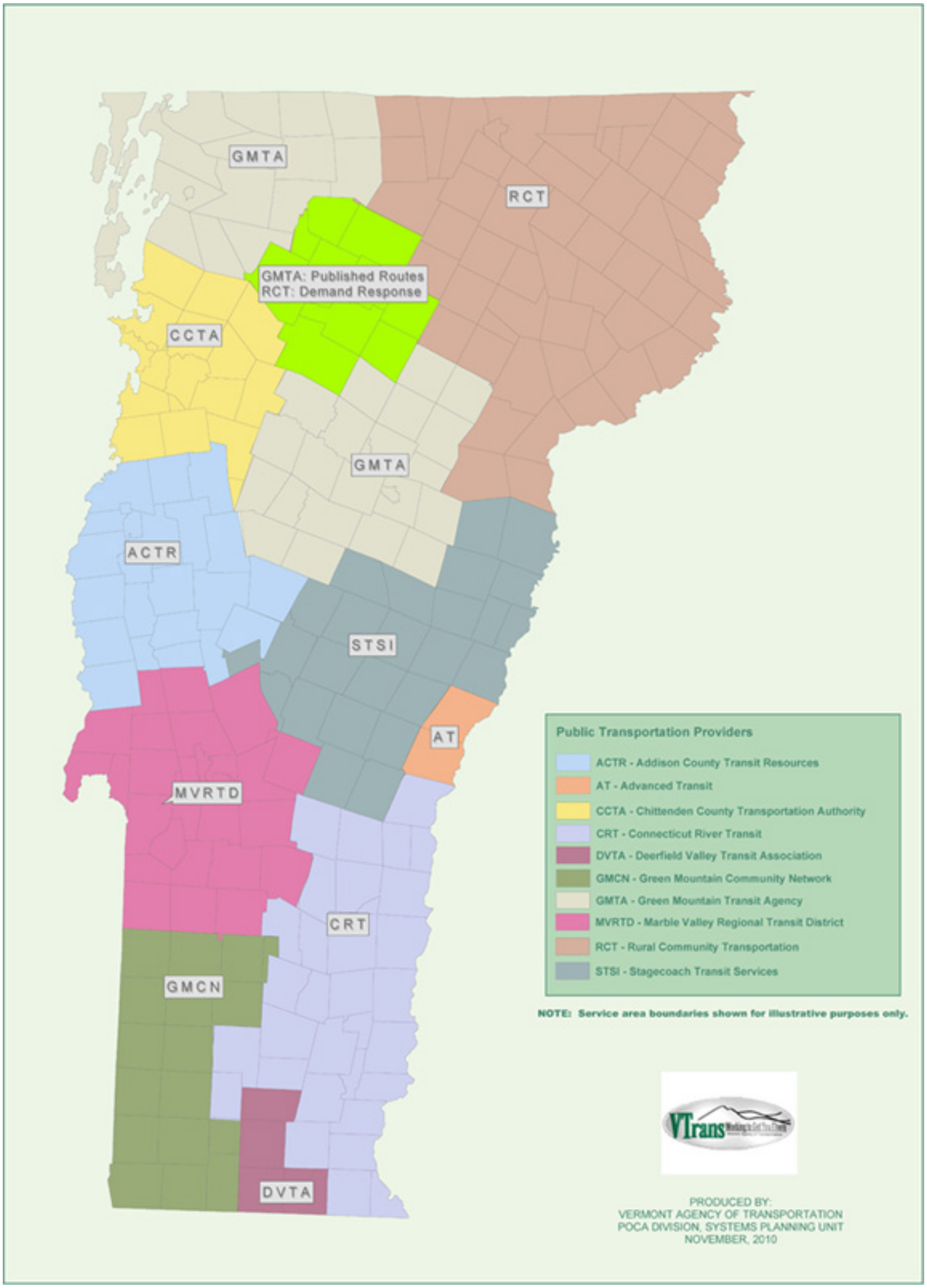
Appendix A: Maps of Vermont



Metro and nonmetro counties, 2013

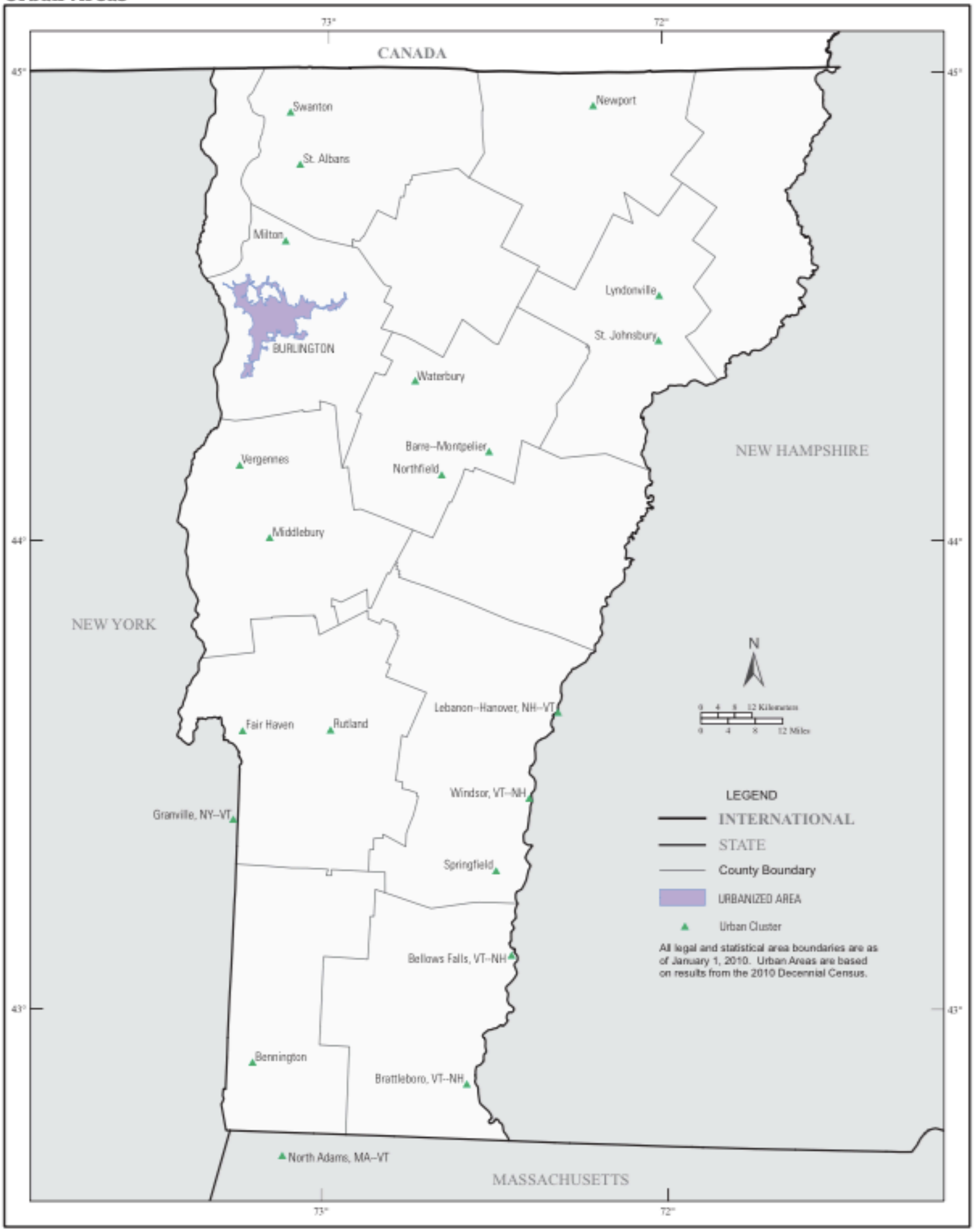


Source: USDA, Economic Research Service using data from the U.S. Census Bureau.

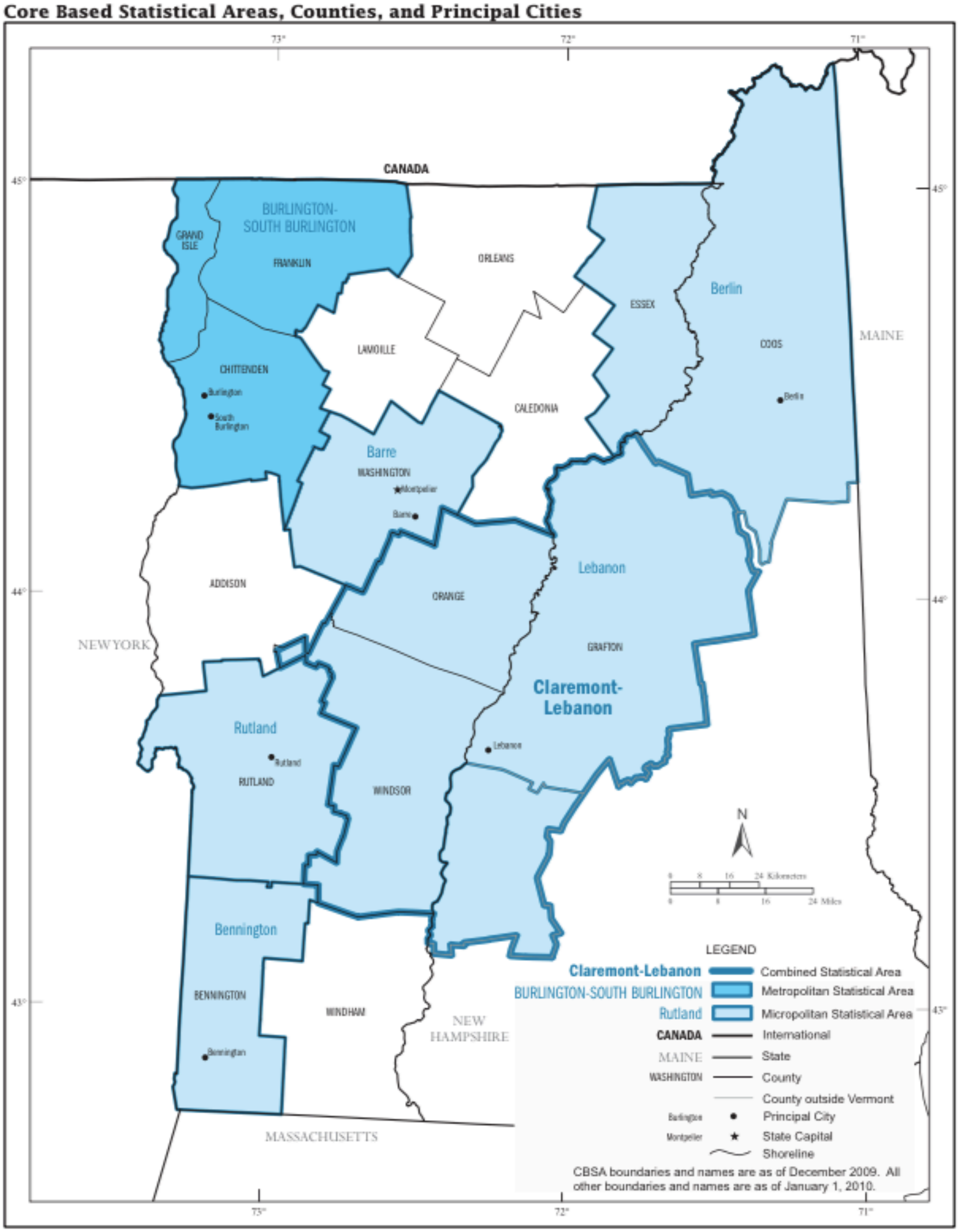


Map of Public Transit Providers in Vermont, Produced by VTrans

Urban Areas


CANADA
Swanton
Newport
St. Albans
Milton
Lyndonville
BURLINGTON
St. Johnsbury
Waterbury
Barre–Montpelier
NEW HAMPSHIRE
Vergennes
Northfield
Middlebury
NEW YORK
Lebanon–Hanover, NH–VT
Fair Haven
Rutland
Windsor, VT–NH
Granville, NY–VT
Springfield
Bellows Falls, VT–NH
Bennington
Brattleboro, VT–NH
North Adams, MA–VT
MASSACHUSETTS
N
0 4 8 12 Kilometers
0 4 8 12 Miles
LEGEND
INTERNATIONAL
STATE
County Boundary
URBANIZED AREA
Urban Cluster
All legal and statistical area boundaries are as of January 1, 2010. Urban Areas are based on results from the 2010 Decennial Census.
73°
72°
45°
44°
43°

Core Based Statistical Areas, Counties, and Principal Cities



Appendix B: Gas Price Data

FUEL	Jan '13	Feb '13	March '13	April '13	May '13	June '13	July '13	August '13	Sept '13	Oct '13	Nov '13	Dec '13
Gasolin	$3.58	$3.75	$3.858	$3.73	$3.56	$3.596	$3.56	$3.750	$3.748	$3.614	$3.467	$3.545
FUEL	Jan '12	Feb '12	March '12	April '12	May '12	June '12	July '12	August '12	Sept '12	Oct '12	Nov '12	Dec '12
Gasolin	$3.49	$3.61	$3.85	$3.92	$3.94	$3.75	$3.58	$3.67	$3.851	$3.82	$3.701	$3.67
FUEL	Jan '11	Feb '11	March '11	April '11	May '11	June '11	July '11	August '11	Sept '11	Oct '11	Nov '11	Dec '11
Gasolin	$3.17	$3.27	$3.44	$3.70	$3.97	$3.85	$3.75	$3.71	$3.71	$3.56	$3.53	$3.46
FUEL	Jan '10	Feb '10	March '10	April '10	May '10	June '10	July '10	August '10	Sept '10	Oct '10	Nov '10	Dec '10
Gasolin	$2.76	$2.80	$2.78	$2.86	$2.92	$2.79	$2.76	$2.75	$2.68	$2.75	$2.88	$3.14
FUEL	Jan '09	Feb '09	March '09	April '09	May '09	June '09	July '09	August '09	Sept '09	Oct '09	Nov '09	Dec '09
Gasolin	$1.73	$1.91	$1.94	$2.03	$2.14	$2.51	$2.61	$2.62	$2.64	$2.55	$2.74	$2.71
FUEL	Jan '08	Feb '08	March '08	April '08	May '08	June '08	July '08	August '08	Sept '08	Oct '08	Nov '08	Dec '08
Gasolin	$3.18	$3.10	$3.21	$3.31	$3.63	$3.97	$4.09	$3.92	$3.71	$3.43	$2.67	$1.97
FUEL	Jan '07	Feb '07	March '07	April '07	May '07	June '07	July '07	August '07	Sept '07	Oct '07	Nov '07	Dec '07
Gasolin	$2.42	$2.29	$2.55	$2.75	$2.98	$3.06	$2.99	$2.92	$2.82	$2.81	$3.02	$3.13
FUEL	Jan '06	Feb '06	March '06	April '06	May '06	June '06	July '06	August '06	Sept '06	Oct '06	Nov '06	Dec '06
Gasolin	$2.34	$2.40	$2.29	$2.60	$2.93	$2.82	$2.82	$2.99	$2.88	$2.48	$2.23	$2.34
FUEL	Jan '05	Feb '05	March '05	April '05	May '05	June '05	July '05	August '05	Sept '05	Oct '05	Nov '05	Dec '05
Gasolin	$1.90	$1.96	$1.98	$2.22	$2.21	$2.12	$2.25	$2.31	$3.29	$2.91	$2.43	$2.19
FUEL	Jan '04	Feb '04	March '04	April '04	May '04	June '04	July '04	August '04	Sept '04	Oct '04	Nov '04	Dec '04
Gasolin	$1.57	$1.68	$1.73	$1.78	$1.81	$2.08	$1.99	$1.96	$1.92	$1.98	$2.07	$1.98