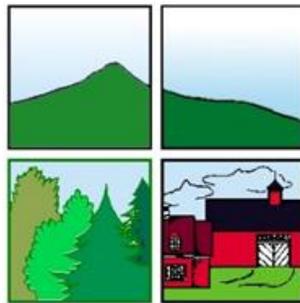


Transportation Planning for an Uncertain Energy Future:

Creating a Resilient Transportation System for
the Monadnock Region



Southwest Region Planning Commission

June 2015

The preparation of this report has been financed in part through a grant from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

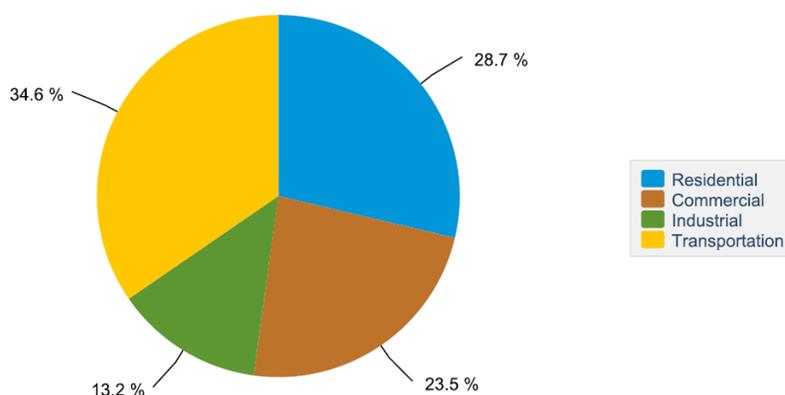
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Introduction

The transportation sector, more than any other sector in New Hampshire, depends heavily on petroleum-based fuels that come from out of state. According to data from the Energy Information Administration, approximately 95% of all energy consumed by the transportation sector in New Hampshire came from petroleum in 2012. In contrast, only 28% of the energy consumed by the residential sector, 18% of the energy consumed by the commercial sector, and 20% of the energy consumed by the industrial sector came from petroleum that same year.¹

New Hampshire Energy Consumption by End-Use Sector, 2012



 Source: Energy Information Administration, State Energy Data System

This energy comes at a high cost. Like the rest of the New England states, New Hampshire is located at the end of the energy pipeline. In 2012, transportation accounted for 34.6% of total energy consumption yet accounted for 50% of total energy expenditures in the state,² and while New Hampshire is ranked 42nd in the nation for energy consumption per capita, it is ranked 23rd for energy expenditures per capita.³ As the sources and supply chains for petroleum become increasingly global, the state can expect to contend with even higher costs and increased volatility in the global petroleum market.

The southwest region of New Hampshire faces unique challenges due to its rural, small-town character and the lack of viable alternatives to vehicular travel. However, municipalities and others in the region can start planning now to mitigate the impacts of rising and increasingly volatile petroleum prices on the transportation sector. Planning and policies that promote alternative fuels and advanced vehicle technology, reduce vehicle miles traveled (VMT) through Transportation Demand Management and land use planning, and increase access to alternative transportation options such as walking, biking, and public transit are all strategies that will help build resilience in the transportation system and prepare New Hampshire businesses and families for an uncertain energy future.

¹ U.S. Energy Information Administration (US EIA), 2015. <http://www.eia.gov/state/?sid=NH>

² NH OEP (2014). NH 10-Year State Energy Strategy, Chapter 6.

³ U.S. Energy Information Administration (US EIA), 2015. <http://www.eia.gov/state/?sid=NH>

Background

Consumer Travel Behavior

Three years ago, the Keene Sentinel conducted a poll asking its readers "With gas prices hovering at more than \$3.80 a gallon in Keene, are you changing how you drive?" The results were interesting with 14.6% of readers responding "yes, I bought a more efficient vehicle," 51.5% of readers responding "I combine trips and don't drive unless I have to," 2.5% responding "I use public transportation or carpool" and the remaining 31.3% responding "I haven't changed my habits." The survey shed a light on the importance of affordable energy for our population and the importance of energy resilience. Uncertain energy supply and its impact on prices can have a major and immediate impact on the local economy and quality of life.⁴

How consumers change their travel behavior in response to changes in price, called *travel price sensitivities*, is an important consideration around energy and transportation. Price sensitivities indicate the value that consumers place on a good and their ability to change consumption when prices change.⁵ They are measured in terms of elasticity, or the percentage change in consumption caused by a percentage change in price. A lower elasticity means that a price change will cause a relatively small changes in consumption, whereas a higher elasticity means that a price change will cause a relatively large change in consumption. Lower elasticities imply that consumers lack viable alternatives and would be significantly burdened by price increases. Various factors that affect transport elasticities are listed below.

Factors that Affect Transport Elasticities

- Higher value travel, such as business and commute travel, tend to be less price sensitive than lower value travel.
- Higher income people tend to be less sensitive to pricing and more sensitive to service quality than lower income people.
- Prices tend to affect consumption in proportion to their share of household budgets. Elasticities tend to increase as fuel prices rise.
- Consumers tend to be more responsive to price changes they consider durable, such as fuel tax increases, compared with oil market fluctuations perceived as temporary.
- Pricing impacts tend to increase over time. Short-run (first year) effects are typically a third of long-run (more than five year) effects.
- Travel tends to be more price sensitive if travelers have better options, including different routes, modes, and destinations.
- Travelers tend to be particularly sensitive to visible and frequent prices, such as road tolls, parking fees, and public transit fares.

⁴ Keene Sentinel (2012) http://www.sentinelsource.com/opinion/talkback/how-are-gas-prices-affecting-your-life/poll_0adc75ca-9943-11e1-b7b1-001a4bcf887a.html

⁵ Litman, Todd (2012). *Changing Vehicle Travel Price Sensitivities*. Victoria Transport Policy Institute http://www.vtpi.org/VMT_Elasticities.pdf

Effects of Increasing Fuel Prices

In the short-term (one year), fuel price increases tend to cause fuel consumption to decline. This occurs because people drive less and reduce driving speeds in response to higher fuel prices.⁶ Also, families with multiple vehicles will choose to drive more fuel-efficient vehicles. For example, when fuel prices increased by 20% between 2007 and 2008, some studies showed that there was a 4.0% decrease in fuel consumption and a 3.5% decrease in vehicle miles traveled.⁷ In the long term, fuel consumption decreases due to increasing fuel economy (people buying more fuel-efficient cars) and increasing land use accessibility, i.e. people moving to areas with shorter commutes and more alternative transportation options. For example, a 10% increase in gasoline price was found to reduce demand for housing in areas with long average commutes by 10% after a 4-year lag.⁸

According to recent studies, U.S. travel elasticities are beginning to increase as fuel and vehicle-travel costs rise relative to income.⁹ In many areas, improved transport and land use options are reducing the burden of fuel costs on consumers by creating better alternatives to driving and automobile-dependent communities. Many consumers, notably the Millennials, are choosing to live in communities that are more compact and multi-modal and shifting away from automobile dependency.¹⁰ These trends are expected to continue into the future and should be taken into account for transportation-related planning and policies.

Conventional Fuels and Vehicle Technology

Almost all vehicles on the road today are powered by petroleum-based fuels, i.e. gasoline and diesel. The distribution and refueling networks for these fuels are well established with more than 150,000 gasoline and diesel stations across the country.¹¹ In the Southwest Region of New Hampshire, there are approximately 53 refueling stations (see the map on page 6).¹² In contrast, there are only four alternative fueling stations that are publicly available.¹³

Estimated global oil reserves have greatly increased within the past decade due to improved extraction technologies.¹⁴ Since 2008, U.S. crude oil production increased by 70%, rising from an average of 5 million barrels per day in 2008 to 8.6 million barrels per day in 2014. The International Energy Agency (IEA) estimates that global technically recoverable reserves, or the amount of oil that could be produced with current technology irrespective of price, could support current rates of production for almost 200 years, and production could continue with oil set at 2012 prices using current technology for 55 years.¹⁵

Conventional vehicles which rely on internal combustion engines are considered to be technologically mature; however further gains in efficiency are expected due to more stringent federal corporate average fuel economy (CAFE) standards which require an average fuel economy of 35.5 mpg by 2016 and 54.5 mpg by 2025.² Increased efficiency could have a significant impact on overall energy consumption by the transportation sector in New Hampshire, which in 2012 accounted for about 35% of

⁶ Litman, Todd (2012). *Changing Vehicle Travel Price Sensitivities*. Victoria Transport Policy Institute http://www.vtpi.org/VMT_Elasticities.pdf

⁷ Dan Brand (2009). *Impacts of Higher Fuel Costs*. Federal Highway Administration. www.fhwa.dot.gov/policy/otps/innovation/issue1/impacts.htm.

⁸ Raven Molloy and Hui Shan (2011). *The Effect of Gasoline Prices on Household Location*, Federal Reserve Board. <http://www.federalreserve.gov/pubs/feds/2010/201036/201036pap.pdf>

⁹ Litman, Todd (2012). *Changing Vehicle Travel Price Sensitivities*. Victoria Transport Policy Institute http://www.vtpi.org/VMT_Elasticities.pdf

¹⁰ *Millennials in Motion: Changing Travel Habits of Young Americans and Implications for Public Policy*.

¹¹ NCHRP Project 20-83(04), Report 750 Series Volume 5. *Effects of Changing Transportation Energy Supplies and Alternative Fuel Sources on Transportation.* Chapter 3. AASHTO TRB, 2014.

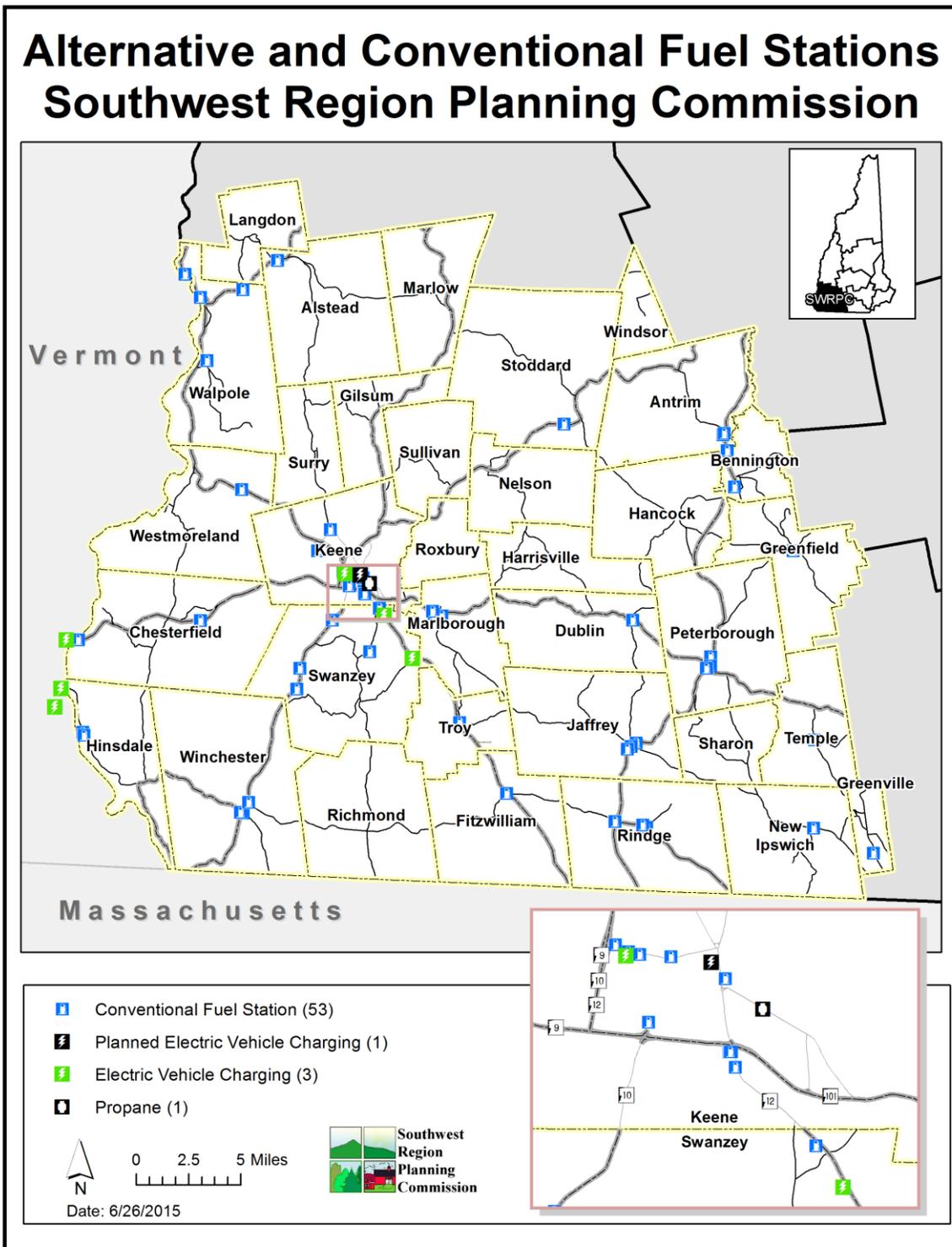
¹² Southwest Region Planning Commission GIS data.

¹³ Alternative Fuels Data Center Alternative Fueling Station Locator. <http://www.afdc.energy.gov/locator/stations/>

¹⁴ American Petroleum Institute (2015). *The State of American Energy*. Washington, D.C.

¹⁵ NCHRP Project 20-83(04), Report 750 Series Volume 5

total energy consumption within the state.¹⁶ According to the New Hampshire 10-Year State Energy Strategy, the single largest driver affecting energy consumption and emissions within the transportation sector is the fuel economy of light duty gasoline-powered vehicles, which comprise roughly 90% of New Hampshire's fleet.¹⁷



¹⁶ US EIA (2015). <http://www.eia.gov/state/?sid=NH>

¹⁷ NH OEP (2014). New Hampshire 10-Year State Energy Strategy.

While gains in average fleet fuel economy will be important for reducing emissions and improving air quality, the higher up-front cost of the more fuel-efficient vehicles may be a challenge for low or moderate income families to afford. Another consideration is the impact of a more fuel-efficient fleet on funding for the New Hampshire Department of Transportation (NH DOT). Currently, fuel prices in New Hampshire include 23.8 cents per gallon dedicated to the state's transportation system (including a 4.2 cent per gallon increase passed by the Governor and Legislature in 2014).¹⁸ The federal gas tax, which also funds NH DOT projects, faces the same challenge. That gas tax has remained at a steady 18.4 cents per gallon since 1993. As gasoline consumption decreases, so does this revenue stream for the NH DOT. Thus, it will be important for the state to consider alternative funding streams to maintain its budget.

Alternative Fuels and Vehicle Technology

Concerns relating to energy independence, climate change, and air quality have prompted federal and state policies to promote alternative fuel sources and vehicle technologies that would reduce dependence on oil. These include electric and plug-in hybrid electric vehicles, liquid natural gas and compressed natural gas (LNG/CNG), biofuels, and fuel cell technology. While many of these technologies are promising, the need for new fueling infrastructure as well as the need to improve performance and cost of component technologies are current barriers to widespread adoption.

Electric Vehicles

Electric vehicles (EVs) are vehicles that are partially or fully powered by batteries charged from an off-board source of electricity, e.g. grid power. They generally fall into two categories, all-electric vehicles, often called battery electric vehicles (BEVs), and plug-in electric vehicles (PHEVs), also called plug-in hybrids. Hybrid electric vehicles (HEVs) are technically not electric vehicles because they are powered entirely by gasoline, however they do use electricity generated from regenerative braking to help power the vehicle.¹⁹

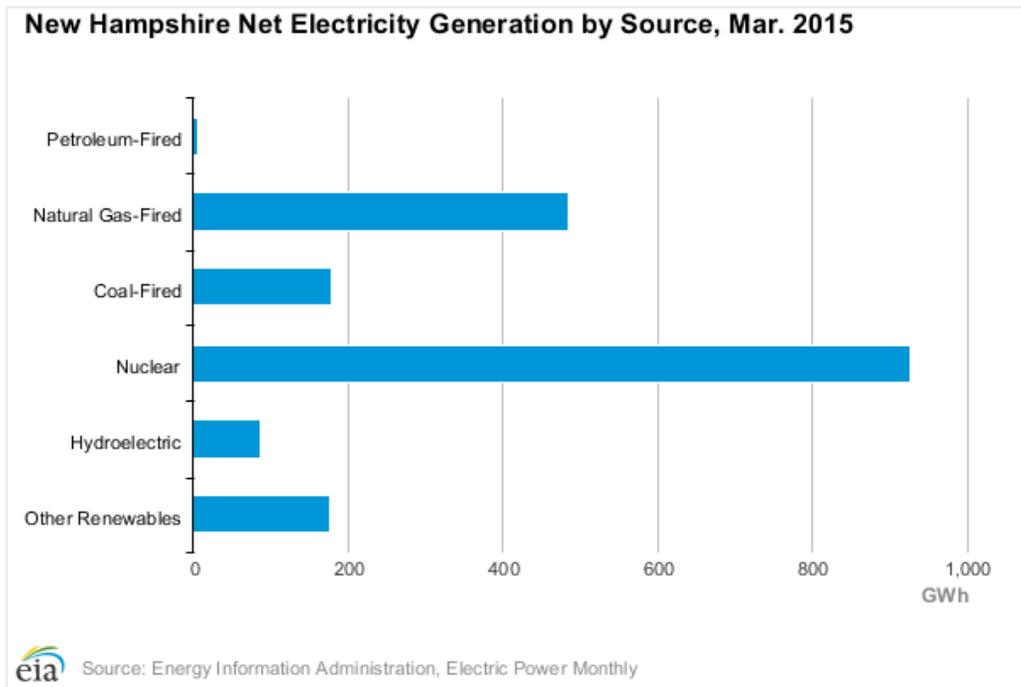
ELECTRIC VEHICLES: AN OVERVIEW

HYBRID ELECTRIC VEHICLES (HEVs)	PLUG-IN ELECTRIC VEHICLES (PHEVs)	BATTERY ELECTRIC VEHICLES (BEVs)
		
<p>HEVs are powered by an internal combustion engine and an electric motor, which uses energy stored in batteries. HEVs recapture some energy during braking and store it as electricity, called regenerative braking. These hybrids cannot be plugged in and charged, but they can be very fuel efficient.</p>	<p>PHEVs can operate on both electricity and gasoline and include both an electric motor and an internal combustion engine. Batteries can be charged by an outside electric power source, by the internal combustion engine, or through regenerative braking.</p>	<p>BEVs operate on electricity alone. The batteries must be charged by an outside electric power source. Charging times vary based on how depleted the battery is, how much energy it holds, the type of battery, and the type of Electric Vehicle Supply Equipment (EVSE) being used.</p>

¹⁸ NH DOT (2015). <http://www.nh.gov/dot/road-toll/>

¹⁹ Alternative Fuels Data Center (2014). Hybrid and Plug-in Electric Vehicles. <http://www.afdc.energy.gov/vehicles/electric.html>

Although BEVs produce zero tailpipe emissions and PHEVs produce zero tailpipe emissions when in all-electric mode, they do have associated emissions from the electricity produced to power the vehicles. These life cycle emissions vary depending on the energy sources used to power the electric grid. In New Hampshire, the electricity mix is dominated by nuclear power which provides about 50% of net electricity generation, followed by natural gas (26%), coal (9.5%), renewables (9.4%, not including hydroelectric), hydroelectric (4.7%), and petroleum (0.3%).²⁰ Thus, EVs and PHEVs have a significant life cycle emissions advantage over conventional vehicles, and this advantage is expected to increase as the electricity grid shifts toward cleaner sources of power generation. New Hampshire's renewable portfolio standard (RPS) requires 24.8% of electricity sold in the state to come from renewable energy resources by 2025, and it is the first state to require that a portion of the RPS comes from thermal energy.²¹



Electric vehicles have lower infrastructure costs relative to other alternative fuels because they can use the existing electrical distribution system. While most EV charging is expected to take place at the residences of EV owners, publicly available charging stations will need to be established at regular intervals around the state in order for widespread adoption of EVs to occur. Public EV charging stations increase the effective range of EVs and open up the market to consumers who may not have charging capabilities at home, such as renters in multi-unit dwellings.

According to the U.S. Department of Energy's Alternative fuels Data Center, New Hampshire currently has 40 publicly available EV charging stations which are mostly located in the Southeast portion of the state and along Interstate Route 93.²² In the Southwest region, there are three publicly available EV charging stations, one at Antioch University New England in Keene (two level 1 outlets and one level 2 outlet), one at Roundtree Ford in Swanzey (one level 2 outlet), and one at Nissan of Keene in Swanzey (one level 1 outlet). There is also a charging station at the Chesterfield Inn for guest use only (two level

²⁰ US EIA (2015). <http://www.eia.gov/state/?sid=NH>

²¹ American Council on Renewable Energy (ACORE). 2014. Renewable energy in the 50 states: Northeastern region. <http://www.acore.org/files/pdfs/states/NewHampshire.pdf>

²² See the Alternative Fueling Station Locator: <http://www.afdc.energy.gov/locator/stations/>

Electric Vehicle Supply Equipment (EVSE)

AC Level 1 Charging

12 – 16 amps

120V

Provides 2 to 5 miles of range per hour of charging, primarily used for residential and workplace charging.

AC Level 2 Charging

Up to 80 amps

208V or 240V

Provides 10 to 20 miles of range per hour of charging, primarily used for residential, workplace, and public charging. Requires installation of home charging or public charging equipment and a dedicated circuit, depending on the EVSE requirements.

DC Fast Charging (DC Level 2)

Up to 200 amps

208 to 600V

Provides 60 to 80 miles of range in less than 20 minutes, primarily used for public charging. Requires utility upgrades and dedicated circuits.

2 outlets). There are plans for two level 2 charging stations (one level 2 outlet each) at the Commercial Street parking lot in Keene, which if approved would be available for public use in 2015.

The N.H. Department of Environmental Services estimates that there are somewhere between 500 and 600 registered EVs in the State.²³ The NH Department of Safety projects these numbers will grow by about 10% per year as more models hit the market, prices drop, and ranges increase.²⁴ New Hampshire is seventh in the nation for per-capita hybrid vehicle ownership; as of January 2014, there were 13,347.8 HEVs registered per 1 million people, or 17,710 HEVs total in the state.²⁵ In the Southwest region there are approximately 56 registered EVs, however this number is likely a low estimate due to under-reporting.²⁶ Towns may want to consider collecting accurate data related to alternative vehicles, for example when cars are registered, in order to improve these estimates.

 **HYBRID ELECTRIC VEHICLES
(REGISTERED VEHICLES, 2014)**

STATE	RANK	HEVS PER 1M PEOPLE	TOTAL HEVS
CALIFORNIA	1	20,379.3	790,769
WASHINGTON	2	17,039.2	120,323
OREGON	3	16,998.7	67,489
VERMONT	4	16,016.0	10,035
VIRGINIA	5	13,811.8	115,001
HAWAII	6	13,675.4	19,413
NEW HAMPSHIRE	7	13,347.8	17,710
MASSACHUSETTS	8	13,146.3	88,677
MARYLAND	9	12,700.9	75,906
COLORADO	10	11,971.2	64,116

Source: IHS Automotive data with Clean Edge analysis. IHS Automotive data is a snapshot of every vehicle in operation as of January 1, 2015.

²³ From email correspondence with DES staff.

²⁴ See NH Senate Bill 401-FN-A. <http://www.gencourt.state.nh.us/legislation/2014/sb0401.html>

²⁵ Data from U.S. Clean Tech Leadership Index (June 2015). <http://cleanedge.com/indexes/u.s.-clean-tech-leadership-index>

²⁶ See Appendix A for town-level data of alternative vehicle registrations.

Natural Gas- and Propane-Powered Vehicles

Interest in natural gas (NG) and liquid petroleum gas (LPG, also referred to as propane or autogas) as a transportation fuel recently increased due to the advent of horizontal drilling and hydraulic fracturing, which has expanded domestic reserves of economically recoverable natural gas and triggered sharp reductions in prices.²⁷ During the ten year period from 2000-2010, proven natural gas reserves rose 71% and, until recently, natural gas prices were low enough relative to gasoline and diesel to be cost competitive despite high up-front costs for infrastructure. The sharp drop in petroleum prices in late 2014 has reduced this price difference, however gasoline prices are expected to rise again relative to natural gas.

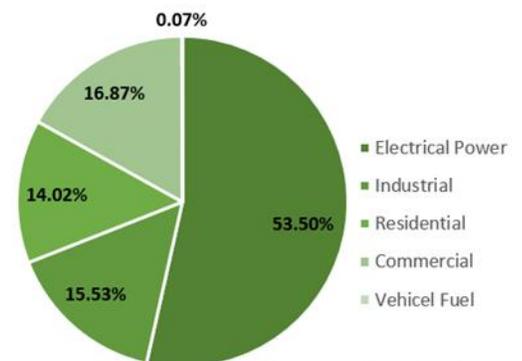
In spite of this, the natural gas fuels market comprises only a small fraction of the larger natural gas market. In 2014, only 0.13% of the natural gas consumed in the U.S. and only 0.07% of the natural gas consumed in New Hampshire was used for vehicle fuel.²⁸ This data shows that natural gas as a transportation fuel competes with other uses, mainly electrical power generation, industrial and commercial processes, and home heating.

Due to the gaseous nature of methane, natural gas must be either compressed (CNG) or chilled and liquefied (LNG) for use in Natural Gas Vehicles (NGVs). LNG has a greater energy density than CNG and can allow for a longer range, but LNG fueling stations are more costly to build and require additional safety measures. Light- and medium-duty vehicles generally rely on CNG, whereas heavy-duty vehicles can use either CNG or LNG.

While natural gas may offer modest reductions in greenhouse gas emissions over gasoline and diesel, the possibility of methane leakage during extraction, distribution, and/or fueling is a major concern. Methane, the main component of natural gas, is a potent greenhouse gas with a 34-times greater climate warming impact than carbon dioxide. Thus, methane leakage could undermine any reductions in emissions. Other environmental concerns include the impact of hydraulic fracturing, also called “fracking,” on water quality and increased seismic activity.

The largest barrier to the use of NGVs is not supply but rather a lack of infrastructure to support NGVs. Natural gas fueling stations must be connected to natural gas pipelines, but the natural gas distribution network does not extend to the southwest region of New Hampshire

N.H. Natural Gas Consumption by End Use Sector, 2014



Source: US Energy Information Administration, Office of Oil & Gas.

Northeast Region Natural Gas Pipeline Network



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

²⁷ NCHRP Project 20-83(04), Report 750 Series Volume 5 Chapter 3.

²⁸ US EIA (2015). <http://www.eia.gov/state/?sid=NH>

(see map of Northeast Region Natural Gas Pipeline Network). In the future, if the natural gas distribution system does extend to the Southwest region, CNG and/or LNG fueling stations will have to be built in order to support NGVs. According to a 2014 report published by the National Renewable Energy Laboratory for the U.S. Department of Energy, costs for installing a CNG fueling station can range up to \$1.8 million depending on the size and application.²⁹ Smaller fueling units average \$10,000, including installation. According to the Energy Information Administration, one LNG fueling site can range from \$1 to \$4 million.

Propane, also called autogas, is available in the Southwest region through Liberty Utilities for use by fleet vehicles. According to 2014 alternative vehicle registration data, there are currently 7 registered vehicles that run on propane in the Monadnock region.³⁰ New Hampshire has two CNG fueling stations located in Pembroke and Nashua. Nashua has the only CNG fleet operating in the state; the City built CNG fueling infrastructure in 2011 with about \$1.1 million in funding assistance from the Federal Government.

Biofuels (Ethanol, Biodiesel, and Renewable Hydrocarbon Biofuels)

Biofuels are liquid fuels made from agricultural or other renewable biological materials such as corn, soybeans, and algae. The two most common types of biofuels in use are ethanol and biodiesel. One drawback of biofuels is their lower energy density; one gallon of E85 (85% ethanol blend) has 73% to 83% of the energy of one gallon of gasoline, and one gallon of neat biodiesel (B100) has 93% of the energy of one gallon of diesel.³¹ This reduces the range of vehicles running on E85 and B20 fuels. Historically, one of the main advantages of using biofuels is the reduction in tailpipe emissions. For this reason, biofuels have been used to help manage air quality problems. However, engines manufactured in 2010 and later have to meet the same emissions standards, whether running on biodiesel, diesel, or any alternative fuel.

Ethanol is mostly used as a blending agent with gasoline to increase octane and cut down on emissions, and most vehicles can use gasoline-ethanol blends containing up to 10% ethanol by volume.³² Some vehicles, called Flexible Fuel Vehicles (FFVs), are designed to run on E85, an alternative fuel with much higher ethanol content than regular gasoline. Biodiesel can also be used as an additive (typically 20%) to reduce vehicle emissions or in its pure form as a renewable alternative fuel for diesel engines. B20 and lower-level blends generally do not require engine modifications, and using B20 or lower biodiesel blends is optimal during cold weather months when gelling and other material compatibility issues are a concern.³³

In the Southwest region there are no publicly available biodiesel stations (defined as B20 or higher blends), however the City of Keene has been using B20 biodiesel fuel in its municipal fleet since July of 2001 and has been selling B20 biodiesel fuel to Keene Housing, the Keene School District, and Home Healthcare Hospice & Community Services (HCS) for use in their fleets.³⁴ Clarke Distributors, located in Keene, uses B20 biodiesel in 14 on-road heavy duty trucks.

²⁹ See http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf

³⁰ See Appendix A for town-level data of alternative vehicle registrations.

³¹ See the Alternative Fuels Data Center Fuels Comparison chart: http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf

³² See the EPA "Biofuels Basics" webpage: <http://www.epa.gov/ncea/biofuels/basicinfo.htm>

³³ See the Office of Energy Efficiency and Renewable Energy (EERE) "Biodiesel Basics" webpage: <http://energy.gov/eere/energybasics/articles/biodiesel-fuel-basics>

³⁴ See the Cities for Climate Protection Committee minutes from April 2, 2014:

[http://www.ci.keene.nh.us/sites/default/files/2014_04_02_CCP_minutes_ADOPTED\[1\].pdf](http://www.ci.keene.nh.us/sites/default/files/2014_04_02_CCP_minutes_ADOPTED[1].pdf)

Renewable hydrocarbon biofuels (also called drop-in biofuels, biohydrocarbons, "green" hydrocarbons, and sustainable or advanced hydrocarbon biofuels) are emerging fuels produced from biomass sources through a variety of processes. These products include renewable gasoline, renewable diesel, and renewable jet fuel. They are similar to their petroleum-based counterparts in chemical makeup and are considered to be fully infrastructure-compatible fuels. Unlike pure biodiesel or E85, they can be used in vehicles without engine modifications and can be transported using the same pipeline distribution network used for petroleum-based fuels.³⁵ Renewable hydrocarbon biofuels are just emerging and will require further development before they are commercially viable.



The City of Keene ladder truck, shown here being serviced, is just one of many City vehicles that runs on B20 Biodiesel.

Fuel Cell Technology

Fuel Cell Vehicles (FCVs), also known as Fuel Cell Electric Vehicles (FCEVs), use hydrogen which is converted to electricity in a fuel cell to power an electric motor. The only by-products of this process are water and heat, making FCVs zero-emissions vehicles.³⁶ Life cycle emissions, however, depend on how the hydrogen is produced. Hydrogen is an energy carrier, not an energy source, and it must be produced from a hydrogen-containing compounds such as water (H₂O), natural gas (i.e. methane, CH₃), and other hydrocarbons including fossil fuels and biomass. About 95% of the hydrogen used today in the U.S. is produced from natural gas using a process called steam methane reforming. Renewable electrolysis is an alternative method that uses an electric current to split water into hydrogen and oxygen, however this is an energy-intensive process and its environmental benefits depend on the source of the electricity used (i.e. fossil fuels v. renewable sources).³⁷

While FCVs are starting to become commercially available in some areas of the country, fuel cell technology is still emerging and, as with EVs and NGVs, there is a lack of fueling infrastructure to support widespread adoption. There are currently only 12 hydrogen stations in the U.S.; the closest station to New Hampshire is located in southern Connecticut.³⁸ In order to promote the widespread commercialization of FCVs, in 2013 the U.S. Department of Energy (DOE) and other stakeholders launched H₂USA, a public private partnership focused on improving the infrastructure to support FCVs. On April 21, 2015 H₂USA announced two tools to support hydrogen fueling infrastructure deployment. The tools, the Hydrogen Refueling Stations Analysis Model (HRSAM) and the Hydrogen Financial Analysis Tool (H2FAST), were developed by Argonne National Laboratory and the National Renewable Energy Laboratory (NREL) respectively to address the key technical and financial barriers to hydrogen fueling infrastructure deployment.³⁹ They can be accessed online at:

http://www.hydrogen.energy.gov/h2a_delivery.html.

³⁵ For more information, see the Alternative Fuels Data Center "Renewable Hydrocarbon Biofuels" webpage:

http://www.afdc.energy.gov/fuels/emerging_hydrocarbon.html

³⁶ NCHRP Project 20-83(04), Report 750 Series Volume 5 Chapter 3.

³⁷ See the EERE "Hydrogen Production" Fact Sheet: http://energy.gov/sites/prod/files/2014/09/f18/fcto_hydrogen_production_fs_0.pdf

³⁸ See the Alternative Fueling Station Locator: <http://www.afdc.energy.gov/locator/stations/>

³⁹ H₂USA Press Release from April 21, 2015: http://h2usa.org/sites/default/files/H2USA-Fueling-Station-Reports-April-2015_0.pdf

While the supporting infrastructure for FCVs does not yet exist in New Hampshire, once it does, they could take off quickly due to their high ranges and low fueling times. FCVs have comparable driving ranges to gasoline- and diesel-powered motor vehicles and they are becoming cost-competitive with conventional vehicles. For example the Toyota Mirai fuel cell electric vehicle, which is expected to hit the market in California in late 2015, has a Manufacturer's Suggested Retail Price of \$57,500. The range is around 310 miles, refueling will take about five minutes, and fuel is included for the first three years of ownership.⁴⁰ According to Katsuhiko Hirose, the project general manager for Toyota Motor Corporation's fuel cell development division, Toyota is trying to push the price down even further so it is more affordable for the general public.⁴¹

Promoting Alternative Fuels and Advanced Vehicle Technology

While petroleum and conventional vehicle technologies currently dominate the transportation sector, concerns about energy security, climate change, air quality, and rising petroleum prices have led to an increased interest and investment in alternative fuels and advanced vehicle technologies. Promoting the adoption of these fuels and technologies and supporting infrastructure through planning efforts will help provide residents in the Southwest region with more choices and ensure that tourists who own alternative vehicles are not deterred from visiting the area. It will also reduce greenhouse gas emissions, lessen the region's dependence on petroleum, improve air quality, and may provide economic development benefits in the form of business and job growth in the alternative fuel and advanced vehicle technology industries.

In the near future, electric vehicles are the most likely alternative vehicle to become widely adopted in the Southwest region. The N.H. Office of Energy and Planning identifies electric vehicles in its 10-Year State Energy Plan as "the best near-term option for increasing the State's energy independence as power generation shifts to locally produced clean energy."⁴² EVs can use the existing electrical distribution system and are commercially available. Efforts are already underway at the state level to promote EVs in New Hampshire; the Department of Environmental Services is currently running a rebate program to support the development of a statewide network of publicly available EV charging stations.⁴³ Eligible applicants can receive a \$3,000 rebate for a single connector AC Level 2 charging station and a \$5,000 rebate for dual connector AC Level 2 charging station.



A Tesla Model S charging at the Supercharger network station in Delaware. Tesla recently installed 12 DC fast charging stations on Route 93 in Hookset, NH as a result of the DES rebate program.

Other action that could be taken at the State level includes adopting the California Low and Zero Emission Vehicle Standards (CA LEV and ZEV). This strategy is proposed in the OEP 10-Year State Energy Strategy as a way to provide an incentive for manufacturers to actively market EVs and other higher

⁴⁰ <http://www.caranddriver.com/toyota/mirai>

⁴¹ Guilford, D. Automotive News, March 9, 2015.

<http://www.autonews.com/article/20150309/RETAIL01/303099965/toyota-aims-to-cut-price-of-fuel-cell-vehicle>

⁴² NH OEP (2014). New Hampshire 10-Year State Energy Strategy.

⁴³ For more information, see the NH DES "Drive Electric NH" Home Page.

<http://des.nh.gov/organization/divisions/air/drive-electric/index.htm>

efficiency vehicles in the state.⁴⁴ NH could also consider offering incentives for purchasing EVs in addition to or in place of adopting the California Low and Zero Emission Vehicle Standards, as the Association of Global Automakers has suggested.⁴⁵

There are many ways that towns and cities can promote electric vehicles at the municipal level. One way is to encourage the development of EV charging infrastructure. The Transportation and Climate Initiative, a collaboration of transportation, energy, and environment agencies from the 11 Northeast and Mid-Atlantic states and Washington D.C. that focuses on reducing emissions from the transportation sector, offers several resources to assist towns and cities in becoming EV-Ready (see table below). In addition to these resources, the Alternative Fuels Data Center has an [online score card](#) that communities can use to assess their readiness for the arrival of plug-in electric vehicles (PEVs) and electric vehicle supply equipment (EVSE).⁴⁶

Another strategy to promote the adoption of EVs in the region is to organize test drive events. During the National Drive Electric Week (NDEW) in 2014, Over 5,500 EV test drives or rides were offered in 98 cities across the country.⁴⁷ Plug in America, a California-based non-profit that works to promote the shift to BEVs and PHEVs, found that EV auto sales increased by 24% in the month following NDEW, while all auto sales increased by only 2%.⁴⁸ In the San Francisco region, the Bay Area “Experience Electric” Campaign conducted over 4,200 EV test drives in 2014 and found that participants were very likely to purchase an electric vehicle as their next car. In the following months, they found that 6% of participants had purchased an electric vehicle and an additional 6% had leased one.⁴⁹

Resources for Becoming “EV-Ready”

[Creating EV-Ready Towns and Cities: A Guide to Planning and Policy Tools](#). This resource document takes an in-depth look at five policy tools that municipalities can use to facilitate and encourage the development of a consistent and accessible network of EV charging infrastructure (i.e. EVSE). It can be accessed at <http://www.transportationandclimate.org/creating-ev-ready-towns-and-cities-guide-planning-and-policy-tools>

[Siting and Design Guidelines for Electric Vehicle Supply Equipment](#). These guidelines identify key siting and design issues that are relevant to local governments, developers, homeowners, businesses, utility providers, and others. It can be accessed at <http://www.transportationandclimate.org/siting-and-design-guidelines-electric-vehicle-supply-equipment>

[EV Ready Codes for the Built Environment](#). This document provides an overview of building and electrical codes and their relation to EVs, highlights best practices from around the country, and makes recommendations for jurisdictions in the Northeast and Mid-Atlantic. It can be accessed at <http://www.transportationandclimate.org/ev-ready-codes-built-environment>

⁴⁴ NH OEP (2014). New Hampshire 10-Year State Energy Strategy.

⁴⁵ See <https://www.nh.gov/oep/energy/programs/documents/sb191pc-2014-7-25-global-automakers.pdf>

⁴⁶ <https://www.afdc.energy.gov/pev-readiness>

⁴⁷ See <https://driveelectricweek.org/history.php>

⁴⁸ Plug in America (2015). The Promotion of Electric Vehicles in the United States: A Landscape Assessment. <http://images.pluginamerica.org/Landscape/The-Promotion-of-Electric-Vehicles-in-the-US-final.pdf>

⁴⁹ Plug in America (2015). The Promotion of Electric Vehicles in the United States: A Landscape Assessment. <http://images.pluginamerica.org/Landscape/The-Promotion-of-Electric-Vehicles-in-the-US-final.pdf>

This data shows that providing opportunities for residents to try out and experience EVs will increase their likelihood of buying or leasing an EV. Municipalities in the Monadnock Region could work together to organize an “Experience Electric” campaign, or alternatively, a town or city could partner with a non-profit or advocacy group to organize such an event. Municipalities or volunteers within the community could also organize an event to coincide with the National Drive Electric Week, which takes place on an annual basis in September. The National Drive Electric website offers resources to help volunteers and City Captains plan such events.⁵⁰

Transportation Demand Management & Land Use Planning

Transportation demand management (TDM) is a general term for strategies that result in more efficient use of transportation resources.⁵¹ TDM aims to reduce overall travel demand (specifically of single occupancy vehicles, or SOVs) or to redistribute travel demand across different modes, times, and travel routes. There are many different TDM strategies, and a comprehensive set of such strategies can significantly impact travel behavior, system efficiency, and SOV rates.⁵²

TDM strategies generally fall into four main categories: improve transport options, incentives to use alternative modes and reduce driving, parking and land use management, and policy and Institutional reforms. Examples of strategies that fall under each of these categories are listed to the right.⁵³

The Monadnock Region has its own set of challenges and opportunities when it comes to transportation demand management. The region has a lower population density than the state average (103 people/mi² vs. 146 people/mi²) and an average town size of 2,321 people (excluding Keene). Low population densities and rural character presents a barrier to some strategies such as establishing a successful mass transit system. However, many of the small towns have village centers with strong Main Streets, historic buildings, and other cultural assets which lend themselves well to other strategies, such as creating mixed-use walkable centers. By integrating travel demand management into local land use planning, communities can not only improve transportation services but can also meet environmental, cultural, recreational, housing, and economic development goals as well as help improve overall quality of life.

SELECTED TDM STRATEGIES BY CATEGORY
<p>IMPROVE TRANSPORT OPTIONS</p> <p>Bicycling & Pedestrian Improvements, Car sharing, Carpools/Ridesharing, Flextime, Improved Taxi Service, Shuttle Services, Tele-Commuting, Bike Sharing/Public Bike System, Transit Improvements.</p>
<p>INCENTIVES TO USE ALTERNATIVE MODES AND REDUCE DRIVING</p> <p>Bicycle & Pedestrian Encouragement, Commuter Financial Incentives, Congestion Pricing, Distance-based Pricing, Fuel Taxes, Road and Parking Pricing, Traffic Calming.</p>
<p>PARKING & LAND USE MANAGEMENT</p> <p>Bicycle Parking, On-street Parking, Parking Regulations, Pedestrian Improvements, Park & Ride, Connectivity, Mixed Land Use Zones, Infill Development, Access Management.</p>
<p>POLICY AND INSTITUTIONAL REFORMS</p> <p>Asset Management, Complete Streets, Context Sensitive Solutions, Robust Decision Making, Contingency-Based Planning, Regional Transportation Planning, Transportation Systems Management.</p>

⁵⁰ See <https://driveelectricweek.org/resources.php>

⁵¹ Victoria Transport Policy Institute (2014). Online TDM Encyclopedia. <http://www.vtpi.org/tdm/>

⁵² Seattle Urban Mobility Plan Chapter 7: Best Practices in Transportation Demand Management. <http://www.seattle.gov/transportation/briefingbook.htm>

⁵³ Victoria Transport Policy Institute (2014). Online TDM Encyclopedia. <http://www.vtpi.org/tdm/>

Land Use Impacts on Travel

FACTOR	DEFINITION	TRAVEL IMPACTS
DENSITY	People or jobs per unit of land area (acre or hectare).	Increased density tends to reduce per capita vehicle travel. Each 10% increase in urban densities typically reduces per capita VMT by 2-3%.
MIX	Degree that related land uses (housing, commercial, institutional) are mixed	Increased land use mix tends to reduce per capita vehicle travel, and increases use of alternative modes, particularly walking for errands. Neighborhoods with good land use mix typically have 5-15% lower vehicle-miles.
REGIONAL ACCESSIBILITY	Location of development relative to regional urban center.	Improved accessibility reduces per capita vehicle mileage. Residents of more central neighborhoods typically drive 10-30% fewer vehicle-miles than residents of more dispersed, urban fringe locations.
CENTEREDNESS	Portion of commercial, employment, and other activities in major activity centers.	Increased centeredness increases use of alternative commute modes. Typically 20-50% of commuters to major commercial centers drive alone, compared with 80-90% of commuters to dispersed locations.
CONNECTIVITY	Degree that walkways and roads are connected and allow direct travel between destinations.	Improved roadway connectivity can reduce vehicle mileage, and improved walkway connectivity tends to increase walking and cycling.
ROADWAY DESIGN AND MANAGEMENT	Scale, design and management of streets.	More multi-modal street design and management increases use of alternative modes. Traffic calming tends to reduce vehicle travel and increase walking and cycling.
WALKING AND CYCLING CONDITIONS	Quantity and quality of sidewalks, crosswalks, paths and bike lanes, and the level of pedestrian security.	Improved walking and cycling conditions increases non-motorized travel and can reduce automobile travel, particularly if implemented with land use mix, transit improvements, and incentives to reduce driving.
TRANSIT QUALITY AND ACCESSIBILITY	Quality of transit service and degree to which destinations are transit accessible.	Improved transit service quality increases transit ridership and can reduce automobile trips, particularly for urban commuting.
PARKING SUPPLY AND MANAGEMENT	Number of parking spaces per building unit or acre, and how parking is managed.	Reduced parking supply, increased parking pricing and increased application of other parking management strategies can significantly reduce per capita vehicle travel. Cost-recovery parking pricing (charging motorists directly for the cost of providing parking) typically reduces automobile trips by 10-30%.
SITE DESIGN	The layout and design of buildings and parking facilities.	More multi-modal site design can reduce automobile trips, particularly if implemented with improved transit services.
MOBILITY MANAGEMENT	Various programs and strategies that encourage more efficient travel patterns.	Mobility management policies and programs can significantly reduce vehicle travel by affected trips. Vehicle travel reductions of 10-30% are common.

Source: Todd Litman (2006), Smart Growth Policy Reforms, Victoria Transport Policy Institute

Land Use Planning

Land use refers to various factors, such as density, mix, connectivity and the quality of the pedestrian environment. Each of these land use factors has impacts on the transportation system, as described in the table above. Coordinating (or integrating) land use and transportation planning and development is commonly considered today as one facet of "smart growth", sustainable development, new urbanism, or other similar concepts.⁵⁴

Mix Land Uses

Mixed land use involves a range of complementary land uses that are located together in a balanced mix, such as residential homes, shops, offices, community centers, and recreational facilities and parks. Zoning that allows for mixed land uses in certain areas, such as commercial centers, village centers, downtown areas, and dense urban neighborhoods helps to reduce vehicle miles traveled by shortening the distance that people have to go to reach goods and services and by making alternative modes of transportation more viable. Mixed land use can enhance the vitality and perceived security of areas by increasing the number of people on the street and in public spaces. It can also improve the retail and economic development of an area by making it a more desirable place to live, work, and shop.

Infill Development

Targeting development in areas where previous investments in infrastructure have already been made will help to reduce sprawl and save money on infrastructure costs. By designating areas to receive new development in the City or Town Master Plan (and ensuring that local ordinances support that plan), communities can save taxpayer money and provide predictability to developers looking for an appropriate place to build. Communities may want to consider reviewing their land use policies and regulations to ensure that there are incentives for infill and brownfield development and disincentives for greenfield development. Communities can encourage infill development by creating a zoning ordinance that either identifies specific areas within a municipality that are subject to the infill development ordinance or by identifying areas of infill development by definition. In both cases, a community may also choose to further enhance a zoning ordinance by identifying design guidelines within the Site Plan Review Regulations.⁵⁵

Cluster Development/Conservation Subdivision

Cluster development involves concentrating development in a certain area while preserving adjacent open space (i.e. natural areas or agricultural land). One form of cluster development is conservation subdivisions, which can be allowed or required through zoning. Conservation subdivisions allow (or require) developers to build the same number of units on smaller lots (or more units if there is a density bonus system) while preserving a percentage of the developable land for conservation as natural or agricultural land.⁵⁶ Conservation subdivisions have lower infrastructure costs; in non-clustered developments, more roads and other infrastructure must be built and maintained by the municipality. It is also cheaper to provide police and fire protection to cluster developments because the homes are not as dispersed. Conservation subdivisions help to protect rural character by conserving more land as open space, they can be used to limit fragmentation of wildlife habitat and to preserve areas with important

⁵⁴ Federal Highway Administration (2013). Coordinating Land Use and Transportation. http://www.fhwa.dot.gov/planning/processes/land_use/

⁵⁵ Innovative Land Use Planning Techniques: A Handbook for Sustainable Development. Chapter 1.6: Infill Development. http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_1.6.pdf

⁵⁶ International City/County Management Association (). Putting Smart Growth to Work in Rural Communities. http://icma.org/en/icma/knowledge_network/documents/kn/Document/301483/Putting_Smart_Growth_to_Work_in_Rural_Communities

ecosystem services, such as stormwater storage/filtration, and if located near goods and services, can reduce vehicle miles traveled.⁵⁷



Traditional subdivision (left) vs. a conservation subdivision (right). Both images show the same 130-acre parcel and contain 55 units. Source: <http://www.landchoices.org/conservationsubs.htm>

LAND USE PLANNING – SELECTED RESOURCES

Innovative Land Use Planning Techniques: A Handbook for Sustainable Development. Created to address the need for guidance and technical assistance on Innovative Land Use Controls authorized by RSA 674:21, this handbook provides resources and model ordinances for various planning topics including multi-density zoning, environmental characteristics zoning, and Site-Level design. It can be accessed from the DES website at

http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm

The Federal Highway Administration Tool Kit for Integrating Land Use and Transportation Decision-Making. This online resource is a list of methods, strategies, and procedures for integrating land use and transportation planning, decision-making, and project implementation. It also includes case studies, references, and links. It can be accessed at

http://www.fhwa.dot.gov/planning/processes/land_use/toolkit.cfm

Putting Smart Growth to Work in Rural Communities. (2010). Created by the International City/County Management Association, this publication is intended to show how Smart Growth approaches can be adapted and applied in rural contexts. It can be accessed online at http://icma.org/en/icma/knowledge_network/documents/kn/Document/301483/Putting_Smart_Growth_to_Work_in_Rural_Communities

⁵⁷ Innovative Land Use Planning Techniques: A Handbook for Sustainable Development. Chapter 1.4: Conservation Subdivision. http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_1.4.pdf

Parking Management

Every vehicle trip requires parking at its destination, and finding a parking spot is often the first experience that people have upon reaching a destination. Insufficient parking options can create problems such as spillover (motorists parking where they should not) and exacerbate congestion as motorists circle the area while looking for parking spaces.⁵⁸ However, too much parking creates problems as well. Parking facilities are expensive to construct and maintain, they increase stormwater runoff by increasing impervious surface area, they incentivize driving which can contribute to congestion, and large parking lots can make areas feel unfriendly for pedestrians and bicyclists. The strategies listed below are options for managing parking to ensure it meets demand while mitigating the negative impacts of too much parking.

Add or Increase On-Street Parking

This can be done by converting a travel lane to a parking lane, widening streets where there is sufficient space to add parking, and converting parallel parking to diagonal parking. Advantages to this strategy include the convenience of on-street parking, high visibility, and cost-efficiency. One on-street parking space can serve several different locations, and thus on-street parking is a form of shared parking.⁵⁹ On-street parking can also make pedestrians feel safer by providing a barrier between the walkway and the roadway. However, on-street parking only makes sense in areas where there is enough space to accommodate parking spaces on the road. On-street parking must compete with other uses of the public right-of-way, such as additional traffic lanes, bike lanes, or extended sidewalks.



Diagonal (left side) and parallel (right side) on-street parking on Washington Street in Keene, NH.

Parking Regulations

Municipalities can limit the maximum amount of time a vehicle can park at convenient spaces to encourage turnover, limit the types of vehicles that may use certain parking spaces (such as delivery vehicles and residents' vehicles), and limit on-street parking of larger vehicles to ease traffic flow. These types of parking regulations are widely used and understood and are easy to implement. They help to prevent people from using public parking resources for long-term storage and have minimal costs associated with implementation. However, they do require planning, signs, and enforcement, and they can be unpopular to enforce.

Pedestrian Improvements in Village Centers

This increases the range of parking facilities that can serve a destination, and creates a safer, more pleasant experience for users. Pedestrian improvements include measures such as adding visible

⁵⁸ See <http://www.vtpi.org/tdm/tdm72.htm>

⁵⁹ For more information on shared parking, see the Victoria Transportation Policy Institute TDM Encyclopedia page on shared parking: <http://www.vtpi.org/tdm/tdm89.htm>

crosswalks, creating pedestrian paths/shortcuts, adding sidewalks on both sides of the street where it makes sense to do so, adding street trees or other sources of shade, and adding pedestrian signals at signalized intersections.

Increase Bicycle Parking

Bicycle parking takes up significantly less room than automobile parking and has many co-benefits, including incentivizing a healthy behavior, creating more choices for residents, providing more options for residents who do not own a car or cannot drive, drawing in tourists who enjoy recreational cycling, and reducing emissions by encouraging mode switching. Bicycle-friendly areas tend to have higher property values and attract younger residents.⁶⁰ Municipalities can require bicycle parking in certain areas of the town or city through zoning,⁶¹ they can encourage bicycle parking donations through programs similar to the City of Keene's Building a Spirit of Place program,⁶² or they can purchase and install bicycle racks on their own. The Monadnock Region Transportation Management Association currently offers a "Rack it Up" program that provides free bike racks to organizations in certain towns. For more information about this program, contact the Commission at 357-0557. The Association of Bicycle and Pedestrian Professionals offers a free online [Bicycle Parking Guideline document](#) with more information about siting requirements for bicycle parking.⁶³



A parking meter on Main Street in Keene regulates how long people can park in a desirable location in the downtown area. This parking meter can also be used for bicycle parking as indicated by the blue "Bike Parking" sign.

Park and Ride

Park and Ride facilities located near highway ramps, transit stations, and bus stops facilitate rideshare and transit use.⁶⁴ In rural areas such as the Southwest region, a good strategy may be to assess potential park and ride locations near intersections of regional arterial highways where carpooling and vanpooling is most likely to take place. The [Franklin County Park and Ride Study](#) is an example of how a region similar to Southwestern NH can plan for and identify potential park and ride facilities.⁶⁵

⁶⁰ Flusche, Darren. 2012. *Bicycling Means Business: The Economic Benefits of Bicycle Infrastructure*.

[http://www.advocacyadvance.org/site_images/content/Final_Econ_Update\(small\).pdf](http://www.advocacyadvance.org/site_images/content/Final_Econ_Update(small).pdf)

⁶¹ See, for example, the City of Cambridge Bicycle Parking Guide:

https://www.cambridgema.gov/~media/Files/CDD/Transportation/Bike/Bicycle_Parking_Guide_20130926.pdf

⁶² City of Keene "Building a Spirit of Place" program. <http://www.ci.keene.nh.us/our-city/building-spirit-place/adopt-bike-rack>

⁶³ Association of Pedestrian and Bicycle Professionals (2002). *Bicycle Parking Guidelines*.

http://c.ymcdn.com/sites/www.apbp.org/resource/resmgr/publications/bicycle_parking_guidelines.pdf

⁶⁴ VTPI (2014). <http://www.vtpi.org/tdm/tdm27.htm>

⁶⁵ Franklin Regional Council of Governments (2008). *Franklin County Park and Ride Study*. http://frcog.org/wp-content/uploads/2014/04/%E2%80%A2-ParkandRideStudy_Final-Report-%E2%80%A2-.pdf

Brownfields Redevelopment

Brownfield sites are defined by the EPA as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.”⁶⁶ A site is classified as a brownfield by having an environmental assessment done on the property which will determine the extent of real or perceived contamination. Investors and developers are often hesitant to work with brownfields sites due to the risk of being held liable for any contamination on site. The unfortunate result is that many properties that already have access to water, sewer, electricity, roads, and other infrastructure remain vacant or under-used because no one wants to take on the liability risk. However, municipalities can encourage redevelopment of brownfields by targeting areas for infill development, working with the SWRPC Brownfields Assessment program, and showing community support for the redevelopment of brownfields sites.

SWRPC Brownfields Assessment Program

The Southwest Region Planning Commission (SWRPC) administers a region-wide Brownfields Assessment Program to help communities in the region determine the extent of contamination on brownfields sites. The program is implemented by SWRPC staff with the help of a Brownfields Advisory Committee (BrAC) and a pool of contracted environmental consultants, and it is funded through grants from the EPA, which allow SWRPC to inventory, characterize, assess, and conduct planning and community involvement related to brownfields sites.⁶⁷ So far, the program has helped over 24 sites in the region.⁶⁸ For more information about the SWRPC Brownfields Assessment program, contact the Commission at 357-0557.



This 12,000 gallon underground storage tank was removed from the 4 Corners Store in Richmond using funding from the SWRPC Brownfields Assessment Program.

Brownfields Cleanup and Redevelopment

Once a site has been assessed and the level of contamination (if any) is known, the next step is to clean up the site and, in some cases, to develop a plan for its reuse. There are several different options for brownfields cleanup funding. These include grants or loans from the Capital Regional Development Council Revolving Loan Fund, the NH DES Brownfields Cleanup Revolving Loan Fund & Brownfields Cleanup Grant Program, and the Regional Economic Development Corporation Revolving Loan Fund.⁶⁹ Uses of cleaned-up Brownfields range from housing, community facilities, and public green space to office space and commercial use. They benefit the community by adding to the tax base, drawing in new investors, beautifying the community, helping to provide needed amenities (such as affordable housing, community centers, employment centers, general stores, etc.), and cleaning up the environment.

⁶⁶ U.S. Environmental Protection Agency (2012). Brownfields and Land Revitalization webpage.

http://www.epa.gov/brownfields/basic_info.htm

⁶⁷ Southwest Region Planning Commission Brownfields Program Webpage. <http://www.swrpc.org/brownfields>

⁶⁸ See the SWRPC Brownfields Site Table at <http://www.swrpc.org/brownfields/participatingsites>

⁶⁹ For more information about cleanup funding, see <http://www.swrpc.org/brownfields/brownfieldsresources>

Access Management

Access Management refers to the systematic control of the location, spacing, design, and operation of driveways, street openings and median openings to a roadway.⁷⁰ Generally, the goal of access management is to increase safety by reducing the number of conflict points from turning cars as well as to enhance traffic flow. Benefits of access management include smoother traffic flow, reduced delay times and fewer crashes. Access management also helps prevent sprawl, improves conditions for pedestrians and bicyclists, and improves emergency response times.⁷¹

Towns interested in adopting stronger access management can do so by amending zoning regulations, subdivision regulations, site plan review, and driveway permits as well as adopting memorandum of understanding with NH DOT on its driveway permitting process. Selected access management strategies that municipalities may want to consider are listed in the table below.⁷²

ACCESS MANAGEMENT STRATEGIES

1. Lay the foundation for access management in your local comprehensive plan.
2. Limit the number of driveways per lot (generally, one per parcel).
3. Locate driveways away from intersections.
4. Connect parking lots and consolidate driveways (so vehicles can travel between parcels without reentering an arterial).
5. Provide residential access through neighborhood streets (residential driveways should generally not connect directly to arterials).
6. Increase minimum lot frontage on major streets (minimum lot sizes on major arterials should be larger than on minor streets).
7. Promote a connected street system (avoid street networks that force all local traffic onto arterials).
8. Encourage internal access to outparcels (i.e., locations in shopping centers located on arterial streets).
9. Regulate the location, spacing and design of driveways.
10. Coordinate with the Department of Transportation.

⁷⁰ Monadnock Region Transportation Management Association (N.D.). Access Management.

<http://www.monadnocktma.org/municipalities/accessmgt>

⁷¹ Victoria Transport Policy Institute (2014). Access Management. <http://www.vtpi.org/tdm/tdm1.htm>

⁷² Table from the Victoria Transport Policy Institute Access Management webpage: <http://www.vtpi.org/tdm/tdm1.htm>

Increase Access to Alternative Transportation Options

A lack of transportation options can isolate residents who cannot drive, lead to congestion on arterial roadways, and drive up transportation-related costs. Cars are among the most expensive way to travel (for surface transportation); according to AAA's 2015 "Your Driving Costs" study, the average annual cost to own a sedan is \$8,698.⁷³ This high cost disproportionately affects low- and moderate- income families, who spend a larger percentage of their income on transportation-related expenses. It also has a large impact on aging households that rely on a fixed income. As the Monadnock Region's population continues to age, it will become even more important to offer alternative transportation options. Increasing transportation options will also help to attract and retain younger generations, who prefer walkable communities with multiple transportation options.⁷⁴

In order to improve access to alternative transportation, municipalities may want to consider the following strategies.

Pedestrian Improvements

Safe and convenient pedestrian facilities provide many benefits, including reduced traffic congestion in walkable centers, user savings, economic development, and an environment that encourages physical activity and promotes better health. Characteristics of walkable communities include sidewalks on both sides of the street, visible crosswalks at intersections, crosswalk signals at signalized intersections, street trees and street furniture, slower traffic speeds, and pedestrian-scale lighting. While not all of these improvements make sense in every context, communities should consider implementing pedestrian improvements along Main Streets, village centers, commercial districts, compact/dense neighborhoods, and in school zones. In general, these are the areas where pedestrian activity is desired and more likely to occur.

Cycling Improvements

Bicyclists in New Hampshire face many challenges, such as narrow or nonexistent shoulders, steep hills, winter weather, and few bicycle facilities such as dedicated bike lanes and secure and convenient bicycle parking options. While protected bike lanes are a great way to increase safety for bicyclists, it is not always practical or financially possible to do so, especially on rural roads. In many cases, adding a 2-3' paved shoulder to a roadway is sufficient to increase safety for both bicyclists and motorists. People driving cars will swerve into the opposite lane of traffic in order to pass a cyclist, creating a dangerous situation that can lead to collisions. With a 2-3' shoulder, cars can safely pass cyclists with the required 3 feet lateral passing distance without entering the lane of oncoming traffic.

Multi-use paths are another cycling improvement that provides safe alternatives for travel between places and to downtown areas. Several communities in the region, including Jaffrey, Keene, Peterborough, and Swanzey have been establishing multiuse paths that can accommodate both bicycles and pedestrians for recreational and daily trips. Currently there are 35.8 miles of improved rail trails in the region with plans for more to come.⁷⁵

⁷³ AAA (2015). Your Driving Costs. <http://newsroom.aaa.com/tag/your-driving-costs/>

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⁷⁵ Data from the Southwest Region Planning Commission. 2015

Bicycle and Pedestrian Plans

Many states and communities are creating Bicycle and Pedestrian Plans (also called Bicycle and Pedestrian Safety Plans, Bicycle and Pedestrian Master Plans, etc.) as a way to address the safety needs of these vulnerable users of the roadway. The State of New Hampshire has a Statewide Bicycle and Pedestrian Plan which was last updated in 2000, however it should be updated to reflect current transportation laws, regulations, funding mechanisms, and other changes that have taken place over the past 15 years.⁷⁶ Currently, there is no regional Bicycle and Pedestrian Plan for the Monadnock Region. The Southwest Region Planning Commission or the Monadnock Region Transportation Management Association should consider developing such a plan to help the region address bicycle and pedestrian infrastructure needs.

Communities should also consider creating local Bicycle and Pedestrian Plans. The Pedestrian and Bicycle Information Center provides a list of sample plans on its website along with facility design resources for both pedestrian and bicycle facilities.^{77,78} For examples of local plans that consider the needs of cyclists and pedestrians, see the City of Keene 1999 Bicycle/Pedestrian Path Master Plan⁷⁹ or the Town of Peterborough 2012 Comprehensive Transportation Plan.⁸⁰

Pedestrian & Cycling Improvements

1. Improve or create sidewalks, crosswalks, paths and bike lanes.
2. Universal Design/ADA compliant facilities.
3. Develop pedestrian oriented land use and building design (New Urbanism).
4. Increase road and path Connectivity, with special non-motorized shortcuts.
5. Street furniture (e.g., benches) and design features (e.g., human-scale street lights).
6. Traffic Calming, Streetscape Improvements, Traffic Speed Reductions, Vehicle Restrictions and Road Space Reallocation.
7. Safety education, law enforcement and encouragement programs.
8. Bicycle Parking.
9. Community Bike Share programs.
10. Pedestrian and Bicycle wayfinding systems.

⁷⁶ See <https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/BikePedPlan.pdf>

⁷⁷ Sample Plans: http://www.pedbikeinfo.org/planning/sample_plans.cfm

⁷⁸ Facility Design Resources: <http://www.pedbikeinfo.org/planning/facilities.cfm>

⁷⁹ City of Keene Bicycle/Pedestrian Pathways Advisory Committee & City of Keene Planning Department (1999).

<http://www.ci.keene.nh.us/sites/default/files/bikepathmpfinal.pdf>

⁸⁰ See

<http://www.peterborough.ca/Assets/City+Assets/Transportation/Documents/Transportation+Plan/2012+Comprehensive+Transportation+Plan+Report.pdf>

Public Transit

A regional transit system allows people to affordably access education, employment, healthcare, and services, and it also makes it possible for many people to remain in their homes as they age. While in urban areas transit is seen as a solution to congestion problems, in rural areas transit systems can function as a lifeline for residents who cannot afford a car or who are unable to drive.

Currently, the Southwest Region has very few fixed-route transportation options; only 0.9% (17.6 miles) of the Southwest Region's roadways are serviced by public bus routes. The City Express, which is operated by Home Healthcare Hospice and Community Services (HCS), provides public transportation in Keene from 8:00 am to 5:00 pm Monday through Friday.⁸¹ The Current bus service, formally Connecticut River Transit, services parts of Walpole and Hinsdale.⁸² As a result of limited transit options, the majority of residents in need of transportation services rely on family members and friends or volunteer driver networks, such as those operated by the American Red Cross (ARC), Contocook Valley Transportation Company (CVTC), and faith-based institutions such as churches.⁸³

While the rural nature of the region presents a challenge to establishing successful transit service, there are many examples of rural transit systems that have been successfully implemented around the country.⁸⁴ The Advanced Transit Service in the Upper Valley region of New Hampshire provides an example of a successful inter-city bus system that provides options for people to move between communities in their region.⁸⁵ North Central Montana Transit (NCMT) is another example of a regional transit system that is highly successful despite its rural locale. When NCMT made its first bus trip in 2009, the population density of the region was a 1.5 people per square mile (in the Southwest Region, it is 103 people/mi²) and the county seat had a population of 9,700 people.⁸⁶ Agencies in the Monadnock Region should consider working together to research, plan, and implement a regional inter-city bus system, if feasible.



The City Express in Keene operates two routes stopping at 16 locations throughout the City, including major shopping areas and downtown, medical and recreational facilities and many residential areas. The City Express can also stop along the route if 'flagged' as long as it is safe to stop.

⁸¹ For route and schedule information, see <http://www.hcsservices.org/transportation/>

⁸² See <http://crtransit.org/> for route and schedule information.

⁸³ Southwest Region Planning Commission (2015). Monadnock Region Future: A Regional Plan for Southwest New Hampshire.

⁸⁴ See, for example, "Putting Transit to Work in Main Street America," a 2012 report by Reconnecting America that includes 10 case studies. <http://reconnectingamerica.org/assets/PDFs/201205ruralfinal.pdf>

⁸⁵ <http://www.advancetransit.com/>

⁸⁶ Kack, David. 2010. *Get on the Bus: Connecting Small Communities on Montana's Hi-Line*. TR News 270 September–October 2010. <http://onlinepubs.trb.org/onlinepubs/trnews/trnews270rpo.pdf>

Selected Resources for Rural Public Transit

Innovative Rural Transit Services: A Synthesis of Transit Practice. (TCRP Synthesis 94) This report, produced by the Transit Cooperative Research Program (TCRP), includes a review of literature and other sources, results from a survey of state DOTs and other organizations, and case studies of innovative rural transit and intercity services. The report can be accessed online at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_94.pdf

Putting Transit to Work in Main Street America. This document contains 10 case studies that fall into three categories of rural transit: Improved Local/Regional Bus Networks, Circulator Systems, and Intermodal Transit Centers and Transit Hubs. It can be accessed at <http://reconnectingamerica.org/assets/PDFs/201205ruralfinal.pdf>

Effective Approaches to Meeting Rural Intercity Bus Transportation Needs. (TCRP Report 79) This report is divided into three sections. The first provides information on the history, funding sources, and perceived barriers to rural intercity bus service. Section two gives strategies to improve and support intercity bus services, and section three gives detailed project descriptions for several different states. It can be accessed online at <http://www.buses.org/files/download/ruralbusreport.pdf>

Complete Streets

Complete Streets are streets that are safe and accessible for all users, including motorists, pedestrians, bicyclists, and transit users regardless of age or ability. A Complete Streets policy ensures that transportation agencies routinely design and operate the entire right-of-way to enable safe access for all users. Common elements of Complete Streets include sidewalks, paved shoulders, bike lanes, bicycle shared lane markings (sharrows), visible crosswalks, traffic calming measures such as street trees and narrower lane widths, and more. There are three communities that have adopted Complete Streets policies in New Hampshire: Portsmouth⁸⁷, Concord⁸⁸, and Dover.⁸⁹ The City of Keene adopted a Complete Streets Resolution in 2011.⁹⁰

The Town of Swanzey and the City of Keene are currently in the process of developing Complete Street Policies with assistance from the Southwest Region Planning Commission. Once they are adopted, they will become the first communities in the Monadnock Region to adopt Complete Streets policies. For more information about complete streets in the Monadnock Region, see the Monadnock Region Transportation Management Association (MRTMA) website:

<http://www.monadnocktma.org/completestreets>

The National Complete Streets Coalition provides many free online resources for developing a complete streets policy.⁹¹ For more resources, see below.

⁸⁷ See <http://www.smartgrowthamerica.org/documents/cs/policy/cs-nh-portsmouth-policy.pdf>

⁸⁸ See <https://docs.google.com/a/antioch.edu/file/d/0B5N91fVXkIToUFR1dWVUelZKSku/edit>

⁸⁹ See <http://www.dover.nh.gov/Assets/government/city-operations/2document/planning/outreach/Complete%20Streets%20Traffic%20Calming%20Guidelines.pdf>

⁹⁰ See <http://www.granitestatefutures.org/pdf/CompleteStreets7-2011.pdf>

⁹¹ National Complete Streets Coalition website: <http://www.smartgrowthamerica.org/complete-streets>

Complete Streets– Selected Resources

[Complete Streets Local Policy Workbook](#). This resource, developed by the National Complete Streets Coalition and Smart Growth America, provides guidance for writing a complete streets policy for your community.

[The Best Complete Streets Policies of 2014](#). The National Complete Streets Coalition ranks each year's new Complete Streets policies to provide leaders at all levels of government with examples of strong Complete Streets policies.

[Taking Action on Complete Streets: A Toolkit for Implementation](#). Created by the National Complete Streets Coalition, this toolkit provides guidance, resources, and case studies for a successful implementation strategy.

Conclusion

This report examined the impact of the energy sector on the transportation sector and identified three main strategies that local and regional planners can use to address an uncertain energy future: Promoting alternative fuel and advanced vehicle technologies; transportation demand management and land use planning; and alternative transportation options. These strategies have many benefits that go beyond mitigating high petroleum prices. Increasing alternative transportation options will address the needs of an aging population while drawing in younger people who prefer to live in more walkable communities that have a variety of transit options. Promoting alternative fuels and advanced vehicle technologies will improve air quality, reduce the region's greenhouse gas footprint, contribute to New Hampshire's energy security, and boost the economy by attracting business and investment from the alternative fuel and advanced vehicle technology industries. Transportation Demand Management and Land Use Planning can help create more livable communities by reducing sprawl, protecting the rural character of the region, and targeting development in desired areas. As petroleum prices rise and become more and more volatile, communities can use these strategies to reduce petroleum consumption and maintain the high quality of life residents have come to expect.

Appendix A: 2014 Alternative Vehicle Registration Data by Town

The following data was acquired from the New Hampshire Department of Environmental Services (DES). The information comes from Town registration data which is sent to the Department of Motor Vehicles, usually by the Town Clerk. According to DES, this data most likely under-reports the true number of alternative fuel vehicles registered in the region as many alternative fuel vehicles are incorrectly listed as conventional vehicles.

B = PLUG-IN ELECTRIC E = ELECTRIC H = HYBRID N = NATURAL GAS P = PROPANE

MAKE	MODEL	MY	FUEL	Town	Type
CHEV	VOLT	2013	B	ALSTEAD	4DSED
PLYM	COUPE	1939	P	ALSTEAD	COUPE
CHEV	VOLT	2012	B	ANTRIM	4DSED
SMRT	SMART FO	2014	E	ANTRIM	2DSED
CHEV	VOLT	2012	B	CHESTERFIELD	HATCH
NISS	LEAF	2013	E	CHESTERFIELD	APURP
GLBL	CLBCR	2003	E	CHESTERFIELD	NEV
CHEV	VOLT	2013	B	DREWSVILLE_WALPOLE	HATCH
GLBL	GEM	2012	E	DREWSVILLE_WALPOLE	4DSED
CHEV	VOLT	2014	B	DUBLIN	4DSED
HOND	FIT	2015	E	DUBLIN	HATCH
NISS	LEAF	2012	E	DUBLIN	HATCH
HOND	FIT	2015	E	FITZWILLIAM	HATCH
HOND	FIT	2015	E	FITZWILLIAM	HATCH
HOND	INSIGHT	2013	E	FITZWILLIAM	HATCH
FORD	C-MAX	2013	B	HANCOCK	HATCH
GLBL	G82	2002	E	HANCOCK	4DSED
FORD	C-MAX	2014	B	HINSDALE	HATCH
FORD	FUSION	2014	B	HINSDALE	4DSED
FORD	FUSION	2015	B	HINSDALE	4DSED
GLBL	GEM	2012	E	JAFFREY	COUPE
TESL	S	2013	E	JAFFREY	4DSED
FORD	C-MAX	2013	B	KEENE	HATCH
FORD	C-MAX	2013	B	KEENE	HATCH
FORD	C-MAX	2013	B	KEENE	HATCH
CHEV	VOLT	2011	B	KEENE	4DSED
CHEV	VOLT	2012	B	KEENE	HATCH
CHEV	VOLT	2012	B	KEENE	4DSED
FORD	FUSION	2014	B	KEENE	4DSED
FORD	FUSION	2014	B	KEENE	4DSED
NISS	LEAF	2013	E	KEENE	HATCH
NISS	LEAF	2013	E	KEENE	HATCH
HOND	FIT	2015	E	KEENE	HATCH
GLBL	ZONE	2010	E	KEENE	NEV
TESL	MODEL S	2013	E	KEENE	4DSED

B = PLUG-IN ELECTRIC E = ELECTRIC H = HYBRID N = NATURAL GAS P = PROPANE

MAKE	MODEL	MY	FUEL	Town	Type
NISS	LEAF	2012	E	KEENE	HATCH
TOYT	HYBRID	2004	E	KEENE	4DSED
FORD	SUPERDUT	2010	P	KEENE	PKUP
GMC	TK10903	1979	P	KEENE	PKUP
FORD	FUSION	2014	B	LANGDON	4DSED
CHEV	VOLT	2013	B	MARLBOROUGH	4DSED
CHEV	COLORADO	2007	P	MARLBOROUGH	PKUP
CHEV	VOLT	2014	B	MARLOW	HATCH
CHEV	VOLT	2012	B	PETERBOROUGH	4DSED
CHEV	VOLT	2014	B	PETERBOROUGH	4DSED
NISS	LEAF SV	2015	E	PETERBOROUGH	HATCH
GLBL	GLOBAL	2001	E	PETERBOROUGH	4DSED
TESL	S	2013	E	PETERBOROUGH	4DSED
TESL	S	2013	E	PETERBOROUGH	4DSED
ISU	AXIOM4X4	2003	P	PETERBOROUGH	APURP
CHEV	VOLT	2012	B	RINDGE	4DSED
CHEV	VOLT	2012	B	RINDGE	4DSED
CHEV	AVALANCH	2004	E	RINDGE	PKUP
NISS	LEAF	2011	E	RINDGE	4DSED
FORD	C-MAX	2013	B	SURRY	HATCH
CHEV	VOLT	2013	B	SWANZEY	4DSED
CHEV	VOLT	2015	B	SWANZEY	HATCH
FORD	FUSION	2014	B	SWANZEY	4DSED
HOND	FIT	2015	E	SWANZEY	HATCH
CHEV	1500	2014	P	SWANZEY	PKUP
CHEV	VOLT	2013	B	TEMPLE	4DSED
HOND	CR-Z	2011	P	TEMPLE	2DSED
HYUN	SORENTO	2008	E	WESTMORELAND	APURP

Appendix B: Transportation Funding

Local/Regional

Decisions on transportation financing at the local level typically come through a local highway department budget on maintenance-related items and through capital improvement plans or warrant articles for larger or discrete transportation improvement projects. The financing tools that local governments have to fund transportation may come through property taxes (general, central business service district, tax increment financing district, village district), bonding, or special revenue funding through user fees such as vehicle registration fees, parking fees, airport fees or solid waste fees. For example, many NH communities are using NH RSA 261:153 VI, a \$5 vehicle registration fee, as a revenue source for supporting transit in their communities.

State

State funding is restricted by statute to four highway and bridge programs: State Aid Highway Block Grant Aid, State Aid Highway Program, State Aid Bridge Program and the Betterment Program. These programs are derived from Article 6A in the Constitution of New Hampshire, which stipulates taxes and fees relating to motor vehicles are restricted to the purpose of funding construction, reconstruction and maintenance of public highways in the State. State funding for walking, biking and rail does not exist and these are traditionally paid for with federal and local funding.

Federal

The Moving Ahead for Progress in the 21st Century Act (MAP-21) is a funding and authorization bill that governs U.S. federal surface transportation spending. MAP-21 authorized the Transportation Alternatives Program (TAP) to provide funding for programs and projects defined as transportation alternatives, which includes on- and off-road pedestrian and bicycle facilities, infrastructure projects for improving non-driver access to public transportation and enhanced mobility, community improvement activities, and environmental mitigation; recreational trail projects; safe routes to school projects; and projects for planning, designing, or constructing boulevards and other roadways largely in the right-of-way of former divided highways. The TAP replaced the funding from pre-MAP-21 programs including the Transportation Enhancement Activities, Recreational Trails Program, Safe Routes to School Program.

Federal Transportation Funding in New Hampshire in FY 2013 (Millions) and Benefitting Transportation Modes



Source: FHWA, FTA, FAA