Avoiding the Pump: Gas and Diesel Consumption Reduction in Eugene, Oregon



Analysis of Eugene, Springfield and Tigard's Registered Vehicles, 2003-2011

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Executive Summary

Gasoline and diesel consumption has direct impacts on the natural environment, local economy, and social equity of communities across the United States. Eugene's gas and diesel consumption has declined significantly over the last eight-year period. While statewide gas and diesel receipts declined by roughly 1%, Eugene's dropped by 15%. Neighboring Springfield saw a decline of 5% over the same time period. In contrast, the region's estimated vehicle miles traveled (VMT) have remained fairly flat.

This report uses vehicle age as a proxy for fuel economy to study one of the potential explanations for Eugene's fuel consumption reduction: a hypothetical increase in fuel-efficient vehicles. It calculates the vehicle age mix based on Oregon Department of Motor Vehicles (DMV) data for all vehicles registered in Eugene, Springfield and Tigard from 2003-2011. This analysis has spurred recommendations for additional opportunities and provided insight into how to collect more granular information regarding gasoline consumption and reduction trends within the state of Oregon.

This type of research and data analysis can inform other municipalities seeking to understand gas and diesel reduction and consumption trends based on the makeup of registered vehicles. The information can help local and regional agencies support existing efforts to reduce greenhouse gas emissions. The methods used to evaluate Eugene, Springfield and Tigard's DMV data can be applied to municipalities across the county.

Introduction

The United States transportation sector's gas and diesel consumption comprises a significant portion of the country's total greenhouse gas emissions. Supporting behaviors that decrease gasoline consumption is a direct way for the United States to reduce its dependence on fossil fuels and mitigate further anthropogenic impacts of climate change. In order for communities to reach their greenhouse gas emissions reduction goals, policy analysts must investigate gasoline consumption trends. Reducing greenhouse gas emissions by improving fleet fuel efficiency and minimizing single occupancy vehicle use can have a significant impact on community-wide emissions and directly supports reduction goals set in state and city climate policies and sustainability plans.

The state of Oregon passed House Bill 3543 in 2007, which recommended 46 actions to reduce greenhouse gas emissions statewide. The goals began with reducing statewide greenhouse gas emissions by 2010, reducing emissions by 10% of 1990 levels by 2020, and reducing emissions by 75% of 1990 levels by 2050.[1] The bill also established a Global Warming Commission to aid in the success of the reduction goals and provide recommendations for the future. The recommendations address varying emissions contributors from a wide array of sectors. The designated commissioners are also responsible for examining the impacts of the cap and trade system, developing educational objectives for communicating with the public about climate change, and monitoring tracking systems that study climate change's effects on Oregon's marine and terrestrial ecosystems.[2] Furthermore, the bill provides specific strategies to help mitigate the impacts of climate change, and suggests methods for adapting to the inevitable climatic changes Oregon will face as a result of rising greenhouse gas emissions.

HB 3543 addresses the unavoidable threats climate change could have on state residents' public health, their economic well-being, and the temperature and precipitation fluctuations that may inevitably devastate and forever change Oregon's natural environment. The bill states that significant opportunities still exist to reduce greenhouse gases, especially through high contributing sectors like transportation and and electricity production.[3] These objectives align with the purpose of this project and research. By investigating the recent gasoline usage reduction in Eugene, this project contributes to broader greenhouse gas reduction goals for the state of Oregon and provides valuable insight into how to support climate change mitigation.

This report also aims to support the efforts of Eugene's Climate and Energy Action Plan (CEAP). The Land Use and Transportation section of the CEAP considers the factors that affect transportation in Eugene, how that transportation contributes to citywide greenhouse gas emissions, and what can be done to mitigate transportation-related emissions. Preparing Eugene for rising fuel prices is

[1] House Bill 3543. (2007). Relating to climate change; appropriating money; and declaring an emergency. 74th Oregon Legislative Assembly. p. 1.
[2] Ibid. p. 1.
[3] Ibid. p. 2.

arguably unavoidable, so efforts to reinforce current gasoline reduction behaviors are imperative to ensure a lower-risk and more resilient future for Eugene and its residents.

The inherent risk associated with volatile oil prices supports an international trend to move our communities and global economies away from carbon intensive fuels. In addition, the influx of potential climate refugees and projected statewide rising populations makes oil price fluctuations and congestion even more palpable threats to the livability of Eugene.[4] By creating proactive ways for the community to reduce fuel usage, the risk of rising oil prices can be less impactful. The decline in fuel consumption among Eugene residents can be used as a galvanizing force to encourage additional fuel use reductions. Conservation is an inherent value among the environmentally conscious and concerned citizens of Eugene, making gas and diesel reduction something the city can be proud of and continue to promote.

Project Background

Eugene's community gasoline and diesel consumption has declined significantly over the last eight-year period. While statewide gas and diesel receipts declined by roughly 1%, Eugene's declined by 15% and neighboring Springfield saw a decline of 5%. Regional estimates of vehicle miles traveled (VMT) remained fairly flat.[5] This anomaly has left analysts wondering if there is a particular set of mitigating circumstances in Eugene that would allow for a drastic decline in consumption accompanied by a comparably steady rate of VMT. This report builds on research performed by the City of Eugene and Lane Council of Governments and attempts to assess several of the factors that may be contributing to the conundrum.

This research is composed of three main agendas. First, it analyzes the age of passenger vehicles registered in Eugene between the years of 2003 and 2011 and compares them to the adjacent community of Springfield and the Portland suburb of Tigard. These figures act as an initial proxy for the communities' fleet fuel economy. Second, it gathers information on VMT data estimation systems and local activities that may be linked to gas and diesel consumption and VMT. These results may suggest whether the VMT estimates are accurate and what accompanying activities may have contributed to the decline. Third, it provides suggestions to the Oregon Department of Motor Vehicles (DMV) and other state and local agencies that can help those entities better input and integrate their data to provide accurate, granular information that will help them meet greenhouse gas emissions targets and improve the health and infrastructure of local communities.

[4] City of Eugene, Oregon. *A Community Climate and Energy Action Plan for Eugene*. Sept. 2010. p. 29.
[5] See Appendix B.

Methods

The following methodology explains the steps taken by the project team to decipher the DMV data purchased by City of Eugene from the Oregon DMV for Eugene, Springfield, and Tigard. The data was originally provided as an aggregate spreadsheet of all registered vehicles for the years 2003-2011 by car make and model for the cities of Eugene, Springfield, Tigard and Washington County. The data were analyzed as follows:

- Reviewed aggregate registered vehicle counts
- Selected sample: Eugene, Springfield and Tigard, OR (Washington County omitted to maintain consistency in region type)
- Consolidated and sorted DMV inventory spreadsheets by year of registration
- Sorted by year each car was produced
- Consolidated vehicle fleets by year car was manufactured and number of cars corresponding to each of those years
- Produced line graph showing trends in age of vehicle fleet by registration years 2003-2011 for all three cities
- Assigned numerical categories to manufacture year spans: 10 and newer, 11-20, and 21 and older
- Using those numerical values, consolidated the vehicle counts into three categories
- Compiled the number of vehicles corresponding to each registration year for each of the three cities, by the three numeric year categories
- Created graphs showing the trends of the vehicle age mix as they changed throughout the 2003-2011 registration years for each city

Findings

An area's fleet fuel efficiency is highly specific to its location, and depends on the following factors: fleet age, vehicle maintenance, weather and topography, local trip lengths, driving habits, acceleration, and fuel evaporation and spillage during sales and use.[6] To complement these key efficiency-related factors, this research has compiled a matrix of additional theories at the City of Eugene's request that might lead to a reduction in gasoline and diesel consumption without affecting the area's VMT, as illustrated in Chart 1 below. The combined effect of trends such as the increased amount of hybrid vehicles on the road and idling reduction programs likely have significant but harder-to-measure impacts on gas and diesel consumption trends in Eugene.

[6] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*. Retrieved 11 February 2013 from http://wiki.umd.edu/transportation/images/d/dc/Review_of_methods_for_estimating_vehicle_miles_traveled.pdf.

Chart 1: Theories of Trends and Programs Contributing to Fuel Consumption Decline

Consumption Reduction Theories	Details
Cash for Clunkers Program (2009)	The reduction in older vehicles on the road and their assumed replacement with newer, more efficient vehicles raises Eugene's average fuel economy and maintains VMT.[7]
Diesel Reduction Programs (ongoing)	West Coast Collaborative (WCC): Part of EPA's National Clean Diesel Campaign, the WCC influences reductions in diesel consumption along the West Coast by sharing information on funding and research for new technologies and alternative fuels, behavior change strategies, education and outreach about vehicle retrofits and retirement/replacement plans. The WCC partners directly with many municipalities in Oregon.[8]
	Cascade Sierra Solutions: Implements programs allowing truck drivers to plug into local electricity grids while idling for long stops, significantly reducing diesel fuel consumption.[9] [10]
	Lane Regional Air Protection Agency/Clean School Bus USA: This local EPA-funded project encouraged schools to reduce school bus idling, retrofit current school bus fleets with new technologies and new cleaner fuels, and replace old school buses with new ones that meet stringent pollution control standards.[11]

[7] KLCC Radio, "Cash for Clunkers Program" (2009). Retrieved 14 March 2013 from http://www.klcc.org/Feature.asp?FeatureID=1285

[8] West Coast Collaborative. "Sectors: Public Fleets and School Buses/Trucking" (2005)/2008). Retrieved 11 March 2013 from http://westcoastcollaborative.org/projects-list.htm.

[9] Oregon Department of Environmental Quality, "Financial Incentives" (2007). Retrieved 13 March 2013 from http://www.deq.state.or.us/aq/fleet/incentive.htm

[10] Cascade Sierra Solutions. "Strategies." (2009). Retrieved 12 March 2013 from http://www.cascadesierrasolutions.org/strategies.aspx

[11] Lane Regional Air Protection Agency, "Projects and Programs: Clean School Bus USA" (2004). Retrieved 12 March 2013 from http://www.lrapa.org/projects_and_programs/clean_school_bus_USA.php.

Increase in Hybrid and Electric Vehicles (ongoing)	An increase in hybrid vehicles results in a higher average fuel economy in Eugene, lowering the frequency and amount of gasoline purchased in Eugene. An increase in electric vehicles keeps Eugene's VMT steady while significantly lowering the amount of gasoline purchased and the ratio of gas purchased to VMT.[12]
Increase in Fuel Efficient Vehicles (ongoing)	An increase in fuel efficient vehicles results in a higher average fuel economy in Eugene, lowering the frequency and amount of gasoline purchased in Eugene.

The Data: What it Reveals about Fuel Consumption Rates in Three Oregon Cities

The initial project scope was to create a detailed synopsis of fleet fuel economy by vehicle make and model for the registration years 2003-2011 for each city. The goal was to reveal whether the average fuel efficiency of Eugene's fleet was steadily increasing over the study period because of citywide adoption rates of more efficient vehicles. In general, newer vehicles have better fuel economy than older vehicles, because fuel efficiency slowly decreases over time. In addition, Corporate Average Fuel Economy (CAFE) standards require higher fuel efficiency for new vehicles at set intervals.[13]

As the research progressed, data inconsistencies and gaps in model type made it difficult to assume a fuel economy for individual vehicles. In addition, the project team was not equipped with software resources to align EPA fuel economy data with local DMV data, a critical part of calculating these figures. Lane Council of Governments Transportation Planner Josh Roll later successfully combined and decoded the data using open source R software to provide this information.[14]

After adapting the original scope, the project team took a modified approach to overcome the incomplete data set. The data did provide complete records of the year each individual vehicle was manufactured. Using this data as a new starting point, the team consolidated and calculated the age mix of the fleets by registration year for Eugene, Springfield and Tigard.

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[12] National Public Radio. "Map: Hybrid And Electric Sales Across The Country" (2011). Retrieved 12 March 2013 from http://www.npr.org/2011/11/22/142476940/map-hybrid-and-electric-sales-across-the-country.

[13] National Highway Traffic Safety Administration. *Corporate Average Fuel Economy Standards.* Web. http://www.nhtsa.gov/fuel-economy

[14] Josh Roll. Lane Council of Governments, Transportation Planner. "Regional and State Fleet Composition Comparison." (March 2013). See Appendix A.

The following tables and charts representing Eugene, Springfield and Tigard divide the ages of the fleets into three categories: 10 years and newer, 11 to 20 years old, and 21 years and older. The trends in fleet age are depicted over the eight-year time period. Municipalities with higher percentages of newer vehicles may have more efficient overall fleet fuel economy.

Table 1: Eugene Vehicle Fleet Age Mix, Registration Year 2003-2011

Eugene Vehicle Fleet Age, Registration Year 2003 - 2011									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
21+ yrs.	6906	6425	5998	5866	6077	6692	7121	6834	6325
11-20 yrs.	69266	61792	62800	63045	64243	68078	70505	73509	76319
10 yrs. & newer	72052	80290	81335	82260	81764	84311	80285	75904	72913
Total	148224	148507	150133	151171	152084	159081	157911	156247	155557

Figure 1: Eugene Vehicle Fleet Age Mix, Registration Year 2003-2011

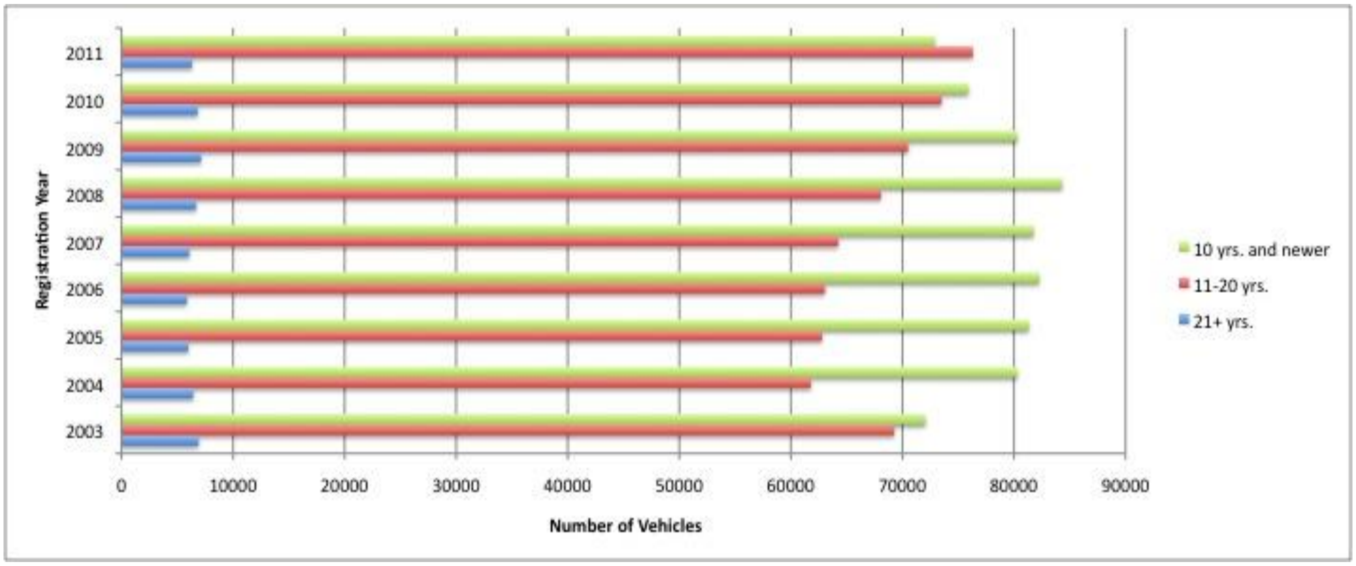


Table 2: Springfield Vehicle Fleet Age Mix, Registration Year 2003-2011

Springfield Vehicle Fleet Age, Registration Year 2003 - 2011									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
21+ yrs.	2972	2740	2867	2949	3220	3230	3124	2950	2842
11-20 yrs.	29236	29295	29390	29829	30394	30903	32105	32981	34000
10 yrs. and newer	24325	24556	25138	25300	25146	24307	22643	21055	19800
Total	56533	56591	57395	58078	58760	58440	57872	56986	56642

Figure 2: Springfield Vehicle Fleet Age Mix, Registration Year 2003-2011

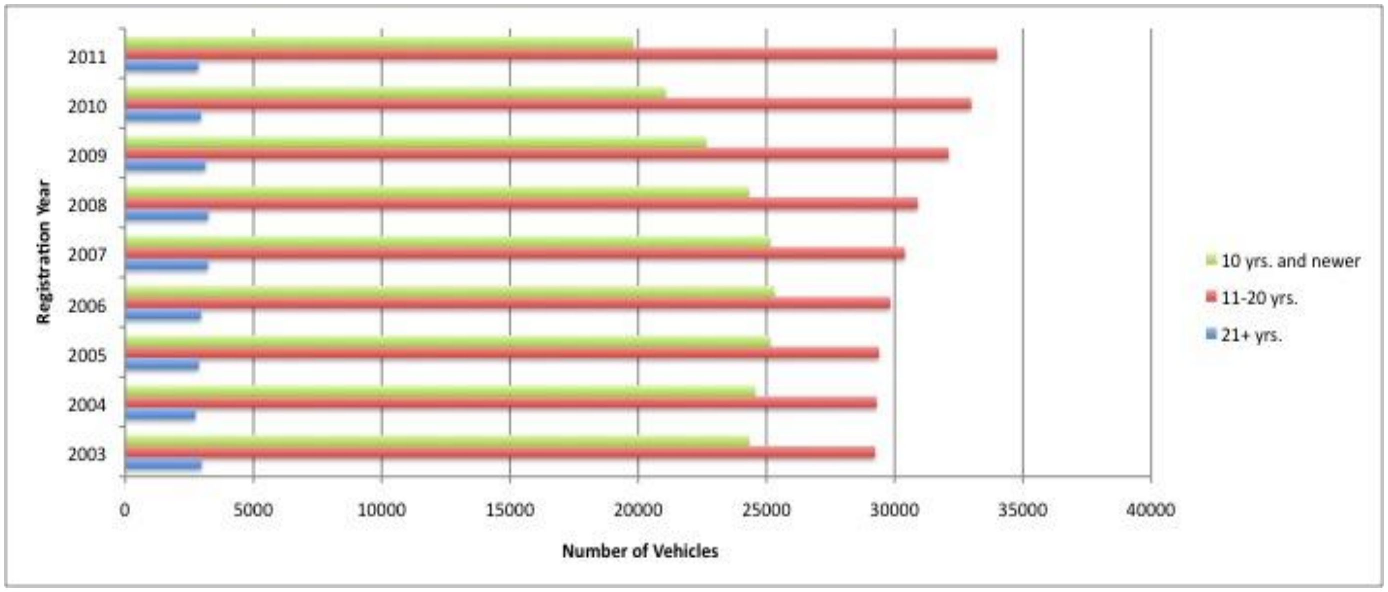


Table 3: Tigard Vehicle Fleet Age Mix, Registration Year 2003-2011

Tigard Vehicle Fleet Age, Registration Year 2003 - 2011									
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
21+ yrs.	1388	1338	1296	1291	1310	1288	1264	1238	1364
11-20 yrs.	15757	16410	16584	17443	18097	18868	20272	21525	22712
10 yrs. and newer	30220	30544	30901	31732	31957	30688	28922	27357	25920
Total	47365	48292	48781	50466	51364	50844	50458	50120	49996

Figure 3: Tigard Vehicle Fleet Age Mix, Registration Year 2003-2011

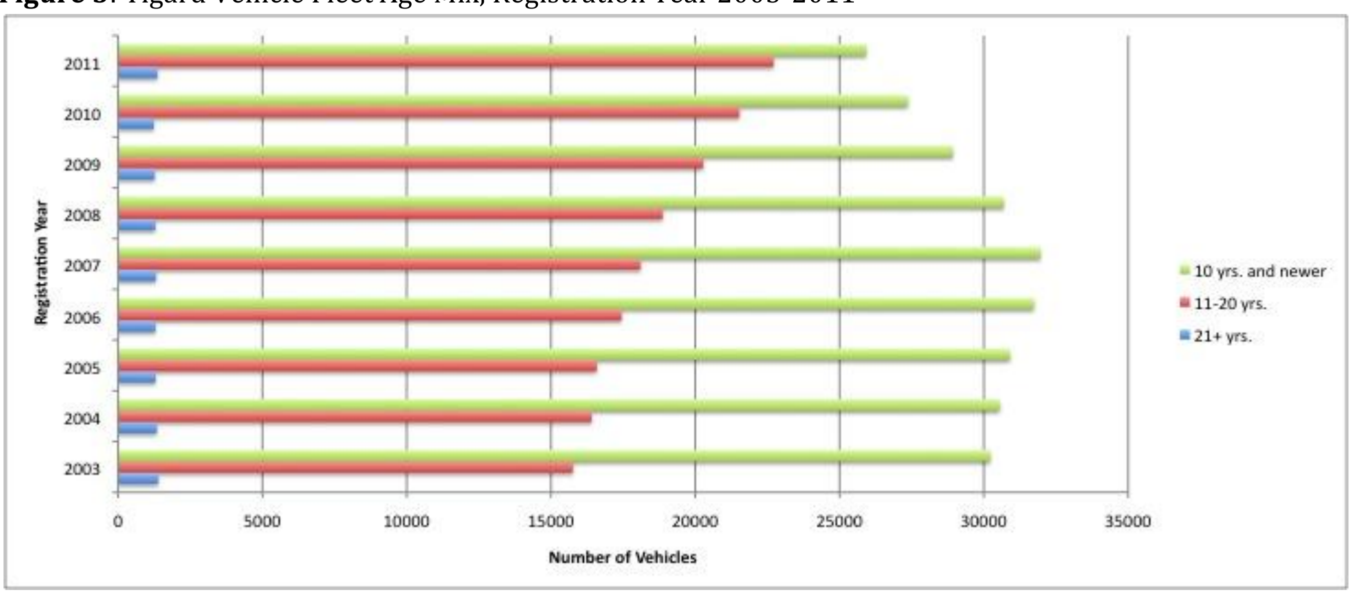
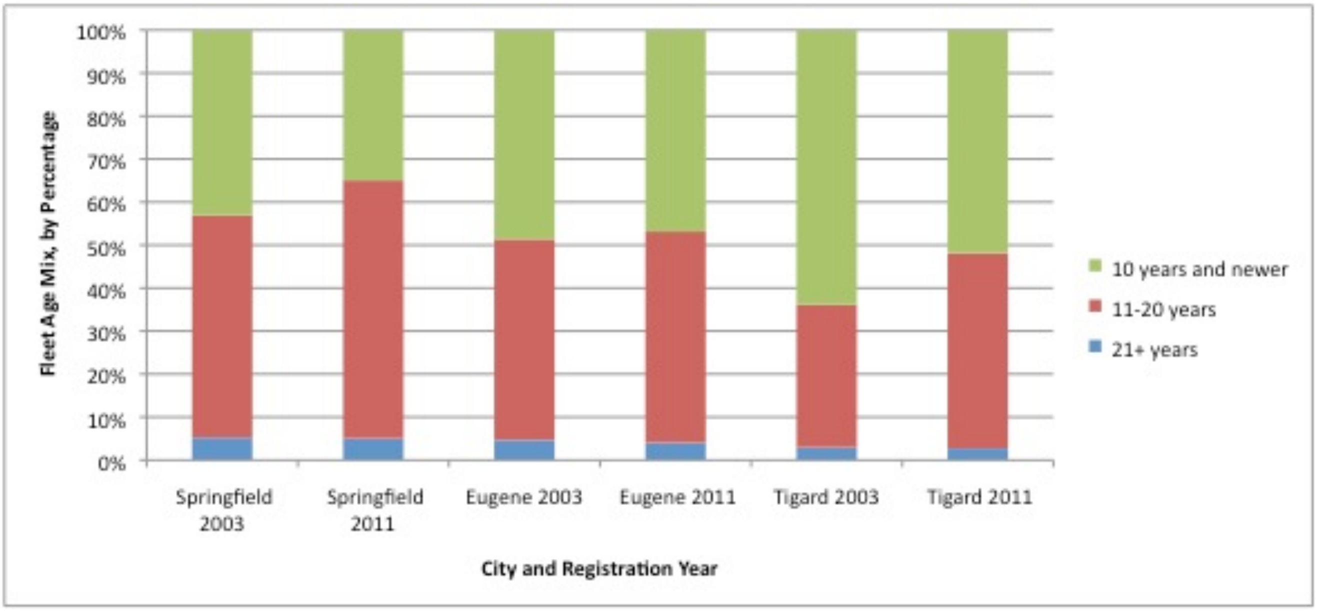


Table 4: Cities' Fleet Age Mix in 2003 & 2011, As Percent of Total Fleet

Cities' Fleet Age Mix in 2003 & 2011, As Percent of Total Fleet						
	Springfield 2003	**Springfield 2011**	**Eugene 2003**	**Eugene 2011**	**Tigard 2003**	**Tigard 2011**
21+ years	5.26%	5.02%	4.66%	4.07%	2.93%	2.73%
11-20 years	51.71%	60.03%	46.73%	49.06%	33.27%	45.43%
10 yrs/newer	43.03%	34.96%	48.61%	46.87%	63.80%	51.84%

Figure 4: Cities' Fleet Age Mix in 2003 & 2011, As Percent of Total Fleet



Vehicle Miles Traveled

The VMT metric provides an estimate of the number of miles vehicles travel within a given boundary over a given period of time. VMT calculations should always be considered an *estimate*, not a *count*, because myriad factors affect travelers' behavior on a daily basis that influence their actual routes and miles driven. These figures allow federal, state and local agencies to calculate statistics on vehicle fuel efficiency and air quality, among others. At the federal level, the U.S. Government has committed to a goal of reducing VMT via a number of policies, including the Clean Air Act, the President's 1993 Climate Change Action Plan, and the Congestion Mitigation Air Quality Improvement Program.[15]

Locally, VMT estimates assist planners in determining where transportation and infrastructure funding should be allocated, estimating greenhouse gas emissions from surface transportation along with gas and diesel consumption, and assessing the impact of traffic on a given location or

[15] US DOT/FHWA/OHPI/HPMS. "Reducing Vehicle Miles Traveled -- Statutory Language." (N. D.). Retrieved 8 March 2013 from https://www.fhwa.dot.gov/ohim/epastat.cfm.

corridor.[16] These estimates will continue to play an important role as states and municipalities respond and adapt to climate change and the economic, public health and environmental concerns related to air quality. They also may shape future issues of mobility and accessibility as part of regions' sustainable transportation plans. Because of their significance, it is important that analysts and policymakers understand VMT estimates' potential and their limitations.

Municipalities, regions and states may use a variety of methods to estimate VMT on their functional classes of roads, from local streets to interstates. The two most common, and most relevant to the local area, are discussed below.

Highway Performance Monitoring System

The Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS) is based on traffic counts and is the country's most widely accepted method for estimating VMT.[17] Cities, counties and states collect HPMS data and provide it to the state's Department of Transportation (DOT) for processing. These counts act as a snapshot of data taken over a 24-hour period to obtain the average annual daily traffic (AADT).[18] The counts are used to characterize traffic in a given area and a statistical model applied to the samples estimates traffic volumes over the entire road network.[19] On Oregon State highways, ODOT performs counts on different roads every three years, such that after three years, all roads have been sampled.[20] Many cities or counties lack the resources to conduct the same frequency and rigor of sampling, but they submit the traffic counts they have to ODOT to be included in the HPMS process.[21] ODOT processes the data and submits the HPMS VMT estimates to FHWA. Figure 5 below illustrates the path HPMS data takes from collection to the FHWA, and, eventually to Congress, where it plays an important role in strategic planning and funding.

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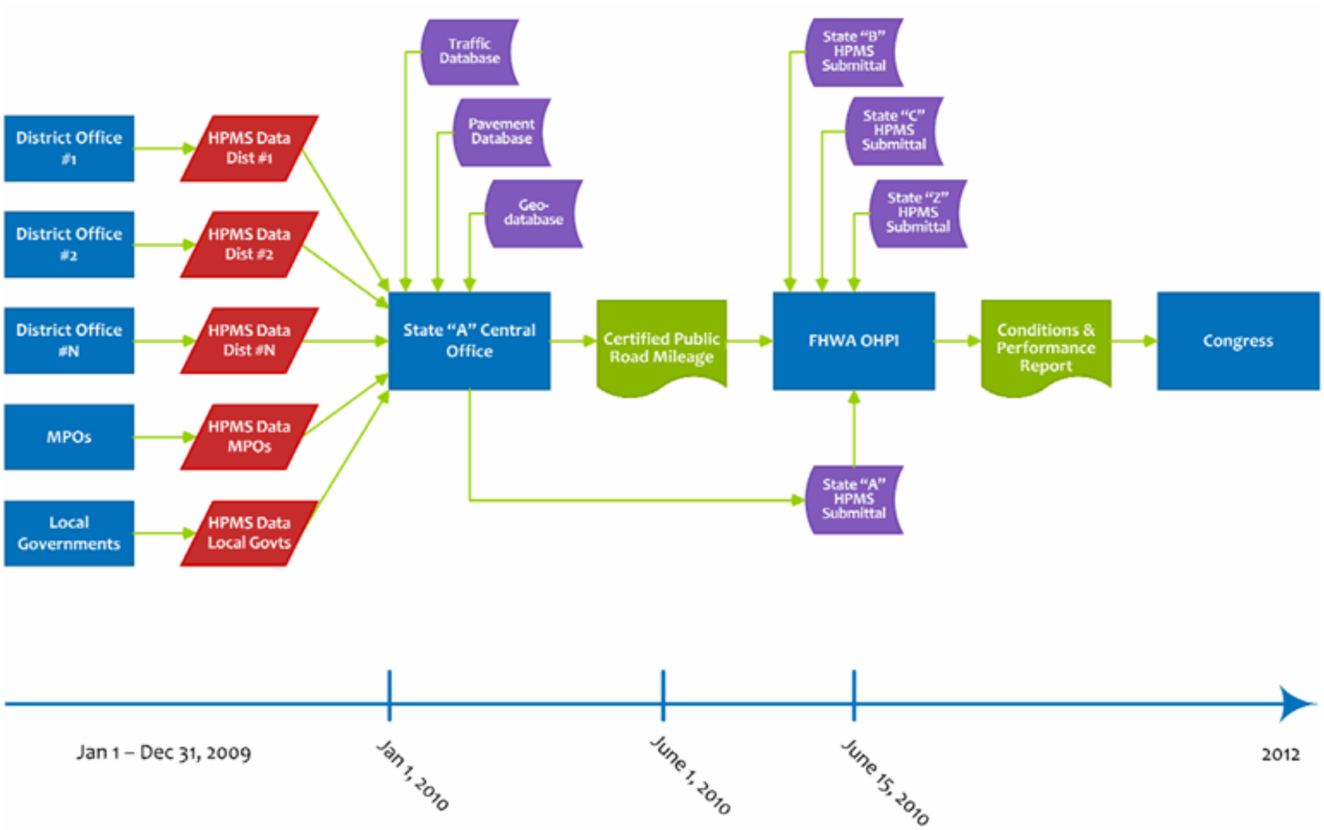
[16] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*.
[17] Ibid.
[18] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*. df
[19] Susan G. Payne. Central Lane Metropolitan Planning Organization, Lane Council of Governments, Senior Planner (personal communication, March 11, 2013).
[20] Ibid.
[21] Ibid.

Figure 5: HPMS Data Processing Cycle[22]



HPMS is designed to reveal VMT in a consistent manner across the country. In order to produce accurate results, those calculations must be performed in the same way each time. Equations executed by HPMS can be found in the HPMS Field Manual[23] and in Kumapley and Fricker's discussion of methods for estimating VMT[24]. HPMS is useful for comparing VMT trends over time and in different locations. According to a 2008 Washington Department of Ecology report,[25] trends in changes in driving behavior are only identifiable over a five-year minimum period. The report also notes that VMT is a good indicator of actual miles traveled at the state and county levels, but that it is less accurate below the county level. There are several recognized shortcomings of the HPMS method. These concerns tend to revolve around incomplete data sets due to lack of information on certain functional classes of roads, as well as a concentration on federal-aid roads.[26]

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[22] US DOT/FHWA/OHPI/HPMS. "Field Manual: Chapter 1." (N. D.)

[23] US DOT/FHWA/OHPI/HPMS. "Field Manual: Chapter 1." (N. D.)

[24] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*.

[25] "Vehicle Miles Traveled: Measurement." (2008). Retrieved 6 February 2013 from http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/tran/071308_vehicle_miles_traveled.pdf.

[26] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*.

Regional Travel Demand Model[27]

The regional travel demand model is designed to *forecast* traffic volumes, mode share and other important attributes on area roads. The model is based on survey data and is calibrated every time new base year information becomes available. It is integrated with a land use scenario describing the locations of local jobs and homes. The model forecasts trips that take place based on destinations to which people need to travel. These trips include ones made by workers going to their jobs, shoppers going to the store, etc., as well as the travel mode they use, including biking, walking, transit or personal automobile. The model distributes the trips across the region's roadways so that they go from the point of origin to their destination. Travel volume is determined by adding up those trips on each segment of the travel network. To determine vehicle miles traveled, the model multiplies the volume by the length of the roadway segments that was used to compute the volume.[28]

Modeling scenarios are also subject to uncertainties, as they are dependent on the accuracy and currency of the data upon which they are based.[29] Again, regional VMT forecasts are best used as an estimate to reflect trends over time, and not as a specific measurement.

Lessons Learned

The following recommendations aim to provide information to the City of Eugene and its partners to enhance data collection techniques and outcomes related to state and local vehicle fleets, fuel consumption and VMT.

Data Consistency

The DMV data provided for this research contain inconsistencies in vehicle make and model coding, as well as missing inputs on many vehicles' model types. These trends suggest the Oregon DMV is using a system to input its vehicle registration data that does not take full advantage of database opportunities to reduce user error. As such, we recommend that a database system with a "drop-down list" model be implemented to reduce discrepancies in vehicle make and model naming and ensure that all categories are completed when submitting registration data for each vehicle. Improving the accuracy of vehicle registration data will streamline future research into fuel consumption and VMT. In the coming years, local, state and federal governments will likely require increasing amounts of data on fleet fuel consumption pending carbon regulation or pricing

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[27] Susan G. Payne. Central Lane Metropolitan Planning Organization, Lane Council of Governments, Senior Planner (personal communication, March 11, 2013).

[28] Ibid.

[29] Kumapley, Robert and Jon Fricker. "Review of Methods for Estimating Vehicle Miles Traveled." (N. D.). *Transportation Research Record 1551*.

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scenarios. Adapting Oregon databases now is a proactive measure that will improve and increase information flows and serve as a model for other states.

Opportunities for Data Collaboration

Updated Oregon DMV vehicle registration databases can be enhanced by incorporating the Environmental Protection Agency's fuel economy data[30] so that it automatically populates additional cells in the database with the desired information (e.g. city mpg, highway mpg, engine size, etc.). Linking the DMV data with EPA's fuel economy statistics will make its information much more robust, easily accessible to a variety of users without employing sophisticated modeling techniques, and more useful to agencies and organizations interested in transportation, infrastructure, and the overarching themes of health, the environment and an economy transitioning away from carbon.

Recommended Next Steps

The following are recommended next steps for further research, data collection, analysis of VMT, and gas and diesel consumption data. These recommendations should be conducted with the intent of grasping a more complete understanding of why Eugene's consumption levels and VMT trends are unique. With a better understanding of what affects these trends and recognizing which data sets are most important, actions can be taken towards applying that new information to other municipalities.

Test Theory List

- Collect quantitative data for each trend and program from master list of theories. Look at specific level of effect each theory has on gas and diesel decline.
- Continue hypothesizing about other contributing factors to gas and diesel consumption decline.

Further Data Comparisons

- Compare existing data to a wider range of similar towns and regions nationwide. Look into similarly progressive towns and universities with similar demographics and/or hybrid and electric vehicle adoption rates (e.g. Boulder, CO; Davis, CA; Corvallis, OR; Salem, OR; Bellingham, WA).
- Contrast existing data to comparably-sized cities with similar and different traffic congestion trends to study the effects of congestion on fuel consumption.[31]

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[30] U.S. Dept. of Energy. *The official U.S. government source for fuel economy information.* Web. http://www.fueleconomy.gov/feg/ws/index.shtml.

[31] Eugene Register-Guard and News Service Reports. "Congestion? Not so much." (February 2013). Retrieved 20 February, 2013 from http://rgnews.registerguard.com/web/updates/29467143-55/traffic-congestion-cities-spent-cost.html.csp

Larger-Scale Data Analysis

- Review longer history of gas and diesel consumption in Eugene. Study older data to help understand VMT and reduction trends.
- Review whether separating Eugene and Springfield's fuel consumption data is the most accurate way to compare it to regional VMT.

Conclusions

This analysis is one step of many that will help inform the City of Eugene and other Oregon municipalities of the potential trends that may be affecting local gasoline and diesel consumption. To achieve significant greenhouse gas emissions reductions and face an uncertain climate future, a number of actions will be required. Based on these findings and recommendations, this report supports a vision of a future Eugene that depends less on fossil fuels and more on its engaged and proactive community and government.

Appendix

A. “Regional and State Fleet Composition Comparison.”
Josh Roll. Lane Council of Governments, Transportation Planner. March 2013.

B. “Estimated Vehicle Miles Traveled in Eugene-Springfield.”
Provided by City of Eugene. February 2013.

To: OLIS Students and City of Eugene
From: CLMPO: Josh Roll
Date: 3.6.13
Subject: Regional and State Fleet Composition Comparison

The following information is presented regarding the observation that fuel consumption at Eugene fuel stations has decreased by more (in percentage terms) between 2003 and 2011, relative to Eugene's closest neighbor Springfield as well as the state and other jurisdictions within the state. Three attributes (Vehicle Ownership, Age, Fuel Efficiency) of the fleets were examined in order to gain a better sense of how the vehicles in each jurisdiction may be affecting fuel consumption. The outputs are broken down into *All Vehicles* and *Vehicles Newer than 1978* since the Environmental Protection Agency (EPA) data on fuel efficiency only had data on vehicles from 1979 onward. The proportion of vehicles older than 1978 was typically low, ranging from 2%-9% depending on the jurisdiction and snap shot year (See Table A.)

Table A.

Proportion of Vehicles Older than 1978									
	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***
Eugene	8%	7%	6%	5%	5%	4%	4%	4%	3%
Springfield	9%	8%	7%	6%	6%	5%	5%	4%	4%
Tigard	4%	4%	3%	3%	3%	2%	2%	2%	2%
WashingtonCounty	5%	4%	4%	3%	3%	3%	3%	2%	2%

Data Definitions

- DMV data – Data received from the City of Eugene describing the fleet make, model and year counts by jurisdiction by snapshot year. Make and model are in coded terms which truncate the names, e.g. "Toyota" and "Tacoma" would be "TOY" and "TAC".
- EPA data – Data pulled from EPA website and existing data sources describing vehicle fuel efficiency by operating mode by make, model, engine size (cylinders), and year. The make and model are in literal terms meaning they are full descriptive of the make and model.
    a. City – City Driving Mode
    b. Highway – Highway Operating Mode
    c. Combo – Combination of both City and Highway Operating Mode

- Population Research Center Data (PSRC) population data – This data comes from Portland State University PSRC and are estimates of population by jurisdiction for each year of interest. http://www.pdx.edu/prc/annual-population-estimates

1. Vehicle Ownership

Using DMV data and PSRC population data rates of vehicle ownership were calculated for each jurisdiction for the beginning and end years of available DMV data. Available DMV data on the number of vehicles is summarized in Table 1.1. It appears that the number of vehicles increased by less in percentage terms than any of the other jurisdictions.

Table 1.1

Vehicles Newer than 1978 Number of Vehicles by Jurisdiction										
	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	% Change from 2003-2011
Eugene	142,810	144,996	147,887	150,464	152,522	152,389	151,475	150,464	150,176	4.90%
Springfield	53,382	54,383	55,774	57,032	58,051	58,241	58,055	57,394	57,227	6.72%
Tigard	45,474	46,581	47,240	49,056	50,054	49,643	49,342	49,085	48,957	7.11%
WashingtonCounty	362,099	369,374	382,697	398,495	412,628	411,272	408,853	411,860	417,804	13.33%

Table 1.2 describes population by jurisdiction for 2003 and 2011. Interim years can be found at the PSRC website.

Table 1.2

Population by Jurisdiction										
	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	% Change from 2003-2011
Eugene	143,910								157,010	8.34%
Springfield	54,720								59,695	8.33%
Tigard	45,130								48,415	6.79%
WashingtonCounty	472,600								536,370	11.89%

Using the number of vehicles and the population we can then compute a vehicle ownership rate to see if the number of vehicles per person is changing and if that change is different across jurisdictions. Table 1.3 describes the rates for 2003 and 2011 and the change over that time. Eugene decreased its vehicle ownership rate by 3.75% with Springfield also decreasing its vehicle ownership rate by only by 1.76%. Both Tigard and Washington County both increased their vehicle ownership rates by 0.35% and 1.64% respectively.

Table 1.3

Vehicle Ownership Rate by Jurisdiction										
	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	% Change from 2003-2011
Eugene	0.992								0.956	-3.75%
Springfield	0.976								0.959	-1.76%
Tigard	1.008								1.011	0.35%
WashingtonCounty	0.766								0.779	1.64%

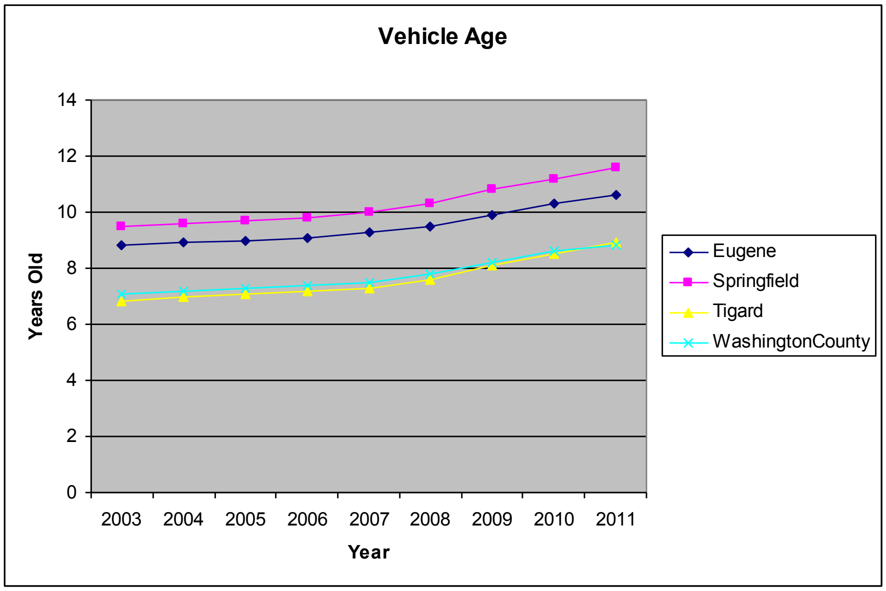
2. Vehicle Age

Using the DMV data a summary of vehicle age by snapshot year and by jurisdiction was created. Table 2.1 and Figure 2.1 describes this summary. Contrary to what would be expected if the fleet in Eugene was in facto newer and more efficient, the average age for vehicles 1978 and newer, Eugene and especially Springfield fleets are older by 2-3 years compared to the two other jurisdictions. The calculated average is consistent with the data from another DMV data set LCOG had on hand that details make, model and year for the entire state. Table 2.2 below details the average vehicle age by county. One thing to take note of is the relative stability in the age of vehicles up until the recession which seems to have caused people to hang onto their cars for longer resulting in greater average age for all jurisdictions. (Table 2.1)

Table 2.1

Vehicles Newer than 1978 Average Age of vehicles Only Vehicles newer									
Year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Eugene	8.8	8.9	9	9.1	9.3	9.5	9.9	10.3	10.6
Springfield	9.5	9.6	9.7	9.8	10	10.3	10.8	11.2	11.6
Tigard	6.8	7	7.1	7.2	7.3	7.6	8.1	8.5	8.9
WashingtonCounty	7.1	7.2	7.3	7.4	7.5	7.8	8.2	8.6	8.8

Figure 2.1



Vehicle Age
Years Old
14
12
10
8
6
4
2
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
Eugene
Springfield
Tigard
WashingtonCounty

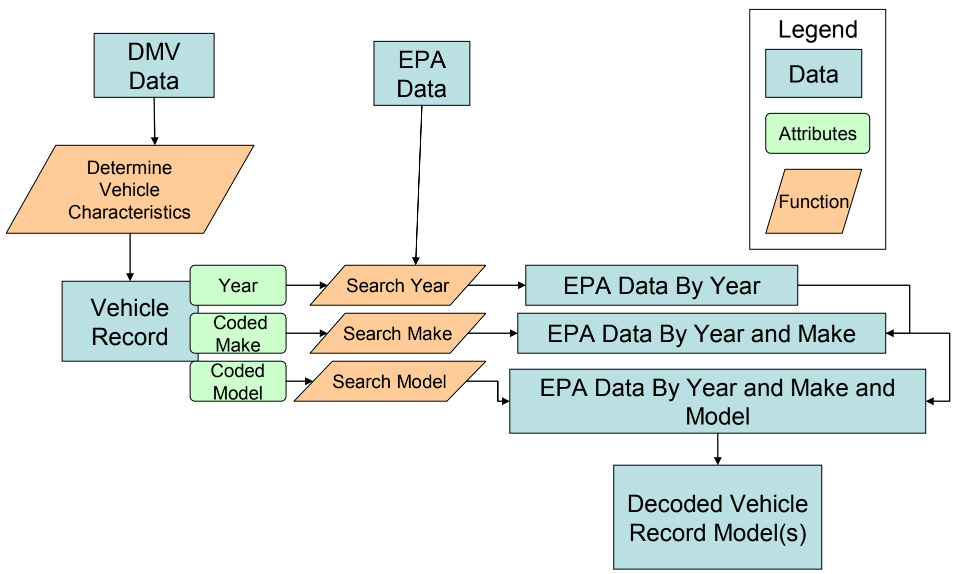
Table 2.2

2011 Statewide DMV Data	
Average Vehicle Age	County
11.8	Baker
10.8	Benton
9.9	Clackamas
11	Clatsop
11.6	Columbia
12	Coos
12.1	Crook
11.4	Curry
10.8	Deschutes
12	Douglas
11.3	Gilliam
12.3	Grant
12.3	Harney
11.4	Hood River
11.2	Jackson
12	Jefferson
12	Josephine
11.9	Klamath
12.4	Lake
11.4	Lane
11.1	Lincoln
11.8	Linn
11.7	Malheur
11.1	Marion
11.3	Morrow
9.8	Multnomah
8.4	Out of Country
6.3	Out of State
10.8	Polk
11.6	Sherman
11.7	State Owned Vehicle
11.4	Tillamook
11.3	Umatilla
11.4	Union
11.6	Wallowa
11.8	Wasco
9	Washington
12.2	Wheeler
11.4	Yamhill

3. Fleet Efficiency

Using a process coded in the R open source software platform, CLMPO ‘decoded’ the DMV data so that a city, highway, and combo operating mode fuel ratings could be appended to the data from official EPA data on mile per gallon by make, model, and year. The vehicle make and model information within the DMV data was presented in a coded form as explained above in the data description section whereas the EPA data had full descriptions of the vehicle make and model. This reality make a simple join of the data impossible and required the implementation of some fuzzy logic within the processing. Fuzzy logic works by identifying a pattern to search for within a sample data set. So if we have a coded make and model for a Toyota Tacoma is TOY and TAC respectively then we search using those coded values and should identify the pattern “TOY” for Toyota (TOY = TOYata) and TAC for Tacoma (TAC = TAComa). The search is hierarchical and first limits the search by year before trying to find a Make match but once the process limits the records by year and Make then a model is searched for within a usually small number of available possibilities. The process is described in Figure 3.1

Figure 3.1



The process was not able to assign an MPG to any vehicles older than 1979 because there was not data on MPG available for those vehicle years. After removing vehicles older than 1979 from the DMV data, there were still a proportion of the records in which an MPG could not be assigned. Table 3.1 details the percentage of vehicles by year and by jurisdiction where no MPG was assigned and which will be removed from further analysis. These vehicles are vehicles that were not in the EPA data likely because they were heavier duty trucks that made deliveries but would not typically be included in the EPA data. Motorcycles were also not assigned an MPG though they typically represent a small proportion of vehicles and vehicle miles traveled.

Table 3.1

Vehicles without an assigned MPG as Percentage of all vehicles newer than 1979									
	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***
Eugene	34%	8%	9%	9%	9%	10%	10%	10%	10%
Springfield	32%	8%	9%	9%	10%	10%	10%	10%	10%
Tigard	34%	7%	7%	8%	8%	9%	9%	9%	9%
WashingtonCounty	34%	7%	8%	9%	9%	9%	10%	10%	10%

It is unclear what was going on with the data in the 2003 sample but the data appears to be worse than the other years resulting in a much higher proportion of vehicles not getting an MPG assigned. The rest of the years for all jurisdictions are reasonable, I think, with up to 10% of the data needing to be removed, leaving the analysis with a 90% sample.

A major limitation to the assignment process is that the DMV data did not have engine size or the number of cyclinders. These two attributes can affect a vehicle's MPG considerably and reduce the clarity by which the MPG assignment was done. Without engine size and cylinder information, all MPGs for a particular make and model were averaged and then assigned to that vehicle. This is a major limitation to the final MPG assignment because it could be that of all the Toyota Tacomas in any of the jurisdictions, most of them are 4 cylinder with an MPG of 19 in the city where as the 6 cylinder are MPG rating is 16 resulting in an average of 17.5. These differences are not great but some vehicles engine sizes can have a much bigger effect, sometimes being different by as much as 10 MPG or more.

Also, in some cases the fuzzy logic was not able to distinguish between very similarly named model types. For instance the coded model type for a Volkswagon Passat is "PAS" which the logic was unable to distinguish between a "Passat" and a "Passat Wagon". Not sure how much of an issue this is but there is more variation between models with different engine sizes than there is in different versions of the same model like in the example of the Passat.

The results of averaging the MPG by operating mode by year and jurisdiction seem to indicate very little difference in average fleet efficiency between the jurisdictions for all of the driving models. Further, the average fleet efficiency did not change considerably between 2003 and 2011, only by between 2% and 5% depending on the mode and jurisdiction. Tables 3.2 – 3.4 and Figures 3.2 – 3.4 detail these outcomes for city, highway and combo driving modes.

Table 3.2

Mpg Change over time for City										
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	Change from 2003 - 2011
Eugene	17.61	18.19	18.12	18.09	18.1	18.17	18.22	18.28	18.39	104%
Springfield	17.47	17.99	17.86	17.75	17.69	17.68	17.69	17.68	17.75	102%
Tigard	17.53	17.92	17.86	17.81	17.82	17.91	18	18.07	18.21	104%
WashingtonCounty	17.55	18	17.94	17.89	17.94	18.04	18.12	18.21	18.35	105%

Figure 3.2

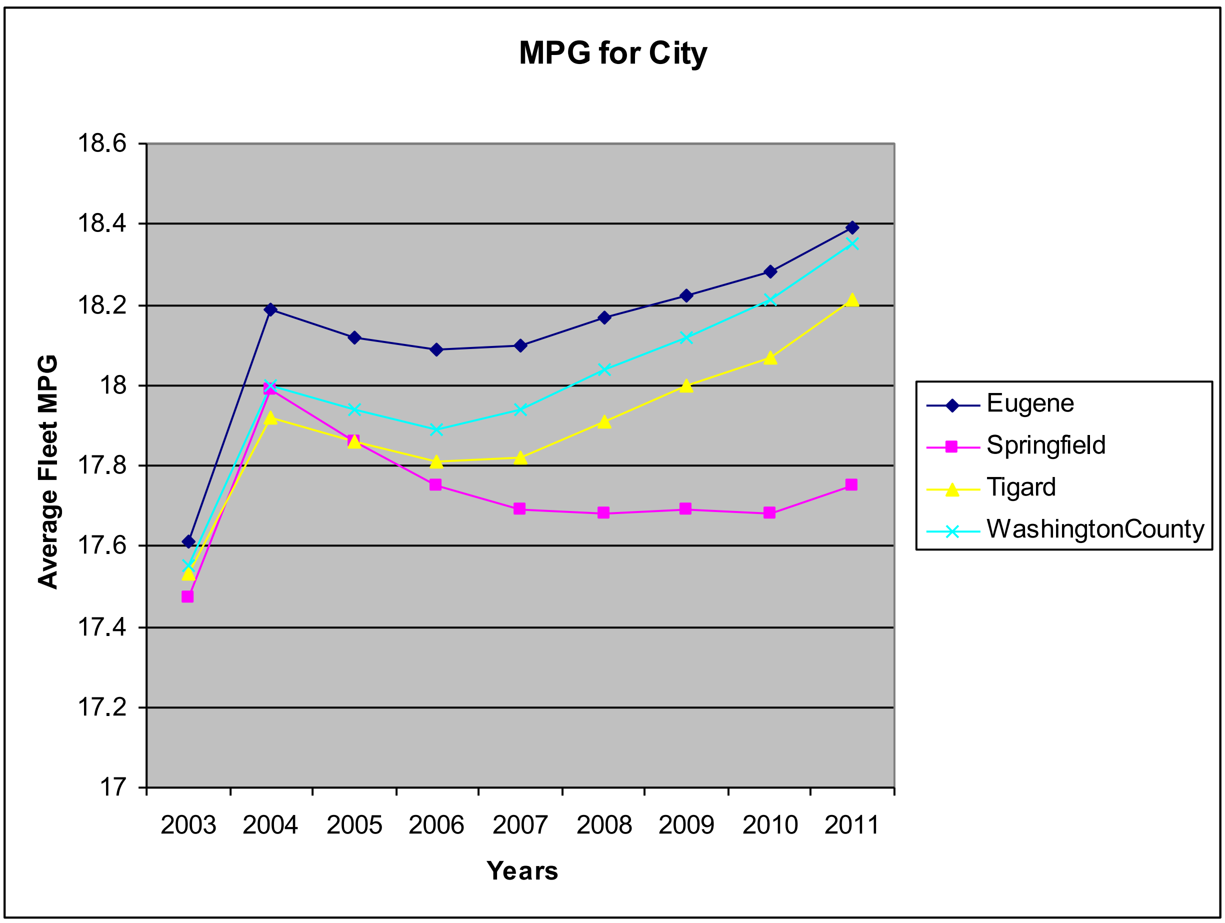


Table 3.3

Mpg Change over time for Hwy										
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	Change from 2003 - 2011
Eugene	23.64	24.35	24.26	24.19	24.17	24.24	24.28	24.33	24.46	103%
Springfield	23.49	24.17	24	23.84	23.75	23.73	23.73	23.72	23.78	101%
Tigard	23.54	24.14	24.1	24.02	24.02	24.11	24.21	24.27	24.44	104%
WashingtonCounty	23.57	24.21	24.18	24.1	24.13	24.24	24.33	24.44	24.61	104%

Figure 3.3

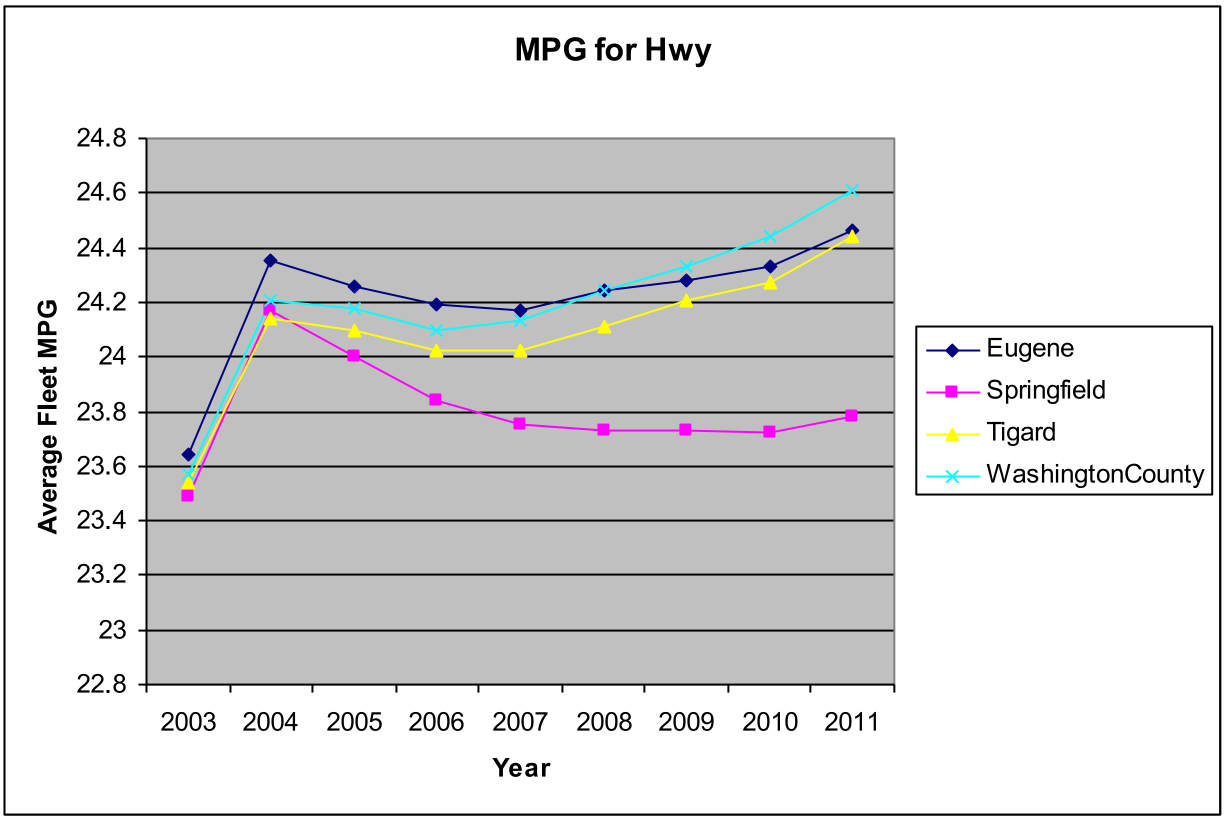
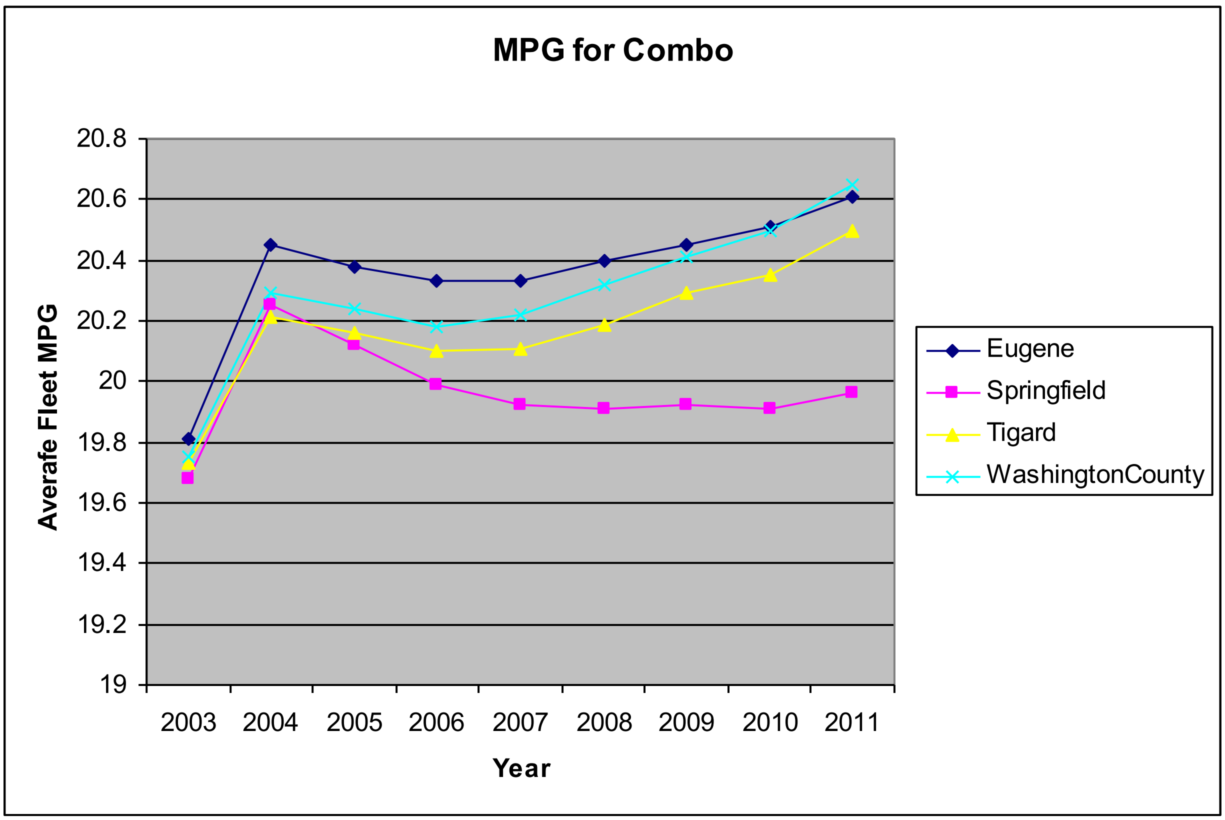


Table 3.4

MPG Change over time for Combo										
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	Change from 2003 - 2011
Eugene	19.81	20.45	20.38	20.33	20.33	20.4	20.45	20.51	20.61	104%
Springfield	19.68	20.25	20.12	19.99	19.92	19.91	19.92	19.91	19.96	101%
Tigard	19.73	20.21	20.16	20.1	20.11	20.19	20.29	20.35	20.5	104%
WashingtonCounty	19.75	20.29	20.24	20.18	20.22	20.32	20.41	20.5	20.65	105%

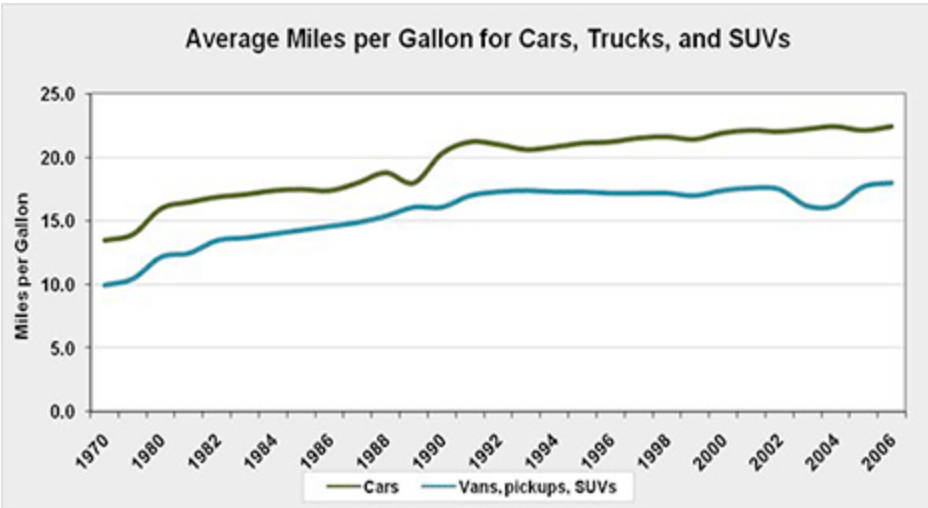
Figure 3.4



In regards to the question spawning this analysis, is Eugene's fleet more efficient?; the answer appears to be in the case for city driving mode yes but only marginally. For the other driving modes not so much and certainly not considerably.

This outcome should not be surprising since much in the way of engine efficiency for vehicles has been sacrificed for power over the last few decades. In an article put out by Bureau of Transportation Statistics it, the author demonstrates how fuel efficiencies have not gone as far as many would like since the 1970s. The graph in figure 3.5 doesn't include years beyond 2006 but a vast change would be unexpected.

Figure 3.5



Source: U.S. Bureau of Transportation Statistics

4. Discussion

The above results do not answer the ultimate question regarding the reason for less fuel consumption at Eugene stations compared to observed fuel consumption data from Springfield and the state stations. Of the fleet characteristics measured the analysis, the results of looking at age and mileage would indicate the opposite of what is observed in the fuel consumption data. The results from looking at vehicle ownership for the analysis, however, would support what is being observed in the fuel consumption data.

There are certain limitations in the way the data was processed in order to arrive at average fleet MPGs which lend less credibility to that part of the analysis. However, any even a highly reliable overall fleet MPG would still need to be considered knowing that the number of vehicles anyone particular vehicle traveled would have implications on the fuel consumption. For instance, the average fleet MPG might be 20 MPG but vehicles with 15 MPG drive 95% of the vehicle miles traveled rendering the *average* less meaningful.

The answer to the question regarding Eugene's substantial drop in fuel consumption is likely multifold. Less vehicle ownership, maybe a more efficient fleet (certainly more efficient relative to 2003, though maybe not relative to other jurisdictions), the kinds of travel (inner city versus long distance), mode shift(more travel done by active modes and transit), less trips because fewer people are employed(Lane County unemployment rate 8.2% whereas Washington County is

6.9%), and other factors that make the question very complicated. Another issue in all of this could be that fuel consumption for Eugene and Springfield should not be separated since they are in a single metropolitan area where residents from one area purchase fuel from the other. It's impossible to tell if that works out to a balance or if Eugene residents buy more from Springfield or vice versa. More work is definitely needed and the question is very interesting.

B. "Estimated Vehicle Miles Traveled in Eugene/Springfield."
Provided by City of Eugene. February 2013.