Central Lane Scenario Planning HIA

A Health Impact Assessment of Regional Health Impacts and Related Cost Savings from Greenhouse Gas Reduction

Lane County Public Health

ABSTRACT

Central Lane Scenario PlanningRegional Health Impacts and Related Costs from Greenhouse Gas Reduction Mitigation Health Impact Assessment Report | June 2015

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Summary of Findings

Climate change threatens human health and well-being in many ways, including impacts from increased extreme weather events, wildfire, decreased air quality, threats to mental health, and illnesses transmitted by food, water, and disease-carriers such as mosquitoes and ticks. Some of these health impacts are already being tracked in the United States. Climate change will, absent other changes, amplify some of the existing health threats the nation now faces. Certain people and communities are especially vulnerable, including children, the elderly, the sick, the poor and some communities of color.

As required by the 2009 Oregon Legislature, the Central Lane Metropolitan Planning Organization (Central Lane MPO) is assessing options for reducing greenhouse gas (GHG) emissions in the Central Lane MPO region, including the City of Coburg, City of Eugene, City of Springfield, Lane County, and Lane Transit District (LTD). The Central Lane Scenario Planning process (CLSP) looked at a variety of transportation polices to affect GHG reduction. These polices would affect GHGs in three ways: reduce driving or vehicle miles traveled (VMT), improve the fuel economy of the vehicle fleet, or reduce the carbon intensity of fuels used for transportation. The CLSP process evaluated the effectiveness of policies within each of these methods but ultimately held vehicle efficiency and the carbon intensity of fuel constant across all scenarios because it was determined that local agencies would have little control over these policies. Therefore, policies tested in alternative scenarios focused on reducing VMT and include increased transit service, increased diversion of vehicle trips to active transportation (walking and biking), changes in the cost to drive like gas taxes and parking, and changes in marketing and incentive programs that aim to get people to drive less or improve fuel economy for their vehicles.

To understand the potential for the policies under consideration to impact health, Lane County Public Health and the Central Lane MPO teamed up to conduct the Regional Health Impacts and Related Costs from Greenhouse Gas Reduction Mitigation Health Impact Assessment (HIA). HIA is a framework for understanding how program, project, and policy decisions could impact health using the best available public health evidence and local health data. This HIA used the robust literature review from the Climate Smart Scenario HIA[1] transportation data and policy information from Central Lane MPO, health data from Lane County Public Health, and a health impact modeling tool developed at Cambridge University called the Integrated Transport Health Impact Modeling Tool, or ITHIM.[2]

The HIA shows that the strategies and investments in land use and transportation systems under consideration not only protect health by reducing the risks of climate change, the investments may also improve the region's health by increasing physical activity, reducing overall traffic collisions, and improving air quality. With reductions in chronic disease and fewer traffic fatalities for drivers as a result in lower vehicle miles traveled, the region could prevent 20 premature deaths and save more than $30 million each year in health care costs by implementing the GHG reduction strategies and investments under consideration.

Physical activity

A planned-for increase in biking and walking is a key greenhouse gas-reduction strategy under consideration. The most significant and attainable health benefit of active transportation is increased physical activity. Increased physical activity from active transportation could account for as much as 95% of potential avoided deaths and 99% of potential avoided illness resulting from implementing the greenhouse reductions strategies under consideration.

We can improve our region's health and reduce premature deaths by increasing the number of people who regularly walk or bike to the library, school, work, church or store. A safe and convenient transportation system provides individuals with the flexible and healthy options they need to routinely choose more active modes of transportation. Prioritizing non-automobile users in the design and maintenance of streets not only increases the number of people who choose to bike and walk, it also increases the safety of all users and will facilitate walking, bicycling and use of public transit.

Traffic safety

Motorized traffic fatalities and injuries decrease but due to the increase in miles covered in active transportation modes, ITHIM shows the absolute numbers of pedestrian and bicycle fatalities will rise even as the rate decreases due to population growth. While physical activity benefits outweigh the risks of active transportation, effort should be made to mitigate traffic hazards for pedestrians and cyclists through traffic calming, street design and mode separation. Efforts should also be made to capture the 53% of 'interested but concerned' individuals in the region who would like to bike, but are worried about safety issues.

Air quality

Improved air quality is an important benefit of addressing GHG. The scenarios considered result in modest $PM_{2.5}$ reductions of 1%. ITHIM results predict a modest decrease in respiratory illness, heart disease cases associated with air pollution, and premature death of lung cancer patients from long-term $PM_{2.5}$ exposure.

ITHIM only incorporates long-term exposure to $PM_{2.5}$ and may underestimate health benefits associated with improved air quality. As suggested by the Portland Air Toxics Solutions Project, additional benefits may accrue from lower ambient ozone and air toxic concentrations.
There is no safe level of $PM_{2.5}$ exposure; seasonal air quality concerns from high winter $PM_{2.5}$ and high summer ozone events require regional solutions such as leading public efforts to change travel behavior in order to minimize health risk. Poor air quality can be localized and many vulnerable populations live near transportation corridors. Care should be taken to influence increased physical activity while minimizing exposure when designing active transportation facilities and adjoining transportation corridors.

Introduction

Oregon Climate Policy

In 2007 Oregon passed House Bill 3543, which sought GHG emission reductions of 10 percent below 1990 levels by 2020, and 75 percent below 1990 levels by 2050. Then in 2009 the Oregon Legislature enacted House Bill 2001, which required the Central Lane MPO to conduct scenario planning that would determine a preferred approach to meeting GHG reduction targets for 2035. Unlike Portland Metro, which was directed by H.B. 2001 to adopt the policies and strategies featured in the preferred scenario, the Central Lane MPO only needs to consider them. However, in July of 2014 the City of Eugene adopted the Climate Recovery Ordinance (CRO) which requires the city of Eugene to meet Climate and Energy Action Plan goals that seek to make all city-owned facilities and operations climate neutral by 2020, and to have the city operations and facilities as well as all businesses, individuals, and others working in the city to reduce fossil fuel consumption by 50 percent by 2030.

Central Lane Scenario Planning

Starting in 2013 the Central Lane Metropolitan Planning Organization (Central Lane MPO) initiated the Central Lane Scenario Planning (CLSP) process in response to House Bill 2001. This legislation funded and directed the Central Lane MPO to develop and select a set of strategies that meet greenhouse gas (GHG) targets for light-duty vehicles. For the Central Lane MPO area the state target stipulated a per capita reduction of 20% by 2035. While the primary purpose of the CLSP process was directed at GHG reduction the Central Lane MPO's partner agencies which include the City of Coburg, City of Eugene, City of Springfield, Lane County, and Lane Transit District (TD) were also interested in understanding the co-benefits of emission reduction strategies. Health impacts and outcomes were determined to be an important cobenefit to assess as a part of the overall CLSP process.

2035 GHG targets for Oregon metropolitan areas

per capita light vehicle GHG emissions reduction

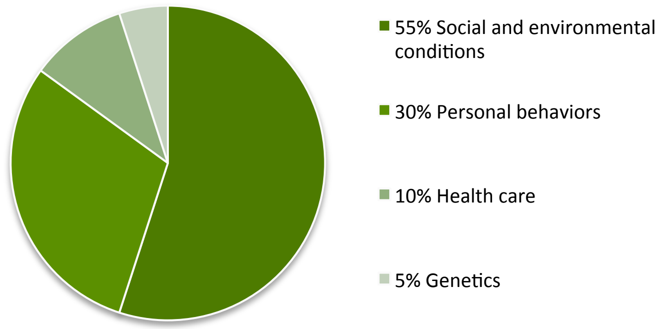
Metropolitan area	Adopted target[1]
Portland Metro[2]	20%
Salem-Keizer	17%
Corvallis	21%
Eugene-Springfield[3]	20%
Bend	18%
Rogue Valley	19%

[1] Adopted by the Land Conservation and Development Commission in May 2011
[2] Required scenario planning and adoption
[3] Required scenario planning

Central Lane MPO staff partnered with staff from Lane County Public Health with support from the Oregon Health Authority (OHA) to conduct a health impact assessment (HIA) of the GHG reduction strategies being evaluated for the CLSP process. HIAs provide decision-makers and the public with information about how a proposed policy, program or project may affect the health of people. Travel outcomes from the GreenSTEP tool were combined with the Integrated Transport and Health Impact Modeling (ITHIM) tool to assess health outcomes for different alternative scenarios in order to understand the health impacts and associated health care cost savings. This information was instrumental in helping CLSP staff select strategies for a preferred scenario that would meet the states GHG reduction goal.

Transportation, Land Use and Public Health

Health is more than an apple a day, or what happens in your doctor's office. Our health is made up of our genes and personal choices, but also by factors such as access family income, educational levels, and race. Public health professionals call these the social determinants of health. The World Health Organization's 2008 Commission on the Social Determinants of Health found that more than half of world-wide differences in health outcomes could be explained by the environments in which people live, work, and play. Our individual choices are based on the options available. Developing communities where people can make healthy choices can help all Oregonians reach their full health potential.



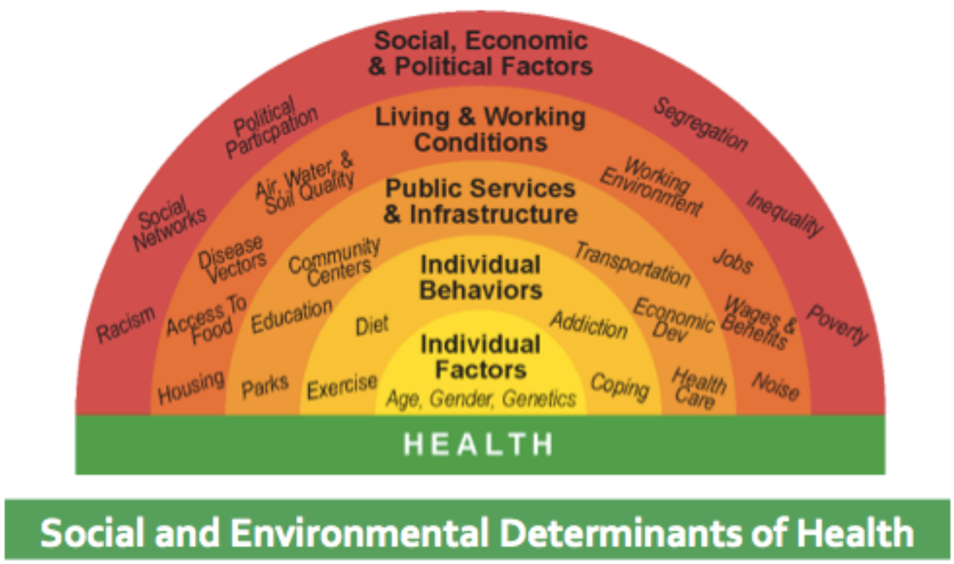


Image source: Whitehead, M. & Dahlgren, G. (1991). What can we do about inequalities in health? *The Lancet, 338*, 1059-1063.

Cancer and heart disease are currently the top two "underlying causes of death," accounting for 48% of all deaths in Oregon. This reflects a larger trends of chronic disease such as heart disease, Type II diabetes and cancer surpassing communicable and infectious disease as the primary cause of mortality (death) and morbidity (illness) in high-income countries such as the U.S. Behaviors linked to these chronic diseases, such as tobacco use, physical inactivity, poor diet, and alcohol and drug use have been identified as top risk factors for illness and death in Canada and the United States.

Overall, the five leading causes of death in Oregon and in Lane County in 2010, the most recent year for which we have complied and analyzed all data, were cancer, heart disease, lung disease, stroke, and unintentional injuries (including car crashes). Transportation and land use policies, plans, and investments can impact each of the leading causes of death in Oregon by influencing traffic safety, air pollution, physical activity, housing options, and access to community resources such as parks, schools, and living wage jobs.

Physical activity

The CDC recommends 150 minutes per week of moderate physical activity for adults. Meeting this goal can increase life expectancy and reduce expensive and debilitating diseases. Nearly half of all Oregonians do not meet this recommendation, and only 25% of of Lane County adults report meeting the CDC's physical activity guidelines. In 2013, just over half of Lane County 8th grade students (52%) and only one-third of Lane County 11th grade students reported walking to school 1 or more days per week. Only 13% and 8% of Lane County 8th and 11th grade students, respectively, reported riding a bike to school 1 or more days per week.[3] Similarly, according to the American Community Survey 16% of Lane County residents ages 16 and over report active modes of transportation to and from work.[4]

The CDC recommends 150 minutes per week of moderate physical activity for adults. Meeting this goal can increase life expectancy and reduce expensive and debilitating diseases. 75% of Lane County adults do not meet this recommendation.

People who get physical activity while getting around their communities are much more likely to meet physical activity goals.[5] Many of the planned investments and actions have been shown to increase walking, biking and use of transit and reduce how often and how far people drive to meet their everyday needs. This will likely add 20–30 minutes of additional daily physical activity for individuals who shift to more active modes, greatly reducing the physical inactivity disease burden.

Traffic Safety

The risk of injury and premature death for bicyclists and pedestrians is significantly higher than for car drivers and passengers.[6] However, even when considering the combined risks of traffic crashes and exposure to pollutants, researchers have concluded that the health benefits of physical activity from active transportation greatly outweigh the risks.[7] Further, reductions in driving that result from increases in biking and walking will reduce air pollution and improve traffic safety for everyone.

The design of the places where people drive, take transit, bike and walk matters

The design of our streets and communities directly impacts the safety of people biking and walking, and how often they choose active transportation. A transportation system with many safe and convenient options provides people with flexible and healthy choices needed to routinely shift modes from single occupancy vehicles to more active modes of transportation. [8]

Health equity
Research clearly establishes that where we work, play, eat and live is as important to our health as our genes, our behaviors and our medical care. Social, physical, and economic environments, and conditions, called "social determinants of health," have dramatic implications for how long and how well people live.[9,10] These "social determinants of health" vary within Lane County's metro region and include aspects such as educational attainment; income; access to healthy food, safe environments to walk or bike and access to other goods or services; and housing. Transportation plays a key role in assuring equitable access to many of these determinants and can help to mitigate some of the current disparities that exist.

In Oregon, as well as across the nation, communities of color and low-income communities have poorer overall health outcomes than almost every other group. These health inequities are rooted in social injustices that make some population groups more vulnerable to poor health than others. We know, for example, that too many people lack access to nutritious food, sidewalks and parks, smoke-free air and other healthy options. This is particularly true for African Americans, Asian Pacific Islanders, Latinos, Native Americans, low-income individuals, people with disabilities, immigrants, refugees, and other underserved populations. As a result, these communities suffer from chronic diseases at much higher rates than the rest of the population. For example, the neighborhoods of Trainsong (Census Block 4200) and Bailey Hill (Census Block 4405) are within only a few miles of each other in the City of Eugene, however health outcomes and social conditions differ noticeably (Table 2).

Table 1 Social Determinants of Health in the Trainsong and Bailey Hill Neighborhoods

Social Determinant	**Trainsong (4200)**	**Bailey Hill (4405)**	**Lane County**
Age-adjusted Years of Potential Life Lost (YPLL)	11,892	3,044	6,537
Body Mass Index (BMI)	26.2	25.2	26.6
High School Attainment	85.2%	97.4%	90.4%
Median Income	$21,713	$87,216	$46,388
% Above Poverty	56.9%	94.2%	83.4%
Housing Costs >30%	56.1%	29.7%	39.0%
Hispanic	14%	4%	6%

Transportation infrastructure and service can vary significantly between communities. Not all residents of our state have equal access to healthy transportation options and health-promoting community resources. Some populations, such as people of color and older adults, also bear a disproportionate burden of disease.[11] Transportation systems have the potential to either alleviate or exacerbate existing health disparities.

Assessing Health Impacts of Future Transportation Policy Choices

The Central Lane Scenario Planning (CLSP) process looked at a variety of transportation polices to affect GHG reduction. These polices would affect GHGs in three ways: reduce driving or vehicle miles traveled (VMT), improve the fuel economy of the vehicle fleet, or reduce the carbon intensity of fuels used for transportation. The CLSP process evaluated the effectiveness of policies within each of these methods but ultimately held vehicle efficiency and the carbon intensity of fuel constant across all scenarios because it was determined that local agencies would have little control over these policies. Therefore, policies tested in alternative scenarios focused on reducing VMT and include increased transit service, increased diversion of vehicle trips to active transportation (walking and biking), changes in the cost to drive like gas taxes and parking, and changes in marketing and incentive programs that aim to get people to drive less or improve fuel economy for their vehicles.

The initial step of the CLSP process was to establish what plans and policies currently adopted or under consideration of adoption would achieve in terms of GHG reduction in 2035. It was found that current plans and policies would only achieve a 3% reduction in per capita GHG emissions for light-duty transportation, short of the 20% reduction goal laid out by H.B. 2001. The CLSP process then moved forward testing the effectiveness of policy bundles, or groups of individual policies on reducing GHGs. Individual policy bundle sensitivity test results are presented in Figure 1 below. Ultimately, over 108 different scenarios were tested with the results informing the formation of two alternative scenarios and later the preferred alternative scenario.

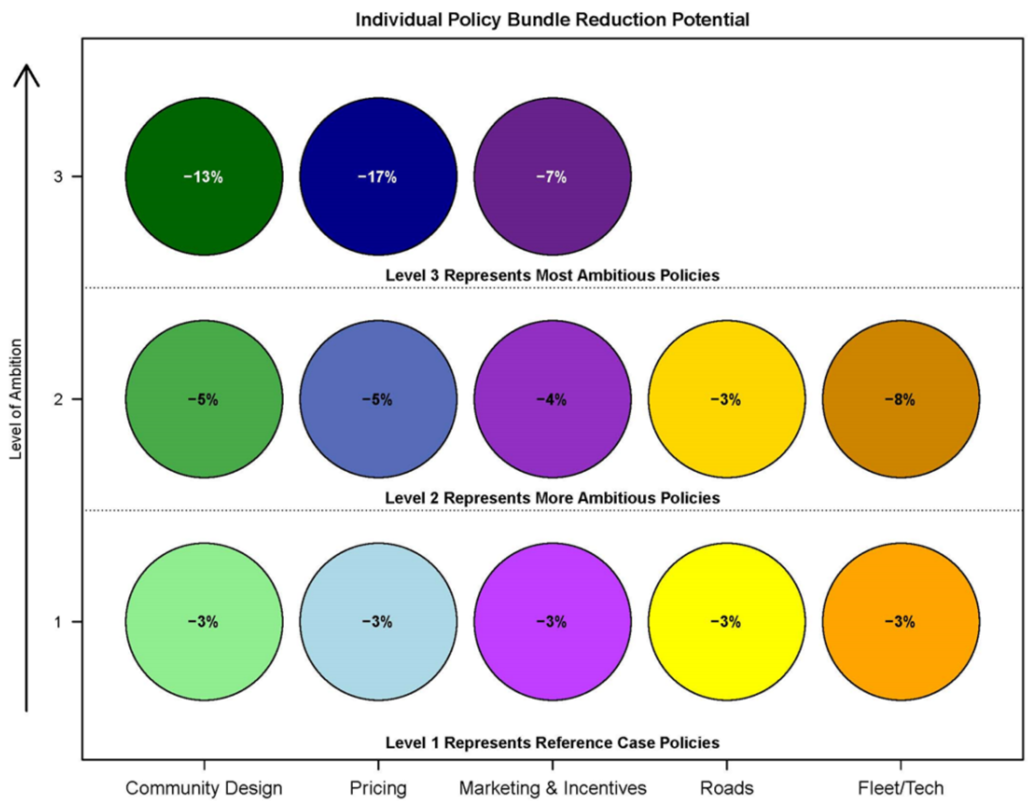


Figure 1

Alternative Scenario Health Assessment

Analysis was done to understand the health impacts of the first set of alternative scenarios in comparison to the reference case for 2035. The alternative scenarios represented changes compared to the reference case with increases in transit service and the expected diversion of driving to bicycling as well as changes to the way and amount people pay to drive. Appendix H.1 details the transportation policy changes. In short, the reference case (Scenario A) assumes a doubling of bicycle miles traveled in the base year, with further increases modeled in Scenarios B and C. LCOG used the Integrated Transport and Health Impact Model (ITHIM) to estimate changes in the burden of disease resulting from the scenarios. Developed at Cambridge University, ITHIM is a modeling tool that uses comparative risk assessment methods to estimate health impacts of changes in transportation behavior. ITHIM outputs suggest positive health benefits for all scenarios (Figure 2) and a reduction in associated health care costs (Figure 3). Detailed results for health outcomes are presented in more detail in Appendix H.2 and detailed health care cost savings results and methodology are included in Appendix H.3.

Scenario A (Reference Case) is expected to result in 4.7 annual avoided deaths in 2035. Increased physical activity is expected to result in 6.8 avoided deaths in Scenario A; however, ITHIM projects an increase of 2.1 traffic fatalities. ITHIM suggests that Scenario B would result in approximately 18.5 fewer deaths annually by 2035 with 19.3 avoided deaths attributable to increase physical activity. Scenario C would result in 28.9 avoided deaths.

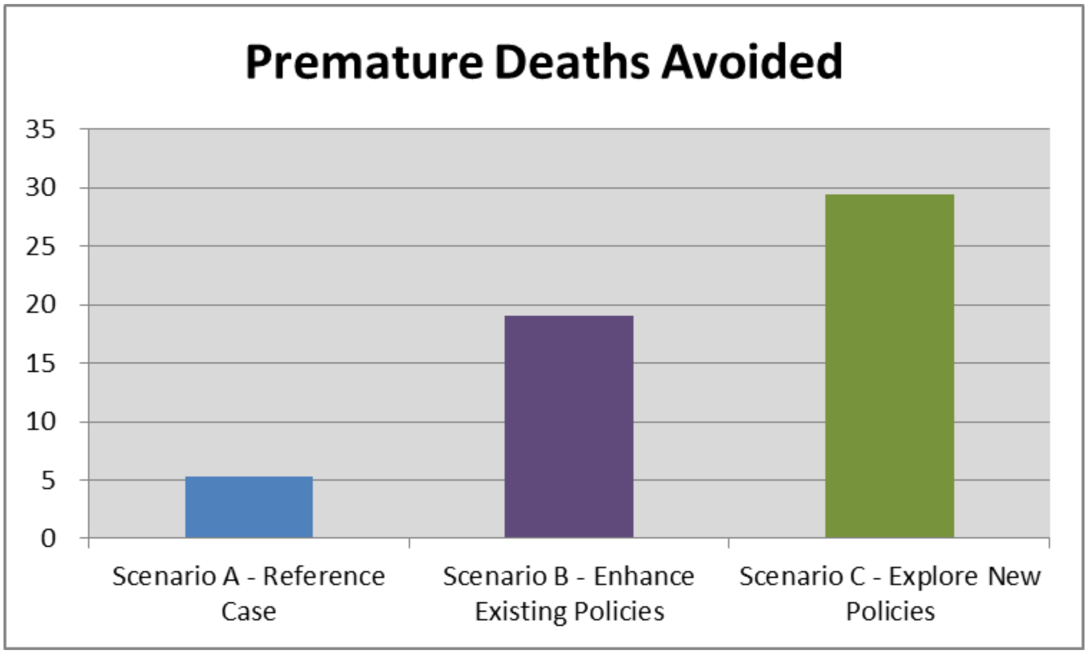


Figure 2

Chronic diseases are associated with transportation and land use policies and infrastructure; these diseases such as diabetes, cardiovascular disease, and some cancers are also costly and impact the greater regional, state, and national economies. Health care spending has been growing quickly and based on recent trends, is outpacing the growth in the overall economy. If this pace continues, health care spending could overtake spending on other vital sectors of the economy. Health care costs also affect businesses and families. Reducing the annual growth rate of health care spending by 1.5 percentage points is estimated to increase household income for a typical family of four by $2,600 in 2020.[12] Businesses benefit from lower health care expenses and reduced illness in the form of lower health care benefit costs and higher productivity. This assessment used two methodologies to estimate net changes to health care costs resulting from the proposed strategies and investments: a value of statistical life, and a cost of illness approach. A summary of results are below, and detailed results are in appendix H.3.

Avoided Mortality

The net benefit of avoided mortality from increased physical activity countered by decreased traffic safety is 4.7 lives annually for Scenario A, 18.5 for scenario B, and 28.9 for Scenario C. Applying the central guidance figure from the U.S. DOT, these lives should be valued at $41 million, $160 million, and $250 million annually. The VSL range is provided in the table below.

Table 1. Valuation of Net Benefit of Avoided Deaths using VSL by Scenario

Physical Activity and Traffic Safety			
	Scenario A	**Scenario B**	**Scenario C**
Avoided Deaths	4.7	18.5	28.9
VSL - Median	$41,000,000	$160,000,000	$250,000,000
VSL - Low	$23,000,000	$91,000,000	$140,000,000
VSL - High	$58,000,000	$220,000,000	$350,000,000

Avoided Morbidity

Residents living within the Central Lane MPO spend approximately $740 million annually on chronic diseases such as cancer, heart disease, stroke and diabetes that could be impacted by changes in physical activity and traffic safety. That total is both direct (health care expenditures) and indirect (absenteeism – included with the exception of cancer outcomes) costs; approximately 40% of all health care costs are paid by Medicare and Medicaid with funds from State and Federal taxes. Applying national COI to ITHIM estimated changes in illness, Scenario A are expected to result in savings of $8.6 million; Scenario B and C are expected to lead to healthcare savings of $32.6 million and $47 million respectively.

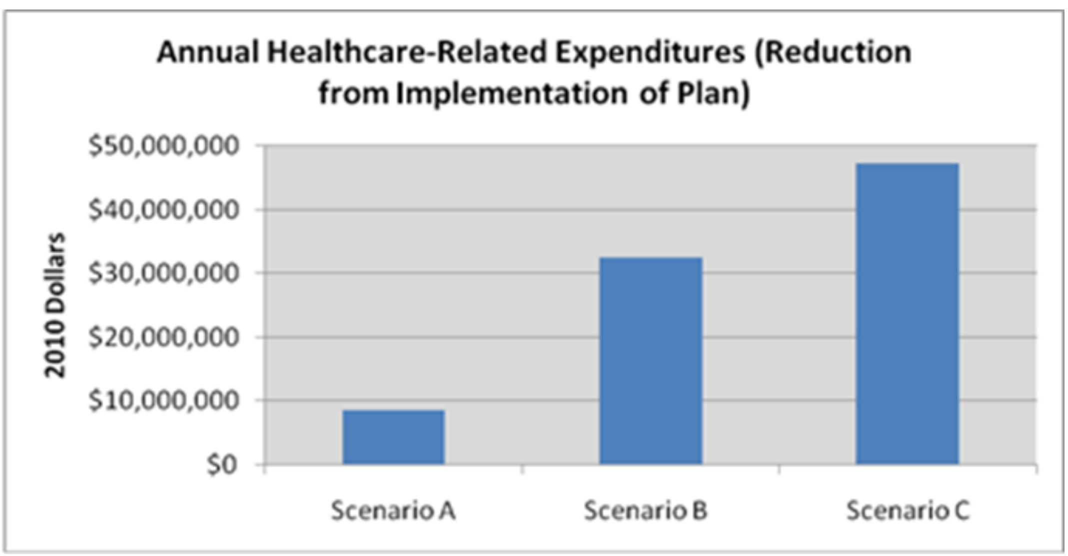


Figure 3

Changes in health outcomes and associated costs in scenarios B and C reflect the increase in active transportation miles in these scenarios. Both of these scenarios include significant increases in active transportation such as biking, walking, and taking transit; the majority of the gains in the three scenarios are achieved through increases in bicycle diversion of driving trips. Though the results present overall health benefits it is worth pointing out that safety outcomes actually worsen in Scenario B. **Figure 4** describes in more detail this outcome and full details are included in **Appendix H.2 and Appendix H.3**.

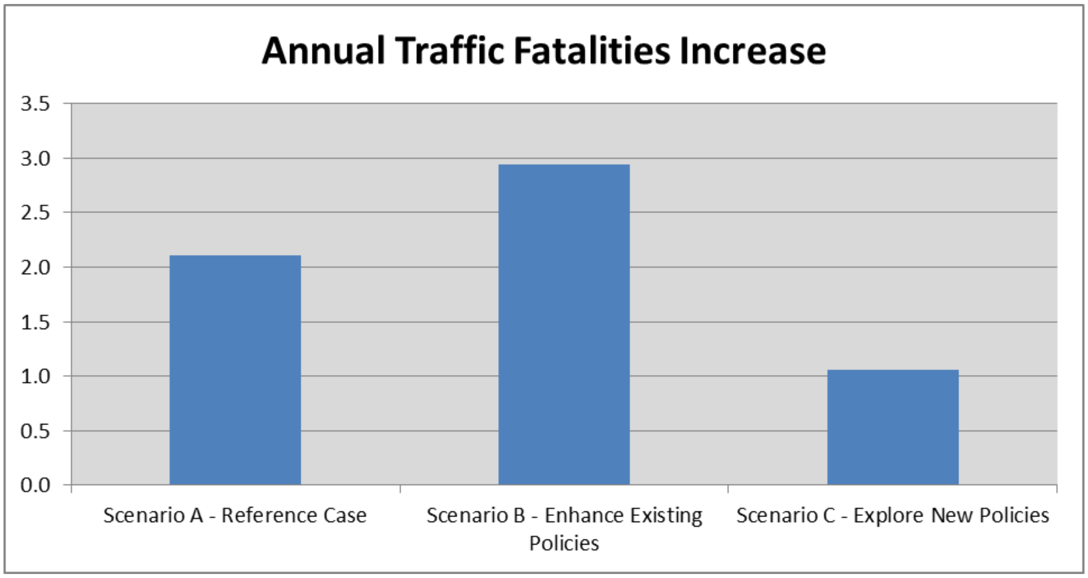


Figure 4

Premature deaths
Absent significant infrastructure design changes, bicycle and pedestrian traffic injuries from serious collisions are expected to increase across all scenarios. This translates into additional health care expenditures in the region of $2.6 million, $3.6 million, and $0.3 million annually for Scenarios A, B, and C.

The primary reason for the increase in crashes and associated negative health outcomes in Scenario B is due to the substantial increase in bicycle and walk activity without substantial driving reduction which maintains high levels of risk for people who walk or ride bikes. In Scenario C, driving is reduced while bicycling increase to the point where traffic fatalities increase less overall compared to the Reference Case. These results highlight the importance of supplying users of the transportation system with safe bicycle facilities that reduce the relative risk associated with bicycling. The actual and perceived danger from existing crash risk makes is a barrier to achieving the levels of cycling called for in Scenario B.

Increased physical activity more than offsets the cost of traffic crashes. Implementation of Scenario A could result in over $11 million (2010$) in annual savings attributable to physical activity resulting in less chronic disease. This would increase to $36 million annual savings with implementation of Scenario B and nearly $48 million with Scenario C. Most savings comes from increased cycling, followed by walking to transit. Walk to transit in Scenario C would save approximately $6.5 million annually. The breakout of savings related to physical activity is graphically represented in Figure 2 in Appendix H.3.

It is important to note that the health outcomes reflected above do not include changes in health outcomes from improved air quality from lower emissions of PM 2.5 air pollution though these changes are reflected in the outcomes discussed below.

Preferred Scenario Assessment

Central Lane MPO used health analysis from the Alternative Scenario assessment, in conjunction with information gathered through public outreach and elected officials, to construct a Preferred Alternative Scenario that would meet the state GHG reduction target while maximizing co-benefits. The preferred scenario health projections are similar to the outcomes found in Scenario B above since the transportation policies and subsequent travel outcomes were very similar. The Preferred Scenario policies are detailed in **Appendix H.4** below.

The Preferred Alternative Scenario is expected to result in 18 annual avoided deaths in 2035. Increased physical activity and improved air quality are expected to result in 20.5 avoided deaths, which are partially offset by a projected increase of 2.4 traffic fatalities. Under this scenario, ITHIM projects a 1.4% decrease in the burden of disease, nearly all of which is attributable to increased physical activity. These changes would result in an estimated $30.6 million in avoided treatment costs.

The health outcomes listed above reflect an overall reduction in PM 2.5 concentrations of 1%. We consider a 1% decrease in PM2.5 to be a conservative assumption based on improving vehicle technology and decreased per capita car travel. Even with this very modest decrease positive health impacts are observed and these changes are reflected in the results presented above.

Similar to the traffic fatality outcomes described in the Alternative Scenario testing above, it was found that the Preferred Alternative Scenario would result in more traffic fatalities than the Reference Case due to substantial increases in bicycle travel without changes in the bicycle crash rate. The existing crash rate makes it unlikely that the modeled level of cycling could be achieved. More Detailed results are featured in **Appendix H.5.**

Conclusions and Recommendations

Significant shifts in the climate are already happening and as the climate continues to warm the impacts to public health will become more apparent. We can expect exposure to more frequent heat waves, an increase in asthma, changes in disease patterns and diminishing water quality and quantity. Curbing climate change is a pressing public health issue, and reducing greenhouse gas emissions will have inevitable health benefits for Oregonians by slowing down climate change and improving air quality.

Addressing changing climate through land use and transportation investments, policies and actions has long-term health implications. In addition to reducing greenhouse gas emissions, the policies and investments under consideration in the Central Lane Scenario Planning can positively impact health by increasing physical activity, reducing traffic collisions and improving air quality.

The changes required to reduce GHG emissions represent a significant investment of resources. Central Lane Metropolitan Planning Organization can maximize the return of future implementation of these strategies and investments by improving the health benefits of these investments and minimizing any potential health risks for all members of the community.

To maximize public health benefits and meet the state target, emphasize the types of strategies and investments that best increase active transportation and physical activity while making the roads safer for all people.

- **Prioritize strategies that lead to increases in active travel for all populations in the region, in particular for children, seniors, people with low incomes, communities of color, and people with chronic health conditions or disabilities.** Example strategies include marketing and incentive programs targeted to these populations, improved active travel infrastructure on routes to schools, and improved public transportation service in areas where these populations live.
- **Mitigate potential increases in pedestrian and bicyclist injuries and fatalities through proven design strategies**, such as increasing the visibility of vulnerable road users; separate facilities like sidewalks, bike boulevards or protect bike lanes; and traffic calming or speed control measures. The feeling of safety given by these mitigations may also expand the percentage of the population willing to bike and walk.
- **Prioritize strategies that lead to decreases in road traffic injuries and fatalities for all populations in the region**, in particular for children and older adults. Community design, pricing and incentives strategies that lead to reductions in VMT may also increase safety in the region.
- **Implement active transportation strategies with an understanding of existing local health conditions and inequities.**
    a. Increasing the number of people biking and walking could cause a small increase in injuries and deaths from collisions. Implement strategies in ways that do not worsen

these health conditions and inequities, such as planning for necessary safety infrastructure.

b. The Central Lane MPO region residents do not all have equal access to active transportation opportunities. An effort should be made to improve access for all communities.

- **Prioritize strategies that lead to decreases in air pollution exposure for all populations in the region;** in particular for low income communities, children, seniors, people with low incomes, and people with chronic health conditions or disabilities. An example strategy may be creating and promoting walking and biking routes adjacent to low-traffic roads specifically in lower income neighborhoods).

Appendix H.1 – Alternative Scenario

Policy	Base Year Scenario - 2005	Base Year Scenario - 2010	Scenario A (Reference Scenario)	Scenario B (Enhance Existing Policies)	Scenario C (Explore New Policies)
Community Design					
Bicycle Diversion					
Coburg	0%	0%	0%	25%	30%
Eugene	5%	8%	15%	40%	50%
Springfield	1%	2%	6%	32%	35%
Per Capita Transit Service	12	13 (8% Growth)	18 (50% Growth)	28 (134% Growth)	34 (183% Growth)

Policy	Base Year Scenario - 2005	Base Year Scenario - 2010	Scenario A (Reference Scenario)	Scenario B (Enhance Existing Policies)	Scenario C (Explore New Policies)
Pricing					
Gas Tax ($2005) per gallon	$0.46	$0.46	$0.52	$0.98	$0.18
Local Portion of Gas Tax ($2005)	$0.04	$0.04	$0.04	$0.50	$0.00
VMT Fee ($2005) per mile	$0	$0	$0	$0	$0.03
Percent of Social Costs Accounted for in the Cost to Drive	0%	0%	0%	0%	0%
Clean Air Fee (Carbon Tax)	$0	$0	$0	$0	$50
Pay-as-you-drive Insurance					
Percentage of Hhs Participating	0%	0%	0%	50%	100%
Rate per Mile ($2005)	$0.00	$0.00	$0.00	$0.05	$0.05
Parking Management					
Work Trips w/ Charged Parking					
Coburg	4%	4%	4%	5%	5%
Eugene	8%	8%	7%	23%	25%
Springfield	5%	5%	4%	8%	10%
Other Trips w/ Charged Parking					
Coburg	0%	0%	0%	0%	2%
Eugene	4%	5%	4%	17%	20%
Springfield	1%	1%	1%	5%	5%
Average Cost to Park ($2005)	$2.93	$3.19	$2.74	$6.00	$6.00
Work Parking Buyout	0%	0%	0%	25%	50%

Policy	Base Year Scenario - 2005	Base Year Scenario - 2010	Scenario A (Reference Scenario)	Scenario B (Enhance Existing Policies)	Scenario C (Explore New Policies)
Marketing and Incentives					
Employer-based Commute Reduction Program					
Percentage of Employees Participating in Program	3%	3%	3%	60%	60%
VMT Reduction	5.4%	5.4%	5.4%	5.4%	6.8%
Individualized Marketing Program					
Percentage ofHouseholds Participating in Program	1%	1%	1%	60%	60%
VMT Reduction	9%	9%	9%	9%	11.3%
Eco-driving Education	0%	0%	0%	83%	83%
Low-rolling Resistance Tires	0%	0%	0%	82%	82%
Vehicle Optimization	0%	0%	0%	82%	82%
Carshare Vehicles Available	2	3	3	182	182

Appendix H.2 - ITHIM Methodology and Detailed Results for Central Lane Scenario Planning

To quantitatively estimate how the Scenarios under consideration by Central Lane MPO impact health, an analysis using the Integrated Transport and Health Modeling (ITHIM) tool was used. ITHIM was developed by public health researchers in the United Kingdom to assess the potential health impacts of GHG emissions reductions scenarios for London, UK and Delhi, India.[13] [14] The model was later adapted for use in the San Francisco Bay area and applied to transportation scenarios created to comply with California's GHG emissions reduction goals, primarily by replacing global burden of disease figures with U.S. vital statistic.[15] OHA adapted the tool between 2012 and 2014 for use in the Portland metropolitan region to support the Climate Smart Communities Scenario planning.[16] [17] [18] The tool has been further refined for use in The Central Lane MPO.

METHODOLOGY

ITHIM is a comparative risk assessment approach. It compares the change across different scenarios by applying measures of changes in exposure to current knowledge about disease patterns and responses to exposure to estimate changes in mortality (deaths) and illness (as measured by disability adjusted life years or DALYs). ITHIM calculates mortality and illness for both baseline and alternative scenarios; outputs are generally reported in the difference between baseline and scenario. Baseline and horizon years were set at 2010 and 2035 to match scenario planning parameters. Conceptually, baseline in ITHIM is the expected number of deaths and illness given the current rate of exposure for the expected population distribution in 2035. Estimated impact is thus the difference between the expected outcome at baseline and the scenario.

ITHIM's methodology is grounded in a global burden of disease approach, which allows for the change in disease associated with changes in exposure to be isolated. Leveraging the burden of disease approach requires understanding current disease patterns before applying relative risks to appropriate demographics. ITHIM better captures study area conditions when the tool includes local burden of disease data. THIM was initially developed using global burden of disease data; this was updated with U.S. prevalence data for the San Francisco and early Metro (Portland, Oregon) work[19]. The last iteration of Metro work utilized Oregon-specific prevalence data derived from Oregon vital statistics from 2008-2010. This was further refined to support Central Lane MPO's greenhouse gas scenario planning by using vital statistics from urban counties in Oregon from 2008-2010.

Other modifications in place for this run of ITHIM include: reporting separately diseases that have both physical activity and air quality components; adjusting assumptions about walking and cycling speeds by age and gender to reflect the Oregon Household Activity Survey[20], projected to 2035 using the 1995, 2001, and 2009 National Household Travel Survey[21]; and adjusting the distribution of the horizon population for age and gender using Oregon Office of Economic Analyses forecasts.

ITHIM applies relative risk of disease to changes of exposure and demographics. Relative risk is a statistical construct used by epidemiologists to understand the ratio of the probability of an event (developing a disease or dying) for those exposed compared to the probability of developing the disease without the exposure. In practice, relative risks are drawn from meta-analyses of large, longitudinal studies. For example, the probability of developing diabetes between two different groups – those who met the Surgeon General's exercise recommendations and those who did not – can be calculated from national, longitudinal survey data. Applying relative risks allows ITHIM to estimate the number of new deaths or incidence of disease given current prevalence (or burden of disease) rates and the expected change in exposure from each scenario. By doing so, ITHIM is able to quantify the difference between baseline and scenario; it also allows for comparisons across scenarios.

ITHIM uses the relative risks for thirteen separate diseases assigned to three exposure pathways: physical activity, traffic safety, and particulate air pollution as indicated by PM2.5 (see Table 1). One advantage of a burden of disease approach is that it facilitates comparisons across various pathways. For example, ITHIM allows for a comparison in impacts from each disease included and, by summing diseases by exposure type, from exposure pathways. Understanding the exposure pathway and/or disease driving health benefits (or burdens) allows for specific recommendations and mitigation measures to maximize health given the constraints of the scenarios. It allows, for instance, the ability to state that Scenario B will prevent three times as many stroke deaths (through increased exercise) as traffic fatalities.

Table 1 Exposure Pathway, Variable, and Included Illness for ITHIM

	Exposure Pathway		
	Physical Activity	**Traffic Safety**	**Air Quality**
Exposure variable	Per capita miles traveled by mode as modeled by GreenSTEP	Miles traveled by person by mode by type of street (non-arterial, arterial, freeway) as modeled by GreenSTEP	$PM_{2.5}$: 5-year average monitored data as baseline; assumptions of decreases by 1,5,and 10 percent for analyses.
Included Illness	Breast Cancer Colon Cancer Stroke[2] Ischemic Heart Disease[2] Depression[3] Dementia Diabetes Hypertensive Heart Disease[2]	Serious Traffic Injuries	Lung Cancer[1] Inflammatory[1,3] Heart Disease Stroke[2] Ischemic Heart Disease[2] Hypertensive Heart Disease[2] Respiratory[1] Disease

(1) Illness is measured by disability adjusted life years (DALYs) which is the summation of Years of Life Lost (YLL) and Years of Life with Disability (YLD). These illnesses do not have YLD rates available.
(2) While primarily affected by changes in exposure to physical activity, ITHIM also applies an air quality factor to these illnesses.
(3) Relative risks of death were not available for these illnesses.

LIMITATIONS

ITHIM has a number of limitations. The model is limited to diseases with available vital statistics and high confidence in the literature of relative risks or odd ratios. ITHIM underestimates health benefits due to data availability and the specific exposures and diseases represented in each pathway. Inclusion of a disease within ITHIM is based upon the availability of data for the relative risk, the relative importance of the disease for that particular exposure, and the ability to control the relative risk for other diseases of interest. Because ITHIM is limited to the 13 diseases in Table 1, it likely underestimates the health benefits from reducing GHG emissions in all of the major exposure pathways. Contemporary trends in medical science are increasingly linking physical activity to many other diseases, conditions, and cancers. Similarly, traffic safety in ITHIM is limited to prevalence rates of *reported* collisions; ITHIM thus underestimates the number of prevented collisions to the extent that collisions are under-reported – particularly for bicyclists. Air quality is limited in ITHIM to PM2.5 exposure only and thus underestimates health benefits from lower concentrations of a variety of ambient pollutants including ozone and air toxics.

ITHIM assumes spatial homogeneity of both disease and exposure and is not able to model spatial variations within the region. For example, ITHIM has difficulty characterizing differential air quality impacts from near roadway exposures. While ITHIM appropriately applies relative risk by gender and age, ITHIM does not facilitate analysis by race or income.

Finally, limitations of the transportation and air quality modeling transfer to health modeling. ITHIM cannot account for elements that transportation modeling did not capture such as changes in attitudes and social norms. All models also lack robust ways to account for design and technology features of future facilities. The most prominent example of this is ITHIM's inability to account and adjust for design features that encourage adoption and protect active modes of transportation. Another example is that future estimates of crashes will be influenced by vehicle technology to reduce fatalities and severe injury in crashes for vehicle passengers. Anti-lock brakes, air bags, crumple zones and now crash avoidance technologies like in-vehicle radar, lane departure warnings, blind spot detection and stability control will help reduce vehicle crashes further or make them less severe.

TRANSPORTATION ASSUMPTIONS AS ITHIM INPUTS

The assumptions about distance traveled by pedestrians, cyclists, and cars are provided in Table 2. Each of the three scenarios assumes significant shifts in the number of miles traveled by bicycle. The Reference Case (Scenario A) assumes a doubling of bicycle miles traveled in the base year (2010) with further increases in Scenario B and Scenario C. These bike miles do not account for recreation and exercise travel that would likely accompany an increase in biking for transportation related purposes.

Table 2 Planning Scenario Assumptions by Mode for ITHIM

Mode	Weekly Miles Traveled			
	2010	Scenario A	Scenario B	Scenario C
Walk to Destination	1.1	1.1	1.2	1.2
Walk to Transit	0.2	0.3	0.4	0.5
Walk (All)	1.3	1.4	1.6	1.7
Bike	1.9	3.7	11.1	13.3
Vehicle	152.0	155.4	153.3	124.1

DETAILED RESULTS

Active Modes of Transportation: Physical Activity and Traffic Safety

Tables 3 and 4 provide detailed ITHIM results by exposure pathway for all three scenarios. Note that ITHIM's raw count output assumes a stable (in this case 2010) population; all results in the report have been adjusted approximately 30.6% upward to account for population growth within the Central Lane MPO boundary between 2010 and 2035.

Table 3 provides expected avoided mortality (deaths). Scenario A (Reference Case) is expected to result in 4.7 annual avoided deaths in 2035. Increased physical activity is expected to result in 6.8 avoided deaths in Scenario A; however, ITHIM projects an increase of 2.1 traffic fatalities. ITHIM suggests that Scenario B would result in approximately 18.5 fewer deaths annually by 2035 with 19.3 avoided deaths attributable to increase physical activity. Scenario C would result in 28.9 avoided deaths.

Table 3 Summary of Annual Mortality (Death) Benefits in 2035 by Scenario, Health Outcome, and Health Pathway

Health Outcome	Scenario					
	A – Reference Case		B – Enhance Existing Policies		C – Explore New Policies	
	Count	Adj	Count	Adj	Count	Adj
Breast Cancer	0.0	-0.1	-0.2	-0.2	-0.3	-0.4
Colon Cancer	-0.1	-0.1	-0.4	-0.5	-0.5	-0.7
Stroke	-0.8	-1.1	-2.3	-3.0	-3.2	-4.2
Ischemic Heart Disease	-2.6	-3.4	-7.3	-9.6	-9.8	-12.8
Depression	0.0	0.0	0.0	0.0	0.0	0.0
Dementia	-0.3	-0.4	-0.8	-1.1	-1.4	-1.8
Diabetes	-0.9	-1.2	-2.7	-3.5	-3.6	-4.7
Hypertensive Heart Disease	-0.4	-0.5	-1.1	-1.4	-1.4	-1.9
Physical Activity Total	**-5.2**	**-6.8**	**-14.8**	**-19.3**	**-20.3**	**-26.5**
Traffic Safety	**1.6**	**2.1**	**2.3**	**2.9**	**0.8**	**1.1**
Total	**-3.6**	**-4.7**	**-14.1**	**-18.5**	**-22.1**	**-28.9**

Table 4 provides detailed output for illness as measured by disability adjusted life years (DALY). DALYs are the summation of years of life lost (YLL) and years living with a disability (YLD) due to illness. Results are presented in counts – best thought of as a combination of avoided disease and less acute cases – for both 2010 population and adjusted to 2035 population projections. This table also provides percent reduction from current disease prevalence levels. Percent reduction from current disease prevalence levels is included because it is more intuitive measure of disease reduction; it also plays a prominent role in monetizing illness. For example, Scenario B is projected to prevent 641 DALYs from physical activity. Of those DALYs, 188 will be from avoided or less serious diabetes cases; 188 avoided DALYs is equivalent to an 8% reduction in current levels of diabetes in the region. The 8% reduction can then be applied to current, local diabetes cost as an estimate of related cost savings.

Similar to avoided deaths, avoided illness is greatest for Scenario C followed by Scenario B and Scenario A. ITHIM estimates that serious injuries from traffic collisions would actually increase by 6.7% for Scenario A, 9.2% for Scenario B, and 0.7% for Scenario C.

Table 4 Summary of Annual Morbidity (Illness) Benefits in 2035 by Scenario, Health Outcome, and Health Pathway

Health Outcome	Scenario								
	A – Benchmark			B – Enhance Existing Policies			C – Explore New Policies		
	Count	Adj	% reduction	Count	Adj	% reduction	Count	Adj	% reduction
Breast Cancer	-1.1	-1.5	0.2%	-4.8	-6.3	1.0%	-8.0	-10.5	1.7%
Colon Cancer	-1.8	-2.4	0.4%	-7.8	-10.2	1.8%	-11.0	-14.4	2.6%
Stroke	-25.9	-33.9	2.0%	-81.9	-106.9	6.3%	-107.6	-140.5	8.3%
Ischemic Heart Disease	-43.4	-56.7	2.1%	-135.1	-176.5	6.6%	-177.3	-231.5	8.7%
Depression	-14.8	-19.4	0.5%	-64.2	-83.8	2.2%	-81.0	-105.8	2.8%
Dementia	-10.2	-13.3	0.3%	-39.5	-51.6	1.0%	-64.2	-83.9	1.7%
Diabetes	-43.7	-57.0	2.6%	-138.3	-180.7	8.3%	-178.9	-233.7	10.7%
Hypertensive Heart Disease	-6.1	-7.9	1.5%	-19.1	-24.9	4.7%	-25.7	-33.6	6.4%
Physical Activity Total	**-147.1**	**-192.0**		**-490.8**	**-640.9**		**-653.8**	**-853.8**	
Traffic Safety	**39.0**	**50.9**	**6.7%**	**53.7**	**70.2**	**9.2%**	**4.2**	**5.5**	**0.7%**
TOTAL	**-108.0**	**-141.1**		**-437.0**	**-570.7**		**-649.6**	**-848.3**	

Understanding Drivers of Physical Activity Health Gains

The scenarios currently under consideration by Central Lane MPO have differing levels of walking, bicycling, and transit. Each of these modes routinely increases physical activity. Walking and cycling result in different metabolic equivalents and vary slightly in terms of relative risks. The literature is also indicates those who walk to transit are more likely to reach physical activity recommendations than non-transit riders.

While ITHIM treats walking to transit and walking to destinations as a general walk trip, a sensitivity analysis was performed to isolate the relative contribution of each mode to increased physical activity (Table 5, Figure 1, and Figure 2). Given the weight of increased bicycle trips in each of the scenarios, most of the physical activity gains come from cycling. Walking to nearby destinations accounts for 0.7-2.0% of physical activity gains; walking to transit accounts for 3.8-11.4%.

Table 5 Health Benefits from Physical Activity by Mode (Annual by 2035)

Mode	Scenario A				Scenario B				Scenario C			
	DALY		Mortality		DALY		Mortality		DALY		Mortality	
	Count (Adj)	% of PA	Count (Adj)	% of PA	Count (Adj)	% of PA	Count (Adj)	% of PA	Count (Adj)	% of PA	Count (Adj)	% of PA
Walking to Destination	-2.7	1.4%	-0.1	2.0%	-4.2	0.7%	-0.2	1.1%	-7.5	0.9%	-0.4	1.4%
Walking to Transit	-10.7	5.6%	-0.6	8.2%	-24.5	3.8%	-1.3	6.2%	-60.4	7.1%	-3.4	11.4 %
Cycling	-178.7	93.0%	-6.1	89.8%	-612.2	95.5%	-19.9	92.7%	-785.9	92.0%	-26.1	87.2 %
Total	**-192.0**	**100%**	**-6.8**	**100%**	**-640.9**	**100%**	**-21.4**	**100%**	**-853.8**	**100%**	**-29.9**	**100%**

Figure 2 Avoided Deaths (Annual, Adjusted to 2035) from Physical Activity by Scenario and Mode

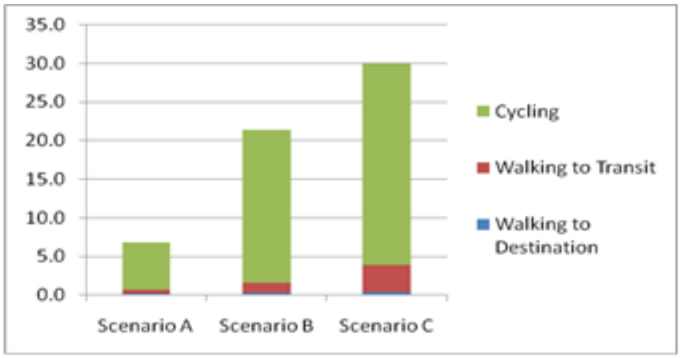
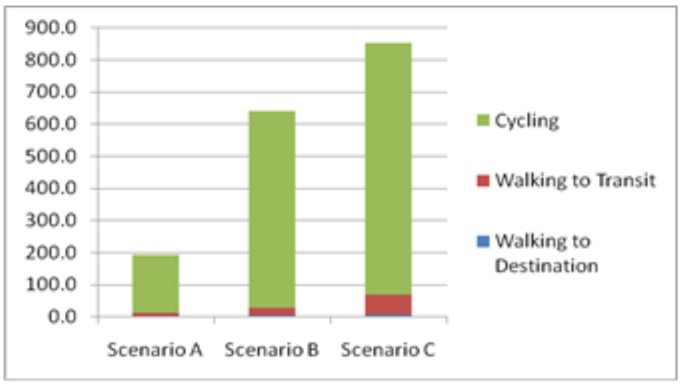


Figure 3 Avoided DALYs (Annual, Adjusted to 2035) from Physical Activity by Scenario and Mode



To understand how walking and biking miles compare, a simple sensitivity analyses was run in ITHIM. Walking and bicycling were set at an additional 0.25, 0.5, 1, 2, 5 and 10 mile increments. Results are provided in Table 6, Figure 3, and Figure 4 below. Physical activity gains come from time spent being physically active. On average, a person walks between 2 and 4 miles/per hour rate; cyclists travel much faster and thus get to destinations quicker and with less time at an elevated heart rate. As a result, if on average individuals walked an additional mile per week, over 11 deaths would be avoided. If individuals averaged a mile more of biking per week, only 3.6 deaths would be avoided.

Table 6. Comparison of Health Effects by Active Modes by Additional Mile(s) Traveled

Additional Miles over 2010 Baseline	DALY		Mortality	
	Walk	Bike	Walk	Bike
0.25	34.2	15.2	1.5	0.4
0.5	83.1	35.5	4.1	0.9
1	193.3	115.7	11.3	3.6
2	359.6	186.1	22.8	6.3
5	797.4	383.0	51.9	12.4
10	1331.3	642.7	85.7	20.8

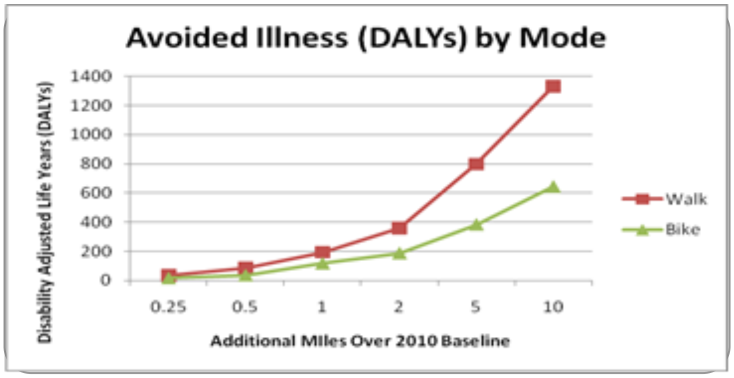


Figure 4. Avoided Illness (DALYs) by Mode for Additional Miles Traveled over 2010 Baseline

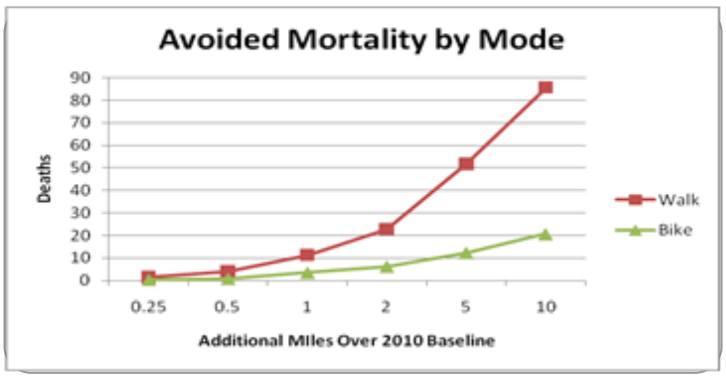


Figure 5. Avoided Deaths by Mode for Additional Miles Traveled over 2010 Baseline

Understanding Traffic Safety by Mode

ITHIM models traffic safety by estimating the number of crashes resulting in fatalities and serious injuries by mode and by type of road. Tables 6 and 7 present results for traffic fatalities and injuries respectively in 2035. Note that all counts have been adjusted for 2035 population. Also note that injuries are serious injurious only.

Table 7 ITHIM Estimates of Annual Expected Traffic Fatalities by Mode in 2035

Mode	Baseline	Scenario A	Scenario B	Scenario C
Walk	10.0	10.6	10.5	10.3
Cycle	3.0	4.2	6.8	7.1
Bus	0.0	0.0	0.0	0.0
Car	13.6	13.8	12.2	10.8
Motorbike	0.6	0.6	0.6	0.0
Total [1]	28.3	30.4	31.3	29.4
Sum of Difference between Baseline and Scenario		2.1	2.9	1.1

(1) Note that the total is not the sum of the modes presented as it also adds in a small number of HGV crashes

Table 8 THIM Estimates of Annual Expected DALYs from Traffic Injuries by Mode in 2035

Mode	Baseline	Scenario A	Scenario B	Scenario C
Walk	208.1	218.8	216.6	213.3
Cycle	65.3	93.6	150.9	157.9
Bus	0.0	0.0	0.0	0.0
Car	435.3	449.6	415.0	372.4
Motorbike	25.7	25.8	25.3	0.0
Total [1]	759.8	813.3	832.5	767.9
Sum of Difference between Baseline and Scenario		50.9	70.2	5.5

(1) Note that the total is not the sum of the modes presented as it also adds in a small number of HGV crashes

While the rate of traffic injuries and death declines for all types of users under all scenarios, the absolute number of injuries and death due to collisions increases. Collisions involving cars are the most common collision. In Scenario A, vehicle miles traveled increases slightly; increases in vehicle miles is an increase in exposure for collisions with cars for all modes, and by extension increased risk of serious injuries and death for all modes. In Scenarios B and C, VMT begins to decrease and car collisions are prevented. However the planning scenarios rely heavily upon increased bicycle miles and, to a lesser extent, increased pedestrian miles. Thus, active modes are at such increased exposure risk for collisions that the absolute number of cyclist and pedestrian injuries and deaths increases.

Figure 6 Traffic Safety (Mortality) by Mode and Scenario

These results strongly suggest that infrastructure design for active modes such as walking, cycling, and walking to transit – a factor not well accounted for in ITHIM – be carefully implemented to counteract the trend of increased collisions. It also highlights the role of reduced per capita VMT in reducing exposure and thus improving traffic safety for all modes.

AIR QUALITY HEALTH IMPACTS

Reduction in air pollution is another important way in which health is impacted by transportation related policy decisions. Reduction in fossil fuel consumption will likely result in decrease of particulate matter, ozone, and other air toxics. The standard indicator for modeling health impacts associated with mobile, transport related emissions is particulate matter as measured by $PM_{2.5}$. This indicator captures both respiratory and cardiovascular health improvements from increased air quality. The 5-year (2008-2012) average ambient level of $PM_{2.5}$ in Eugene and Springfield is 6.747 ug/m3[22]. The Central Lane Scenario Planning efforts identified emissions changes in PM2.5 but did not apply those emission changes to a dispersion model due to time and budget constraints. However, the following provides a sensitivity analysis of a 1%, 5%, and 10% reduction in ambient PM2.5 levels.

Table 9 Mortality Benefits (Annual in 2035) from Assumed Reduction (1, 5, and 10 Percent) of PM2.5

Health Outcome	1% reduction in PM2.5		5% reduction in PM2.5		10% reduction in PM2.5	
	Count	Adj	Count	Adj	Count	Adj
Lung Cancer	-0.1	-0.1	-0.5	-0.7	-1.1	-1.4
Inflammatory Heart Disease	0.0	0.0	-0.1	-0.1	-0.1	-0.2
Respiratory Disease	-0.1	-0.1	-0.3	-0.4	-0.7	-0.9
Stroke	-0.1	-0.1	-0.3	-0.4	-0.6	-0.8
Ischemic Heart Disease	-0.1	-0.2	-0.6	-0.8	-1.3	-1.7
Hypertensive Heart Disease	0.0	0.0	-0.1	-0.2	-0.2	-0.3
Air Quality ($PM_{2.5}$) Mortality Total	**-0.4**	**-0.5**	**-2.0**	**-2.7**	**-4.1**	**-5.3**

Reductions in ambient PM2.5 levels of 1%, 5%, and 10% would result in 0.5, 2.7, and 5.3 for annual avoided deaths by 2035 for the three scenarios respectively. In the most aggressive assumption of a 10% reduction, 1.4 lung cancer deaths and 1.7% ischemic heart disease deaths – likely fatal heart attacks – would be avoided. Reductions in ambient PM2.5 levels would also result in reduction in illness. For example, a 10% reduction in PM2.5 results in a 0.8% reduction in lung cancer severity, a 0.4-0.5% decrease in several different types of cardiovascular disease, a 0.3% reduction in stroke incidence and severity, and a 0.2% reduction in respiratory disease.

Table 10 Morbidity Benefits (Annual DALYs in 2035) from Assumed Reduction (1, 5, and 10 Percent) of PM2.5

Health Outcome	Scenario								
	1% reduction in PM2.5			5% reduction in PM2.5			10% reduction in PM2.5		
	Count	Adj	% reduction	Count	Adj	% reduction	Count	Adj	% reduction
Lung Cancer	-1.1	-1.5	0.1%	-5.6	-7.3	0.4%	-11.1	-14.5	0.8%
Inflammatory Heart Disease	-0.1	-0.1	0.0%	-0.6	-0.7	0.2%	-1.1	-1.4	0.4%
Respiratory Disease	-0.6	-0.7	0.0%	-2.9	-3.7	0.1%	-5.7	-7.4	0.2%
Stroke	-0.5	-0.6	0.0%	-2.2	-2.9	0.2%	-4.4	-5.8	0.3%
Ischemic Heart Disease	-1.1	-1.4	0.1%	-5.0	-6.5	0.2%	-9.8	-12.8	0.5%
Hypertensive Heart Disease	-0.2	-0.2	0.0%	-0.9	-1.1	0.2%	-1.7	-2.2	0.4%
Air Quality ($PM_{2.5}$) DALY Total	**-1.8**	**-2.4**		**-9.0**	**-11.7**		**-17.9**	**-23.4**	

Appendix H.3 - Monetization Methodology and Detailed Results for Central Lane Scenario Planning

Chronic diseases are associated with transportation and land use policies and infrastructure; these diseases such as diabetes, cardiovascular disease, and some cancers are also costly and impact the greater regional, state, and national economies. Health care spending has been growing quickly and based on recent trends, is outpacing the growth in the overall economy. If this pace continues, health care spending could overtake spending on other vital sectors of the economy. Health care costs also affect businesses and families. Reducing the annual growth rate of health care spending by 1.5 percentage points is estimated to increase household income for a typical family of four by $2,600 in 2020.[23] Businesses benefit from lower health care expenses and reduced illness in the form of lower health care benefit costs and higher productivity.

This appendix documents methodologies and results used to estimate the value and approximate savings in health care expenditures associated with the Central Lane Scenario Planning project. It does so by applying value of statistical life (VSL) methodology to mortality and cost of illness (COI) methodologies to morbidity.

METHODOLOGY

Mortality

In policy cost-benefit analysis, avoided mortality is monetized by applying the value of statistical life (VSL) to projected avoided deaths. Although the name implies that each life is worth a particular value, VSL is the aggregation of many individuals' willingness-to-pay (WTP) for a small reduction in mortality risk.[24] The VSL literature is large and robust, with guidance from several federal agencies on how to apply VSL to planning activities. The U.S. Department of Transportation's current VSL default is $9.1 million (in 2012$) with a range of $5.2 to $12.9 million provided for sensitivity analyses.[25] It is important to remember that estimates are "values" but are not necessarily money circulating in the local economy.

Morbidity

Costs associate with morbidity are generally estimated through a cost of illness (COI) approach.[26] The COI approach estimates the economic burden associated with an illness associated with a specific disease using nationally representative surveys of medical utilization such as the Medical Expenditure Panel survey. While COI underestimates the full costs of illness, it accounts direct costs including professional services, hospital services, prescribed medications, and home health care. COI also counts for some indirect costs such as lost productivity. This method does not include pain and suffering from illness. COI models statistically control for co-morbid conditions. COI is also an extreme lower bound estimate of how society values avoidance of disease and death as they do not include the value of a statistical life (VSL).

This analysis used a top-down, attributable fraction COI methodology. To apply COI information, a literature search for national cost of disease was performed, prioritizing national governmental guidance or peer-reviewed estimates from national medical associations, for each disease in the ITHIM model.[27] [28] [29] [30] [31] [32] [33] After adjusting to 2010 dollars, the national costs were scaled by the proportion of the US population living within the Lane MPO or 0.084%. With the exception of cancers, all COIs include both direct and indirect costs. The fraction attributable to the scenario is estimated via ITHIM (see Appendix A) using the percent change in morbidity from baseline year for each disease. The attributable fraction of each disease, when multiplied by the local COI for that disease, provides an estimate of the monetary benefit of the policy intervention. Unlike VSL, the COI numbers represent actual savings in expenditures and thus would lead to an observable change in the local and regional economies.

RESULTS

Avoided Mortality (VSL)

The net benefit of avoided mortality from increased physical activity countered by decreased traffic safety is 4.7 lives annually for Scenario A, 18.5 for scenario B, and 28.9 for Scenario C. Applying the central guidance figure from the U.S. DOT, these lives should be valued at $41 million, $160 million, and $250 million annually. The VSL range is provided in the table below.

Table 1. Valuation of Net Benefit of Avoided Deaths using VSL by Scenario

Physical Activity and Traffic Safety			
	Scenario A	**Scenario B**	**Scenario C**
Avoided Deaths	4.7	18.5	28.9
VSL - Median	$41,000,000	$160,000,000	$250,000,000
VSL - Low	$23,000,000	$91,000,000	$140,000,000
VSL - High	$58,000,000	$220,000,000	$350,000,000

Avoided Morbidity (Illness as measured by Cost-of-Illness)

The Central Lane MPO spends approximately $740 million annually on chronic diseases that could be impacted by changes in physical activity and traffic safety. Corresponding direct (health care expenditures) and indirect (absenteeism – included with the exception of cancer outcomes) are provided in Table 2. Net healthcare related savings from physical activity and traffic safety are provided in Figure 1. Applying national COI to ITHIM estimated changes in illness, Scenario A are expected to result in savings of $8.6 million; Scenario B and C are expected to lead to healthcare savings of $32.6 million and $47 million respectively.

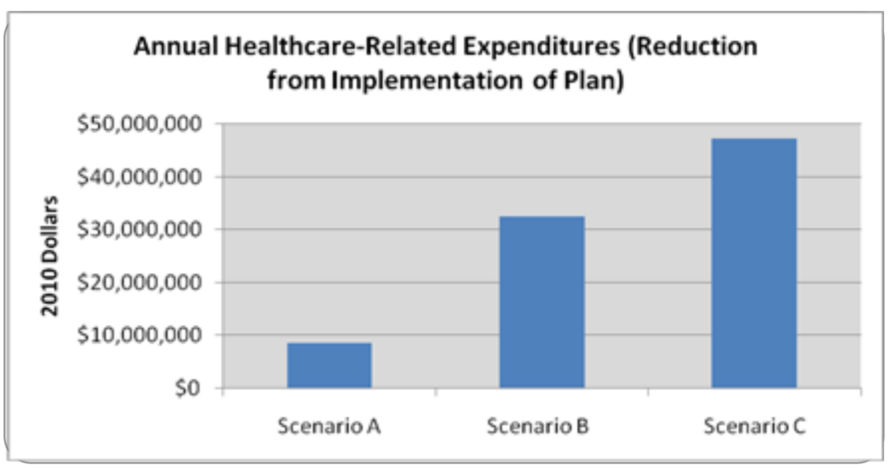


Figure 7 Net Cost of Illness Savings from Physical Activity and Traffic Safety by Scenario

Table 2. Local Cost of Illness and Anticipated Change in Healthcare Expenditure by Scenario

Condition	Local Annual COI (2010$)	Change in Expenditures (in 2010 $) Attributable to the Plan by 2035		
		Scenario A	Scenario B	Scenario C
Cancer				
Breast	$22,998,226	-55,264	-237,500	-395,857
Colon and rectum cancer	$22,631,518	-96,888	-413,450	-586,349
Cardiovascular				
Stroke-PA	$30,660,000	-616,649	-1,946,665	-2,556,684
Heart disease-PA	$210,672,000	-4,498,673	-14,003,739	-18,374,545
Mental Illness				
Dementia	$131,880,000	-348,641	-1,351,785	-2,195,876
Depression	$88,392,805	-454,217	-1,965,605	-2,481,384
Other				
Diabetes	$195,510,000	-5,130,380	-16,250,563	-21,016,942
PHYSICAL ACTIVITY TOTAL COI	**$702,744,549**	**-11,200,711**	**-36,169,308**	**-47,607,636**
TRAFFIC INJURY COI	**$39,192,232**	**2,619,231**	**3,608,247**	**283,973**
TOTAL COI	$741,936,780	**-8,581,480**	**-32,561,061**	**-47,323,663**

Absent significant infrastructure design changes, bicycle and pedestrian traffic injuries from serious collisions are expected to increase across all scenarios. This translates into additional health care expenditures in the region of $2.6 million, $3.6 million, and $0.3 million annually for Scenarios A, B, and C (Table 2). Increased physical activity, however, is anticipated to result in significant health care savings. Implementation of Scenario A could result in over $11 million (2010$) in annual savings attributable to physical activity resulting in less chronic disease. This would increase to $36 million annual savings with implementation of Scenario B and nearly $48 million with Scenario C. Most savings comes from increased cycling, followed by walking to transit. Walk to transit in Scenario C would save approximately $6.5 million annually. The breakout of savings related to physical activity is graphically represented in Figure 2.

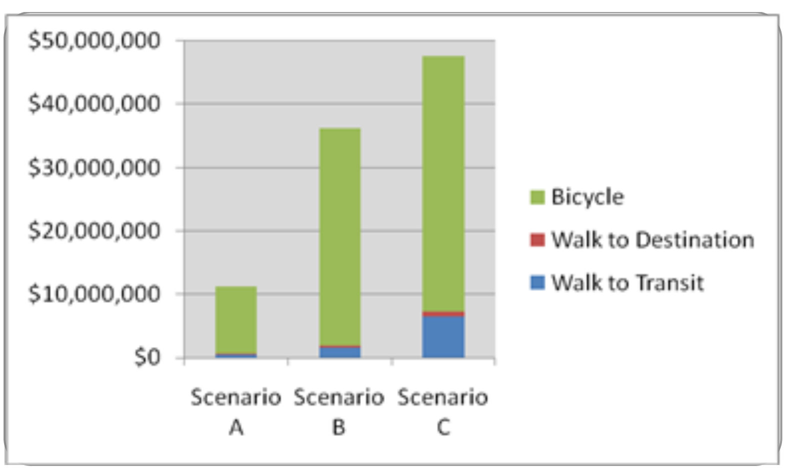


Figure 2. Cost of Illness Savings from Increased Physical Activity by Scenario and Mode

Appendix H.4

Community Design			
Policy	Base Year Scenario - 2010	Scenario A (Reference Scenario)	Preferred Scenario
Bicycle Diversion			
Coburg	0%	0%	5%
Eugene	8%	15%	38%
Springfield	2%	6%	20%
Per Capita Transit Service	13 (8% Growth)	18 (50% Growth)	26 (100% growth)

Pricing			
Policy	Base Year Scenario - 2010	Scenario A (Reference Scenario)	Preferred Scenario_v1
Gas Tax ($2005) per gallon	$0.46	$0.52	$0.18
Local Portion of Gas Tax ($2005)	$0.04	$0.04	$0.00
VMT Fee ($2005) per mile	$0	$0	$0.03
Percent of Social Costs Accounted for in the Cost to Drive	0%	0%	0%
Clean Air Fee (Carbon Tax)	$0	$0	$0
Pay-as-you-drive Insurance			
Percentage of Hhs Participating	0%	0%	100%
Rate per Mile ($2005)	$0.00	$0.00	$0.05
Parking Management			
Work Trips w/ Charged Parking			
Coburg	4%	4%	4%
Eugene	8%	7%	15%
Springfield	5%	4%	6%
Other Trips w/ Charged Parking			
Coburg	0%	0%	0%
Eugene	5%	4%	4%
Springfield	1%	1%	1%
Average Cost to Park ($2005)	$3.19	$2.74	$6.00
Work Parking Buyout	0%	0%	0%

Marketing and Incentives			
Policy	**Base Year Scenario - 2010**	**Scenario A (Reference Scenario)**	**Preferred Scenario_v1**
Employer-based Commute Reduction Program			
Percentage of Employees Participating in Program	3%	3%	60%
VMT Reduction	5.4%	5.4%	5.4%
Individualized Marketing Program			
Percentage ofHouseholds Participating in Program	1%	1%	60%
VMT Reduction	9%	9%	9%
Eco-driving Education	0%	0%	82%
Low-rolling Resistance Tires	0%	0%	82%
Vehicle Optimization	0%	0%	82%
Carshare Vehicles Available	3	3	182

Appendix H.5 – Preferred Alternative Scenario Detailed ITHIM Results

Table 1 Summary of Annual Morbidity (DALY) and Mortality (Death) Benefits in 2035

Preferred 2				
	DALY		Mortality	
Health Outcome	**Count**	**Adj**	**Count**	**Adj**
Breast Cancer	-4.2	-5.5	-0.2	-0.2
Colon Cancer	-6.8	-8.9	-0.3	-0.5
Stroke	-76.1	-99.4	-2.4	-3.1
Ischemic Heart Disease	-125.6	-164.0	-7.5	-9.8
Depression	-56.2	-73.4	0.0	0.0
Dementia	-34.6	-45.2	-0.9	-1.2
Diabetes	-128.5	-167.8	-2.7	-3.5
Hypertensive Heart Disease	-17.7	-23.2	-1.1	-1.4
Physical Activity Total	**-449.8**	**-587.3**	**-15.1**	**-19.8**
Lung Cancer	-1.1	-1.5	-0.1	-0.1
Inflamatory Heart Disease	-0.1	-0.1	0.0	0.0
Respiratory Disease	-0.6	-0.7	-0.1	-0.1
Stroke (AQ)	-0.4	-0.6	-0.1	-0.1
Ischemic Heart Disease (AQ)	-1.0	-1.3	-0.1	-0.2
Hypertensive Heart Disease (AQ)	-0.2	-0.2	0.0	0.0
Air Quality (PM2.5) Total	**-3.4**	**-4.5**	**-0.4**	**-0.5**
Traffic Safety	**43.0**	**56.1**	**1.8**	**2.4**
TOTAL	**-410.2**	**-535.7**	**-13.7**	**-17.9**

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