600 NE Grand Ave.
Portland, OR 97232-2736

Revised 3/31/14

Metro | *Agenda*

Meeting: Metro Council Work Session
Date: Tuesday, Apr. 1, 2014
Time: 2 p.m.
Place: Council Chamber

CALL TO ORDER AND ROLL CALL

2 PM	**1.**	**ADMINISTRATIVE/ COUNCIL AGENDA FOR APR. 3, 2014 / CHIEF OPERATING OFFICER COMMUNICATION**	
2:15 PM	**2.**	**2015 GROWTH MANAGEMENT DECISION: RESIDENTIAL PREFERENCE SURVEY – INFORMATION/DISCUSSION**	**Ted Reid, Metro** **Dave Nielsen, Home Builders Association of Metropolitan Portland** **Tom Armstrong, City of Portland**
3 PM	**3.**	**BREAK**	
3:05 PM	**4.**	**CLIMATE SMART COMMUNITIES SCENARIOS PROJECT: FINAL PREP FOR APRIL 11 JOINT MPAC/JPACT MEETING – INFORMATION/DISCUSSION**	**John Williams, Metro** **Kim Ellis, Metro** **Patty Unfred, Metro**
3:35 PM	**5.**	**COUNCIL COMMUNICATION**	

ADJOURN

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Agenda Item No. 2.0

2015 GROWTH MANAGEMENT DECISION: RESIDENTIAL PREFERENCE SURVEY

Metro Council Work Session
Thursday, Apr. 1, 2014
Metro, Council Chamber

METRO COUNCIL

Work Session Worksheet

PRESENTATION DATE: April 1, 2014	**TIME:** 2:15 PM **LENGTH:** 45 minutes
PRESENTATION TITLE:	2015 growth management decision: residential preference survey
DEPARTMENT:	Planning and Development
PRESENTER(s):	Ted Reid, Metro 503-797-1768 ted.reid@oregonmetro.gov Dave Nielsen, Home Builders Association of Metropolitan Portland Tom Armstrong, City of Portland, Bureau of Planning and Sustainability

WORK SESSION PURPOSE & DESIRED OUTCOMES

Purpose:
Provide Council with background on a residential preference survey that will be out for responses in mid-to-late April and documented in the 2014 Urban Growth Report.

Outcome:
Council members understand:

- What Metro and its partners hope to learn through this research
- What the survey will include
- How the survey will be made available to respondents
- When survey results will be available

TOPIC BACKGROUND & FRAMING THE WORK SESSION DISCUSSION

Metro, local jurisdictions and the private sector work on a continuous basis to maintain and improve the region's quality of life and to prepare for population and employment growth. Many policy and investment decisions are used to achieve those ends. The regional growth management decision is one of those tools and provides a venue for the region to assess its performance. Understanding how people choose where to live is an important element of planning for future growth.

Following the Metro Council's 2011 growth management decision, staff initiated a "2035 Growth Distribution" process coordinated with local jurisdictions. This work forecasted where, given current policies and investments, population and employment growth are likely to occur in the region. In adopting the 2035 Growth Distribution (Ordinance No. 12-1292A), the Council indicated its desire to undertake, with partners, a research agenda in conjunction with the 2014 Urban Growth Report that would improve our understanding of residential preferences.

Metro staff has followed Council's direction and has formed a coalition of public and private sector partners that are helping to fund and shape this research agenda. Metro's partners include:

- City of Hillsboro
- City of Portland
- Clackamas County
- Home Builders Association of Metropolitan Portland
- NW Natural
- Portland Metropolitan Association of Realtors
- Washington County

The project partners have engaged DHM Research and Portland State University to assist with this research. The project partners have spent several months refining the survey technique, text, and images that will be used for this survey. The project partners intend that this survey instrument can be used periodically in the future to gauge whether and how preferences may be changing. The project partners also intend that improvements to the survey can be made over time as we learn which survey techniques are most effective and how to broaden the diversity of respondents.

QUESTIONS FOR COUNCIL CONSIDERATION

Note – this question will be more timely when the Council is making a growth management decision.
Would the Council like MPAC's advice on any policy questions related to residential preferences?

PACKET MATERIALS

- Would legislation be required for Council action ☐ Yes ☒ No
- If yes, is draft legislation attached? ☐ Yes ☐ No
- What other materials are you presenting today?
    - Presentation at work session

Agenda Item No. 4.0

CLIMATE SMART COMMUNITIES SCENARIOS PROJECT: FINAL PREP FOR APRIL 11 JOINT MPAC/JPACT MEETING

Metro Council Work Session
Thursday, Apr. 1, 2014
Metro, Council Chamber

METRO COUNCIL

Work Session Worksheet

PRESENTATION DATE: April 1, 2014 **TIME:** 3:05 p.m. **LENGTH:** 30 minutes

PRESENTATION TITLE: Climate Smart Communities Scenarios Project: Final prep for April 11 joint MPAC/JPACT meeting

DEPARTMENT: Planning and Development; Communications

PRESENTER(S): John Williams, Kim Ellis (x1617, kim.ellis@oregonmetro.gov), and Patty Unfred

WORK SESSION PURPOSE & DESIRED OUTCOMES

- **Purpose:** Staff will provide an update on the April 11 and May 30 joint MPAC and JPACT meetings.
  - *The April 11 meeting will: (1) review MPAC and JPACT's role and community feedback on the proposed policy areas identified for further discussion and input; and (2) engage members in interactive policy-level discussions about the preferred approach and prepare them to discuss with county-level coordinating committees.*
  - *The May 30 meeting will: (1) provide an opportunity for members to report back on and discuss feedback from the county-level coordinating committees; (2) review results of an on-line poll completed by members in May; and (3) make recommendations to the Metro Council on what should be included in the draft preferred approach.*
- **Outcome:** Council provides feedback to staff on the process being used to support the development of MPAC and JPACT recommendations to Council on the draft preferred approach.

BACKGROUND

The Climate Smart Communities Scenarios Project was initiated in response to a mandate from the 2009 Oregon Legislature to reduce per capita greenhouse gas emissions from cars and small trucks by 20 percent below 2005 levels by 2035.

The Climate Smart Communities Scenarios Project continues to engage community, business, public health and elected leaders in a discussion to shape and adopt a preferred approach that meets the state mandate and supports local and regional plans for downtowns, main streets and employment areas.

The results of the Phase 2 scenarios' analysis demonstrate that implementation of regional and locally adopted land use and transportation plans and policies make the state-mandated greenhouse gas emissions reduction target achievable – if we make the investments and take the actions needed to implement those plans.

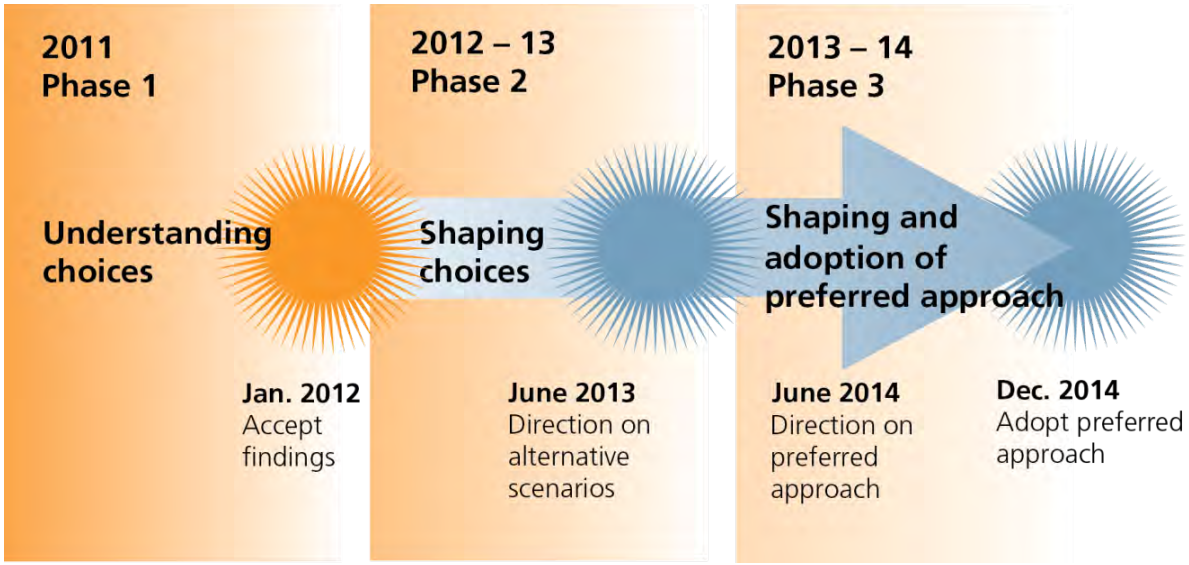
The preferred approach that is developed in 2014 will start with the plans cities, counties and the region have adopted – from local zoning, capital improvement plans, comprehensive and

transportation system plans to the 2040 Growth Concept and regional transportation plan – to create healthy and equitable communities and a strong economy.

The project continues to be on track to meet its legislative and administrative mandates.

Figure 1 shows the project timeline.

Figure 1. Climate Smart Communities Project Timeline



CHANGES SINCE COUNCIL LAST CONSIDERED THIS ITEM

- Metro Councilors and staff provided a **project update to the Oregon Transportation Commission** on March 20. The commission gave strong support and praise for the significant technical, engagement and policy work completed to date and the level of coordination that has occurred between the CSC project and development of the Statewide Transportation Strategy (STS). Members underscored the project's key finding that ODOT and local partners currently lack sufficient funding to make state, regional and local plans a reality. The commission acknowledged the importance of understanding the magnitude of investment needs but raised caution about funding expectations that often come from large-scale planning efforts. The Commissioners highlighted their commitment to continue seeking sustainable ways to fund transportation investments and suggested that a "patchwork" of funding from a variety of sources and new partnerships will be needed. They also noted that funding gaps will need to be addressed at a higher level than the Commission, and expressed the desire to work together with our region and others to make the case for the investing in communities across Oregon.
- The **Oregon Health Authority released an executive summary [Attachment 1] and the final report documenting their health impact assessment** of the three scenarios tested in 2013. OHA will present their findings and recommendations to technical advisory committees in March and early April, and the policy committees later this spring. The full report will be posted on the project website at www.oregonmetro.gov/climatescenarios.
- **DHM Research** conducted a scientific telephone opinion survey of 600 residents (200 residents from each of the region's three counties) related to land use and transportation

strategies being considered in the CSC project. Adam Davis will present the results of the telephone survey at the April 11 MPAC and JPACT joint meeting.

- **JLA Public Involvement** convened the first of two discussion groups on March 28. The second discussion group will be convened on April 2. Additionally, an online Opt In survey is being conducted to enhance community participation and engagement on the project. A public engagement summary report and recommendations for the draft preferred approach will be provided to the Metro Council and Metro's policy advisory committees at the first joint MPAC/JPACT meeting.
- **Staff continued to coordinate outreach** being conducted with the planned comment period for the 2014 RTP update, the Metropolitan Transportation Improvement Program and the Regional Active Transportation Plan. An online comment tool will gather input from March 21 through May 5 that will also inform the CSC project. Three community discussion events hosted by Metro Councilors will be held in April, one in each county, to engage the public in the planning decisions being considered by the Metro Council this year. A Spanish-language only event is also being planned.

Figure 2 provides a summary of Phase 3 engagement activities and Council milestones for reference.

FIGURE 2. PHASE 3 PROJECT MILESTONES AND PUBLIC PARTICIPATION OPPORTUNITIES

Table 1 provides a summary of Phase 3 engagement activities.

TABLE 1. PHASE 3 ENGAGEMENT ACTIVITIES

Who	Engagement activity	Timeframe	Number of participants
Metro Councilors and staff	State Commission Briefings 1 – Land Conservation and Development Commission 2 – Oregon Transportation Commission	 Feb. 14 *(completed)* March 20 *(completed)*	LCDC and OTC members and department directors

Who	Engagement activity	Timeframe	Number of participants
JLA Public Involvement	Stakeholder interviews	Jan. – Feb. *(completed)*	33 elected officials and public health, environmental, business, environmental justice & equity leaders
DHM Research	Focus groups by 3 counties with representative sample of participants	Feb. 22 *(completed)*	22 community members
DHM Research	Public opinion telephone survey with statistically representative sample of participants	March 17–21 *(completed)*	600 community members (200 from each county)
JLA Public Involvement	Discussion groups 1 – Investments and actions discussion 2 – Implementation and monitoring of preferred approach	1 – March 28 2 – April 2	40-50 public health, housing, transportation, environmental, business, environmental justice & equity stakeholders
JLA Public Involvement	Online public comment tool for 2014 RTP update and 2015-18 MTIP that will also inform CSC project*	Mar. 21–May 5	Estimated 2,000+ visitors
DHM Research	Opt In survey on investments and actions priorities and general willingness to invest in priority strategies.	March 25–April 3	Estimate 2,000+ participants
Oregon Policy Consensus Center	Facilitate joint MPAC and JPACT meetings	April 11 May 30	MPAC and JPACT members and alternates
Metro staff	Three community forums* (one in each county)	April 3, 9, and 17	Estimated 75+ residents
Metro Councilors and staff	County-level policy coordinating committee briefings	May 1 – C-4 subcommittee May 5 – EMCTC May 5 – WCCC	City and county officials, MPAC and JPACT members

*Coordinated engagement with RTP, ATP and MTIP

HOW ENGAGEMENT ACTIVITIES WILL INFORM JOINT MPAC AND JPACT MEETINGS

The design of the joint meetings is still under development. Consistent with Council direction on February 27, staff have continued developing meeting materials that describe each of the policy areas to be discussed. The summary will be further expanded to include background information on each policy area, including the estimated costs of each scenario tested and input provided to date through the various engagement activities.

The April 11 joint MPAC/JPACT meeting will use interactive discussions facilitated by Sam Imperati of the Oregon Policy Consensus Center to begin building consensus on what investments and actions should be included in the draft preferred approach. A summary report of completed

engagement activities will be provided at the meeting. In addition, Adam Davis of DHM Research will present the findings from the focus groups and public opinion research. JLA will moderate a panel of community and business leaders who participated in interviews and discussion groups to share their feedback on investments and actions under consideration for inclusion in draft preferred approach.

In between the first and second joint meeting, Metro Councilors and staff will support MPAC and JPACT members with reporting the results of the April 11 meeting to the county-level policy coordinating committees – the C-4 subcommittee in Clackamas County on May 1, the East Multnomah County Transportation Coordinating Committee on May 5, and the Washington County Policy Coordinating Committee on May 5. The purpose of the briefings is to share information from the April 11 meeting and seek input on the draft preferred approach in advance of the second joint meeting.

An electronic survey will be sent to MPAC and JPACT members after the County Coordinating Committee meetings to provide a formal opportunity for members to provide initial recommendations on the draft preferred approach in advance of the second joint meeting. The results of the survey will be compiled and reported at the meeting.

In addition, TPAC and MTAC will review the engagement summary, results of the April 11 MPAC/JPACT meeting and begin developing recommendations to MPAC and JPACT at their April 25 and May 7, respectively. TPAC and MTAC will be asked to finalize their recommendation to MPAC and JPACT at their regular meetings on May 21 and May 23, respectively.

On May 30, MPAC and JPACT will consider the MPAC/JPACT member survey results and recommendations from MTAC and TPAC on the draft preferred approach. The joint meeting will conclude with a formal recommendation to the Metro Council from each committee. The recommendation on the draft preferred approach will be subject to final evaluation and public review.

In June, the Metro Council will then consider JPACT and MPAC 's recommendation. The action is anticipated to direct staff to move forward with Steps 6-8 of the process, which includes evaluating the agreed-upon draft preferred approach, reporting back on the results of the evaluation in September and preparing Regional Framework Plan amendments and a near-term implementation plan for public review during the fall public comment period.

CONSIDERATIONS AND OPTIONS AVAILABLE

Framing policy questions for MPAC and JPACT discussion – The April 11 joint meeting agenda and updated draft materials are not yet available for distribution, but will be presented to Council at the April 1 work session.

Table 2. Key policy questions identified for the MPAC and JPACT recommendation

- *What mix of investments and actions best support your community's vision for healthy and equitable communities and a strong economy while reducing greenhouse gas emissions?*

  1. Make **transit** more convenient, frequent, accessible and affordable
  2. Use **technology and "smarter" roads** to actively manage traffic flow and boost system efficiency
  3. Provide **information (marketing and education)** to expand walking, biking, carpooling, and use of transit and fuel-efficient driving techniques
  4. Make **biking and walking** more safe and convenient
  5. Make **streets and highways** more safe, reliable and connected
  6. Manage **parking** with a market-responsive approach to use parking resources efficiently

- *Given the current uncertainty around transportation funding, how should we pay for investments needed to realize our shared vision for walkable communities, job creation, and affordable housing and transportation choices?*

QUESTIONS FOR COUNCIL CONSIDERATION

1. Does the Council have questions for staff or input regarding the joint MPAC and JPACT meetings?

PACKET MATERIALS

- Would legislation be required for Council action? ☐ Yes ☑ Not at this time
- What other materials are you presenting today?
  - Attachment 1. Climate Community Choices Health Impact Assessment (HIA) Executive Summary (3/14)

Executive Summary

Community Climate Choices Health Impact Assessment

Climate change may pose serious risks to public health. Significant shifts in the climate are already happening. The Third National Climate Assessment found that as the climate continues to change, Oregon will likely experience more frequent heat waves and wildfires, an increase in asthma and other respiratory diseases, changes in disease patterns, and diminishing water quality and quantity [1]. Curbing climate change is a critical public health issue and national public health officials support efforts across the nation to reduce greenhouse gas (GHG) emissions.

The recommendations offered in this Community Climate Choices Health Impact Assessment (CCC HIA) will be considered during Phase 3 of Metro's Climate Smart Communities Scenarios (CSCS) Project, underway in the Portland, Oregon metropolitan region. The focus of the project is to understand and choose the best way to reduce GHG emissions through transportation and land use strategies. The CSCS Project seeks to reduce GHG emissions by reducing per capita vehicle miles traveled (VMT) for light duty-vehicles and by investing in technologies that reduce emissions.

Community Climate Choices Health Impact Assessment Scope

Geography: Portland, Oregon metropolitan region within the Urban Growth Boundary

Timeline: 2010 (base year) to 2035 (horizon year)

Scenarios - adopted local and regional plans with:

- A: existing revenues
- B: increased revenues from existing sources
- C: new plans, policies and revenue sources

Exposure pathways: physical activity, traffic safety, air quality, land use

Quantitative tool: Integrated Transportation Health Impact Model (ITHIM)

Other considerations: magnitude of health costs associated with health pathways, vulnerable populations.

Health Impact Assessment (HIA) is a way to consider how a policy or plan affects community health before the final decision is made. By providing objective, evidence-based information, HIA can increase positive health effects and mitigate unintended health impacts. The Public Health Division of Oregon Health Authority (PHD) conducted this assessment at Metro's request, with funds provided by the Center for Disease Control and Prevention's Healthy Community Design Initiative.

Investments in land use and transportation systems that reduce GHG emissions positively impact health by increasing physical activity, reducing traffic collisions and improving air quality. PHD and Metro agreed that the CCC HIA is necessary to better inform Metro and its partners in the selection of a final scenario by December 2014.

Key findings

This analysis found that the strategies under consideration to reduce GHG emissions also result in important health benefits in all exposure pathways, including increased physical activity, fewer traffic injuries and less exposure to air pollutants. These changes are likely to reduce illness and death in the region.

Through a literature review including 348 peer-reviewed articles and government reports linking the built environment to health, PHD found most of the land use strategies under consideration for the CSCS Project promote health. Evidence shows that elements such as level of residential density, land use mix, the number of nearby community destinations and ease of street connectivity are effective at promoting active transportation. Scenario B and C subsections labeled 'Complete Streets and Active Transportations Investments' support healthy behaviors the most. These strategies include better street connections, safer street crossings, wider sidewalks, safer street crossings, improved bus stops, more bikeways, trails and on-street bicycle facilities, and more efficient operation of transit signals.

The literature also aligns with advisory members' equity concerns. Low-income households in search of affordable housing options may locate in neighborhoods that are not well-served by affordable transportation options and have fewer health-supportive amenities. This underscores the need to create and preserve affordable housing options in areas that are well-served by transit.

Integrated Transport and Health Impact Model (ITHIM)

In addition to literature reviews for all pathways, PHD also used a quantitative model, ITHIM, to help understand the relative impact of each of three exposure pathways — physical activity, traffic safety and air pollution as measured by particulate matter (PM2.5) [2]. ITHIM uses relative risks and burden of disease to estimate avoided illnesses (as measured by disability adjusted life years) and deaths for nine conditions associated with physical activity, three conditions linked to PM2.5 exposure, and current traffic fatality rates. A clear limitation of ITHIM is it underestimates all health benefits by restricting calculations to certain pathways and diseases.

Results from ITHIM predict that strategies for reducing GHG emissions will promote health; health benefits occur in all exposure pathways for all scenarios. Scenario A levels of investment are expected to contribute to 64 avoided premature deaths annually. Scenarios B and C would result in 98 and 133 avoided premature deaths respectively. Every 12% decrease in GHG — the difference between each successive scenario — results in an approximate 0.65% decrease in illness among diseases studied.

Physical activity

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 86–91% of avoided deaths and 69–84% of avoided illness resulting from implementing the CSCS project.

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 increases the safety of all users and will facilitate walking, bicycling and use of public transit.

Traffic safety

Reduced GHG emissions through lower per capita vehicle miles traveled (VMT) results in fewer overall traffic fatalities and injuries. Scenario A results in one avoided traffic fatality per year and decreases disabilities from serious injuries (measured by disability adjusted life years or DALYs) by 2.0%. Scenario C would help avoid 12 traffic fatalities and 12.5% of DALYs from serious injuries a year.

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. Metro is targeting aggressive GHG emission reductions of 12, 24 and 36% for Scenarios A, B and C respectively. However, Metro's scenarios result in only modest PM2.5 reductions of 2.8, 3.2 and 3.6% due to population growth and reliance on fleet change and fuel technologies. 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 PM2.5 exposure.

ITHIM only incorporates long-term exposure to PM2.5 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 PM2.5 exposure and current average concentrations of ozone are above safe levels. Episodic PM2.5 (winter) and ozone (summer) 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.

Recommendations

Climate change poses a risk to the future health of Oregonians. Proposed strategies to mitigate climate change will also increase health benefits associated with physical activity, traffic safety and improved air quality. Based upon the findings of this report and with the support of the CCC HIA Advisory Committee, PHD has developed a series of recommendations to preserve and promote healthy communities throughout the region.

By developing and implementing a preferred scenario that meets or surpasses the GHG emissions reduction target set by the Department of Land Conservation and Development, PHD anticipates an improvement in public health.

The majority of health benefits from the CSCS Project can be attributed to active transportation such as walking and biking to work, transit, school and community destinations. Based on this evidence, this HIA recommends that Metro maximize opportunities for active transportation for all communities by:

[continued on page 4]

- Adopting and identifying stable funding for the design elements listed in the subsection 'Complete Streets and Active Transportation Investments' of Scenarios B and C: street connections, wider sidewalks, safer street crossings, improved bus stops, bikeways, transit signal priority, and on-street bicycle facilities and trails.
- Improving transit service miles to meet levels recommended in Scenario C.
- Using an equity analysis to plan and develop equal access to active transportation throughout the region.
- While the benefits of physical activity far outweigh the risks, active modes of transportation can lead to increased exposure to traffic injury and air pollution. In order to reduce the risk of increased exposure to traffic injury and air pollution for all road users, this HIA recommends that Metro prioritize the design and maintenance of non-automobile facilities by:
- Including safety features for pedestrians and bicyclists, such as separation from motorized traffic, when possible. Prioritize non-automobile users in design and maintenance of streets.
- Providing a parallel bicycle route one block removed from high-volume roads where feasible to reduce exposure to localized pollution while still maintaining access to community destinations.

Per capita VMT reduction is expected to modestly improve air quality as measured by many pollutants including air toxics, but temporal and localized air quality concerns remain. Due to temporal and spatial air quality concerns, this HIA recommends that Metro maximize overall improvements in air quality through actions such as:

- Aligning the CSCS preferred alternative to PATS goals. In collaboration with DEQ, determine how the preferred alternative helps meet Oregon's adopted ambient benchmark concentrations.
- Reducing exposure by using zoning and incentives to improve indoor filtration systems in new buildings along transportation corridors.
- Convening a regional committee to further address episodic air quality events. Solutions should be season specific and could promote incentives for short-term, alternative commute arrangements.
- Finally, to improve health equity, this HIA recommends Metro ensure social and health goals are considered when prioritizing investments by:
- Explicitly and transparently addressing how investment links low-income and other vulnerable households to health-promoting resources.

Oregon Health Authority
PUBLIC HEALTH DIVISON
Environmental Public Health
Center for Prevention and Health Promotion

Materials following this page were distributed at the meeting.

600 NE Grand Ave.
Portland, OR 97232-2736

Metro | Agenda

Revised 4/1/2014

Meeting: Metro Council
Date: Thursday, April 3, 2014
Time: 2 p.m.
Place: Metro, Council Chamber

CALL TO ORDER AND ROLL CALL

1. INTRODUCTIONS

2. CITIZEN COMMUNICATION

3. CONSIDERATION OF THE COUNCIL MINUTES FOR MAR. 20, 2014

4. RESOLUTIONS

4.1 **Resolution No. 14-4511**, For the purpose of Funding Hispanic Engagement for Council Creek Regional Trail and Climate Smart Communities. — **Councilor Kathryn Harrington, Metro**

5. CONTRACT REVIEW BOARD

5.1 **Resolution No. 14-4512**, Resolution of the Metro Council Acting as the Metro Contract Review Board, for the Purpose of Approving a Contract Amendment for the Scouters Mountain Nature Park. — **Gabriele Schuster, Metro**
Mark Davison, Metro

6. ORDINANCES – FIRST READ

6.1 **Ordinance No. 14-1327**, For the Purpose of Annexing to the Metro District Boundary Approximately 47.70 acres Located North of NW Springville Road, East of NW Kaiser Road and South and West of the Multnomah County Line in the North Bethany Area of Washington County. — **Tim O'Brien, Metro**

7. ORDINANCES – SECOND READ

7.1 **Ordinance No. 14-1326,** Amending the FY 2013-14 Budget and Appropriations Schedule and the FY 2013-14 Through 2017-18 Capital Improvement Plan. — **Kathy Rutkowski, Metro**

7.1.1 Public Hearing on Ordinance No. 14-1326.

8. CHIEF OPERATING OFFICER COMMUNICATION

9. COUNCILOR COMMUNICATION

ADJOURN

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Television schedule for April 3, 2014 Metro Council meeting

Clackamas, Multnomah and Washington counties, and Vancouver, WA Channel 30 – Community Access Network *Web site*: www.tvctv.org *Ph*: 503-629-8534 *Date*: Thursday, April 3	**Portland** Channel 30 – Portland Community Media *Web site*: www.pcmtv.org *Ph*: 503-288-1515 *Date:* Sunday, April 6, 7:30 p.m. *Date*: Monday, April 7, 9 a.m.
Gresham Channel 30 - MCTV *Web site*: www.metroeast.org *Ph*: 503-491-7636 *Date*: Monday, April 7, 2 p.m.	**Washington County and West Linn** Channel 30– TVC TV *Web site*: www.tvctv.org *Ph*: 503-629-8534 *Date*: Saturday, April 5, 11 p.m. *Date*: Sunday, April 6, 11 p.m. *Date*: Tuesday, April 8, 6 a.m. *Date*: Wednesday, April 9, 4 p.m.
Oregon City and Gladstone Channel 28 – Willamette Falls Television *Web site*: http://www.wftvmedia.org/ *Ph*: 503-650-0275 Call or visit web site for program times.	

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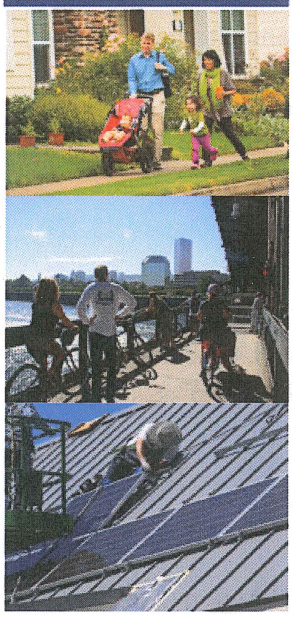
CLIMATE SMART COMMUNITIES SCENARIOS PROJECT

Metro



JPACT/MPAC MEETING AGENDA

Climate Smart Communities Scenarios Project
8 a.m. to noon, Friday, April 11
World Forestry Center

7:30 a.m.	**Registration and light breakfast**	
8 a.m.	**Making the case for investing in great communities** *Welcome and setting the stage for the day.*	MPAC Chair, West Linn Council President Jody Carson JPACT Chair, Metro Councilor Craig Dirksen
8:15 a.m.	**Overview of agenda and process for shaping preferred approach**	Sam Imperati, Facilitator, Oregon Consensus
	Overview of policy questions and discussion materials	John Williams, Metro Deputy Planning Director
8:35 a.m.	**Priorities, opportunities and challenges moving forward – what we heard from community leaders** A *panel discussion of community leaders will share key themes and recommendations from recent stakeholder engagement and discussion groups, followed by a facilitated group discussion.*	Moderator: Jeanne Lawson, JLA Public Involvement <u>Panel members:</u> Linda Moholt, Tualatin Chamber of Commerce Chris Hagerbaumer, Oregon Environmental Council Steve White, Oregon Public Health Institute Roberta Hunte, Portland State University

Meeting outcomes:

- Members gain better understanding of policy areas under consideration
- Members are able to communicate issues fully to represented colleagues and local partners prior to the next joint meeting in May
- Members create a "snapshot" of relative priorities of the group through a straw poll
- Members commit to sharing information and collecting feedback to shape the final draft proposal in May

9:25 a.m.	**Priorities moving forward – what we heard from the public** *A leading pollster shares key takeaways from recent telephone poll and focus groups.*	Adam Davis, DHM Research
9:45 a.m.	**Break**	
10 a.m.	**Small group discussions and straw poll to weigh in on the draft preferred approach** *Members rotate in small groups to six stations to learn more about each investment area, discuss options for shaping the preferred approach and provide initial feedback through a straw poll at the end.*	Members and alternates
11:40 a.m.	**What we learned today** *Review results of straw poll on the draft preferred approach.*	Sam Imperati, Facilitator, Oregon Consensus
11:50 a.m.	**Working together regionally – what's next?** *Share observations from the morning's discussion and review next steps for members to prepare for May 30 joint meeting.*	JPACT Chair, Metro Councilor Craig Dirksen MPAC Chair, West Linn Council President Jody Carson
Noon	**Adjourn**	

Getting there, logistics and more info

The World Forestry Center is accessible by MAX at the Washington Park stop or TriMet bus #63. A parking pass will be provided for members and alternates who park in the Washington Park lot. Metro staff will meet you at the main parking lot entrance to provide you the pass or you can pick it up at the registration table. For staff or other meeting attendees, parking is available for purchase at the lot.

The meeting will be held in Cheatham Hall in the middle of the World Forestry Center campus. Follow directional signs to the meeting.

Both JPACT and MPAC members and alternates will be seated at discussion tables at the April 11 meeting. Audience seating will be provided for all other attendees.

www.oregonmetro.gov/climatescenarios
For more information, call Valerie Cuevas at 503-797-1536.

April 1, 2014

CLIMATE SMART COMMUNITIES SCENARIOS PROJECT
Metro

Climate Smart Communities Scenarios Project

DRAFT TPAC & MTAC Briefing Materials- Shaping the preferred approach

CHOICES FOR OUR FUTURE

The Climate Smart Communities Scenarios Project was initiated in response to a mandate from the 2009 Oregon Legislature to reduce per capita greenhouse gas emissions by 20 percent from cars and small trucks by 2035.

In February 2014, MPAC and JPACT recommended moving forward to shape and adopt a preferred approach that meets the state mandate and supports adopted local and regional plans for downtowns, main streets and employment areas. The starting point for the preferred approach will be adopted local and regional plans – adopted zoning, comprehensive plans, capital improvement plans and transportation plans.

Through May 2014, policymakers and the public will weigh in on these policy questions:

- *What mix of investments and actions best support your community's vision for healthy and equitable communities and a strong economy while reducing greenhouse gas emissions?*
- *Given the current uncertainty around transportation funding, how should we pay for investments needed to realize our shared vision for walkable communities, job creation and affordable housing and transportation choices?*

In May, MPAC and JPACT will make recommendations on a draft preferred approach for Metro Council consideration in June. An evaluation of the draft preferred approach will occur during the summer, 2014 in advance of the final public comment period. A final approach that meets the state's requirement will be considered by the Metro Council for adoption in December 2014.

For more information, visit the project website at:
www.oregonmetro.gov/climatescenarios

Shaping the preferred approach |Policy area summaries
Table of contents

Questions for policymakers | MPAC and JPACT discussion
April 11 & May 30, 2014

To realize our shared vision for healthy and equitable communities and a strong economy while reducing greenhouse gas emissions …

1. How much transit should we provide by 2035?
2. How much should we use technology to actively manage the transportation system by 2035?
3. How much should we expand the reach of travel information programs by 2035?
4. How much of the planned active transportation network should we complete by 2035?
5. How much of the planned street and highway network should we complete by 2035?
6. How should local communities manage parking by 2035?
7. *How should we pay for the investments needed to realize local and regional plans?*

RELATIVE CLIMATE BENEFIT

★★★★★

RELATIVE COST

$ $ $

Make transit more convenient, frequent, accessible and affordable

There are four key ways to make transit service more convenient, frequent, accessible and affordable. The effectiveness of each will vary depending on the mix of nearby land uses, the number of people living and working in the area, and the extent to which travel information, marketing and technology are used.

Frequency – Increasing the frequency of transit service in combination with transit signal priority and bus lanes makes transit faster and more convenient.

System expansion – Providing new community and regional transit connections improves access to jobs and community services and makes it easier to make some trips without multiple transfers.

Transit access - Building safe and direct bike and pedestrian routes and crossings that connect to stops makes transit more accessible and convenient.

Fares – Providing reduced fares makes transit more affordable; effectiveness depends on the design of the fare system and the cost.

Transit is provided in the region by TriMet and South Metro Area Rapid Transit (SMART) in partnership with Metro, cities, counties, employers, business associations and non-profit organizations.

BENEFITS

- improves access to jobs, workforce , goods and services, boosting business revenues
- creates jobs and saves consumers and employers money
- stimulates development, generating local and s tate revenue
- provides drivers and alternative to congested roadways and supports freight movements by taking cars off the road
- increases physical activity
- reduces air pollution and air toxics
- reduces risk of traffic fatalities and injuries

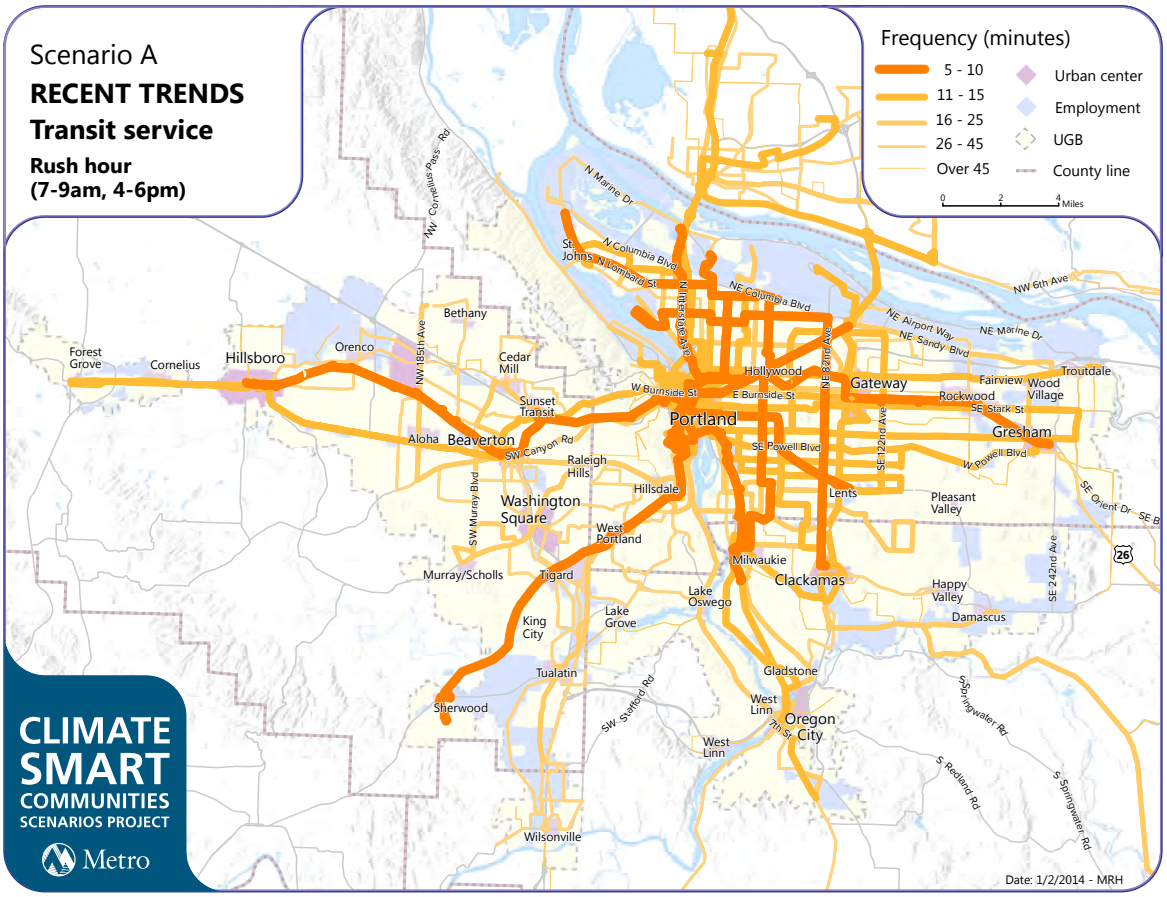
CHALLENGES

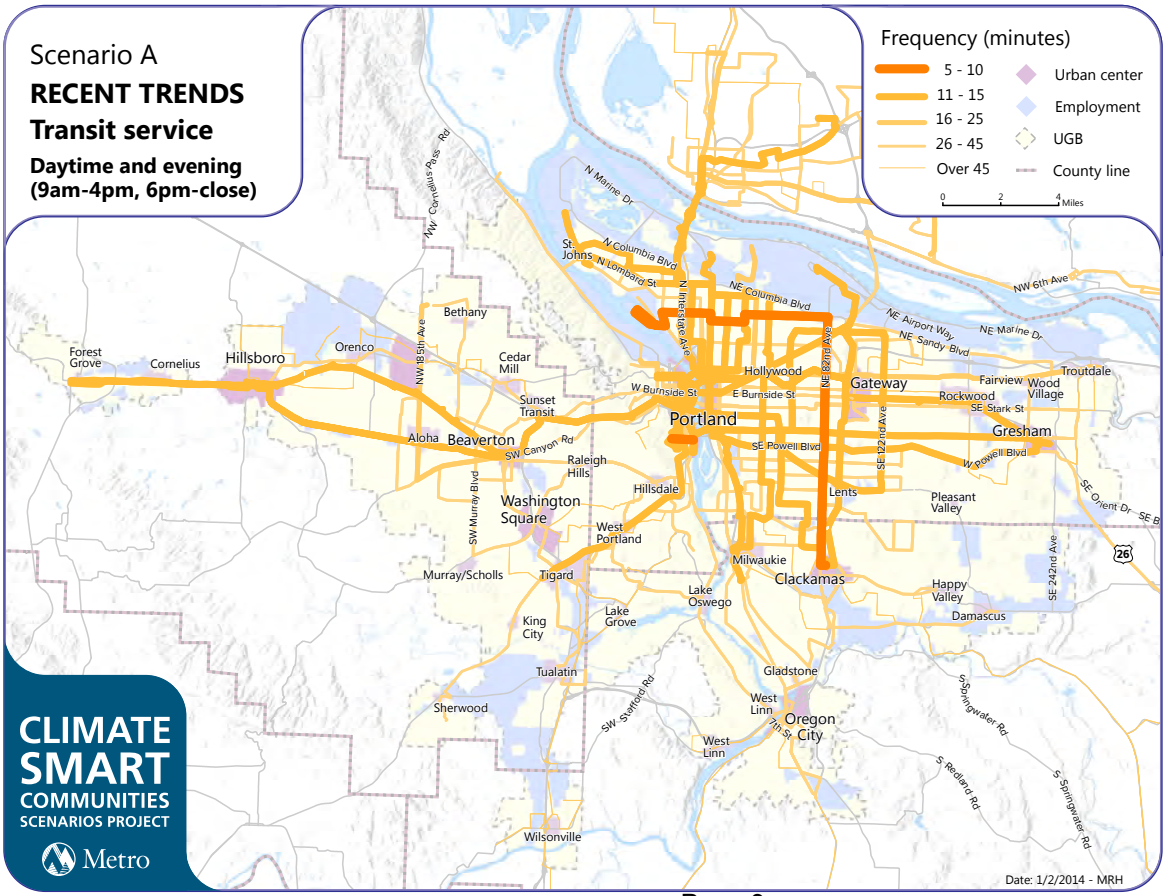
- transit demand outpacing funding
- ability to enhance existing service while expanding coverage and frequency to growing areas
- reduced revenue and federal funding, leading to increased fares and service cuts
- preserving affordable housing options near transit
- ensuring safe and comfortable access to transit for pedestrians, cyclists and drivers
- transit-dependent populations locating in parts of the region that are harder to serve by transit

How much transit should we provide by 2035?

TRANSIT AT A GLANCE

	SCENARIO A	SCENARIO B	SCENARIO C
Revenue hours	5,600	6,200	11,200
Service expansion *(increase from 2010 level)*	14% increase	27% increase	129% increase
Rush hour frequency	10-minute service on 10 routes	10-minute service on 13 routes	10-minute service on 37 routes
Off-peak frequency	30-minute service on most routes	20-minute service on most routes	10-minute service on most routes
New high capacity transit connections	None	Planned connections completed, such as the extension to Vancouver, WA	All regional centers and more town centers served Priority high capacity transit system plan and Southwest Corridor completed
Other service enhancements	Westside Express Service (WES) and Portland streetcar operate at 2010 frequencies	Same as Scenario A, plus more planned Portland streetcar connections completed	WES operates all day with 15-minute service Locally-developed Service Enhancement Plans (SEPs) and the planned Portland Streetcar System Plan mostly completed
Public and private shuttles	Existing private shuttles continue to operate between large work sites and major transit stops	Additional major employers and some community-based organizations work with TriMet to operate shuttles	More major employers and some community-based organizations work with TriMet to operate shuttles
Fares	Reduced fares provided to youth, older adults and disabled persons	Same as Scenario A	Reduced fares provided to low-income families
Estimated cost (2014$)	**$TBA**	**$TBA**	**$TBA**





SCENARIO

A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.

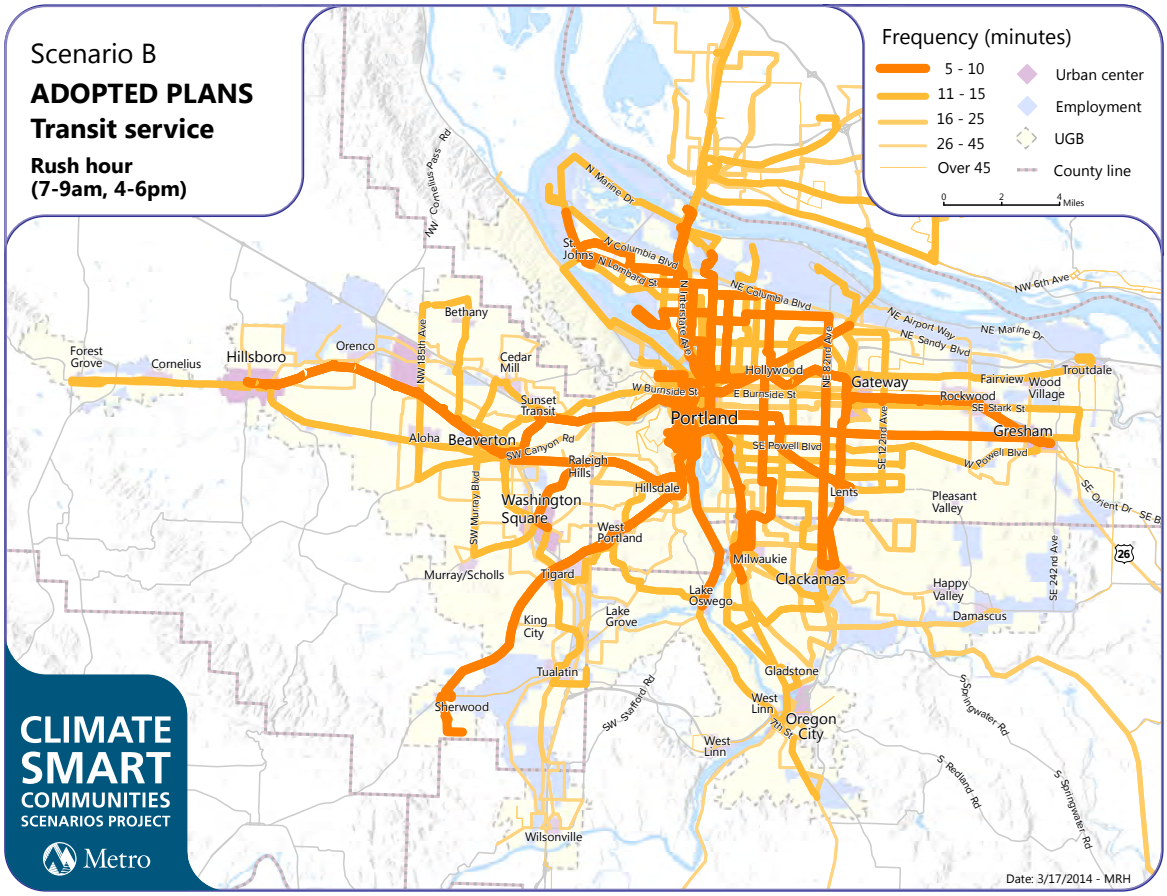
Estimated jobs and households with transit access by 2035

SCENARIO B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

Estimated jobs and households with transit access by 2035



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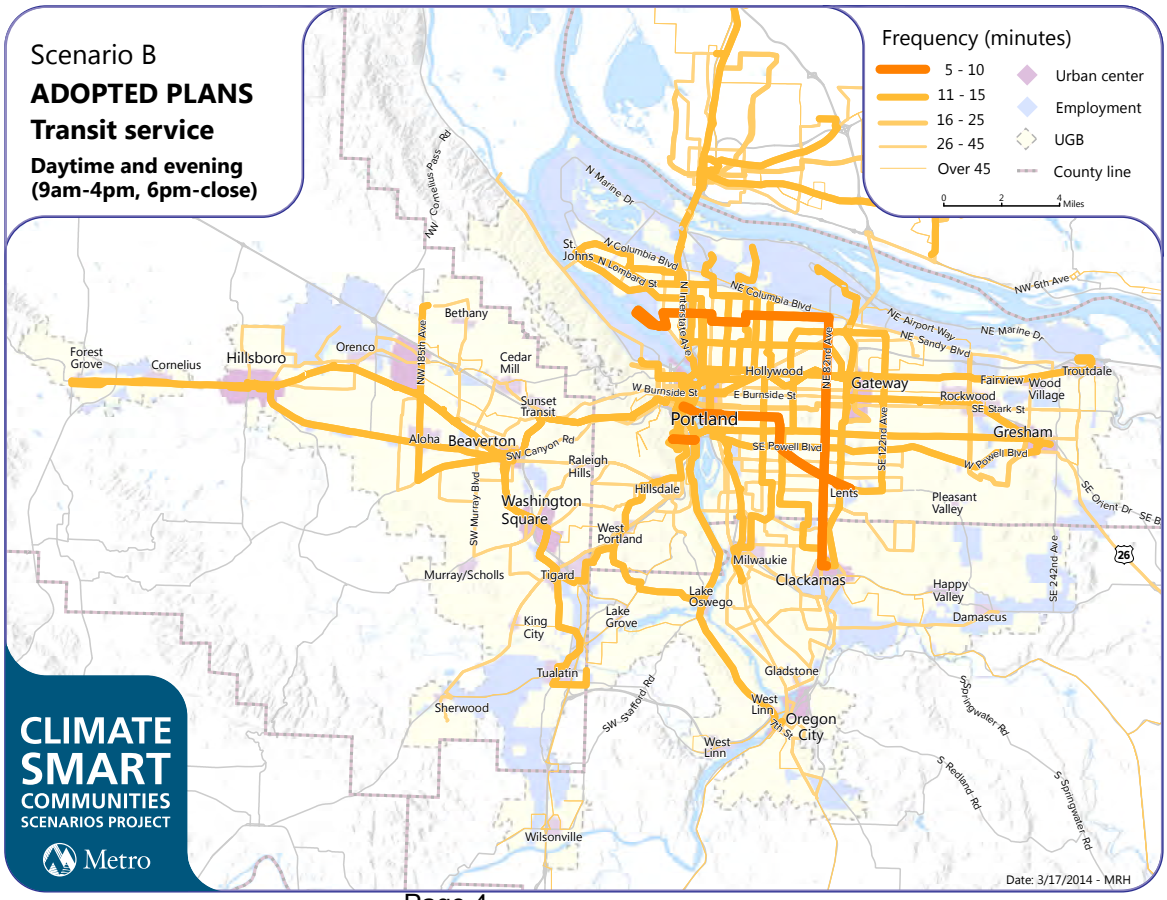
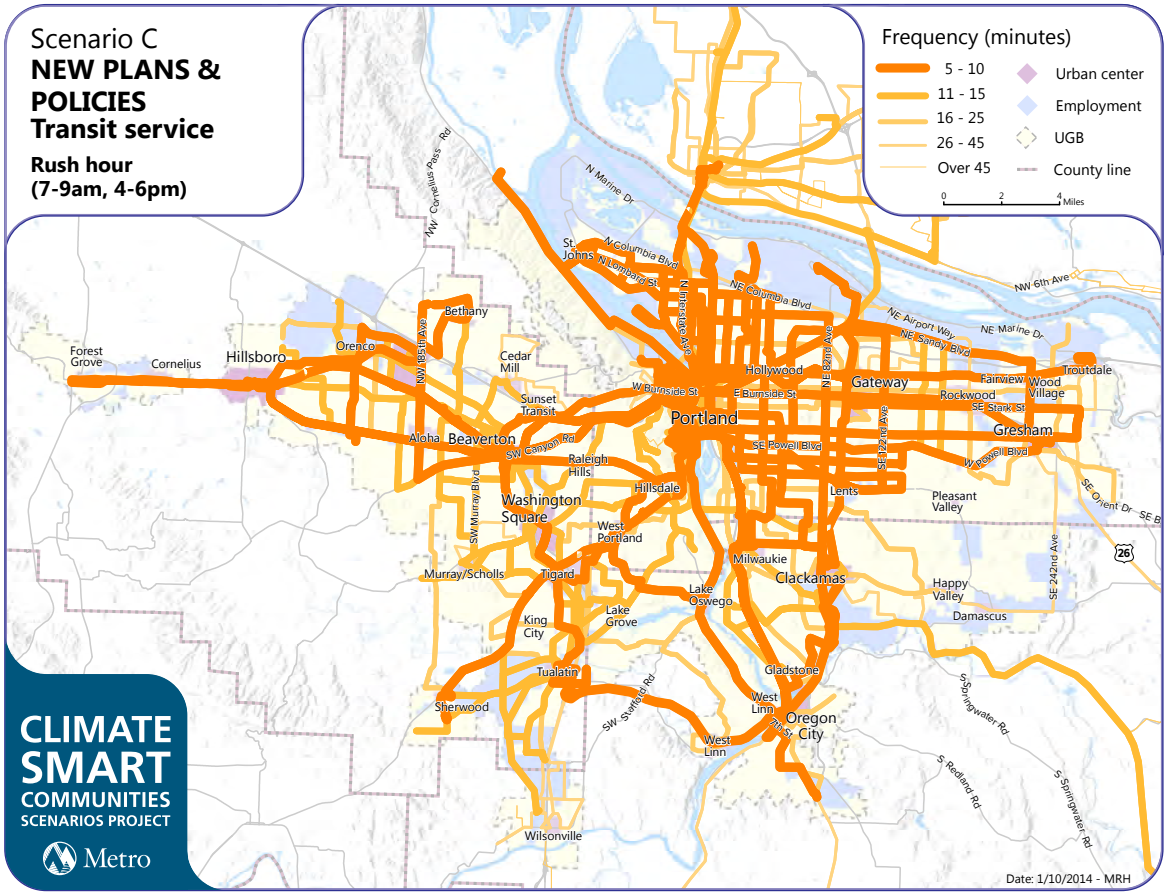
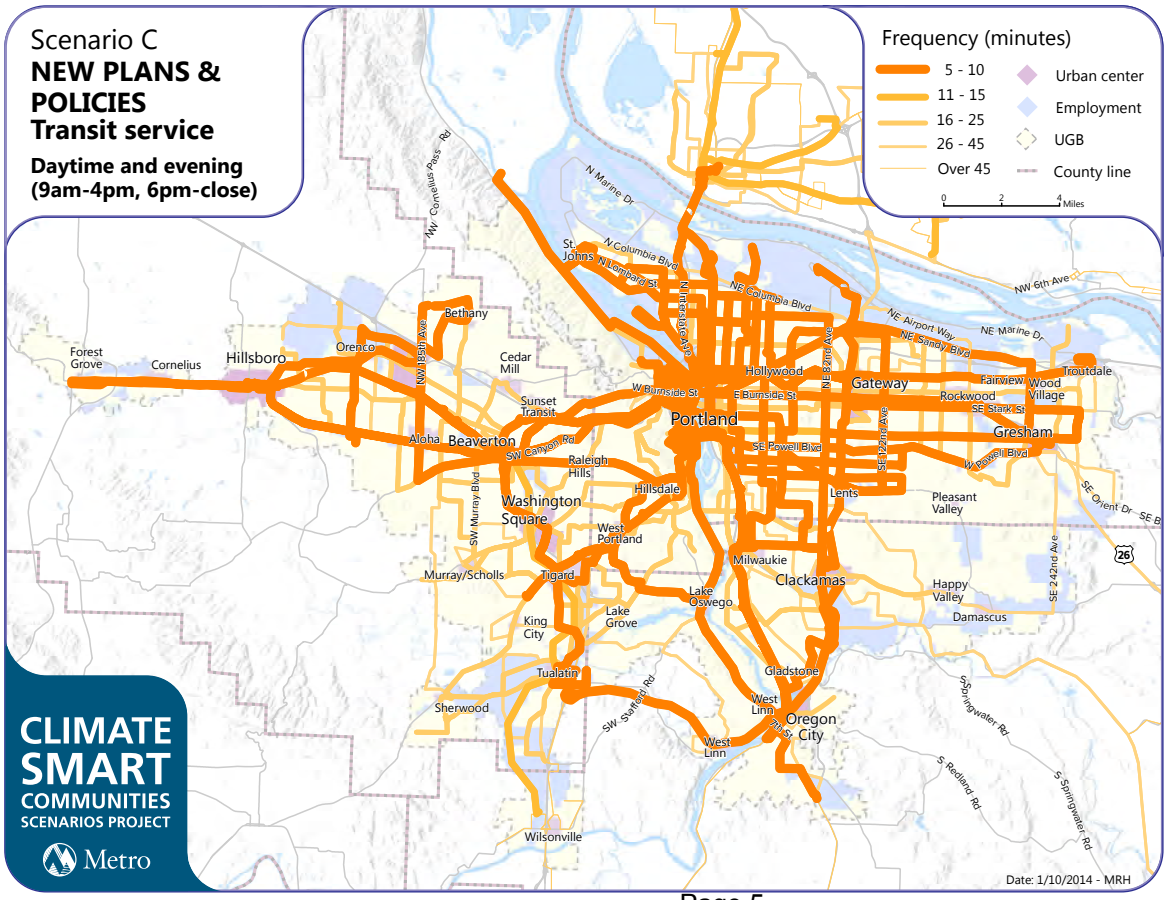




SCENARIO C

New Plans and Policies
This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans.

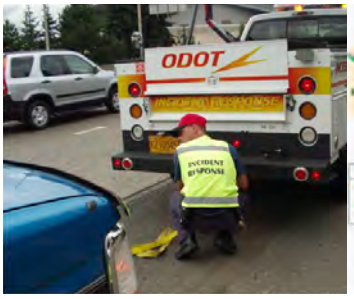
Estimated jobs and households with transit access by 2035



What people are saying

Emerging themes

Key takeaways to share with others



RELATIVE CLIMATE BENEFIT

★★☆☆☆

RELATIVE COST

$ $ $

Use technology to actively manage the transportation system

Using technology to actively manage the Portland metropolitan region's transportation system means using intelligent transportation systems (ITS) and services to reduce vehicle idling associated with delay, making walking and biking more safe and convenient, and helping improve the speed and reliability of transit. Nearly half of all congestion is caused by incidents and other sources that can be addressed using these strategies.

Local, regional and state agencies work together to implement technologies in coordination with other capital investments, including ODOT, Metro, cities, counties, TriMet, South Metro Area Rapid Transit (SMART) and the Port of Portland. Agreements between agencies provide guidance on purchasing and sharing data and technology, operating procedures for managing traffic, and ongoing maintenance and enhancement of technology, data collection and monitoring systems.

Arterial corridor management includes advanced technology at each intersection to actively manage traffic flow. This may include coordinated or adaptive signal timing, advanced signal operations such as cameras, flashing yellow arrows, bike signals and pedestrian count down signs, and communication to a local traffic operations center and the centralized traffic signal system (currently housed at the City of Portland).

Freeway corridor management includes advanced technology to manage access to the freeways, detect traffic levels and weather conditions, provide information with variable message signs, variable speed limit signs, and deploying incident response patrols that quickly clear breakdowns, crashes and debris. These tools connect to a regional traffic operations center.

Traveler information includes using en route variable message and speed signs and 511 internet and phone services to provide travelers with up-to-date information regarding traffic and weather conditions, speeds, incidents, travel times, alternate routes, construction, or special events.

BENEFITS

- provides near-term benefits
- reduces congestion and delay
- makes traveler experience more reliable
- saves public agencies, consumers and businesses time and money
- reduces air pollution and air toxics
- reduces risk of traffic fatalities and injuries

CHALLENGES

- requires ongoing funding to maintain operations and monitoring systems
- requires significant cross-jurisdictional coordination
- workforce training gaps

How much should we use technology to actively manage the transportation system by 2035?

TECHNOLOGY AT A GLANCE

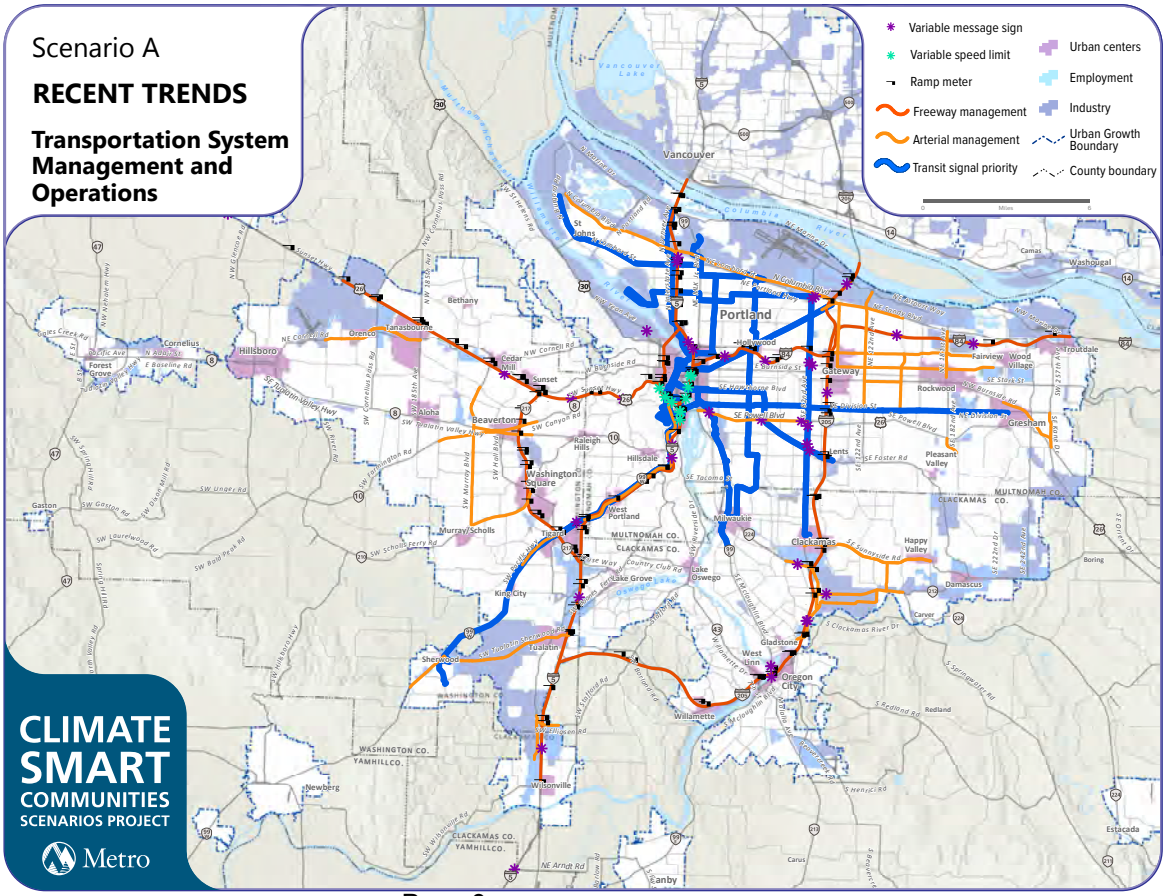
	SCENARIO A	SCENARIO B	SCENARIO C
Advanced traffic signal operations	Traffic signals on some major arterials	Traffic signals on many major arterials	All traffic signals are connected to a centralized system
Transit signal priority	Some bus routes with 10-minute service	All bus routes with 10-minute service	All bus routes with 10-minute service
Freeway ramp meters	Most urban interchanges	Same as Scenario A	All urban interchanges
Freeway variable speed signs	None	Deployed in most high incident locations	Deployed in all high incident locations
Incident response patrols	Some incident response patrols are deployed on area freeways	More incident response patrols are deployed on area freeways	Incident response patrols are deployed on area freeways and major arterials adjacent to freeways
Estimated cost (2014$)	**$113 million**	**$135 million**	**$193 million**

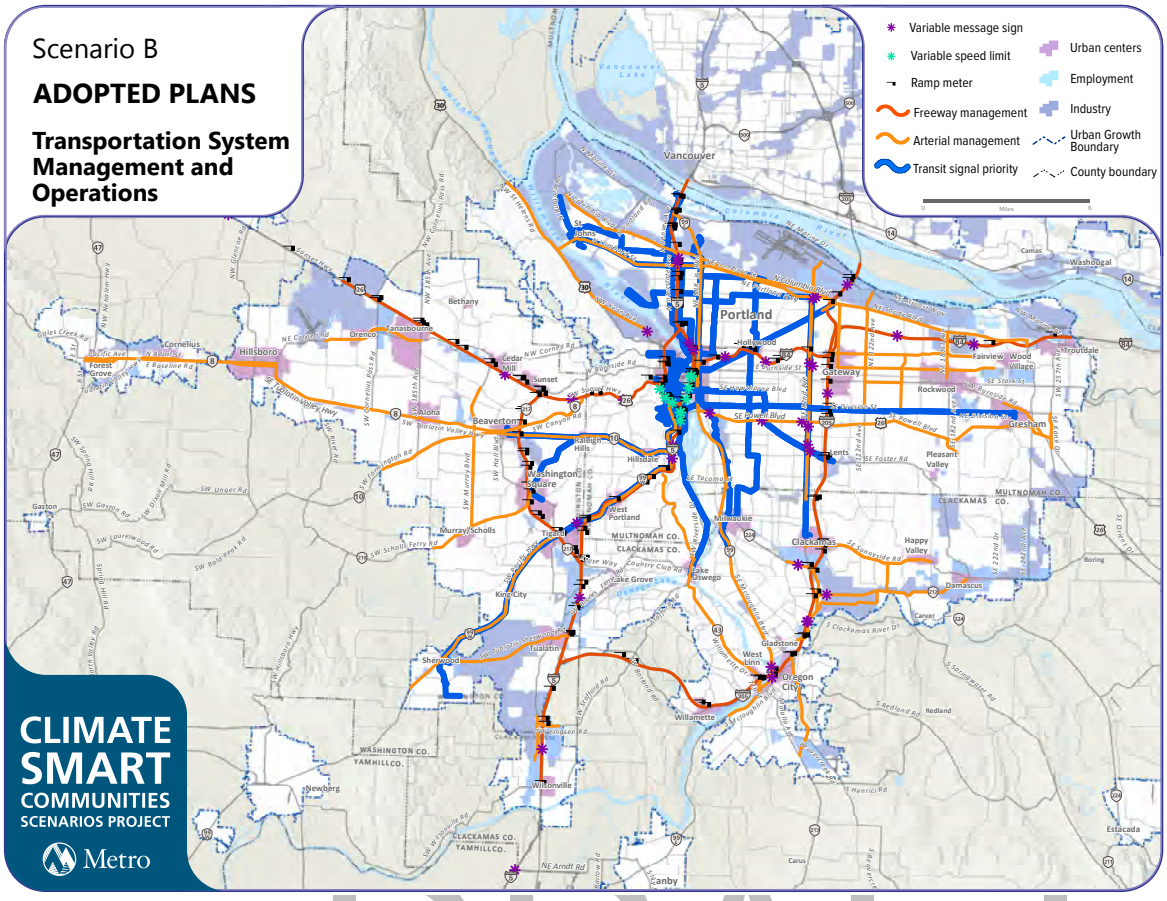
SCENARIO A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.

10% on arterials and freeways
Estimated delay reduction by 2035



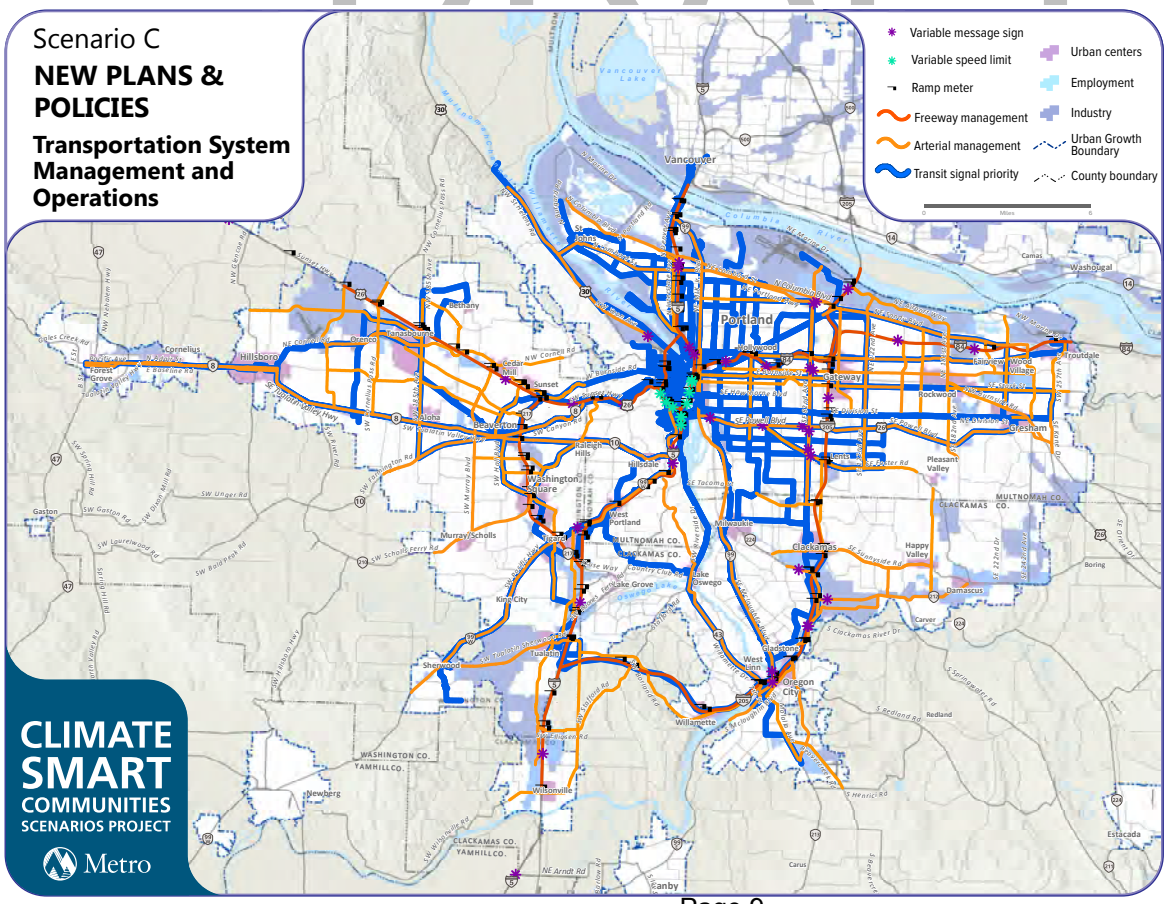


SCENARIO B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

20% on arterials and freeways
Estimated delay reduction by 2035



SCENARIO C

New Plans and Policies

This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans.

35% on arterials and freeways
Estimated delay reduction by 2035

What people are saying

Many cities and counties are already investing in traffic technology and smarter roads.

This seems to be a low cost strategy with immediate benefits.

Extend use of intelligent transportation systems (ITS) to make freight movement more efficient.

Emerging themes

Key takeaways to share with others

RELATIVE CLIMATE BENEFIT

★★★☆☆

RELATIVE COST

$ $ $

Provide information to expand use of travel options and smart driving

Public awareness, education and travel options support tools are cost-effective ways to improve the efficiency of the existing transportation system through increased use of travel options such as walking, biking, carsharing, carpooling and taking transit. Local, regional and state agencies, including ODOT, Metro, cities, counties and transit providers, work together with businesses, and non-profit organizations to implement programs in coordination with other capital investments. Metro coordinates partner's efforts, sets strategic direction, evaluates outcomes, and manages grant funding.

Public awareness strategies include promoting information about travel choices and teaching the public about maintaining vehicles to operate more efficiently and drive habits hat can help save time and money and reduce greenhouse emissions, marketed as eco-driving.

Commuter programs are employer-based outreach efforts that include (1) financial incentives, such as transit pass programs and offering cash instead of parking subsidies; (2) facilities and services, such as ride-matching and carpooling programs, end-of-trip facilities, emergency rides home, and work place competitions; and (3) flexible scheduling such as working from home or compressed work weeks.

Individualized marketing (IM) is an outreach method that encourages individuals, families or employees interested in making changes in their travel choices to participate in a program. A combination of information and incentives is tailored to each person or family's specific travel needs. IM can be part of a comprehensive commuter program.

Travel options support reduces barriers to travel options and supports continued use with tools such as the *Drive Less. Connect.* online carpool matching; trip planning tools; wayfinding signage; bike racks; and carsharing.

BENEFITS

- increases cost-effectiveness of capital investments in transit, carsharing, walking and biking
- saves public agencies, consumers and businesses time and money
- reduces congestion and delay
- increases physical activity and reduces health care costs
- reduces air pollution and air toxics

CHALLENGES

- program partners need ongoing tools and resources to increase outcomes
- factors such as families with children, long transit times, night and weekend work shifts not served by transit
- major gaps exist in walking and biking routes across the region
- consistent data collection to support performance measurement

How much should we expand the reach of travel information programs by 2035?

TRAVEL INFORMATION PROGRAMS AT A GLANCE

	SCENARIO A	SCENARIO B	SCENARIO C
Individualized marketing participation	30% of households	Same as Scenario A	60% of households participate Same as Scenario B plus the addition of Safe Routes to school and equity-based campaigns
Commuter program participation	20% of employees reached (same as 2010) Oregon Employee Commute Options (ECO) rules require work sites with more than 100 employees to have work-place programs	Same as Scenario A	40% of employees reached ECO rules now include work sites with more than 50 employees
Public awareness marketing campaign	50% of public reached Existing ongoing and short-term campaigns lead to more awareness of *DriveLess. Connect.*	Same as Scenario A plus added resources promote new travel tools, regional efforts and safety education	60% of public reached Scenario B plus regionally specific campaigns dedicated to safety and underserved communities
Eco-driving participation	0% of households reached (same as 2010) Statewide program is newly launched	30% of households reached	60% of households reached
Provisions of travel options support tools	2010 program funding levels allow for completion of several new wayfinding signage and bike rack projects	Same as Scenario A plus public/private partnerships to create new online, print and on-street travel tools	Same as Scenario B plus better public/private data integration and more resources for more support tools
Estimated cost (2014$)	**$99 million**	**$124 million**	**$234 million**

SCENARIO A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.

SCENARIO B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

SCENARIO C

New Plans and Policies

This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans

INSERT PHOTOS AND CAPTIONS OF TRAVEL OPTION PROGRAM EXAMPLES

What people are saying

Emerging themes

Key takeaways to share with others




RELATIVE CLIMATE BENEFIT

★★★☆☆

RELATIVE COST

$ $ $

Make biking and walking more convenient

Active transportation is human-powered travel that engages people in healthy physical activity while they go from place to place. Examples include walking, biking, pushing strollers, using wheelchairs or other mobility devices, skateboarding, and rollerblading. Active transportation is an essential component of public transportation because most trips on public transportation begin and end with walking or biking.

Today, about 50 percent of the regional active transportation network is complete. Nearly 18 percent of all trips in the region are made by biking and walking, a higher share thanmany other places. Approximately 45 percent of all trips made by car in the region are less than three miles and 15 percent are less than one mile. With a complete active transportation network supported by education and incentives, many of the short trips made by car could be replaced by biking and walking. (See separate summary on providing information to expand use of travel options.)

For active travel, transitioning between modes is easy when sidewalks and bicycle routes are connected and complete, wayfinding is coordinated, transit stops are connected by sidewalks and have shelters and places to sit. Biking to work and other places is supported when bikes are accommodated on transit vehicles, safe and secure bicycle parking is available at transit shelters and community destinations, and adequate room is provided for bicyclists and walkers on shared pathways. Regional trails and transit function better when they are integrated with on-street walking and biking routes.

ODOT, Metro, cities, counties, TriMet, South Metro Area Rapid Transit (SMART), parks providers, the Port of Portland, and developers are primarily responsible for these investments, working in partnership with community organizations and others to implement.

BENEFITS

- increases access to jobs and services
- provides low-cost travel options
- supports economic development and tourism
- increases physical activity and reduces health care costs
- reduces air pollution and air toxics
- reduces risk of traffic fatalities and injuries

CHALLENGES

- major gaps exist in walking and biking routes across the region
- gaps in the active transportation network affect safety, convenience and access to transit
- many would like to bike or walk but feel unsafe
- everyone does not have access to walking and biking routes
- limited dedicated funding is declining

How much of the planned regional active transportation network should we complete by 2035?

ACTIVE TRANSPORTATION AT A GLANCE

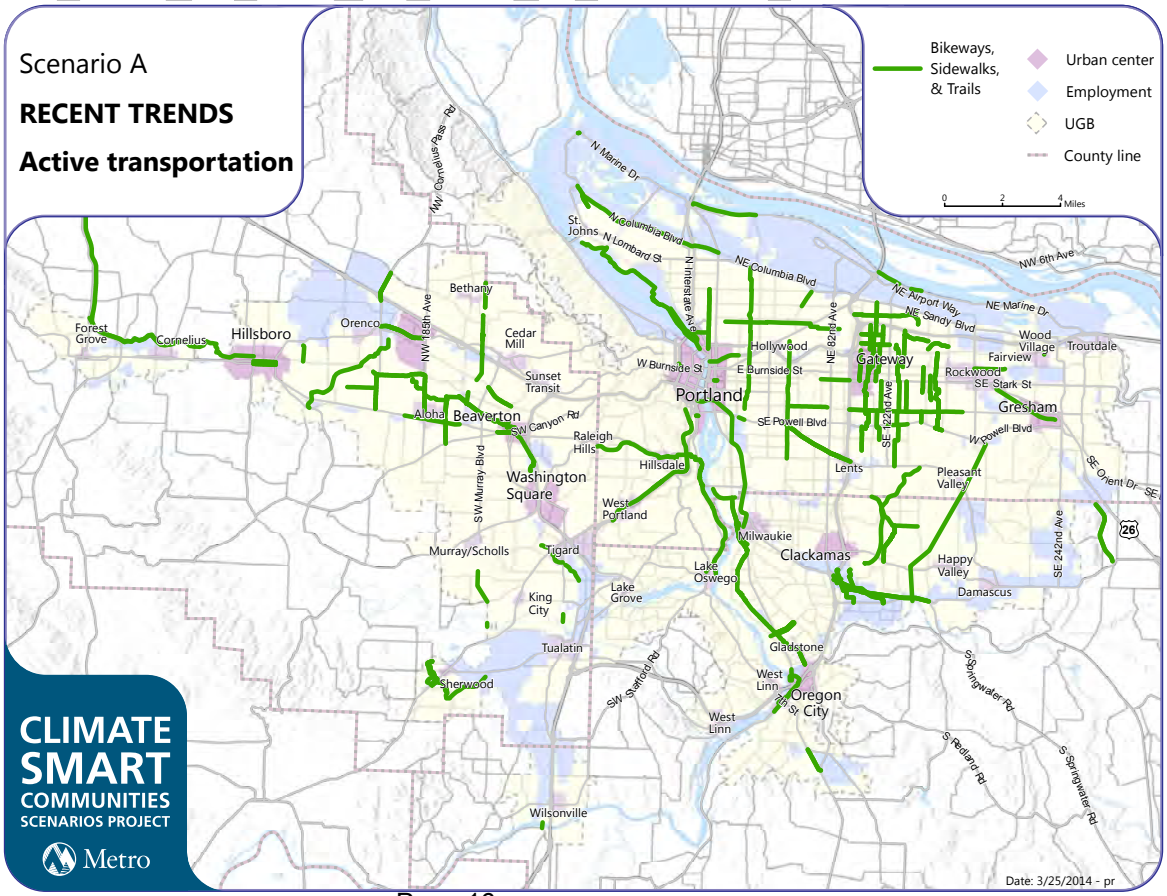
	SCENARIO A	SCENARIO B	SCENARIO C
Completion of regional active transportation network	Federally funded planning and capital projects reflecting existing funding is largely dedicated to transit and road investments	Same as Scenario A, plus planned off-street trails and on-street sidewalk and bikeway projects, such as bicycle lanes, cycle tracks, bicycle boulevards, sidewalks and crossing improvements included in financially constrained RTP	Same as Scenario B, plus full build-out of planned off-street trails, on-street sidewalk and bikeway projects, and improvements to existing facilities
Trails	38% completed	79% completed	100% completed
Bikeways	63% completed	84% completed	100% completed
Sidewalks	54% completed	62% completed	100% completed
Estimated cost (2014$)	**$57 million**	**$948 million**	**$3.9 billion**

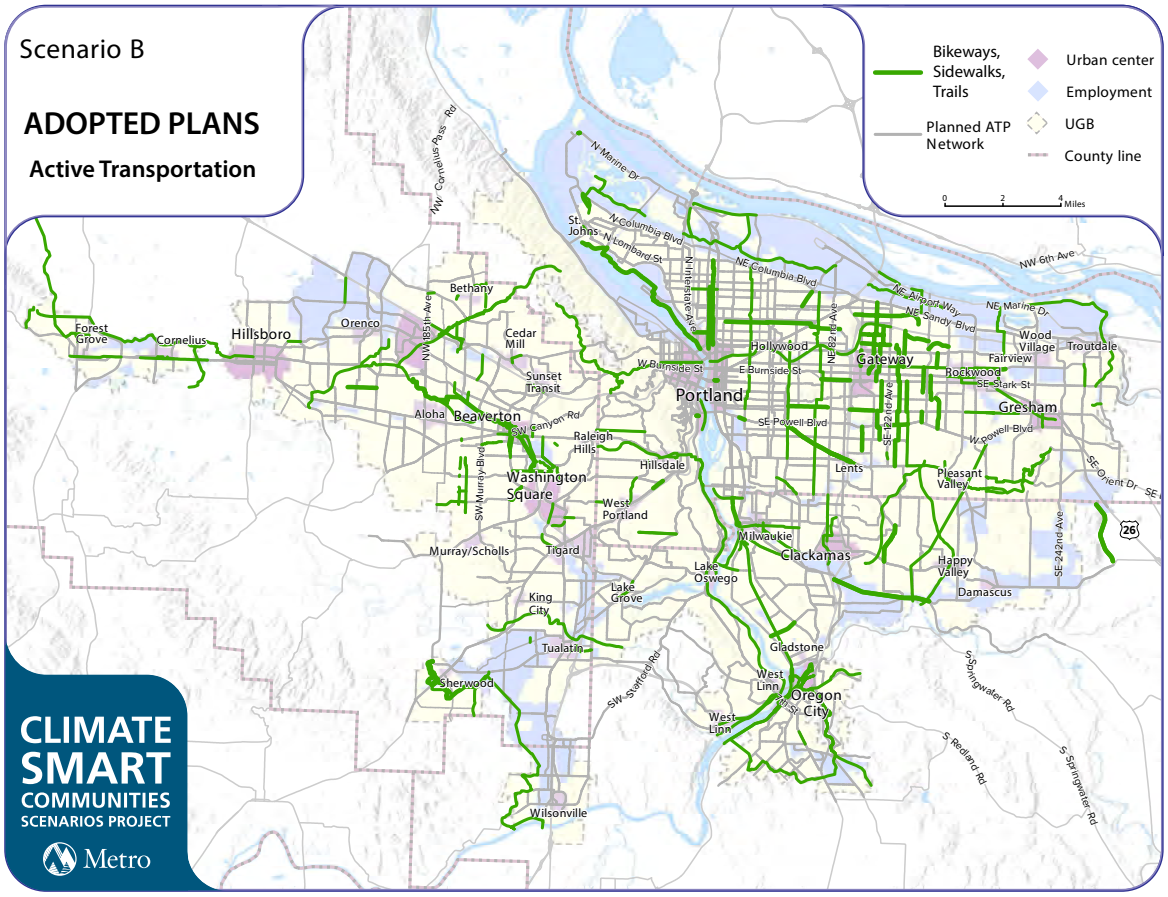
SCENARIO A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.

58
Estimated lives saved annually from increased physical activity by 2035





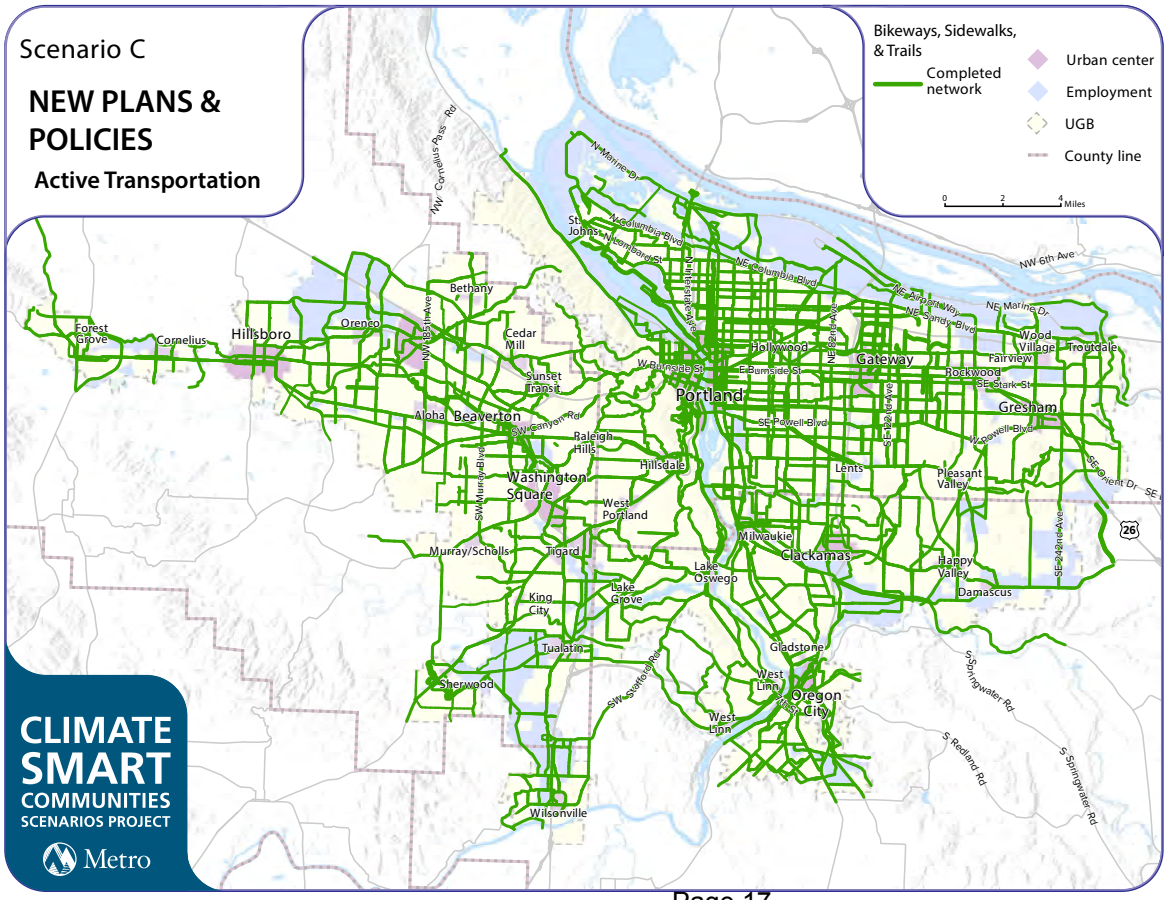
SCENARIO B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

89

Estimated lives saved annually from increased physical activity by 2035



SCENARIO C

New Plans and Policies

This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans.

116

Estimated lives saved annually from increased physical activity by 2035

What people are saying

Emerging themes

Key takeaways to share with others




RELATIVE CLIMATE BENEFIT

★ ★ ★ ★ ★

RELATIVE COST

$ $ $

Make streets and highways more safe, reliable and connected

Today, nearly 45 percent of all trips made by car in the region are less than three miles, and 15 percent are less than one mile. When road networks lack multiple routes designed to serve the same destinations, these short trips must use major travel corridors designed for freight and regional traffic, adding to congestion.

There are three key ways to make streets and highways more safe, reliable and connected to serve longer trips across the region on highways, shorter trips through portions of the region on arterial streets, and the shortest trips on local streets. ODOT, cities, counties, the Port of Portland and developers are primarily responsible for investments in this part of the transportation system.

Maintenance and efficient operation of the existing road system Keeping the road system in good repair and using information and technology to manage travel demand and traffic flow help improve safety, reduce delay and boost efficiency of the existing system. With limited funding, more effort is being made to maximize system operations prior to building new capacity in the region. (See separate summaries describing the use of technology and information.)

Street connectivity Building a well-connected network of complete streets that includes new local and major street connections improves access to community and regional destinations and helps preserve the capacity and function of highways in the region for freight and longer trips. These connections include designs that support walking and biking, and, in some areas, provide critical freight access between industrial areas, intermodal facilities and the interstate highway system.

Network expansion It is often expensive to add lane-miles to relieve congestion. Research has also shown that adding capacity alone is not a sustainable solution to congestion. Targeted widening of streets and highways along with other strategies helps the region provide adequate capacity to connect goods to market and support travel across the region.

BENEFITS

- improves access to jobs, goods and services, boosting business revenue
- creates jobs and stimulates development, boosting the regional economy
- reduces delay, saving businesses time and money
- reduces risk of traffic fatalities and injuries
- reduces emergency response time

CHALLENGES

- declining purchasing power of existing funding sources and growing maintenance backlog and construction costs
- may induce more traffic
- potential community impacts, such as displacement and noise
- concentration of air pollutants and air toxics in major travel corridors

How much of the planned street and highway network should we complete by 2035?

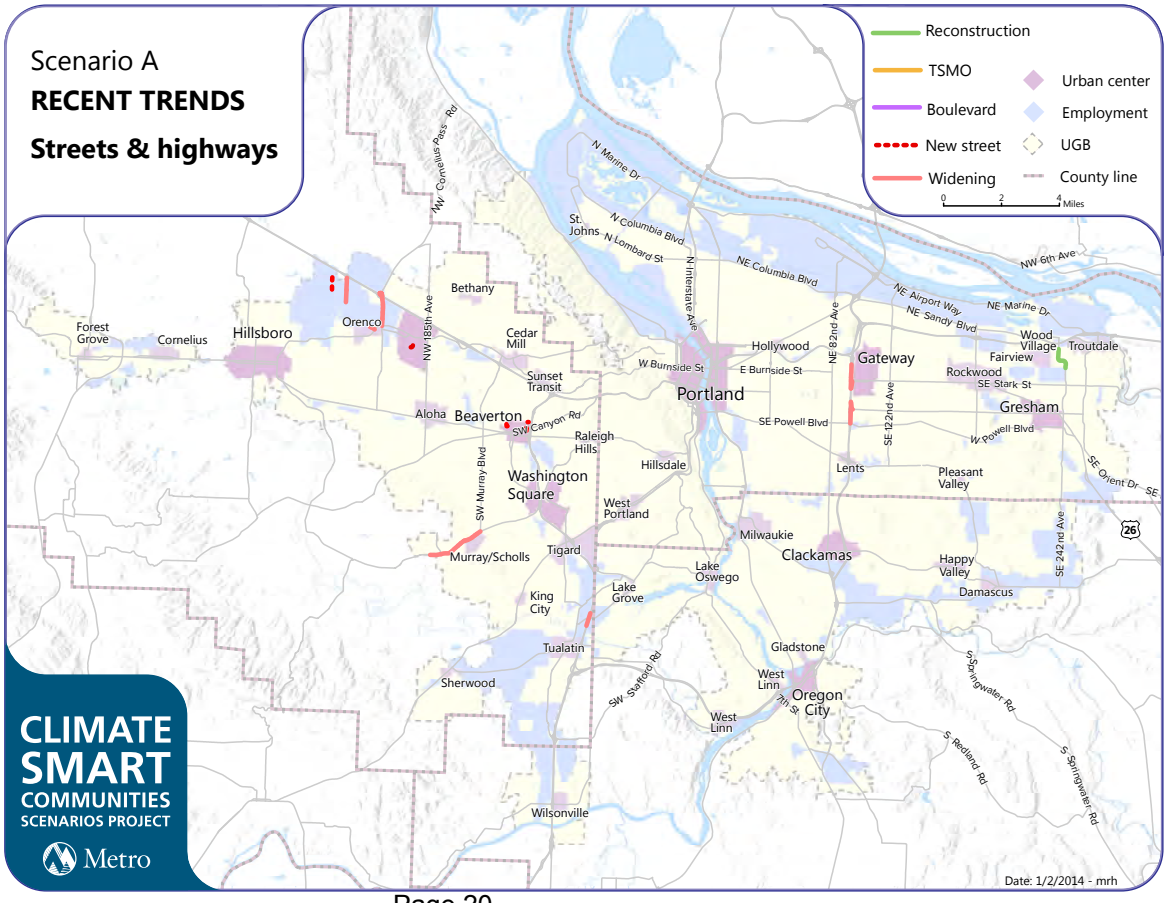
STREET AND HIGHWAYS AT A GLANCE

	SCENARIO A	SCENARIO B	SCENARIO C
Arterials and freeways (lane miles added from 2010)	9 miles added Maintain the existing system and complete committed projects	81 miles added Same as Scenario A, plus complete financially constrained RTP projects such as • planned connections to further build out the regional street grid and improve access to industrial areas and freight facilities • widening some major streets and freeways to address bottlenecks	105 miles added Same as Scenario B plus additional projects in the RTP On-going regional traffic operations center monitoring and incident response patrols are deployed on area freeways and major arterials adjacent to freeways
Maintenance	Some maintenance backlog grows	Fully meet maintenance and preservation needs	Same as Scenario B
Estimated capital cost (2014$)	**$68 million**	**$8.8 billion**	**$11.8 billion**

SCENARIO A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.



SCENARIO

B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

Estimated cost (2014$)
$8.8 billion

SCENARIO

C

New Plans and Policies

This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans.

Estimated cost (2014$)
$11.8 billion

What people are saying

Emerging themes

Key takeaways to share with others

RELATIVE CLIMATE BENEFIT

★★★★½

RELATIVE COST

$ $ $

Manage parking to make efficient use of parking resources

Parking management refers to various policies and programs that result in more efficient use of parking resources. Parking management is implemented through local development codes by cities, counties, TriMet, South Metro Area Rapid Transit (SMART), the Port of Portland, businesses and developers. Managing parking works best when used in a complementary fashion with other strategies; it is less effective in areas where transit or bicycle and pedestrian infrastructure is lacking.

Planning approaches include conducting assessments of the parking supply and using it to better understand needs. A typical urban parking space has an annualized cost of $600 to $1,200 to maintain, while structured parking construction costs averages $15,000 per space.

On-street parking approaches include spaces that are timed, metered, designated for certain uses or have no restriction. Examples of these different approaches include charging long-term or short-term fees, limiting the length of time a vehicle can park, and designating on-street spaces for preferential parking for electric vehicles, carshare vehicles, carpools, vanpools, bikes, public use (events or café "Street Seats" and freight truck loading/unloading areas).

Off-street parking approaches include providing spaces in designated areas, unbundling parking from office/condo purchases or leases, preferential parking (for vehicles listed above), shared parking between land uses (for example, movie theater and business center), park-and-ride lots for transit and carpools/vanpools, parking garages in the center of downtowns and other mixed-use areas that allow surface lots to develop as other uses.

BENEFITS

- allows more land to be available for development, generating local and state revenue
- reduces costs to governments, businesses, developers and consumers
- fosters public-private partnerships that can result in improved streetscape for retail and visitors
- generates revenues where parking is priced
- supports physical activity
- reduces air pollution and air toxics

CHALLENGES

- inadequate information for motorists on parking and availability
- inefficient use of existing parking resources
- parking spaces that are inconvenient to nearby residents and businesses
- scarce freight loading and unloading areas
- low parking turnover rate
- lack of sufficient parking
- parking oversupply, ongoing costs and the need to free up parking for customers

How should local communities manage parking by 2035?

PARKING MANAGEMENT AT A GLANCE

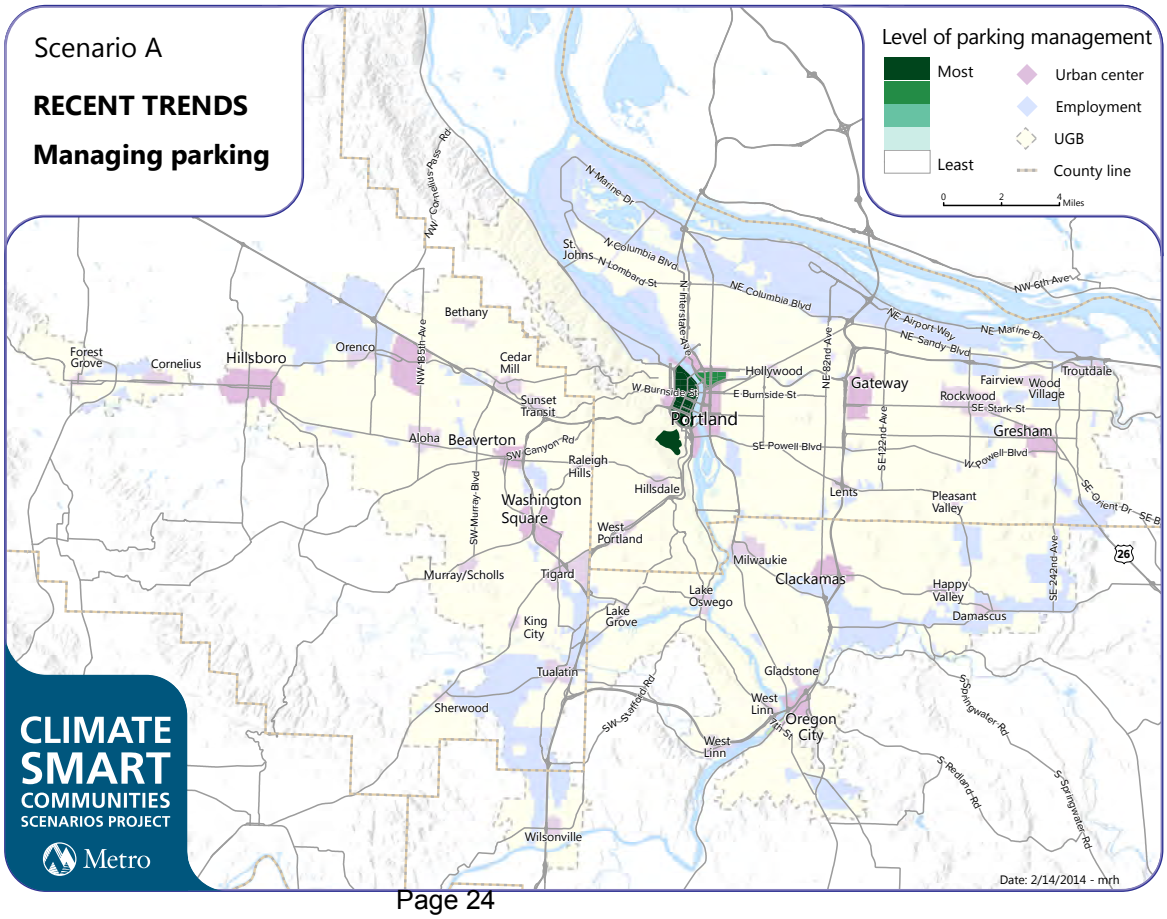
	SCENARIO A	SCENARIO B	SCENARIO C
Parking management	Existing locally-adopted development codes remain the same as 2010 Large employers offer preferential parking Free parking is available in most areas	Same as Scenario A plus communities expand the flexibility of development codes and develop parking plans for all downtown and centers served by high capacity transit as assumed in adopted RTP Parking facilities are sized and managed so spaces are frequently occupied, travelers have information on parking and travel options, and some businesses share parking Free and timed parking is available in many areas	Same as Scenario B plus communities expand the flexibility of development codes to support public-private partnerships in areas served by 10-minute transit service Medium-size employers offer preferential parking. Local codes allow for unbundled parking. Free and timed parking is available in some areas

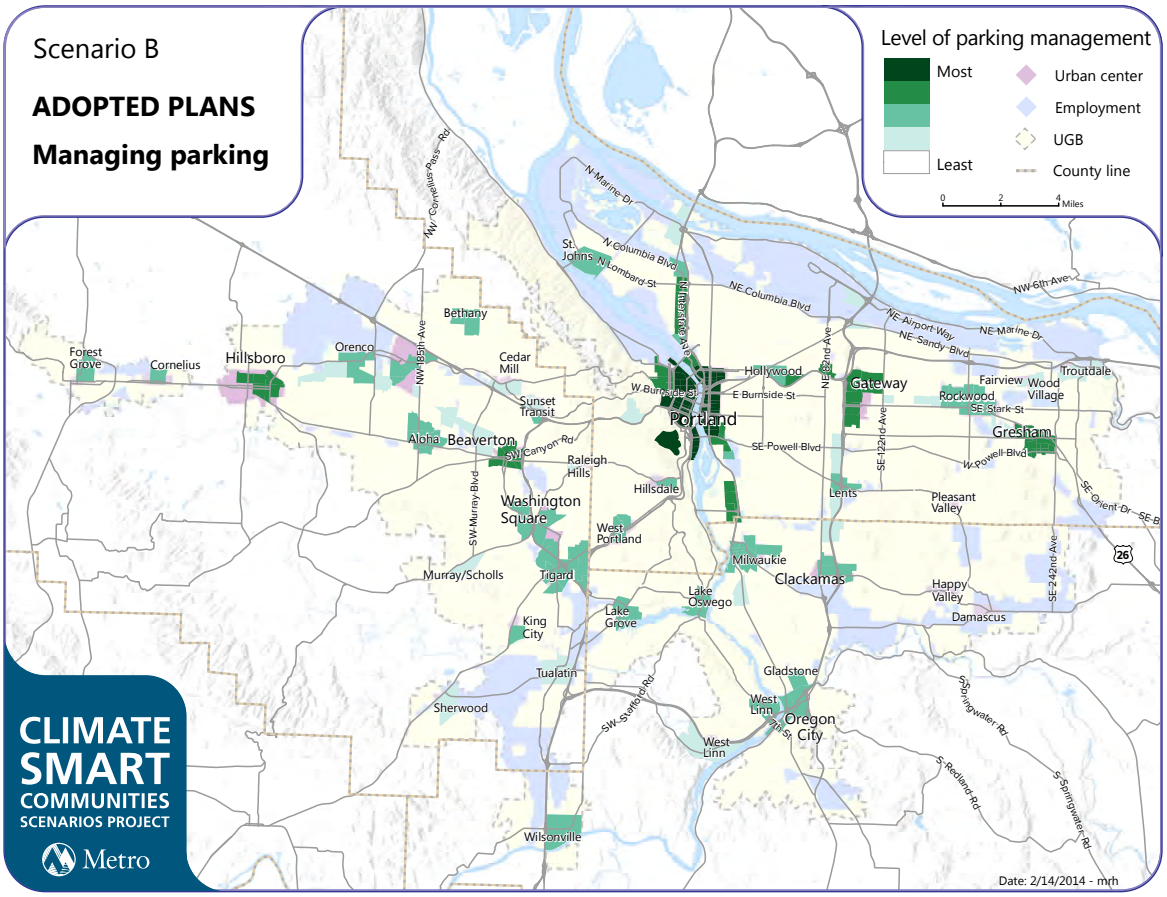
SCENARIO A

Recent Trends

This scenario shows the results of implementing adopted plans to the extent possible with existing revenue.

13% work trips
8% other trips
Estimated share of trips to areas with actively managed parking





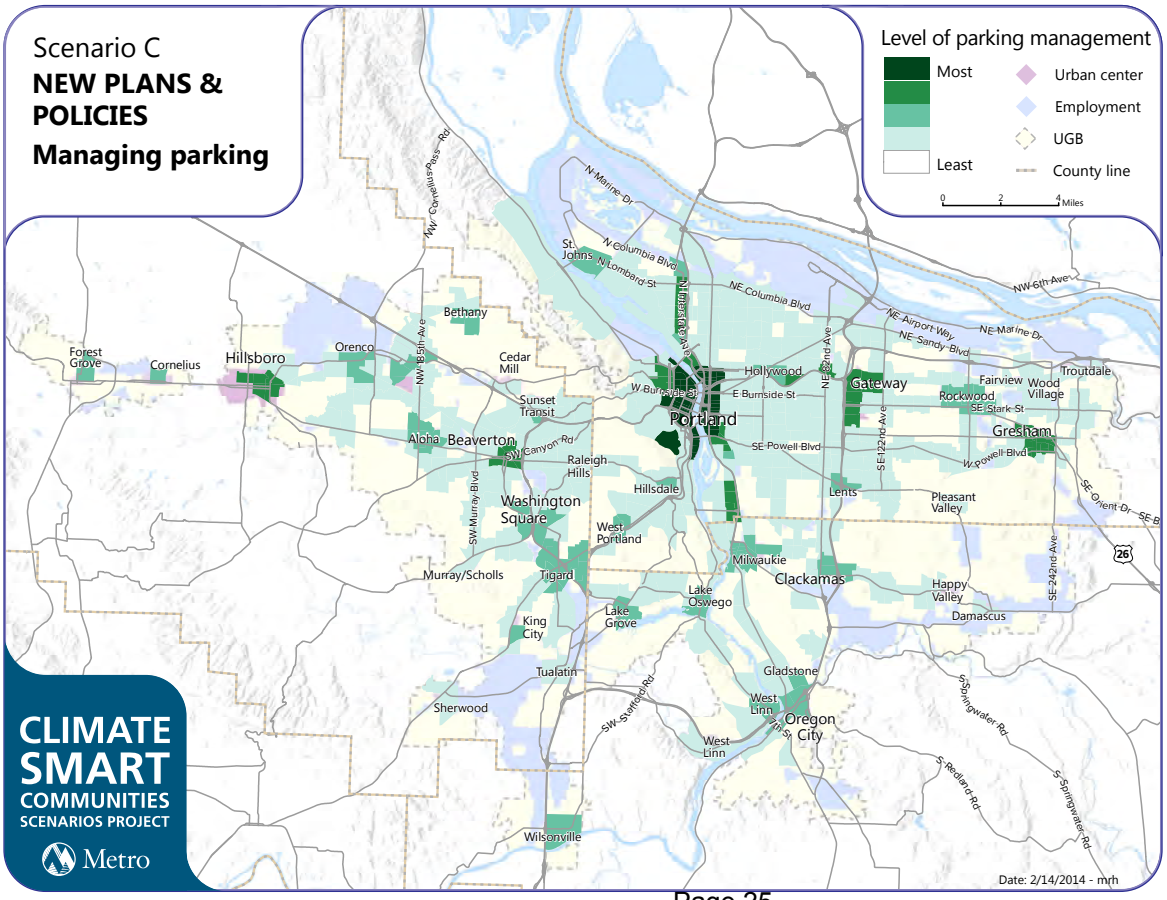
SCENARIO

B

Adopted Plans

This scenario shows the results of successfully implementing adopted land use and transportation plans and achieving the current RTP, which relies on increased revenue.

30% work trips
30% other trips
Estimated share of trips to areas with actively managed parking



SCENARIO

C

New Plans and Policies

This scenario shows the results of pursuing new policies, more investment and new revenue sources to more fully achieve adopted and emerging plans.

50% work trips
50% other trips
Estimated share of trips to areas with actively managed parking

What people are saying

Emerging themes

Key takeaways to share with others

COMMUNITY CLIMATE CHOICES
Health Impact Assessment (HIA)



Flexible, safe, reliable transportation systems
PROVIDE HEALTHY CHOICES.

Oregon Health Authority

Community Climate Choices

Health Impact Assessment

Health Impact Assessment Program
Environmental Public Health Tracking Program
Environmental Public Health
Center for Prevention and Health Promotion
Public Health Division
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TABLE OF CONTENTS

ACRONYMS

BRFSS	Behavioral Risk Factor Surveillance System
CCC	Community Climate Choices
CSCS	Climate Smart Communities Scenarios
DALY	disability adjusted life years (sum of YLL and YLD)
DEQ	Oregon Department of Environmental Quality
GHG	greenhouse gas
GreenSTEP	Greenhouse Gas Strategic Transportation Energy Planning Model
HIA	Health Impact Assessment
ITHIM	Integrated Transport and Health Impact Model
LDV	light-duty vehicle (gasoline powered)
ODOT	Oregon Department of Transportation
PHD	Public Health Division of the Oregon Health Authority
PATS	Portland Air Toxics Solutions
VMT	vehicle miles traveled
WHO	World Health Organization
YLD	years of life with a disability
YLL	years of life lost

EXECUTIVE SUMMARY

Community Climate Choices Health Impact Assessment

Climate change may pose serious risks to public health. Significant shifts in the climate are already happening. The Third National Climate Assessment found that as the climate continues to change, Oregon will likely experience more frequent heat waves and wildfires, an increase in asthma and other respiratory diseases, changes in disease patterns, and diminishing water quality and quantity [1]. Curbing climate change is a critical public health issue and national public health officials support efforts across the nation to reduce greenhouse gas (GHG) emissions.

The recommendations offered in this Community Climate Choices Health Impact Assessment (CCC HIA) will be considered during Phase 3 of Metro's Climate Smart Communities Scenarios (CSCS) Project, underway in the Portland, Oregon metropolitan region. The focus of the project is to understand and choose the best way to reduce GHG emissions through transportation and land use strategies. The CSCS Project seeks to reduce GHG emissions by reducing per capita vehicle miles traveled (VMT) for light duty-vehicles and by investing in technologies that reduce emissions.

CCC HIA Scope

Geography: Portland, Oregon metropolitan region as defined by the Urban Growth Boundary

Timeline: 2010 (base year) to 2035 (horizon year)

Scenarios - adopted local and regional plans with:

- **A**: existing revenues
- **B**: increased revenues from existing sources
- **C:** new plans, policies and revenue sources

Exposure pathways: physical activity, traffic safety, air quality, land use

Quantitative tool: Integrated Transportation Health Impact Model (ITHIM)

Other considerations: magnitude of health costs associated with health pathways, vulnerable populations

Health Impact Assessment (HIA) is a way to consider how a policy or plan affects community health before the final decision is made. By providing objective, evidence-based information, HIA can increase positive health effects and mitigate unintended health impacts. The Public Health Division of Oregon Health Authority (PHD) conducted this assessment at Metro's request, with funds provided by the Center for Disease Control and Prevention's Healthy Community Design Initiative.

Investments in land use and transportation systems that reduce GHG emissions positively impact health by increasing physical activity, reducing traffic collisions and improving air quality. PHD and Metro agreed that the CCC HIA is necessary to better inform Metro and its partners in the selection of a final scenario by December 2014.

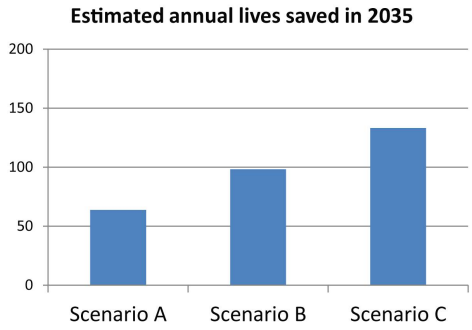
Key findings

This analysis found that the strategies under consideration to reduce GHG emissions also result in important health benefits in all exposure pathways, including increased physical activity, fewer traffic

injuries and less exposure to air pollutants. These changes are likely to reduce illness and death in the region.

Through a literature review including 348 peer-reviewed articles and government reports linking the built environment to health, PHD found most of the land use strategies under consideration for the CSCS Project promote health. Evidence shows that elements such as level of residential density, land use mix, the number of nearby community destinations and ease of street connectivity are effective at promoting active transportation. Scenario B and C subsections labeled 'Complete Streets and Active Transportations Investments' support healthy behaviors the most. These strategies include better street connections, safer street crossings, wider sidewalks, safer street crossings, improved bus stops, more bikeways, trails and on-street bicycle facilities, and more efficient operation of transit signals.

The literature also aligns with advisory members' equity concerns. Low-income households in search of affordable housing options may locate in neighborhoods that are not well-served by affordable transportation options and have fewer health-supportive amenities. This underscores the need to create and preserve affordable housing options in areas that are well-served by transit.



Integrated Transport and Health Impact Model (ITHIM)

In addition to literature reviews for all pathways, PHD also used a quantitative model, ITHIM, to help understand the relative impact of each of three exposure pathways — physical activity, traffic safety and air pollution as measured by particulate matter ($PM_{2.5}$) [2]. ITHIM uses relative risks and burden of disease to estimate avoided illnesses (as measured by disability adjusted life years) and deaths for nine conditions associated with physical activity, three conditions linked to $PM_{2.5}$ exposure, and current traffic fatality rates. A clear limitation of ITHIM is it underestimates all health benefits by restricting calculations to certain pathways and diseases.

Results from ITHIM predict that strategies for reducing GHG emissions will promote health; health benefits occur in all exposure pathways for all scenarios. Scenario A levels of investment are expected to contribute to 64 avoided premature deaths annually. Scenarios B and C would result in 98 and 133 avoided premature deaths respectively. Every 12% decrease in GHG — the difference between each successive scenario — results in an approximate 0.65% decrease in illness among diseases studied.

Physical activity

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 86–91% of avoided deaths and 69–84% of avoided illness resulting from implementing the CSCS project.

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.

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 increases the safety of all users and will facilitate walking, bicycling and use of public transit.

Traffic safety

Reduced GHG emissions through lower per capita vehicle miles traveled (VMT) results in fewer overall traffic fatalities and injuries. Scenario A results in one avoided traffic fatality per year and decreases disabilities from serious injuries (measured by disability adjusted life years or DALYs) by 2.0%. Scenario C would help avoid 12 traffic fatalities and 12.5% of DALYs from serious injuries a year.

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. Metro is targeting aggressive GHG emission reductions of 12, 24 and 36% for Scenarios A, B and C respectively. However, Metro's scenarios result in only modest $PM_{2.5}$ reductions of 2.8, 3.2 and 3.6% due to population growth and reliance on fleet change and fuel technologies. 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.

Portland Air Toxics Solutions Project

DEQ created the Portland Air Toxics Solutions (PATS) project to develop air toxics reduction strategies for the Portland region.

In the Portland area success has been achieved in reducing lead, carbon dioxide and ozone (smog) to meet federal clean air standards.

Despite this progress, DEQ is concerned about air toxics, which are known or suspected to cause serious health problems including cancer, nerve damage and respiratory irritation.

www.deq.state.or.us/aq/toxics/pats.htm

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 and current average concentrations of ozone are above safe levels. Episodic $PM_{2.5}$ (winter) and ozone (summer) 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.

Recommendations

Climate change poses a risk to the future health of Oregonians. Proposed strategies to mitigate climate change will also increase health benefits associated with physical activity, traffic safety and improved air quality. Based upon the findings of this report and with the support of the CCC HIA Advisory Committee, PHD has developed a series of recommendations to preserve and promote healthy communities throughout the region.

By developing and implementing a preferred scenario that meets or surpasses the GHG emissions reduction target set by the Department of Land Conservation and Development, PHD anticipates an improvement in public health.

The majority of health benefits from the CSCS Project can be attributed to active transportation such as walking and biking to work, transit, school and community destinations. **Based on this evidence, this HIA recommends that Metro maximize opportunities for active transportation for all communities by:**

- Adopting and identifying stable funding for the design elements listed in the subsection 'Complete Streets and Active Transportation Investments' of Scenarios B and C: street connections, wider sidewalks, safer street crossings, improved bus stops, bikeways, transit signal priority, and on-street bicycle facilities and trails.
- Improving transit service miles to meet levels recommended in Scenario C.
- Using an equity analysis to plan and develop equal access to active transportation throughout the region.

While the benefits of physical activity far outweigh the risks, active modes of transportation can lead to increased exposure to traffic injury and air pollution. **In order to reduce the risk of increased exposure to traffic injury and air pollution for all road users, this HIA recommends that Metro prioritize the design and maintenance of non-automobile facilities** by:

- Including safety features for pedestrians and bicyclists, such as separation from motorized traffic, when possible. Prioritize non-automobile users in design and maintenance of streets.

- Providing a parallel bicycle route one block removed from high-volume roads where feasible to reduce exposure to localized pollution while still maintaining access to community destinations.

Per capita VMT reduction is expected to modestly improve air quality as measured by many pollutants including air toxics, but temporal and localized air quality concerns remain. **Due to temporal and spatial air quality concerns, this HIA recommends that Metro maximize overall improvements in air quality through actions such as:**

- Aligning the CSCS preferred alternative to PATS goals. In collaboration with DEQ, determine how the preferred alternative helps meet Oregon's adopted ambient benchmark concentrations.
- Reducing exposure by using zoning and incentives to improve indoor filtration systems in new buildings along transportation corridors.
- Convening a regional committee to further address episodic air quality events. Solutions should be season specific and could promote incentives for short-term, alternative commute arrangements.

Finally, to improve health equity, this HIA recommends Metro ensure social and health goals are considered when prioritizing investments by:

- Explicitly and transparently addressing how investment links low-income and other vulnerable households to health-promoting resources.

INTRODUCTION

Health can be defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"[3]. A health impact assessment (HIA) is a way to explicitly consider how a policy or plan facilitates a healthy community before a final decision is made. The objective, evidence-based information provided by the HIA can be used to inform public decisions to increase positive health effects and mitigate unintended health impacts. In this case, the HIA looks at how Metro's Climate Smart Communities Scenarios (CSCS) Project may affect the health of people in the Portland metropolitan region.

The 2009 Oregon Legislature required the Portland metropolitan region to develop a plan to reduce per capita greenhouse gas emissions (GHG) from cars and small trucks by 20 percent below 2005 levels by 2035. The Public Health Division of the Oregon Health Authority (PHD) supports statewide efforts to reduce GHG because curbing climate change is a critical public health issue. There are many ways to reduce emissions while creating healthy, more equitable communities with a vibrant regional economy. The goal of this HIA is to help provide information on which strategies are most health protective and what potential solutions may be when strategies have unintended health consequences.

To meet reduced GHG benchmarks, Metro is targeting fewer per capita single-occupancy vehicle (SOV) trips and vehicle miles traveled (VMT) by increasing land use and transportation investments. The CSCS Project is focused on meeting the emission target by investing in communities and providing services and shopping near where people live, improving transit service, using technology to manage traffic flow, building a well-connected network of complete streets and providing safer routes for walking and biking.

Metro is also considering impacts on public health, the economy, the environment and equity as part of the planning effort. Transportation investments and land use affect health in important ways. 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.

The final plan could maximize health returns by increasing access and reducing barriers to biking, walking, and transit.

The primary health benefit associated with reducing GHG through the CSCS Project is increased physical activity and associated positive health outcomes. The reliance on active transportation to decrease GHG provides the bulk of the health benefits; the final plan could maximize health returns by increasing access and reducing barriers to biking, walking, and transit. This HIA also found the proposed investments and action to reduce GHG could result in decreased cancer, cardiovascular and respiratory burden from cleaner air and decreased traffic injuries from managing congestion.

PROJECT OVERVIEW

Metro's Climate Smart Communities Scenario Project

This HIA informs Phase 3 of Metro's Climate Smart Communities Scenario (CSCS) project which will help choose the best investments and policies to reduce GHG emissions in the Portland metropolitan region. The plan includes strategies that will result in fewer per capita vehicle miles traveled (VMT) by gasoline-powered, light-duty vehicles (LDV). The HIA analyzed expected health benefits associated with reductions in per capita VMT and accompanying improvements in air quality and traffic conditions.

Metro's planning efforts are directed by a series of Oregon legislative mandates and administrative rules. The 2007 Oregon Legislature passed HB 3543 establishing statewide goals to reduce GHG emissions, calling for a reduction of 10% under 1990 levels by 2020 and 75% by 2050. These goals apply to all sectors, including energy production, buildings, solid waste and transportation. In 2009, the Oregon Legislature enacted HB 2001, a broad-based transportation bill that directed Metro to develop a preferred scenario to reduce GHG emissions from LDV while accommodating planned population and job growth. HB2001 also requires Metro to adopt the preferred scenario following public review and for local governments to implement the preferred scenario through local transportation and land-use plans. As a result of these legislative mandates, the Oregon Land Conservation and Development Commission (LCDC) set LDV GHG emissions reduction targets for each of Oregon's six largest metropolitan planning areas in June 2011. The Portland metropolitan area target calls for a 20% reduction below 2005 levels. This reduction is in addition to those expected from cleaner fuels and more fuel-efficient vehicles. A second LCDC rule-making effort in November2012 required Metro to adopt a preferred scenario by December 31, 2014.

To meet the legislative mandates and administrative deadlines, Metro has developed a three-phase process to analyze transportation and land use strategies while engaging the broader community including both citizens and policy makers of local governments, state agencies, port commissions and transit providers. During 2011, Phase 1 tested 144 different scenarios with the help of stakeholder organizations. The results of PHD engagement in Phase 1 are found in the CSCS HIA, released in April 2013[4]. The CSCS HIA quantitatively analyzed six 'representative' scenarios for three health pathways: physical activity, air quality and traffic safety. This analysis showed proposed investments, policies and actions that reduce GHG emissions also reduce VMT, providing important health benefits in all three areas studied. Physical activity accounts for the majority of health benefits in all six scenarios due to the shift to more active modes of transportation.

In Phase 2, which began in 2012, Metro narrowed and refined the 144 different scenarios through extensive modeling, down to three alternative approaches. Scenario A assumes implementing adopted plans with existing revenues and essentially represents a low-investment scenario. Scenario B relies on increased revenues to fund priority investments, reflecting full implementation of the adopted Regional Transportation Plan. Scenario C assumes additional policy and infrastructure investment beyond current adopted plans and would require even more revenue and new funding sources. Scenario C includes

significant improvements to transit service across the region. All three scenarios assume there will be advancements towards cleaner fuels and more fuel-efficient vehicles.

In 2013 Metro released the results of Phase 2 of the CSCS project and has transitioned into Phase 3 – Community Choices. In Phase 3, Metro is seeking input from community and business leaders, local governments, state agencies and the public to determine which investments and actions should be included in a preferred scenario. Metro anticipates defining the draft preferred scenario in late spring 2014, with opportunities for public input in the fall of 2014. The Metro Council is scheduled to consider adoption of the preferred scenario in December 2014.

PHD and Metro agreed that a follow-up HIA, the Community Climate Choices HIA (CCC HIA), was necessary to better inform Metro and its partners in the selection of a final scenario. The CCC HIA provides additional information for Phase 3 decisions through a health-based analysis of the three scenarios developed in Phase 2. The HIA integrates an extended literature search with an update of the quantitative modeling as recommended by the previous HIA.

Climate, transportation, and public health

Climate impacts our health in many ways. Climate change-related events that may adversely affect public health include drought and reduced water supply; extreme heat; wildfires; extreme precipitation and flooding; severe winter storms; worsening air quality due to ozone pollution; decreased frost that leads to changes in vegetation patterns and longer growing seasons; and increases in vector- or insect-borne diseases. To mitigate the effects of climate change, many communities are implementing plans and policies that will reduce GHG emissions [1].

Addressing changing climate through land use and transportation investments, policies and actions has long-term health implications. This approach includes designing communities and streets to make walking, biking, and expanded transit service more safe and convenient. Creating communities that reduce barriers to walking and biking will increase the proportion of Portland metropolitan residents who are able to meet physical activity will increase heart health, reduce body mass index (BMI) and decrease risk for many chronic diseases.

Table 1. Top 10 risk factors ranked by attributable burden of disease, U.S. and Canada in 2010

Rank (out of 43)	Risk factor
1	Tobacco smoking (including second-hand)
2	High BMI
3	High blood pressure
4	High fasting glucose
5	Physical inactivity and low physical activity
6	Diets low in fruits
7	Alcohol use
8	Diet low in nuts & seeds
9	High cholesterol
10	Drug use

Source: Global Burden of Disease Study, 2010[5]

Cancer and heart disease are currently the top two "underlying causes of death," accounting for 48% of all deaths in Oregon[6]. 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[5] (Table 1).

Screening and scoping with the advisory committee

In 2011, PHD was awarded a three-year grant through the CDC's Healthy Community Design Initiative. As part of this grant, PHD agreed to perform three HIAs to explore how to best integrate health considerations into transportation and community planning decisions. The PHD program prioritizes performing HIAs on regional or state-wide transportation and community planning decisions and relies heavily on consultation from a diverse set of multi-disciplinary stakeholders in the form of an advisory committee.

Health Impact Assessment (HIA) begins with a process of scoping with the advisory committee; through scoping, the specific pathways and health conditions of concern are identified and prioritized. The scope of this HIA was influenced a great deal by the previous CSCS HIA addressing Phase 1, which identified increased physical activity, traffic safety and cleaner air as potential ways that the final plan could affect health. It was clear that GHG emission reductions achieved by walking and biking to work and transit would result in significant health benefits through increased physical activity. As people drive less, they are less likely to be involved in traffic collisions. Driving less will also result in cleaner ambient air. These three pathways were addressed in the CSCS HIA released in April 2013.

In the CSCS HIA, PHD used the ITHIM model to help understand the relative impact of the three exposure pathways: physical activity, traffic safety, and air pollution as measured by $PM_{2.5}$ [2]. The ITHIM modeling assumed six scenarios representative of the 144 scenarios under consideration in Phase 1. ITHIM used information about the relative risk of 13 diseases given exposure to two types of inputs provided by ODOT's GreenSTEP model: measures of miles traveled by mode and particulate matter ($PM_{2.5}$) as an indicator of air quality[1]. Results indicated that physical activity is the dominant pathway to health benefits. One of the recommendations of the CSCS HIA was to "carry out additional quantitative health impact assessment of the three scenarios that are identified for further evaluation in spring 2013 to further inform development and adoption of a final preferred scenario."

In early summer 2013, PHD and Metro followed that recommendation and began a second HIA – the Community Climate Choices HIA (CCC HIA) – to better inform Metro and its partners in the selection of a final scenario by December of 2014. To guide the CCC HIA, PHD reconvened 38 regional experts in land use and transportation planning, local governments and public health to help develop the CCC HIA in September 2013. See Appendix B for complete list. PHD held a series of small group and agency-specific

[1] ITHIM is limited to modeling pathways with known risk ratios: nine diseases linked to physical activity, traffic injuries and fatalities, and three diseases linked to $PM_{2.5}$ exposure. Please see Appendix E for more information about ITHIM methodology and limitations.

conversations in addition to full advisory committee meetings in order to maximize participation opportunities in the CCC HIA:

- June 19, 2013: Metro project review and HIA screening with Community Choices program staff.
- August 29, 2013: Meeting with DEQ Air Toxics program staff to discuss air quality questions and concerns raised during the CSCS HIA.
- September 19, 2013: First advisory committee small group conversation to discuss monetization options and finalize the HIA scope (12 participants).
- October 17, 2013: Second advisory committee small group conversation to review initial air quality findings and discuss equity implications (8 participants).
- October 31, 2013: Third advisory committee small group conversation to review initial land use findings and discuss equity implications (11 participants).
- November 12, 2013: Meeting with full advisory committee to review assessment findings, discuss framing considerations and develop draft recommendations (25 participants).

The advisory committee provided feedback on the areas and methodologies of the assessment, initial findings and draft recommendations. Advisory committee members who were unable to attend meetings were encouraged to provide input electronically throughout the process.

Parameters were determined by the scenarios defined by Metro: the analysis uses 2010 as the base year and 2035 as the horizon; geography[2] considered is the Portland metropolitan region within the Urban Growth Boundary, and the three scenarios match those of Phase 2 of Metro's project. Baseline for quantifying health effects applies 2010 prevalence of illness or death to projected 2035 population figures.

The scope of the CCC HIA also incorporates three additional areas of concern that surfaced during the CSCS HIA and CCC HIA processes. First, several advisory group members expressed an interest in expanding the air quality analysis beyond ITHIM's treatment of $PM_{2.5}$. In response, PHD undertook an additional literature review of transportation-

CCC HIA Scope

Geography: Portland, Oregon metropolitan region within the Urban Growth Boundary

Timeline: 2010 (base year) to 2035 (horizon year)

Metro Scenarios - adopted local and regional plans with:

A: existing revenues
B: increased revenues from existing sources
C: new plans, policies and revenue sources

Exposure pathways: physical activity, traffic safety, air quality, land use

Quantitative tool: Integrated Transportation Health Impact Model (ITHIM)

Other considerations: magnitude of health costs associated with health pathways, vulnerable populations

[2] Metro used ODOT's GreenSTEP model for air quality; this regional model does not account for changes in Vancouver, WA emissions. In some instances in the report, health data is reported in a different geography such as 3-county or MSA (7-county); when an alternative to the UGB is used, it is clearly indicated in the tables and text.

related air quality health science. This included exploring other criteria pollutants and air toxics for inclusion in ITHIM as well as understanding both long and short-term exposures to transportation-related air pollution. While data and methodological limitations did not allow for complete integration of these other air pollution concerns, the air quality literature in this HIA has been expanded to discuss these pathways.

Second, many advisory group members expressed an interest in directly analyzing land use strategies within the plan. After an extensive literature review, this HIA includes a section devoted to understanding how the specific land use and transportation strategies may affect health.

Finally, advisory group members and decision makers expressed an interest in understanding the magnitude of saved costs associated with health benefits. Methodological limitations make a global number impossible to compute, but this HIA contains information about the costs of diseases of interest throughout the report.

Methods

HIA is guided by practice standards established by the Society of Practitioners of Health Impact Assessment (SOPHIA). This HIA adheres to the HIA Minimum Elements established by the North American HIA Practice Standards Working Group (Appendix A).

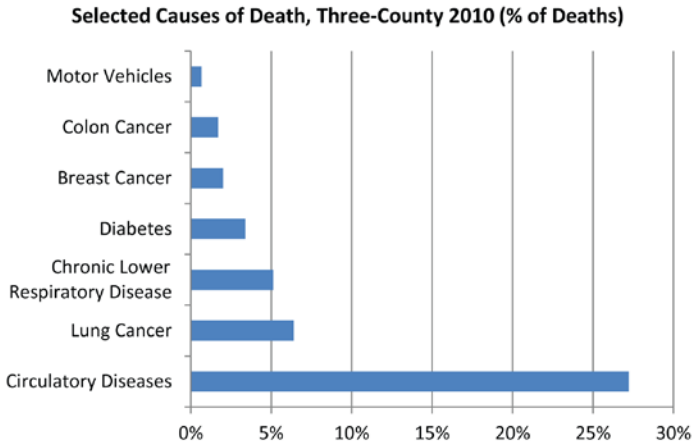
HIA begins by assessing the state of the science for pathways of interest with in-depth literature reviews. PHD maintains a robust database of 348 journal articles, scientific reports, and government guidance linking the built environment to health. In order to address the specific nature of this planning exercise, this database was updated by performing GoogleScholar, Pubmed, and ScienceDirect searches for literature specific to the pathways since 2008: [health] AND [physical activity, safety, and air pollution, land use]. Particular weight was given to systematic reviews, government guidance, and/or articles addressing sub-populations with vulnerabilities such as children, elders, and racial-ethnic minorities.

An important objective of HIA is documenting current health conditions. PHD used state and federal databases to characterize current prevalence and incidence rates. Information about costs associated with health impacts come from a combination of reports from partner state agencies and CDC's Chronic Disease Calculator, v2.0. http://www.cdc.gov/chronicdisease/resources/calculator/

This HIA also quantitatively modeled health impacts using ITHIM for physical activity, traffic safety, and air quality as measured by $PM_{2.5}$. ITHIM uses current and local burden of disease estimates and applies relative risks or measures of expected changes in 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 each scenario (A, B, and C as defined by Metro in Phase 2); outputs are generally reported in the difference between baseline and scenario. Conceptually, baseline in ITHIM is the expected number of deaths and illness given the current rate of exposure for the expected population in

2035. Estimated impact is thus the difference between the expected outcome at baseline and the scenario. More information is available about ITHIM methodology in Appendix E.

CURRENT HEALTH CONDITIONS, RISK FACTORS, AND COSTS



Approximately 11,050 people died in the three-county area (Clackamas, Multnomah and Washington counties) in 2010. Of those deaths, at least 42% were from causes that may be impacted by this plan. For example, primary cause of death statistics for the area indicate nearly one- quarter of deaths are from circulatory disease (heart and strokes), another 11% are from chronic respiratory diseases or lung cancer, and at least 3% of death certificates list diabetes as a primary cause[5]. All other causes, or 58% of deaths, are caused by conditions not directly tracked in the HIA but are likely to improve with implementation of the plan. Approximately one third of the 'other' category (and approximately 20% of the overall total) are cancers with less direct links to physical activity or air-pollution.

Underlying conditions erode quality of life for many individuals. Table 2 on the following page provides Oregon and Portland MSA[3] prevalence rates for chronic conditions and associated risk factors as estimated from the CDC's *Behavioral Risk Factor Surveillance System Survey* (BRFSS) in 2011[8]. According to BRFSS, approximately 3% of adults in the region have survived a heart attack, a similar number suffer from chest pain or heart disease and 2.7% report having survived a stroke. These three cardiovascular conditions are highly associated with risk factors such as physical inactivity, high blood pressure, high cholesterol, and high BMI (weight). Recent BRFSS data also shows that approximately 28% of adults report high blood pressure and 36% have had a high cholesterol reading in the past 5 years. Nearly 40% of adults report not meeting the recommended 150 minutes of aerobic physical activity per week. Over 35% are overweight and nearly 24% are obese[8].

Respiratory illness significantly degrades quality of life. Poor air quality contributes to conditions such as asthma and chronic obstructive pulmonary disease (COPD). A little more than 5% of adults report having COPD. Over 9% of Portland region adults report a current asthma condition; the Oregon adult rate is the sixth highest rate in the country [8, 9]. At least 7–8% of children in Oregon have asthma according to parental response and when teens are directly surveyed, the prevalence increases to 10% [9].

[3] The Portland-Vancouver-Hillsboro OR-WA MSA is defined as the seven county region including Clackamas, Columbia, Multnomah, Washington, and Yamhill Counties in Oregon, and Clark and Skamania Counties in Washington

Table 2. Adult prevalence rates for chronic disease and associated risk factors [8]

BRFSS 2011 category	U.S. state median	Percent of adults [95% Confidence Interval]	
		Oregon	Portland MSA[4]
Heart attack	4.4	3.6 [3.1-4.2]	3.2 [2.5-4.0]
Chest pain or coronary heart disease	4.1	3.6 [3.1-4.0]	3.1 [2.4-3.7]
Stroke	2.9	2.9 [2.5-3.4]	2.7 [2.1-3.3]
Any physical activity last month?	73.8	80.3 [78.7-81.3]	81.5 [79.5-83.6]
150 minutes of aerobic per week	57.7	61.1 [59.3-62.9]	60.3 [57.8-62.8]
High blood pressure	30.8	29.9 [28.5-31.3]	27.9 [26.0-29.9]
Cholesterol checked and high in past 5 years	38.4	38.5 [36.8-40.2]	36.1 [33.8-38.5]
Overweight	35.7	34.8 [33.31-36.4]	35.8 [33.4-38.1]
Obese	27.8	26.7 [25.2-28.3]	23.7 [21.7-25.7]
Diabetic	9.5	9.3 [8.4-10.2]	8.5 [7.3-9.8]
Depression (ever treated)	17.5	23.9 [27.5-25.3]	22.8 [20.8-24.7]
COPD (Chronic obstructive pulmonary disease)	6.1	5.9 [5.2-6.7]	5.2 [4.2-6.3]
Ever had asthma	13.6	16.7 [15.4-18.0]	16.2 [14.3-18.0]
Current asthma	9.1	10.5 [9.4-11.5]	9.6 [8.2-11.0]

Chronic conditions are a significant financial burden to households and taxpayers. While Oregon-specific cost data are sometimes difficult to calculate, the CDC provides a Chronic Disease Cost Calculator to estimate state-specific Medicaid (Oregon Health Plan), Medicare, and private insurance expenditures for the treated population in any given year. The tool estimates annual direct medical costs in 2010 dollars and does not include lost wages, reduced productivity or years lost to premature death. It does minimize double counting across categories by statistically controlling for deaths with more than one cause, also called comorbidity [10]. Additional information about assumptions, data sources and modeling techniques can be found in Appendix D.

[4] Data at this level of geography is age-adjusted and can be compared to other MSAs and the State.

Table 3 displays the estimated expenditures on chronic disease in Oregon, adjusting the costs for proportion of population living in the three-county area. More than $1.5 billion dollars is spent each year on cardiovascular disease in the region. Fifteen percent of Oregon's population are Medicaid recipients and 14%, including some that also qualify for Medicaid, are Medicare recipients [11]. Of the $1.5 billion spent each year on cardiovascular disease, $623 million of that cost is borne by the taxpayer in Medicaid and Medicare payments and at least $481 million is paid by private insurance. The cost incurred in 2010 by all payers for maintenance and complications from diabetes is estimated at $710 million, asthma cost $176 million and depression, which is helped by physical activity, cost $382 million [10].[5]

Table 3. Estimates of 2010 three-county annual expenditures (in 2010 $mil) for select chronic diseases

	Medicaid	Medicare	Private insurers	All payers[1]
Total cardiovascular disease[2]	$120	$503	$481	$1,551
Chronic heart failure	$12	$31	$10	$78
Coronary heart disease	$12	$167	$189	$470
Hypertension	$47	$149	$197	$592
Stroke	$48	$120	$63	$356
Other heart disease	$30	$106	$68	$258
Diabetes	$59	$199	$226	$710
Asthma	$34	$39	$66	$176
Depression	$22	$80	$157	$382

Source: CDC Chronic Disease Calculator, v2.0[10]

(1) All payers is estimated separately and may not equal the sum of Medicaid, Medicare, and private insurers.

(2) Total cardiovascular disease is a summation of the listed conditions, but only includes a portion of hypertension to avoid double counting. Similarly, diabetes complications can lead to cardiovascular disease; summing cardiovascular disease and diabetes would result in double counting. All other categories statistically control for listed conditions as well as common diseases not listed.

According to the CDC, more than $1.5 billion dollars is spent each year on cardiovascular disease in the region. Almost half of that cost is borne by taxpayers.

[5] The Chronic Disease Cost tool also provides projected costs; it estimates that expenditures for cardiovascular disease will increase by 79%, asthma by 66%, and diabetes by77 % by 2020 after accounting for inflation.

FINDINGS: ITHIM – Overview and results

ITHIM was identified in the CSCS HIA as a way to quantify morbidity (illness and injuries) and mortality (death) related to transportation changes. ITHIM was developed by public health researchers in the UK to assess potential health impacts of GHG reductions at a regional level by using population-based disease burden information for 13 different conditions in three potential pathways: physical activity, traffic safety (injuries and fatalities), and air quality [2].

Health outcomes in ITHIM include premature mortality (death) and morbidity (illness). Mortality data is based on burden of disease — specifically the relative risk of a disease given a change in exposure – associated with physical activity, traffic crashes, and air quality. The last time ITHIM results were released for the CSCS HIA, mortality data was based on U.S. risks. To improve accuracy of the model, mortality data for this HIA was based on Oregon-specific risks using 2010 vital statistics [12].

For morbidity, ITHIM calculates disability adjusted life years (DALYs) from the World Health Organization's (WHO) burden of disease database. DALYs are the sum of years of life lost (YLLs) and years living with a disability (YLDs). The YLL component of DALYs in ITHIM was revised using mortality rates from the Oregon Public Health Assessment Tool (OPHAT). Average mortality counts for 2008–2010 were extracted from OPHAT for the transportation related illnesses addressed in ITHIM and entered into the DALY Calculation Template from WHO (http://www.who.int/healthinfo/global_burden_disease/tools_national/en/) to revise YLL. YLD values were imputed from the United States burden of disease for the population of Oregon and entered into the ITHIM.

Table 4. ITHIM data inputs

Data Input	Baseline (2010)	Scenario A Adopted plans with existing revenue	Scenario B Adopted plans with increased revenue	Scenario C Scenario B plus additional policy/ infrastructure and new funding sources	Data source and notes
Reduction in GHG		↓12%	↓24%	↓36%	Modeled using ODOT's GreenSTEP. GreenSTEP inputs include Metro's Household Activity Survey, monitored PM2.5 emissions rates from DEQ.
Vehicle miles traveled (VMT) per person per week	134	125	117	102	
Distance by mode[1]	Walk=1.0% Bike=1.6% Bus=0.21% Car=97.2%	Walk=1.3% Bike=1.7% Bus=0.16% Car=96.7%	Walk=1.5% Bike=2.6% Bus=0.21% Car=95.6%	Walk=1.8% Bike=3.5% Bus=0.39% Car=94.2%	
$PM_{2.5}$ (µg/m3)	6.6317	↓2.8%	↓3.2%	↓3.6%	
UGB population	1,481,118	1,954,716 (2035 Estimate)			U.S. Census

(1) GreenSTEP breaks out VMT per person per week for the modes listed. The inputs reported here have been changed to percent.

ITHIM requires a number of inputs beyond health disease burden information. Metro provided vehicle miles traveled by mode and road type and $PM_{2.5}$ levels for each scenario. (Details are provided in Table 4.) PHD used 2010 census data for age distributions in the three-county area and outputs were increased by approximately 42% to adjust for the additional expected population by 2035.

ITHIM results are summarized in Table 5. (More detailed methodology descriptions, limitations and results are provided in Appendix E; pathway-specific results are discussed in later sections.) ITHIM shows that the current investment trajectory (Scenario A) will result in 64 avoided annual deaths in 2035 or a 0.9% drop in premature mortality given current death rates for conditions considered. ITHIM measures avoided illness through DALYs with current investment trajectories resulting in a 0.7% decrease in illness.

More aggressive investments clearly show greater reductions in disease and death. Scenario C would more than double the number of avoided annual deaths when compared to Scenario A. The 133 avoided annual deaths represent an approximate 2% reduction in current premature mortality rates with these pathways. Similarly, each additional 12% reduction in GHG from light-duty vehicles would garner the co-benefit of a 0.65% reduction in DALYs.

Table 5. Summary of ITHIM results

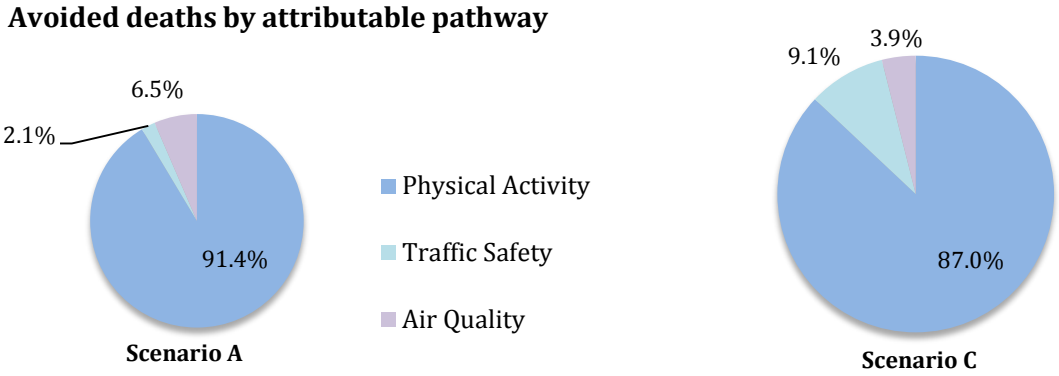
	Avoided	Scenario A		Scenario B		Scenario C	
		Count[1]	Percent reduction	Count[1]	Percent reduction	Count[1]	Percent reduction
Physical activity	Mortality	-58	1.4%	-89	2.1%	-116	2.9%
	DALY[2]	-793	1.3%	-1333	1.9%	-1786	2.8%
Traffic safety	Mortality	-1	1.2%	-4	3.5%	-12	10.5%
	DALY[2]	-72	2.0%	-173	4.9%	-443	12.5%
Air quality ($PM_{2.5}$)	Mortality	-4	0.2%	-5	0.2%	-5	0.3%
	DALY[2]	-37	0.2%	-42	0.2%	-47	0.2%
Total	Mortality	-64	0.9%	-98	1.4%	-133	2.0%
	DALY[2]	-903	0.7%	-1548	1.3%	-2276	1.9%

(1) This count has been adjusted for expected population of the UGB in 2035.
(2) Disability adjusted life years (DALY) is the summation of years of life lost (YLL) and years living with a disability (YLD) due to injury or disease. Note that YLD assumptions were not available some sub-categories and therefore significantly underestimate DALYs for physical activity and air quality.

ITHIM results show that the majority of health benefits associated with GHG emission reductions are from increased physical activity.

ITHIM results also show that the majority of health benefits associated with GHG emission reductions are from increased physical activity: between 87.0–91.4% of prevented deaths and between 78.5–87.9% of prevented illness as measured by DALYs. ITHIM underestimates health benefits of all pathways; the model is limited to nine disease associated with physical activity, reported rates of collisions, and three diseases associated with $PM_{2.5}$ as an indicator of air quality. (Please see Appendix E for expanded discussion of limitations.) Despite these

limitations, these patterns are largely congruent with current patterns of disease burden and knowledge about active transportation addressing the large burden associated with physical inactivity.



Highlights of ITHIM

- Lowering GHG emissions results in health benefits in each scenario.
- Using the strategies proposed, current levels of investment (Scenario A) would result in 64 avoided deaths annually. Scenarios B and C would result in 98 and 133 avoided deaths, respectively.
- Every 12% decrease in GHG emissions (the difference between each scenario) results in approximately a 0.65% decrease in DALYS among diseases studied.
- The vast majority of avoided deaths and illness are attributable to increased physical activity. ITHIM underestimates all health benefits by restricting to certain pathways and diseases. For example, it does not account for health benefits of decreased air toxics. However, the large contribution of physical activity is consistent with current public health knowledge of the burden of disease from inactivity.

FINDINGS: Land use

Local land use regulations and community design shape the physical environment of our region. Land use impacts how we live, work and play, and can moderate or influence healthy environments and behaviors. Zoning has historically been used to protect human health by separating noxious, polluting uses from residential areas. Contemporary trends in land use research have shown a more nuanced if complex understanding of the intersection between land use and health. For example, land use mix and density may dictate the distance and ease in traveling to health-supportive resources such as employment, school, food, and recreation. Many of the CSCS Project strategies and actions focus on the interaction between land use and transportation; for the remainder of this section, "land use" refers to this interaction.

Another way to conceptualize the impact of land use and community design is to consider how physical activity, traffic safety, and air quality may change in different land use contexts and design decisions. The design of transportation facilities within mixed-use areas can impact health in multiple ways. The width, placement and striping of bicycle lanes and sidewalks can induce or prohibit active transportation modes due to perceived safety and desirability, serve as protection from auto collisions, and impact localized concentrations of air pollutants. When schools, shopping, services, residential and employment opportunities are in close proximity, people do not have to travel as far, making walking, bicycling and transit more convenient and viable travel options.

PHD performed a literature[6] review in order to understand the links between health and the specific land use strategies being considered. A summary of the literature for each land use strategy is provided in Table 6. The Magnitude of Health Impacts and Weight of Evidence columns provide a 1-5 scale (5 as the highest) to describe scientific knowledge for each pathway related to the strategy. The Magnitude of Health Impacts column reflect trends in overall burden of disease; strategies that are anticipated to have large effects on disease due to environmental and/or behavior changes were rated higher than those that will have more modest effects. The Weight of Evidence column addresses the quality and quantity of the research; '1's or '2's reflect conflicting or emerging research while a 5 rating reflect a robust literature drawn from meta-analyses, large epidemiological studies, and/or systematic reviews.

Although there is little literature directly linking health to the strategy, there is robust documentation of the health impacts of increased physical activity levels caused by more walking, bicycling and use of transit [13-16]. (See the Physical Activity section for more information.) Consequently, investments, policies and actions that make it more safe and convenient to walk and bike will benefit health. This is

[6] *PHD maintains a robust database of 348 journal articles, scientific reports, and government guidance linking the built environment to health. In order to address the specific nature of this planning exercise, this database was updated by performing GoogleScholar, Pubmed, and ScienceDirect searches for the following since 2008: [health, physical activity, safety, and air pollution] AND [density or sprawl, mixed-use, transportation modes, parking, and transit service]. Particular weight was given to systematic reviews and/or articles addressing sub-populations with vulnerabilities such as children, elders, and racial-ethnic minorities.*

reflected in the Weight of Evidence column of Table 6 (page 22), which addresses the mode shift and health evidence separately for some strategies.

Many of the land use strategies under consideration are spatially interconnected and work synergistically. Residential density at or above levels associated with traditional single-family home urban neighborhoods is health supportive. However, the benefits of residential density require good connectivity to many diverse community destinations within walking and biking distance to encourage active transportation [17-21].

Complete streets may be the most health-promoting aspect of the investments and actions being considered.

Advisory group members repeatedly commented that land use strategies mattered a great deal. This is congruent with literature that stresses the cumulative effect of pedestrian and bicycle facilities, design, and nearby destinations in supporting active transportation options that result in increased physical activity [21-23]. These elements are addressed in the CSCS Project subsections 'Complete Streets and Active Transportation' in Scenarios B and C. Complete streets may be the most health-promoting aspect of the investments and actions being considered.

Transportation systems, and particularly public transit, play an important role in linking low-income households to health promoting resources such as fresh food, health providers and living wage jobs.

Low-income households are particularly reliant on the public transportation network to access job opportunities, shopping, services and other everyday needs [24]. Due to budget constraints, low-income households often live in neighborhoods with more affordable housing that lack supportive resources such as healthy food, parks, community centers and high quality medical care. Housing location has been found to amplify negative health associated with low socio-economic status [25, 26]. These neighborhoods often lack transit services and other amenities such as safe and convenient sidewalks, bike lanes and parks. These locations may have traffic safety risks such as high volume roads or poorly designed intersections that are difficult for vulnerable populations such as children and elders to navigate [26-30]. Community design and land use strategies listed in Table 6 place health supportive resources near affordable housing options. Transportation systems, and particularly public transit, play an important role in linking low-income households to health promoting resources such as fresh food, health providers and living wage jobs [24, 26].

Highlights of land use

- Elements of residential density, land-use mix, number of nearby community destinations and street connectivity are particularly effective at encouraging active transportation. These elements also work synergistically to influence walking, biking and use of transit.
- Most of the land use strategies listed in Table 6 and included in the scenarios promote health across multiple pathways.
- Investments and actions in Scenario B and C's subsections 'Complete Streets and Active Transportation' are the most important elements in encouraging healthy behavior. These elements include street connections, wider sidewalks, safer street crossings, improved bus stops, bikeways, transit signal priority, on-street bicycle facilities and trails.
- Low-income households, in search of affordable housing, may locate in neighborhoods that lack suitable transportation options. These neighborhoods also have fewer health supportive amenities. Low-income households may need access to health supportive resources more than any other group. It is important to create and preserve affordable housing options in areas that are well served by transit.

Table 6. Summary of literature review for land use strategies in Climate Smart Community Choices, Phase 2.

Land use policy	Current levels	Scenario A/B/C	Health pathway	Magnitude of health impact (5 '+' =largest)	Weight of evidence (5 '+' =most)	Additional considerations
Households in mixed use areas	26%	36% 37% 37%	Mixed use in the presence of reasonably high residential density and a short distance from many diverse community destinations is most likely to shift transportation mode and increase physical activity [17, 19].	+++	+++++	Mixed land use should be designed for all incomes including low-income families. Design matters. For example, multi-unit apartment complexes are often a land use buffer and qualify as mixed-use. These apartment complexes need to be fully integrated for connectivity to benefit from mixed-use. Housing/workplaces along major arterials are exposed to higher concentrations of air and noise pollution.
Urban Growth Boundary Expansion	2010 UGB	+28,000 +12,000 +12,000 (acres)	UGB literature is limited; however, limiting UGB expansion increases the likelihood of community destinations near residences by encouraging a compact, urban form. There is robust support for controlling sprawl. Urban development intensity is generally health supportive because nearby available resources increase. (See mixed-use above.) Residential density leads to increased physical activity as individuals shift to active transportation modes for daily activities [31, 32].	+++	++++	Development intensity without connectivity may not result in increased physical activity. Minimizing the expansion of the UGB may put upward pressure on housing prices, potentially exacerbating patterns of low-income households located in areas with limited resources. Controlling the UGB without addressing congestion (see delay reduced by traffic management policy below) can increase commute times which negatively impacts an individual's time for health-promoting activities.

Land use policy	Current levels	Scenario A/B/C	Health pathway	Magnitude of health impact (5 '+' =largest)	Weight of evidence (5 '+' =most)	Additional considerations
Bike travel	9%	10% 15% 20%	Aggressive mode shifts to bicycles will increase physical activity and health.	++++	+++ (mode shift evidence) ++++ (health evidence)	The access, placement, and design of bike facilities must maintain perceived and real safety [33]. Placement should also be designed to minimize air pollution exposure when possible [34].
Transit service (Daily revenue miles)	73,000	80,000 87,000 159,000	Increased transit service increases physical activity [35-38] (walking to/from stops), decreases air pollution, and increases traffic safety.	+++	+++++ (mode shift evidence) +++ (health evidence)	Low-income households are more likely to depend on transit and may have less access to transit. Transportation costs may be inelastic for this group but are a larger share of the household budget, so increases in transit costs may have inequitable impacts. Similarly, these households may choose a longer commute time to find affordable housing, which erodes time available for other health promoting activities. Expansions of service should consider and prioritize reaching low-income neighborhoods.
Work/non-work trips in areas with parking management	13%/ 8%	No change 30%/30% 50%/50%	Parking management influences active transportation and associated physical activity [39, 40].	+++	+++++ (mode shift evidence) + (health evidence)	The potential burden of parking costs and access to alternative transportation modes for low-income households should be considered.

Land use policy	Current levels	Scenario A/B/C	Health pathway	Magnitude of health impact (5 '+' =largest)	Weight of evidence (5 '+' =most)	Additional considerations
Miles of freeway/arterials added	N/A	+9 miles +81 miles +105 miles	Addressing congestion leads to decreased traffic injuries and fatalities, increased time for healthy activities and decreased air pollution [41, 42]. Adding road/lane miles could potentially increase connectivity by completing the system. Major roads are a significant barrier to active transportation, physical activity and social cohesion [26].	+ ++ --	++ ++ ++++	Induced demand may erode the congestion related pathways over time. Health impacts of additional lanes are extremely localized and vary by project. Each project should carefully assess the impact on nearby residents and mitigate air quality, noise and physical barriers during both construction and end-use. Care should be taken in designing multi-mode improvements to maximize health when adding arterial lane miles. The literature describes mixed results from reducing congestion with additional lane-miles. Reducing congestion should reduce the number of crashes, but the crashes may be more severe due to higher speeds associated with good traffic flow.
Delay reduced by traffic management strategies	10%	No change 20% 35%	Addressing congestion leads to decreased traffic injuries and fatalities, increased time for healthy activities and decreased air pollution [41, 42].	++	+++	Addressing congestion through traffic management is a more direct route to controlling commute times versus adding arterials or freeways.) PHD recommends this strategy over additional lane miles.

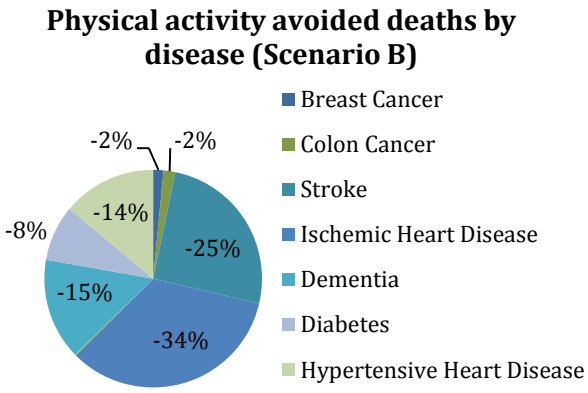
FINDINGS: Physical activity

ITHIM results for physical activity clearly indicate that reductions in GHG through increased walking and biking to transit and destinations produce significant health benefits. Physical activity prompted by investments in Scenario A can be expected to help avoid 58 deaths annually by 2035. Scenario C could help avoid 116 deaths and help reduce disease burden by up to 2.8%.

Table 7. ITHIM results attributable to physical activity

Avoided	Scenario A		Scenario B		Scenario C	
	Count[1]	Percent	Count[1]	Percent	Count[1]	Percent
Mortality	-58	1.4%	-89	2.1%	-116	2.9%
YLL	-468	1.5%	-747	2.3%	-988	3.1%
YLD	-325	1.0%	-586	1.6%	-799	2.3%
DALY[2]	-793	1.3%	-1333	1.9%	-1786	2.8%

(1) This count has been adjusted for expected population in 2035.
(2) Disability adjusted life years (DALY) is the summation of years of life lost (YLL) and years living with a disability (YLD) due to injury or disease. Note that YLD assumptions were not available for some sub-categories and therefore significantly underestimate DALYs for physical activity and air quality.



Physical inactivity is the fifth largest contributor to the current disease burden in the U.S.[5]. A large portion of expected health benefits from the CSCS Project are attributable to physical activity: over 87% of avoided premature deaths and 78.5% of avoided years living with a disability (DALYs) in Scenario C. Activity alleviates disease and death through preventative mechanisms such as reaching and maintaining a healthy weight or body mass index, decreasing blood pressure and cholesterol, and lowering blood glucose levels to prevent diabetes [43-45]. Increasingly, studies are showing that moderate physical activity regimens address cardiovascular disease (heart attack, chest pain, and stroke) and diabetes in a more prescriptive fashion, often performing as well as common pharmaceuticals [46].

Further analysis shows that avoided deaths and illness are largely from cardiovascular disease. In Scenario B, 73 percent of avoided deaths and 55 percent of avoided DALYs in the physical activity category are from heart disease or stroke.

Walking or biking to work, school, transit and other community destinations helps people reach the Surgeon General's physical activity recommendation of 150 minutes per week for adults and 300 minutes per week for children.

Well-functioning Transportation Systems Facilitate Choice and Physical Activity

Consider the transportation choices of an individual who lives in Troutdale and works in downtown Gresham.

Monday: Rides an 8-mile round-trip to workplace along safe and marked bike lanes.

Tuesday: Telecommutes but walks 1.5 miles by walking children to and from school and taking a break at a nearby coffee shop.

Wednesday: A child's extracurricular activity requires taking the family car. However he walks 0.75 miles to get lunch from a great sandwich shop.

Thursday: An important business meeting in downtown Portland is facilitated by taking the MAX into downtown and back to the office. After taking the bus home, he walks 1.25 miles over the course of the day to and from transit.

On Friday: Bike day! Repeat of the 8-mile round-trip bike ride.

Saturday: 3-mile round-trip family bike ride to a park for a soccer game.

Sunday: 3-mile round-trip family bike ride to church.

Assuming the commuter travels at 3-miles per hour when walking and 12 miles per hour when biking, this person has accumulated 150 minutes of physical activity for the week from travel alone.

Active forms of transportation such as walking or biking to work, school, transit and other community destinations are remarkably effective at helping individuals reach the Surgeon General's physical activity recommendation of 150 minutes per week for adults and 300 minutes per week for children [47]. New mass transit options may change daily physical activity levels, and could add 10 minutes of physical activity each day for one group of new transit users [48]. Only 60% of adults in the region currently meet the recommendation[8], suggesting active transportation investments could help a large proportion of the population begin to meet physical activity goals. Failure to meet the recommended 150 minutes of physical activity a week is estimated to reduce life expectancy by 3.4 years [16].

Transportation choices allow individuals to routinely and flexibly integrate physical activity into everyday lives. These choices are dependent upon a well-functioning and safe transportation system for all types of users. It also requires the support of a built environment that encourages active transportation through relatively high residential density featuring mixed use with many diverse, nearby community destinations anchored by high connectivity throughout the system.

An aggressive mode split change clearly drives the ITHIM physical activity results. Increasing the bike-mode split from 9% of 10-mile single-occupancy vehicle (SOV) trips in 2010 to 10, 15 and 20% in Scenarios A, B and C accounts for the majority of anticipated physical activity gains. The significant increase in transit service miles between Scenarios B and C amplifies the walking mode shift through walk trips to transit. Both strategies are critical in creating the health benefits.

Adults and children are more likely to choose active forms of transportation when they perceive they will be able to do so safely [49]. Design details and investments to make streets more complete and comfortable for potential pedestrians and cyclists are not accounted for explicitly in the ITHIM model. Complete streets and active transportation investments will be critical in implementing

aggressive mode shifts needed to reach GHG reduction targets. (See Traffic Safety section for more information about perceived safety.)

Complete streets are needed in all communities. Low-income households are more likely to live in neighborhoods with fewer amenities including pedestrian and bicycling facilities [25, 27]. Suburban communities generally have lower levels of connectivity and less dense transit service. Both low-income and suburban communities will require significant pedestrian, bicycle, and transit investments to accrue health benefits at rates similar to wealthier and more urban parts of the region.

Highlights of physical activity

- The majority of health benefits (87–91% of avoided deaths, 79–88% of avoided illness depending on scenario) are attributable to increased physical activity such as walking and biking to work, transit, school and other destinations.
- A transportation system with many safe and convenient options provides individuals with flexible and healthy choices needed to routinely shift modes from single occupancy vehicles to more active modes of transportation. Prioritizing non-automobile users in design and maintenance of streets increases the safety of all users and will facilitate transportation mode shift to walking, bicycling and using transit.

FINDINGS: Traffic safety

Reduced reliance on single-occupancy vehicles will help control congestion as the metro population continues to grow. ITHIM estimates that current levels of investment will help avoid one traffic fatality (1.2% reduction) and a 2.0% reduction in DALYs due to fewer serious traffic accidents. Scenario C results in far more aggressive traffic safety benefits with 12 lives saved and 12.5% fewer years of disability due to injuries.

Table 8. ITHIM results attributable to traffic safety

	Scenario A		Scenario B		Scenario C	
Avoided	Count[1]	Percent reduction	Count[1]	Percent reduction	Count[1]	Percent reduction
Mortality	-1	-1.2%	-4	-3.5%	-12	-10.5%
YLL	-28	-1.2%	-84	-3.5%	-251	-10.5%
YLD	-44	-3.8%	-89	-7.6%	-192	-16.4%
DALY	-72	-2.0%	-173	-4.9%	-443	-12.5%

(1) This count has been adjusted for expected population in 2035.
(2) Disability adjusted life years (DALY) is the summation of years of life lost (YLL) and years living with a disability (YLD) due to injury.

The U.S. Department of Transportation (DOT) provides guidance in valuing prevented traffic fatalities. The current default value of statistical life (VSL) – a measure that aggregates many individuals' willingness-to-pay for a small reduction in mortality risk – is $9.1 million (in 2012 dollars) with a range of $5.2–$12.9 million provided for sensitivity analyses [50]. DOT also provides guidance about valuing injuries through an Abbreviated Injury Scale (AIS). Developed in the 1970s, AIS uses a QALY-based system to divide all possible injuries from crashes into a six-category scale of severity with the top severity being death. Current levels range (in 2012 dollars) from $27K for a minor laceration injury to $5.4 million for a critical injury such as ruptured liver [50]. There are no clearly established methods to convert DALYs to QALYs in order to apply AIS to ITHIM results.

The modeling indicates a reduction of LDV VMT per person on all types of roads with an increase in bicycle and pedestrian miles on minor streets and arterials. Even though overall traffic safety will improve, the increase of bicyclists and pedestrians on minor streets and arterials results in an increase in the absolute number of accidents for these two modes. The model predicts 2.5 more pedestrian deaths and 1.3 more bicyclist deaths in Scenario B in 2035. Since Scenario B also predicts 7.9 fewer automobile and motorcycle deaths, the overall fatality outcome is a net benefit of 4.0 avoided deaths. Patterns are similar for serious injuries and other Scenarios.

Table 9. ITHIM traffic safety results by mode for Scenario B

Mode	Annual fatalities			DALYs[1]		
	Baseline	Scenario B	Difference	Baseline	Scenario B	Difference
Walk	34.3	36.7	2.5	889.2	952.8	63.6
Cycle	10.4	11.7	1.3	316.7	356.7	40.0
Bus	0.0	0.0	0.0	0.0	0.0	0.0
Car	53.4	45.9	-7.5	1905.8	1639.5	-266.2
HGV	0.8	0.8	0.0	19.1	19.1	0.0
Motorbike	15.9	15.6	-0.4	424.5	413.9	-10.6
Total	114.8	110.7	-4.0	3555.4	3382.0	-173.3

(1) Disability Adjusted Life Years (DALYs)

This uneven distribution of benefits by mode may seem counterintuitive to studies that suggest a 'safety in numbers' effect. The safety in numbers effect is that as the proportion of pedestrians or bicyclists increases to a critical mass, motorized vehicle drivers become trained to 'look' and account for the non-motorist users, resulting in fewer collisions. The effect has been documented internationally and evidence is starting to appear in popular bicycling regions in the U.S. [33, 51-53]. While ITHIM allows for a safety in numbers adjustment, PHD did not exercise the safety in numbers option because it is unclear how to quantify the effect. The model also does not take into account infrastructure investments that may increase future bicyclist safety through increased visibility and separation from motorized traffic.

The physical activity benefits far outweigh the traffic risks associated with active modes of transportation [54-56]. One European study found that cycling instead of driving resulted in life-expectancy gain of 3–14 months over the course of a lifetime, far outweighing the potential risk of inhaled air pollution (0.8–40 days lost) and the risk of traffic accidents (5–9 days lost) [55].

The traffic safety results still indicate a need for safe strategies for pedestrians and bicyclists. The most effective way to increase safety for pedestrians and cyclists is through traffic calming measures and greater physical separation from motorized traffic [57-60]. Pedestrians, especially older adults, seem particularly sensitive to the location of sidewalks [61-63]. Bicyclists fare better on minor side roads than in unseparated bike lanes on major roads and benefit greatly from bicycle-specific facilities [53, 64].

The physical activity benefits of biking and walking far outweigh the traffic risks.

Perceived safety is a leading reason for individuals to avoid more active forms of transportation. Parental perceptions about perceived safety are predictive of children walking and biking to school [65, 66]. Bicyclists also respond to perceived safety. A recent study in the Portland region indicates 60% of Portlanders and 53% of the rest of the region are 'interested but concerned' about cycling. This potential 'market' of cyclists is far more worried about traffic safety than current cyclists; 84% are concerned about being hit by a car compared with 39–52% of 'enthused and confident' or 'strong and fearless' cyclists [67].

The cumulative effect of design strategies, investments and policies to address safety may serve as an indicator that streets are safe for all modes and thus help increase the number of pedestrians and bicyclists [40].

Highlights of traffic safety

- Traffic safety is an important co-benefit of reducing GHG emissions. Scenario A would result in one avoided traffic fatality per year and decrease serious injuries by 2.0%. Scenario C would help avoid 12 traffic fatalities and decrease serious injuries by 12.5% a year.
- The shift in transportation modes results in an increase in the absolute numbers of pedestrian and bicycle fatalities, even as the rate decreases. Even though the physical activity benefits far outweigh the risks of active transportation, this suggests extra effort should be made to mitigate traffic hazards for pedestrians and cyclists through traffic calming, street design and mode separation when possible.
- Fifty-three percent of individuals in the region are 'interested but concerned' about cycling. Addressing perceived safety for pedestrians and cyclists will help implement large mode shifts.

FINDINGS: Cleaner Air

Improving overall air quality is an important health benefit of GHG reduction. Reducing per capita VMT combined with clean fuel technologies are expected to decrease air pollutants attributable to light-duty vehicles. These pollutants include: $PM_{2.5}$, ozone precursors and air toxics such as benzene, 1, 3-butadiene, arsenic and chromium VI. Reductions of these pollutants would likely result in increased respiratory health, decreased cardiovascular events such as heart attacks, and decreased cases of cancers such as lung cancer and leukemia. Additionally, some populations are at greater risk from exposure to air pollution. For example, people with lung cancer have an increased risk of death when exposed to increased levels of $PM_{2.5}$.

To quantify the health impacts of cleaner air, ITHIM developers chose $PM_{2.5}$ as the pollutant indicator for mobile, onroad sources. PHD accepted this choice of pollutant based on the scientific consensus about the strength of and causal nature of the relationships between $PM_{2.5}$ and health. The periodic reviews of pollutants commissioned by the EPA [68-70] and a recent World Health Organization [71] scientific review all suggest that $PM_{2.5}$ is the best air pollution indicator for health-impact analyses. Using $PM_{2.5}$ as the exposure pollutant in ITHIM does underestimate some health effects including some cancer risks[7,8].

The $PM_{2.5}$ inputs for ITHIM were modeled by Metro in ODOT's GreenSTEP. Metro's scenario analyses showed a decrease in annual concentration of particulate matter as measured by $PM_{2.5}$ of 2.8% (Scenario A) to 3.6% (Scenario C). This is expected to result in modest decreases in deaths and illness (Table 10), primarily from fewer respiratory illnesses, reduced heart disease related to air pollution and reduced lung cancer mortality related to long-term $PM_{2.5}$ exposure.

Table 10. ITHIM results attributable to air quality ($PM_{2.5}$)

	Scenario A		Scenario B		Scenario C	
	Count	Percent reduction	Count	Percent reduction	Count	Percent reduction
Mortality	-4	0.2%	-5	0.2%	-5	0.3%
YLL	-37	0.2%	-42	0.2%	-47	0.3%
YLD	0	0.0%	0	0.0%	0	0.0%
DALY	-37	0.2%	-42	0.2%	-47	0.2%

(1) This count has been adjusted for expected population in 2035.
(2) Disability adjusted life years (DALY) is the summation of years of life lost (YLL) and years living with a disability (YLD) due to illness. YLD are unavailable for respiratory and air pollution-related cardiovascular disease as well as lung cancer at this time.

[7] For more information on cancer risks associated with light-duty vehicles in the Portland region please see Portland Air Toxics efforts [74].

[8] Limitations are discussed in greater detail below and found in the discussion of ITHIM methodology in Appendix E. A more detailed discussion of potential air pollutants of interest and the current scientific understanding of health linkages is available in Appendix F.

The modest effect of the CSCS Project on air quality health benefits can be explained by the small reduction in $PM_{2.5}$ in the GreenSTEP model. One reason GreenSTEP is not showing a particularly large reduction in $PM_{2.5}$ is because heavy-duty diesel vehicles are a larger driver of $PM_{2.5}$ but are not under the purview of this project, which focuses on light-duty vehicles (LDV) only. A second reason for the modest decrease in $PM_{2.5}$ is that GHG emissions reduction is a function of both decreased VMT per capita *and* technological and fuel changes. Reductions in $PM_{2.5}$ from per capita VMT reduction are largely displaced with increasing population. Per capita VMT is decreasing, but VMT for the entire region will increase by 22.7% for Scenario A and 13.3% for Scenario B. Only Scenario C shows an overall reduction (2.2%) in regional VMT. The end result is that $PM_{2.5}$ hardly changes at all.

There are additional limitations with using $PM_{2.5}$ as the primary air quality pollutant in ITHIM. The model only accounts for long-term exposure to $PM_{2.5}$ even though there is good evidence that short-term, episodic exposure to $PM_{2.5}$ and other air pollutants results in health effects. ITHIM includes the effects of long-term exposure from $PM_{2.5}$ such as heart disease related to air pollution, lung cancer mortality and respiratory diseases. ITHIM does not address short-term $PM_{2.5}$ exposure including a one-day lag in hospitalizations and emergency department visits for ischemic heart disease and congestive heart failure (heart attacks) following a spike in $PM_{2.5}$ concentrations. A region of 5 million people can expect one premature cardiovascular death from a heart attack for every 10 $\mu g/m^3$ increase in $PM_{2.5}$ during the preceding day [72]. Causal respiratory outcomes are less certain for short-term $PM_{2.5}$ exposure but include emergency room visits and hospitalizations for COPD and respiratory infections [69].

Another limitation of ITHIM is that other important air pollutants highly attributable to LDV are not accounted for in the health model. The advisory group questioned the extent to which ITHIM was underestimating air quality benefits by limiting to $PM_{2.5}$ and suggested expanding the pollutant profile to include other criteria pollutants such as ozone and air toxics such as benzene. Ground-source ozone (smog) is another air-pollutant highly associated with transportation-related air pollution and is strongly correlated with significant long-term and short-term respiratory health effects. Exposure to ozone can result in decreased resistance to respiratory and lung infections. Over time, this exposure may restrict lung growth in children, alter the airway and put significant stress on the cardiovascular system [70]. Analysis of longitudinal cohorts documents a likely causal effect on mortality and morbidity from long-term exposure to ozone. Mortality is estimated at about a 4% increase in risk for every 10 ppb exposure [73]. Ozone and other criteria pollutants could not be quantified in ITHIM due to high multicollinearity between transportation-related pollutants and high correlation of health outcomes.

Also excluded from ITHIM but with significant carcinogenic effects are air toxics. A recent analysis of these pollutants and resulting recommendations are available in the Portland Air Toxics Solutions (PATS) report [74, 75]. Air toxics related to carbon emissions standards may show larger decreases in ambient concentrations than $PM_{2.5}$ in the scenarios. Although not included in ITHIM, decreased concentrations of air-toxics would also result in cancer and non-cancer health benefits. Recommendations from PATS include: use the ongoing regional transportation planning process to reduce vehicle use, target a 20% per person reduction in vehicle emissions by 2035, improve traffic signals to reduce congestion, support

strong national standards for clean vehicles, adopt the latest California clean car standards, and promote electric vehicle charging stations [74, 75].

PHD continues to use $PM_{2.5}$ within ITHIM for several reasons. First, scientific understanding is well developed for $PM_{2.5}$, and it has the largest health impact at current ambient concentrations. (See appendix F for a broader discussion of $PM_{2.5}$ science.) Second, the correlation between variables is high. Pollutants associated with LDV emissions show a great deal of multicollinearity. Health outcomes such as respiratory and cardiovascular disease resulting from exposure are also highly correlated. One recent and highly cited dual-pollutant model of ozone and $PM_{2.5}$ showed ozone is primarily associated with respiratory outcomes and $PM_{2.5}$ with cardiovascular outcomes [73]. This suggests current relative risks for $PM_{2.5}$ may already account for some, but not all, of ozone respiratory effects and lung cancers from arsenic and chromium. Reductions in $PM_{2.5}$ would be expected to have similar rates of reduction in death and disease [71, 72].

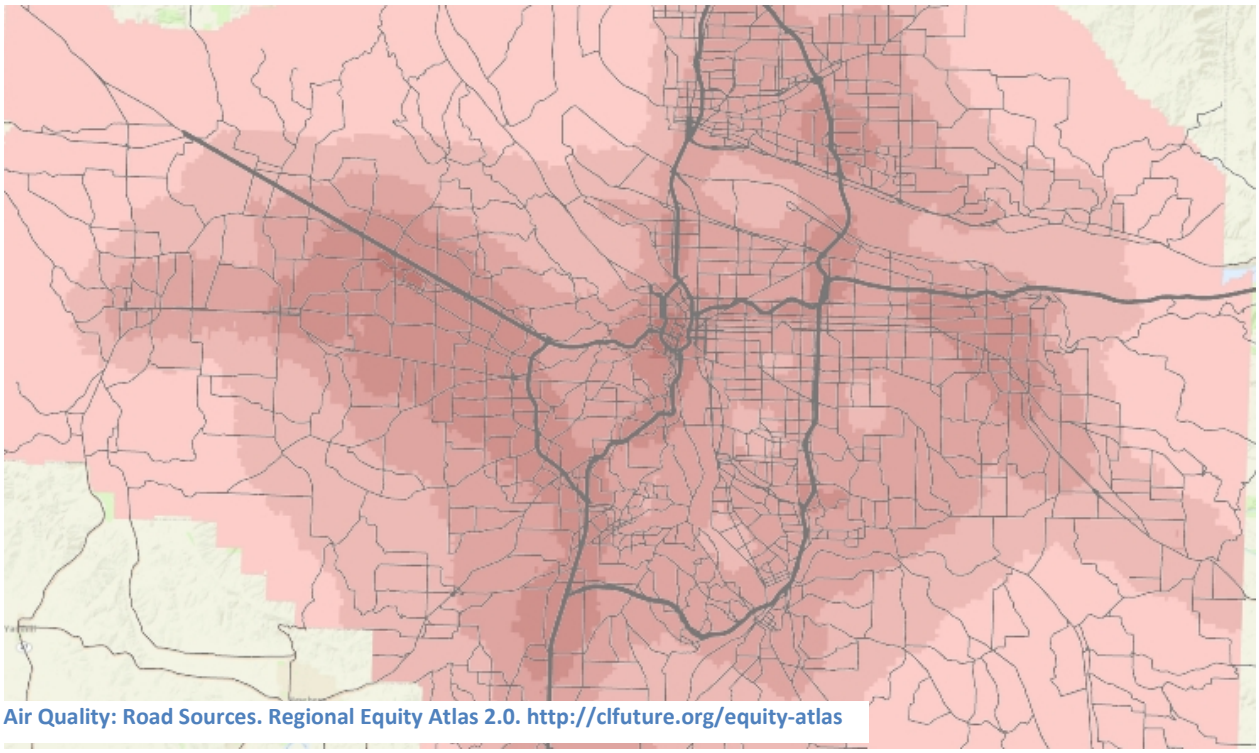
There is no level at which exposure to $PM_{2.5}$ is safe.

The strategies and investments under consideration could protect health by reducing exposure to both $PM_{2.5}$ and ozone.

It is important to note the temporal and localized effects of air pollution. ITHIM is based on long-term exposure, but short-term exposure to $PM_{2.5}$, ozone and other air pollutants is also associated with negative health effects. There is no level at which exposure to $PM_{2.5}$ is safe [71, 72]. Any threshold for which ozone does not degrade health "is likely to lie below 0.045ppm" and may be lower than even 0.035ppm [71]. Climate change is also likely to result in warmer summers with even higher ground-source ozone levels.

Additional analysis of temporal patterns (see Appendix F) shows that there were five episodes of elevated $PM_{2.5}$ and one episode of elevated ozone in 2012. These spikes in short-term exposure are highly correlated and predictable from forecasted weather. Spikes in $PM_{2.5}$ during winter inversion layers and ozone on hot, summer days call for short-term interventions. Regional transportation strategies could help address episodic, short-term exposure to both $PM_{2.5}$ and ozone.

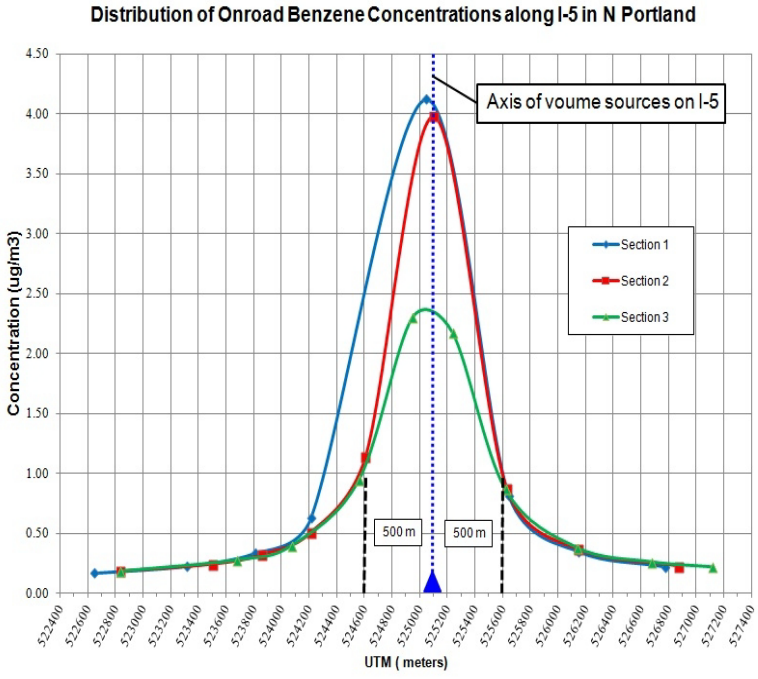
Air pollution is also highly localized[76]. Modest improvements in overall air quality should prompt modest gains in health benefits. These gains could be more significant in communities located near industry and transportation facilities due to the cumulative burden of exposure to air pollution from many sources [77, 78]. Models of air quality along road sources show higher concentrations of pollutants near interstates and on the windward side of the hills west of downtown Portland as seen in the map below.



Air Quality: Road Sources. Regional Equity Atlas 2.0. http://clfuture.org/equity-atlas

A recent DEQ analysis of ambient benzene concentrations along Interstate 5 near Killingsworth Street in North Portland shows that in-road concentration levels are up to ten times higher than urban background levels. While the concentrations drop quickly, concentrations are still 3–4 times higher than urban background levels 500 meters (or 5 blocks) removed from the freeway.

Given the localized nature of air pollution, elevated exposure during transport, particularly in active modes, is a growing concern. The benefits of physical activity outweigh the risks of exposure to air pollutants [54-56, 79]. The literature shows mixed results when measuring concentrations by mode (car, bike, or walking) [80-84]. On major streets, everyone is exposed to much higher levels of air pollution no matter the activity. However, because pedestrians and cyclists have elevated respiratory rates and may be in the roadway



longer, individuals taking these modes have higher personal exposures and uptakes of pollutants [84, 85]. Similarly, individuals working or living along major roads and freeways will also be at risk for higher personal exposure [86].

Highlights of air quality

- Improved air quality is an important benefit of addressing GHG. Metro's scenarios result in modest $PM_{2.5}$ reductions of 2.8, 3.2, and 3.6%. This translates into a relatively modest decrease in lung-cancer deaths, respiratory illness and heart disease related to long-term $PM_{2.5}$ exposure.

- ITHIM underestimates health benefits associated with improved air quality by only incorporating long-term exposure to $PM_{2.5}$. Although likely that additional benefits would accrue from lower ambient ground-source ozone and air toxic concentrations, understanding the extent of such benefits is beyond the scope of this HIA.

- PHD recommends that Metro aligns the CSCS project investments and actions to PATS goals. Metro's scenarios address many of the PATS recommendations such as using technology to manage congestion, more efficient fuel standards and expanded use of electric vehicles. This should lead to a reduction in ambient air toxic concentrations and increased health. It is beyond this analysis to determine if the scenarios meet State of Oregon adopted ambient benchmark concentrations for the suite of pollutants monitored under PATS.

- There is no safe level of $PM_{2.5}$ exposure and safe levels of exposure to ozone are much lower than current ground-source ozone averages. Short-term episodes of elevated $PM_{2.5}$ (winter inversion layers) and ozone (hot, summer days) are not accounted for in ITHIM, but can result in elevated rates of cardiovascular and respiratory death and illness.

- Air quality is localized and many vulnerable populations live near transportation corridors. Transportation corridors are documented to have much higher ambient concentrations of pollutants than other areas. Care should be taken in designing active transportation facilities and buildings adjoining transportation corridors to balance supporting increased physical activity while minimizing exposure.

SUMMARY OF KEY FINDINGS

GHG emission reductions using the proposed strategies will improve health through reducing the risk of climate change and through important health benefits associated physical activity, traffic safety, and improved air quality. Current levels of investment (Scenario A) are expected to contribute to 64 avoided deaths annually; Scenarios B and C would result in 98 and 133 avoided deaths respectively. Every 12 percent decrease in GHG emission – the difference between Metro scenarios - would result in approximately a 0.65 percent decrease in DALYS (illness) among diseases studied.

The majority of health benefits (87-91 percent of avoided deaths, 79-88 percent of avoided illness) from proposed strategies, regardless of scenario, are attributable to increased physical activity from active transportation such as walking and biking to work, transit, school, and other destinations. A transportation system with a broad range of safe and convenient options provides individuals with flexible and healthy choices needed to routinely shift from single occupancy vehicles to more active modes of transportation.

RECOMMENDATIONS

Climate change poses a risk to the future health of Oregonians. Proposed strategies to mitigate climate change will also increase health benefits associated with physical activity, traffic safety and improved air quality. Based upon the findings of this report and with the support of the CCC HIA Advisory Committee, PHD has developed a series of recommendations to preserve and promote healthy communities throughout the region.

By developing and implementing a preferred scenario that meets or surpasses the GHG emissions reduction target set by the Department of Land Conservation and Development, PHD anticipates an improvement in public health.

The majority of health benefits from the CSCS Project can be attributed to active transportation such as walking and biking to work, transit, school and community destinations. **Based on this evidence, PHD recommends that Metro maximize opportunities for active transportation for all communities by:**

- Adopting and identifying stable funding for the design elements listed in the subsection 'Complete Streets and Active Transportation' of Scenarios B and C: street connections, wider sidewalks, safer street crossings, improved bus stops, bikeways, transit signal priority, and on-street bicycle facilities and trails.
- Improving transit service miles to meet levels recommended in Scenario C.
- Using an equity analysis to plan and develop equal access to active transportation throughout the region.

While the benefits of physical activity far outweigh the risks, active modes of transportation can lead to increased exposure to traffic injury and air pollution. **In order to reduce the risk of increased exposure**

to traffic injury and air pollution for all road users, PHD recommends that Metro prioritize the design and maintenance of non-automobile facilities by:

- Including safety features for pedestrians and bicyclists such as separation from motorized traffic when possible. Prioritize non-automobile users in design and maintenance of streets.
- Providing a parallel bicycle route one block removed from high-volume roads when feasible to reduce exposure to localized pollution while still maintaining access to community destinations.

Per capita VMT reduction is expected to modestly improve air quality as measured by many pollutants including air toxics, but temporal and localized air quality concerns remain. **Due to temporal and spatial air quality concerns, PHD recommends that Metro maximize overall improvements in air quality through actions such as:**

- Aligning the CSCS preferred alternative to PATS goals. In collaboration with DEQ, determine how the preferred alternative helps meet State of Oregon adopted ambient benchmark concentrations.
- Reducing exposure by using zoning and incentives to improve indoor filtration systems in new buildings along transportation corridors.
- Convening a regional committee to further address episodic air quality events. Solutions should be season specific and could promote incentives for short-term, alternative commute arrangements.

Finally, to improve health equity, PHD recommends Metro ensure social and health goals are considered when prioritizing investments by:

- Explicitly and transparently addressing how investment links low-income and other vulnerable households to health-promoting resources.

APPENDICES

A. HIA Minimum Elements and Practice Standards

B. Advisory committee

C. Health conditions and prevalence rates by county (BRFSS)

D. CDC Chronic Disease Cost Calculator

E. ITHIM results

F. Air quality white paper

Appendix A. HIA Minimum Elements and Practice Standards

November 2010, Version 2
North American HIA Practice Standards Working Group, Society for the Practitioners of HIA

A health impact assessment (HIA) must include the following minimum elements, which together distinguish HIA from other processes. An HIA:

1. Is initiated to inform a decision-making process, and conducted in advance of a policy, plan, program, or project decision;
2. Utilizes a systematic analytic process with the following characteristics:
    a. Includes a scoping phase that comprehensively considers potential impacts on health outcomes as well as on social, environmental, and economic health determinants, and selects potentially significant issues for impact analysis;
    b. Solicits and utilizes input from stakeholders;
    c. Establishes baseline conditions for health, describing health outcomes, health determinants, affected populations, and vulnerable sub-populations;
    d. Uses the best available evidence to judge the magnitude, likelihood, distribution, and permanence of potential impacts on human health or health determinants;
    e. Rests conclusions and recommendations on a transparent and context-specific synthesis of evidence, acknowledging sources of data, methodological assumptions, strengths and limitations of evidence and uncertainties;
3. Identifies appropriate recommendations, mitigations and/or design alternatives to protect and promote health;
4. Proposes a monitoring plan for tracking the decision's implementation on health impacts/determinants of concern;
5. Includes transparent, publicly accessible documentation of the process, methods, findings, sponsors, funding sources, participants and their respective roles.

Appendix B. List of CCC HIA Advisory Committee members

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Appendix C. County-level BRFSS

BRFSS 2011 category	U.S. state median	Percent of adults [95% confidence interval]				
		Oregon	Portland MSA[2]	Clackamas[1]	Multnomah[1]	Washington[1]
Heart attack	4.4	3.6 [3.1–4.2]	3.2 [2.5–4.0]	3.3 [1.7–5.0]	3.0 [1.5–4.5]	2.6 [1.5–3.8]
Chest pain or coronary heart disease	4.1	3.6 [3.1–4.0]	3.1 [2.4–3.7]	2.8 [1.4–4.2]	2.9 [1.7–4.2]	2.9 [1.6–4.2]
Stroke	2.9	2.9 [2.5–3.4]	2.7 [2.1–3.3]	2.8 [1.2–4.4]	2.7 [1.4–3.9]	3.0 [1.5–4.5]
Any physical activity last month?	73.8	80.3 [78.7–81.3]	81.5 [79.5–83.6]			
150 minutes of Aerobic per week	57.7	61.1 [59.3–62.9]	60.3 [57.8–62.8]	62.5 [56.7–68.2]	65.0 [60.9–69.2]	58.4 [53.0–63.8]
High blood pressure	30.8	29.9 [28.5–31.3]	27.9 [26.0–29.9]	30.6 [25.8–35.4]	26.8 [23.5–30.2]	27.1 [23.0–31.2]
Cholesterol checked and high in past 5 years	38.4	38.5 [36.8–40.2]	36.1 [33.8–38.5]	39.3 [33.5–45.1]	37.0 [32.8–41.2]	33.5 [28.7–38.3]
Overweight	35.7	34.8 [33.31–36.4]	35.8 [33.4–38.1]	35.6 [30.0–41.1]	35.9 [32.0–39.8]	34.3 [29.4–39.2]
Obese	27.8	26.7 [25.2–28.3]	23.7 [21.7–25.7]	25.4 [20.3–30.6]	19.5 [16.3–22.6]	25.5 [21.0–30.0]
Diabetic	9.5	9.3 [8.4–10.2]	8.5 [7.3–9.8]	8.6 [5.7–11.5]	8.8 [6.7–10.9]	6.0 [4.2–7.8]
Depression (ever treated)	17.5	23.9 [27.5–25.3]	22.8 [20.8–24.7]	21.7 [17.2–26.1]	25.5 [21.9–29.1]	22.3 [18.2–26.3]
COPD (Chronic obstructive pulmonary disease)	6.1	5.9 [5.2–6.7]	5.2 [4.2–6.3]	5.2 [3.1–7.3]	5.1 [2.9–7.4]	5.2 [3.2–7.2]
Ever had asthma	13.6	16.7 [15.4–18.0]	16.2 [14.3–18.0]	13.9 [10.2–17.5]	15.4 [12.3–18.5]	20.8 [16.1–25.6]
Current asthma	9.1	10.5 [9.4–11.5]	9.6 [8.2–11.0]	8.3 [5.5–11.0]	9.0 [6.5–11.4]	10.9 [7.7–14.2]

(1) These are not age-adjusted prevalence rates; caution should be used when comparing counties.

(2) The Portland-Vancouver-Hillsboro OR-WA MSA is defined as the seven–county region including Clackamas, Columbia, Multnomah, Washington and Yamhill Counties in Oregon, and Clark and Skamania Counties in Washington

Appendix D. CDC Chronic Disease Cost Calculator

The costs of chronic disease reported are from a recent version (November 2013) of the CDC's Chronic Disease Cost Calculator that can be found at www.cdc.gov/chronicdisease/resources/calculator/index.htm. The Cost Calculator uses a regression-based approach to estimate costs for chronic disease by state and payer type for the treated population. Below is a table of the Oregon (not three-county) results with accompanying notes as provided by the calculator, descriptions of datasets from the technical guide found at www.cdc.gov/chronicdisease/pdf/cdcc_tech_appendix.pdf, and the FAQs found at www.cdc.gov/chronicdisease/resources/calculator/faq.htm.

Overall summary for all diseases for Oregon

	All payers	Medicaid	Medicare	Private insurers	Absenteeism	All payers+ absenteeism
Arthritis	$1,553	$69	$445	$610		
Asthma	$411	$79	$92	$153		
Cancer	$1,888	$43	$620	$878	$202	$1,754
Congestive heart failure	$182	$27	$72	$23	$40	$451
Coronary heart disease	$1,098	$29	$390	$442	$106	$1,994
Hypertension	$1,382	$109	$349	$460	$3	$185
Stroke	$832	$112	$281	$147	$45	$1,143
Other heart disease	$603	$69	$248	$158	$63	$1,445
Depression	$892	$51	$187	$367	$53	$885
Diabetes	$1,658	$137	$464	$528	$9	$612
Diseases of the Heart	$1,883	$125	$710	$624	$94	$986
Total cardiovascular disease	$3,620	$281	$1,174	$1,123	$62	$1,721

*Costs reported in millions.

*Includes costs only for diseases that are selected and have cost values available.

Notes:

Annual expenditures inflated to 2010 $ following recommendations from the Agency for Healthcare Research and Quality. Costs include expenditures for office based visits, hospital outpatient visits, emergency room visits, inpatient hospital stays, dental visits, home health care, vision aids, other medical supplies and equipment, prescription medicines, and nursing homes. Payer populations are not mutually exclusive. Costs for all payers are calculated independently of costs for Medicaid, Medicare, and private insurers. Sums of the total costs across subpopulations may not equal the overall total costs due to rounding. Treated population is defined as the number of people receiving care for the disease in the previous year. The treated population in the Medical Expenditure Panel Survey and the National Nursing Home Survey was likely more resource-intensive than those included in alternative prevalence definitions based on a history of the disease who have not sought treatment recently. All results generated from the tool are estimates. Actual costs may be larger or smaller than those reported. [Continued below.]

The estimates for hypertension and diabetes include a portion of the costs of complications including congestive heart failure (CHF), coronary heart disease (CHD), stroke and other heart diseases. The sum of costs over selected diseases that include hypertension and diabetes could overestimate the costs associated with all the selected diseases. The costs for diseases of the heart include CHD, CHF, and other heart disease. The costs for total cardiovascular disease include diseases of the heart, stroke, and an estimate of hypertension costs that avoids double-counting of costs with other diseases. Excluding the costs of complications lowers the estimates for hypertension and diabetes by approximately 34% and 39%, respectively.

CDC Cost Calculator, default source data sets,

- (See: http://www.cdc.gov/chronicdisease/pdf/cdcc_tech_appendix.pdf for more information)*U.S. Census Bureau:* Total state population and breakdowns by sex and age for 2008 and state population projections by sex and age for 2010 through 2020 came from the U.S. Census Bureau.
- *Kaiser Family Foundation*: Medicare beneficiary data came from the Kaiser Family Foundation 2008 Medicare Health and Prescription Drug Plan Tracker.
- *Medicaid Statistical Information System (MSIS):* Medicaid enrollment data came from the Medicaid Statistical Information System (MSIS) State Summary Fiscal Year 2008. MSIS data are used by CMS to produce Medicaid program characteristics and utilization information for the states. The purpose of MSIS is to collect, manage, analyze and disseminate information on eligibles, beneficiaries, utilization and payment for services covered by State Medicaid programs.
- *Current Population Survey (CPS):* Private insurance enrollment data and breakdowns of enrollment by sex and age by payer (private insurance, Medicaid, and Medicare) came from the Current Population Survey (CPS). Private insurance data came from the 2008 CPS and Medicaid and Medicare data came from the 2007 through 2009 CPS. The Current Population Survey (CPS) is a monthly survey of about 50,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics. The sample is scientifically selected to represent the civilian noninstitutional population. The sample provides estimates for the nation as a whole and serves as part of model-based estimates for individual states and other geographic areas.

Treated Population, per-person costs, and absenteeism *(Treated population is defined as the number of people receiving care for the disease in the previous year.)*

- *Medical Expenditure Panel Survey (MEPS)* Data were pooled from the 2004 through 2008 Medical Expenditure Panel Survey (MEPS) Consolidated Data Files, a nationally representative survey of the civilian non-institutionalized population that provides data on annual medical expenditures, sources of payment, insurance coverage, and days missed from work due to illness or injury for each participant. The combined five-year MEPS sample included 153,012 persons of all ages living in the U.S. Estimates for both the treated population and costs have been adjusted to be nationally representative using MEPS sampling weights for years 2004 through 2008. The default data include years prior to the implementation of Medicare Part D, which took effect in 2006. All expenditure data were inflated to 2010 dollars using the gross domestic product general price index as recommended by Agency for Healthcare Research and Quality to reflect more current dollar values.

- *National Nursing Home Survey (NNHS)* Estimates for the institutionalized population, which are not available in other data sources, were derived from the 2004 National Nursing Home Survey (NNHS). The NNHS is a nationally representative sample of United States nursing homes, their services, their staff, and their residents. The NNHS provides information on nursing homes from two perspectives-that of the provider of services and that of the recipient of care. For recipients, data were obtained on demographic characteristics, health status, and sources of payment. Diseases were defined using International Classification of Disease (ICD-9) codes based on any diagnosis of the condition, either at admission or time of the survey and primary or secondary diagnosis.

Appendix E. ITHIM methodology and detailed results

The Integrated Transport and Health Impact Model (ITHIM) was developed by public health researchers in the United Kingdom to assess the potential health impacts of GHG emission reduction scenarios for London, U.K. and Delhi, India [4]. 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. PHD further adapted the tool for use in the Portland metropolitan region for the CSCS HIA by using census data for the geography that makes up the Portland metropolitan region. In the CSCS HIA, PHD used ITHIM to assess six sample scenarios representative of a range of options associated with the 144 Phase 1 scenarios Metro was currently investigating. One of the recommendations of the CSCS HIA was to rerun ITHIM when the alternative scenarios had been narrowed by Metro to a manageable number. The CCC HIA contains the ITHIM analysis of the three scenarios (A, B, and C) defined in Metro's Phase 2 of the CSCS Project.

METHODOLOGY

For each disease considered, ITHIM applies measures of changes in 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 each scenario and outputs are generally reported in the difference between baseline and scenario. Conceptually, baseline in ITHIM is the expected number of deaths and illness given the current rate of exposure for the expected population in 2035. Estimated impact is the difference between the expected outcome at baseline and the scenario.

ITHIM's methodology is grounded in applying relative risks to appropriate 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 developed from 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 calculated from large cohort studies or in some cases, meta-analyses of multiple studies, 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 and allows for comparisons across scenarios.

One advantage of ITHIM is the ability to compare across various pathways. This is especially true when the tool can be refined to include local data. ITHIM was initially developed using global burden of disease data. This was updated with U.S. prevalence data for the San Francisco and CSCS HIA work. For the CCC HIA, PHD further refined ITHIM by using Oregon-specific prevalence

data for mortalities; local demographic data was used to extrapolate WHO models to local populations for DALYs.

This burden of disease approach allows for a comparison in impacts from each disease included and, by summing diseases by exposure type, from exposure pathways. For instance, it allows PHD to state that Scenario B will prevent six times as many stroke deaths (through increased exercise) as traffic fatalities.

ITHIM uses the relative risks for 13 separate diseases assigned to three exposure pathways: physical activity, traffic safety, and particulate air pollution as indicated by $PM_{2.5}$. The burden of disease approach is helpful in understanding which exposure pathway and/or disease is driving health benefits (or burdens). In turn, this allows specific recommendations and mitigation measures to maximize health given the constraints of the scenarios.

ITHIM depends on modeled and survey data such as burden of disease estimates, relative risk ratios, air pollution estimates and outputs from ODOT's GreenSTEP model. ITHIM does not account for statistical uncertainty of modeled and survey data, which likely increases the uncertainty of ITHIM estimates.

The primary limitation of ITHIM is that it underestimates health benefits due to data availability and the specific exposures and diseases represented in each pathway. Although such an assessment is outside of the scope of this HIA, additional analyses on the reduction of toxic air pollutants and ozone from transportation and transportation-specific policies (such as fleet turnover and advances in fuel technology) would likely show additional health benefits.

Table E-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	$PM_{2.5}$ as modeled by GreenSTEP
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 heart disease[1,3] • Respiratory disease[1]

(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.

ITHIM is limited in its ability to quantify and compare health pathways by the specific diseases included in each pathway. Inclusion of disease 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. Table E-1 lists the specific diseases by exposure category in this version of ITHIM. Because ITHIM is limited to the 13 diseases, it likely underestimates the health benefits from reducing GHG emissions in all of the major exposure routes. 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 $PM_{2.5}$ exposure only and thus underestimates health benefits from lower concentrations of a variety of ambient pollutants including ozone and air toxics.

Air quality affects a broad range of health outcomes and can be described through dozens of exposure variables. Advisory committee members suggested that ITHIM's treatment of the air pollution pathway was particularly weak due to its reliance on $PM_{2.5}$ as the *only* exposure variable for light-duty vehicle (LDV) emissions. PHD feels confident in $PM_{2.5}$ as the indicator due to the state of the science surrounding $PM_{2.5}$ as transportation-related air pollutant. However, PHD acknowledges that $PM_{2.5}$ does not capture the entire LDV emission profile including those of ozone precursors and air toxics. (Please see Appendix F for further discussion.) It is also important to note that $PM_{2.5}$ is considered a good transportation indicator because of the vast amount attributable to heavy-duty diesel emissions; however diesel emissions are beyond the scope of Metro's planning project.

PHD investigated adding additional pollutant profiles into ITHIM but ran into several issues. First, there is a high occurrence of multicollinearity between transportation-related emission pollutants and correlation between health outcomes. For example, in most of the country, long-term ozone and $PM_{2.5}$ measurements are highly correlated. Relative risks constructed with multi-pollutant models are relatively rare. Thus, even though $PM_{2.5}$ appears biologically linked to cardiovascular disease and ozone to respiratory disease, either pollutant can be used to predict both diseases. Summing $PM_{2.5}$ and ozone impacts would certainly double-count to some degree. This also suggests that some of the $PM_{2.5}$ health effects captured in the relative risks for lung cancer, respiratory disease, and cardiovascular disease may be picking up effects from other transportation related pollutants that are highly correlated with $PM_{2.5}$ emissions. For example, reduced time to death for lung cancer patients from $PM_{2.5}$ exposure may also include some lung cancers deaths from benzene exposure given the current science supporting the relative risk estimates. Complicating matters further, the cardiovascular and respiratory systems are biologically linked, making any separation of health outcomes difficult, particularly across a suite of pollutants.

Second, knowledge about the health risks of many air pollutants is based on toxicology studies for cancer. For example, most air toxics tracked by Oregon DEQ are known carcinogens.

However, the risk of air toxics is generally stated in the *lifetime* risk of disease based on at least a multi-year exposure, such as working for many years at an industrial plant with high levels of toxic exposure. *Relative* risk ratios have an interpretation of yearly incidence or prevalence of disease based upon a shorter-term exposure such as a year; and is difficult to convert *lifetime* risk.

DETAILED RESULTS

Table E-2 provides detailed ITHIM results by exposure pathway for all three scenarios. Results include avoided mortality (deaths) and illness. Illness is measured by disability adjusted life years (DALY) which is the summation of years of life lost (YLL) and years living with a disability (YLD) due to illness. Results are presented in counts (or cases) avoided as well as percent reduction from current disease prevalence levels. Also note that ITHIM's raw count output assumes a stable (in this case 2010) population. All results in the report have been adjusted approximately 32% upward to account for population growth within the UGB. For example, there should be 58 fewer deaths from increased physical activity in 2035 if Scenario A is implemented. This is 1.4% decrease in current deaths attributable to physical inactivity.

Table E-2 Avoided mortality and illness (DALY) by exposure pathway and scenario

	Avoided	Scenario A			Scenario B			Scenario C		
		Count	Percent	Count w/ population factor[1]	Count	Percent	Count w/ population factor[1]	Count	Percent	Count w/ population factor[1]
Physical activity	Mortality	-44	-1.4%	-58	-68	-2.1%	-89	-88	-2.9%	-116
	YLL	-355	-1.5%	-468	-566	-2.3%	-747	-748	-3.1%	-988
	YLD	-247	-1.0%	-325	-444	-1.6%	-586	-605	-2.3%	-799
	DALY	-601	-1.3%	-793	-1,010	-1.9%	-1333	-1,354	-2.8%	-1786
Traffic safety	Mortality	-1	-1.2%	-1	-3	-3.5%	-4	-9	-10.5%	-12
	YLL	-21	-1.2%	-28	-64	-3.5%	-84	-190	-10.5%	-251
	YLD	-33	-3.8%	-44	-68	-7.6%	-89	-145	-16.4%	-192
	DALY	-55	-2.0%	-72	-131	-4.9%	-173	-336	-12.5%	-443
Air quality ($PM_{2.5}$)	Mortality	-3	-0.2%	-4	-4	0.2%	-5	-4	-0.3%	-5
	YLL	-28	-0.2%	-37	-32	0.2%	-42	-36	-0.3%	-47
	YLD	-0	-0.0%	0	-0	0.0%	0	-0	-0.0%	0
	DALY	-28	-0.2%	-37	-32	0.2%	-42	-36	-0.2%	-47
Total	Mortality	-48	-0.9%	-64	-74	1.4%	-98	-101	-2.0%	-133
	YLL	-404	-0.9%	-533	-662	1.4%	-874	-974	-2.1%	-1286
	YLD	-280	-0.6%	-370	-511	1.1%	-675	-750	-1.6%	-990
	DALY	-684	-0.7%	-903	-1,173	1.3%	-1548	-1,725	-1.9%	-2276

(1) ITHIM estimates disease reduction based on stable (2010) population figures. Assuming disease burden rates remain the same in 2035, counts are adjusted upward by addressing the 32.0% increase in population expected within the Urban Growth Boundary from 2010 to 2035.

(2) Disability adjusted life years (DALY) is the summation of years of life lost (YLL) and years living with a disability (YLD) due to illness. YLD are unavailable for respiratory and inflammatory cardiovascular disease (all cardiovascular disease associated with air pollution exposure) as well as lung cancer at this time.

To compare exposure pathways, the percent reduction attributable to each was calculated for deaths and illnesses. Table E-3 provides detailed results and shows that the majority of health benefits are from reducing physical inactivity burden.

Table E-3 Percent of health benefits attributable to exposure pathway by scenario

		Percent reduction attributable to exposure pathway		
		A	B	C
Physical activity	Mortality	91.4%	91.1%	87.0%
	YLL	87.8%	85.6%	76.8%
	YLD	88.0%	86.8%	80.6%
	DALY	87.9%	86.1%	78.5%
Traffic safety	Mortality	2.1%	4.1%	9.1%
	YLL	5.3%	9.6%	19.5%
	YLD	11.9%	13.2%	19.4%
	DALY	8.0%	11.2%	19.5%
Air quality	Mortality	6.5%	4.8%	3.9%
	YLL	7.0%	4.8%	3.7%
	YLD	0.0%	0.0%	0.0%
	DALY	4.1%	2.7%	2.1%

THIM provides outputs by disease for exposure pathways in which more than one disease is included. Tables E-4 present the population adjusted avoided illness (DALY) and mortality results for individual diseases in the physical activity and air quality ($PM_{2.5}$) exposure pathways.

Table E-4 Avoided mortality and illness (DALY) by illness and scenario for physical activity and air quality exposure pathways[1]

	Scenario A		Scenario B		Scenario C	
	DALY	**Mortality**	**DALY**	**Mortality**	**DALY**	**Mortality**
Breast cancer	-13	-1	-29	-1	-32	-1
Colon cancer	-11	-1	-21	-2	-24	-2
Stroke	-181	-15	-290	-23	-400	-29
Ischemic heart disease	-205	-20	-319	-30	-442	-42
Depression	-57		-125		-162	
Dementia	-117	-8	-220	-14	-241	-15
Diabetes	-129	-5	-209	-7	-324	-10
Hypertensive heart disease	-79	-9	-119	-12	-161	-16
Physical activity total	**-793**	**-58**	**-1,333**	**-89**	**-1,786**	**-116**
Lung cancer	-21	-2	-24	-2	-26	-3
Inflammatory heart disease (associated with PM2.5 exposure)	-2		-3		-3	
Respiratory disease	-14	-2	-16	-2	-17	-2
Air quality ($PM_{2.5}$) Total	**-37**	**-4**	**-42**	**-5**	**-47**	**-5**

(1) ITHIM estimates disease reduction based on stable (2010) population figures. Assuming disease burden rates remain the same in 2035, counts are adjusted upward by addressing the 32.0% increase in population expected within the Urban Growth Boundary from 2010 to 2035.

ITHIM addresses traffic safety by estimating the number of severe crashes and fatalities by mode and by type of road. The tool is able to account for increased crashes for active transportation users even as overall traffic crashes decrease as miles travel shift from car to other modes. Table E-5 and E-6 present estimates 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. Injury information is further analyzed to develop DALY results presented above.

Table E-5 ITHIM estimates of expected DALYs from traffic injuries by mode in 2035

Mode	**Baseline**	**Scenario A**	**Scenario B**	**Scenario C**
Walk	889.2	958.3	952.8	898.1
Cycle	316.7	312.3	356.7	372.7
Bus	0.0	0.0	0.0	0.0
Car	1905.8	1773.9	1639.5	1418.1
Motorbike	424.5	419.4	413.9	404.4
Total [1]	3555.4	3483.0	3382.0	3112.5
Sum of difference between baseline and scenario		-72.4	-173.3	-442.9

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

Table E-6 ITHIM Estimates of Expected Traffic Fatalities by Mode in 2035

Mode	Baseline	Scenario A	Scenario B	Scenario C
Walk	34.3	37.0	36.7	34.6
Cycle	10.4	10.2	11.7	12.4
Bus	0.0	0.0	0.0	0.0
Car	53.4	49.7	45.9	39.7
Motorbike	15.9	15.8	15.6	15.3
Total [1]	114.8	113.4	110.7	102.7
Sum of Difference between Baseline and Scenario		-1.4	-4.0	-12.1

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

Appendix F. Air Quality White Paper

ITHIM estimates air pollution mortality and morbidity using particulate matter ($PM_{2.5}$) as an indicator. The advisory group suggested exploring the expansion of the pollutant profile and expected health impacts beyond $PM_{2.5}$. Other commonly considered air pollutants include ground-level ozone (O_3) and NO_2 exposure. Ambient air is also monitored for known carcinogens or air toxics. All of these pollutants were investigated for potential inclusion in this HIA.

Air pollution is primarily regulated through the U.S. EPA and monitored by Oregon. The most prominent EPA regulations are for six 'criteria' pollutants. Three of these are particularly relevant to transportation: $PM_{2.5,}$ ozone and NO_2. The regulator context informs both the current conditions and the body of scientific evidence. Table 1 provides a summary of the most recent EPA science reviews for $PM_{2.5}$, ozone and NO_2 and includes known health outcomes and the relative weight of evidence. The health outcomes are cardiovascular ($PM_{2.5}$), respiratory (ozone) and central nervous system illness, and death. Because PM and ozone are further developed, the remainder of this section concentrates on these two pollutants when discussing criteria pollutants.

TABLE 1 Summary of U.S. EPA integrated science assessment weight of evidence for health effects associated with PM, ozone, and NO_2

Health outcome	**PM ($PM_{2.5}$)** 2009 ISA[69]	**O_3** 2013 ISA[70]	**NOx (NO_2)** 2008 ISA[68]
Short term exposure			
Respiratory morbidity	●●●●	●●●●●	●●●●
Cardiovascular morbidity	●●●●●	●●●●	●●
Central nervous system morbidity	Not reviewed	●●●	Not reviewed
Mortality	●●●●●	●●●●	●●●
Long term exposure			
Respiratory morbidity	●●●●	●●●●	●●●
Cardiovascular morbidity	●●●●●	●●●	●●
Reproductive/birth outcomes	●●●	●●●	●●
Central nervous system morbidity	Not reviewed	●●●	Not reviewed
Cancer	●●●	●●	●●
Mortality	●●●●●	●●●	●●

●●●●● **Causal** - Evidence is sufficient to conclude there is a causal relationship and has been shown to result in health effects in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.

●●●● **Causal likely** - Evidence is sufficient to conclude that a causal relationship is likely to exist, but important uncertainties remain.

●●● **Suggestive of causal** - Evidence is suggestive of a causal relationship but is limited. (i.e. - relies only on toxicology, or high quality epidemiological study is inconsistent with past evidence)

●● **Inadequate to Infer** - Evidence is inadequate to determine that a causal relationship exists; available studies are of insufficient quantity, quality, consistency, or statistical power.

● **Not likely to be causal**

Scientific consensus about the strength of and causal nature of the relationships between $PM_{2.5}$ and health is clear from the EPA reviews [68-70]. A recent World Health Organization scientific review also concludes that $PM_{2.5}$ is the best air pollution indicator for health impact analyses [71]. Because the

health pathways and risk ratios are most developed for $PM_{2.5}$, PHD feels confident in using $PM_{2.5}$ as the primary air pollution indicator within ITHIM.

Still, health evidence is mounting for ambient exposure from ozone and certain air toxics. Further, some pollutants affect certain health outcomes more than others. The following sub-sections provide analyses of criteria pollutants ($PM_{2.5}$ and ozone) and carcinogenic air toxics. Each section provides a brief literature review to understand the breadth and severity of health effects followed by presentation of local incidence of disease and pollution conditions. After the discussion of specific pollutants is a section that addresses the spatial distribution of air pollution and the health burden it places on specific vulnerable populations.

Criteria pollutants ($PM_{2.5}$ and ozone)

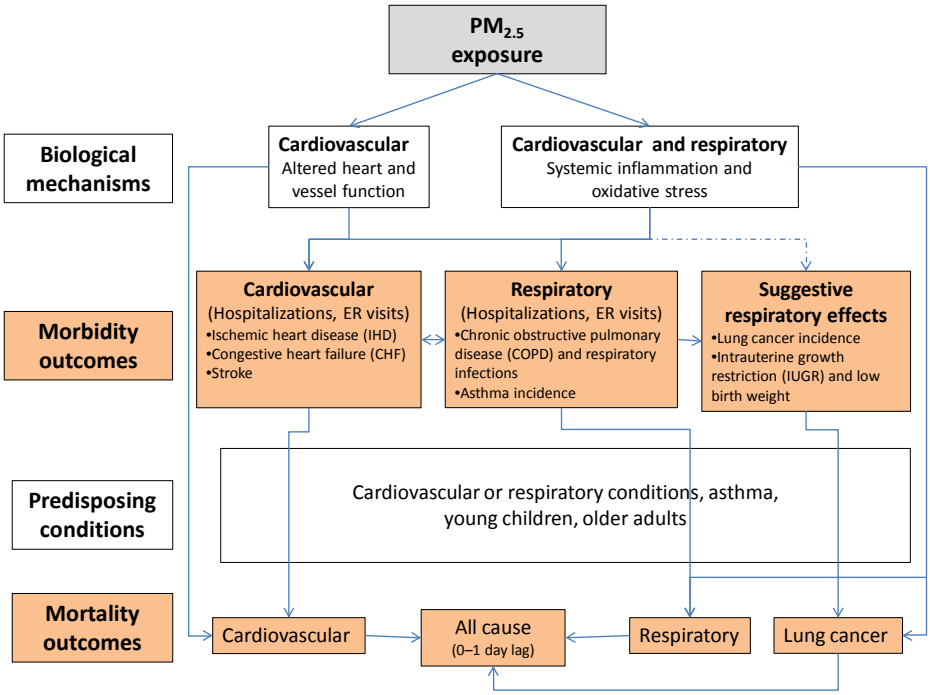
EPA regulates six criteria pollutants including $PM_{2.5}$ and ozone. $PM_{2.5}$ is ambient ultra-fine particles created during the combustion process and is primarily an issue during winter inversion layers. Ozone is created from reactions of precursor pollutants — largely emitted through combustion processes — in the presence of solar radiation. Elevated ground-source ozone concentrations typically occur in the afternoon and during summer months. The primary route of exposure for $PM_{2.5}$ and ozone is through inhalation.

Transportation emissions are a significant source of both pollutants. Nationally, road transportation accounts for 6.9% of $PM_{2.5}$ emission totals. Ozone is routinely reported in terms of precursor pollutants with 38.5% of NO_x and 1.2% of SO_x emission totals attributable to road transportation. Populations clustered near roads are much more likely to be exposed to road transportation sources. A recent study estimated that weighting concentrations by population would result in road transportation as the top contributor of human exposure. In this model, road transportation accounted for 26.3% of $PM_{2.5}$ and 54.3% of ozone exposure [87].

Health pathways for $PM_{2.5}$

Inhaling $PM_{2.5}$ harms the heart and lungs as the particles embed deep within the respiratory tract. Particulate matter degrades health through systemic inflammation, oxidative stress, and altered heart and blood vessel function. Short and long-term health outcomes of concern are primarily cardiovascular with secondary respiratory effects (see Figure E.1).

FIGURE E.1 Pathway diagram- Particulate matter exposure and health outcomes



The EPA states with the highest levels of confidence that short and long-term exposure to $PM_{2.5}$ causes cardiovascular morbidity (illness) and mortality (death), likely causes respiratory disease and death, is increasingly associated with poor birth outcomes such as low birth weight, and is increasingly believed to exacerbate lung cancer resulting in death.

Evidence of ***short-term*** exposure to $PM_{2.5}$ is best developed for cardiovascular mortality and non-fatal cardiovascular events [72]. Documented short-term morbidity outcomes associated with $PM_{2.5}$ include a one day lag in hospitalizations and emergency department visits for ischemic heart disease and congestive heart failure following a spike in $PM_{2.5}$ concentrations. A region of 5 million people can expect one premature cardiovascular death for every 10 $\mu g/m^3$ increase in $PM_{2.5}$ during the preceding day [72]. Causal respiratory outcomes are less certain but include emergency room visits and hospitalizations for COPD and respiratory infections [69].

Long-term exposure to $PM_{2.5}$ also increases the risk of cardiovascular and cardiopulmonary mortality [72]. A recent review suggests chronic exposure to $PM_{2.5}$ increases the nonaccidental risk of death by 6%, cardiovascular death by 12–14%, and lung cancer death by 15–21% for every increase in 10 $\mu g/m^3$ [88].

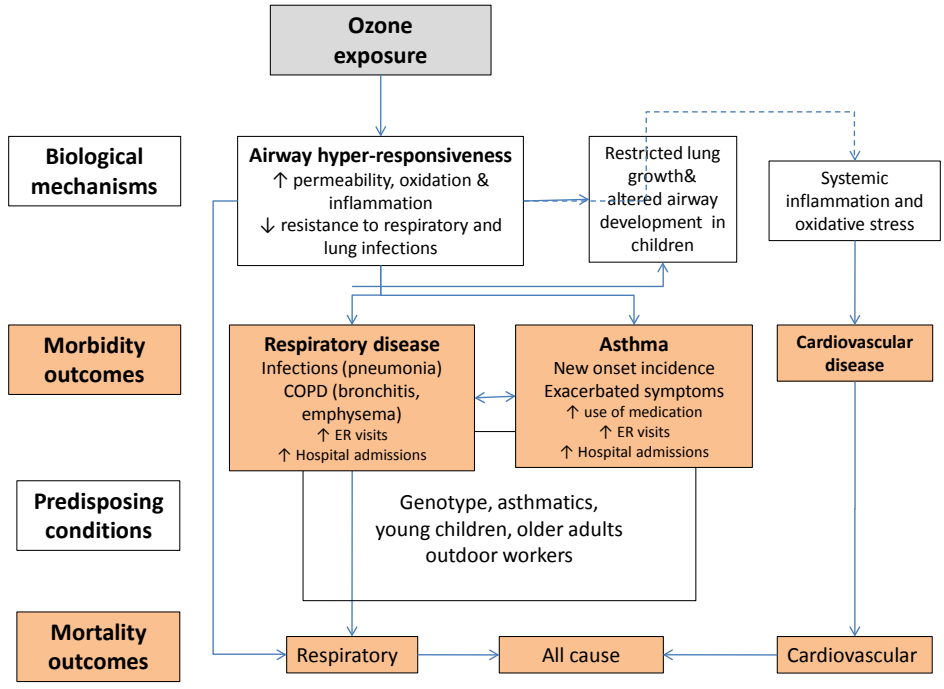
Morbidity outcomes associated with long-term exposure include: bronchitis in children, chronic bronchitis in adults over 30 years, asthma attacks, cardiovascular and respiratory hospital admissions, urgent care or emergency department visits due to asthma and cardiovascular disease, and restricted activity days for adults [71].

Emerging multi-pollutant models suggest pulmonary and respiratory responses associated with $PM_{2.5}$ may be due to highly correlated exposure to co-pollutants such as ozone [73]. Yet the linear relationship between $PM_{2.5}$ exposure and cardiovascular mortality hold at all levels for both short and long-term relationships [71, 72]. This implies **there is no level at which exposure to $PM_{2.5}$ is safe** and that **all reductions in $PM_{2.5}$ would be expected to have similar rates of reduction in death and disease**.

Health pathways for ozone

Ground-source ozone is documented to cause short-term airway hyper-responsiveness including increased permeability, oxidation and inflammation. (See Figure E.2.) Exposure to ozone can result in decreased resistance to respiratory and lung infections. Over time, this may restrict lung growth in children (an asthma risk), alter the airway, and stress the cardiovascular system [70].

FIGURE E.2 Pathway diagram- Ozone exposure and health outcomes



The relationship linking respiratory effects to ***short term*** exposure of ozone is well documented. Short-term health outcomes include respiratory mortality and morbidity as measured by respiratory and cardiovascular hospital admissions. Exposure to ozone has also been shown to increase new onset asthma, asthma symptoms, medication use, emergency room visits, and hospitalizations [70, 71].

Analysis of longitudinal cohorts also documents a likely causal effect on mortality and morbidity from ***long-term*** exposure to ozone. Research shows the strongest associations between long-term exposure and respiratory morbidity and mortality, with a 4% increase in risk for every 10 ppb exposure. Any secondary cardiovascular effects may be due to the correlation between ozone and $PM_{2.5}$ [73]. Other

research suggests that mortality risk increases with ozone exposure in populations with predisposing conditions such as COPD, diabetes and congestive heart failure. Research also supports the conclusion that long-term ozone exposure exacerbates asthma incidence, severity and hospitalization [70, 71].

Analysis of local cardiovascular and respiratory conditions

Ozone and $PM_{2.5}$ have a significant effect on cardiovascular and respiratory conditions. While $PM_{2.5}$ may be more directly linked to cardiovascular outcomes and ozone to respiratory outcomes, the presence of either pollutant can cause and exacerbate both types of health effects.

Many people suffer from heart disease in the Portland region. According to BRFSS, approximately 3% of adults in the region have had a heart attack; a similar number suffer from chest pain or heart disease and 2.7% report having suffered a stroke. These three cardiovascular conditions are highly associated with risk factors such as physical inactivity, high blood pressure, high cholesterol and high BMI (weight). Recent BRFSS data also shows that approximately 28% of adults report high blood pressure and 36% have had a high cholesterol reading in the past five years. Nearly 40% of adults report not meeting the recommended 150 minutes of aerobic physical activity per week. More than 35% are overweight and nearly 24% are obese [8].

Prevalence(1) of adults who have suffered from heart attack, angina and stroke in Oregon and the three-county Portland region

	Heart attack	Angina (chest pain from heart disease)	Stroke
Oregon	3.6%	3.6%	2.9%
Clackamas	3.3%	2.8%	2.8%
Multnomah	3.0%	2.9%	2.7%
Washington	2.6%	2.9%	3.0%

(1) 2011 BRFSS

Cardiovascular disease is costly to treat. Oregon Hospital Discharge Index data in 2008 showed hospitalization charges for heart attacks averaged about $40,000 [89]. The CDC estimates from the Chronic Disease Cost Calculator put the annual direct medical costs at over $1.5 billion for the Portland metropolitan area. Approximately $620 million of the region's cardiovascular costs are associated with Medicare and Medicaid patients which make up 14 and 15% of the Oregon population [10, 11].

Respiratory illness also significantly degrades quality of life. Conditions such as asthma and COPD are caused and/or exacerbated by poor air quality. A little more than 5% of adults report having COPD. More than 9% of Portland region adults report a current asthma condition making the Oregon adult rate the sixth highest in the country [8, 9]. At least 7–8% of children in Oregon have asthma according to parental response and when teens are directly surveyed, the prevalence increases to 10% [9].

Controlling asthma can be difficult and costly. Most asthma patients fill multiple prescriptions regularly. When medications are not adequately controlling symptoms, patients use the emergency department

and hospital system. For every four asthma visits to the emergency department, at least one results in a hospitalization. The average cost of an asthma hospitalization is approximately $14,300. In 2011, this resulted in over $15 million in charges and taxpayers were asked to pay nearly $10 million for Medicaid and Medicare patients [9].

Costs (charges) of asthma hospitalization, 2011

		Clackamas	Multnomah	Washington	Three-county	Oregon(1)
Average cost of hospitalization						**$14,300**
Total costs	**Medicaid/OHP**	$677,661	$2,681,673	$999,123	$4,358,457	$8,000,000
	Medicare	$872,489	$3,452,655	$1,286,371	$5,611,514	$10,300,000
	All payment sources	$2,371,813	$9,385,857	$3,496,931	$15,254,601	$28,000,000

(1) Source: All-Payers, All Claims Database[9]

Analysis of local $PM_{2.5}$ and ozone conditions

The EPA sets National Ambient Air Quality Standards (NAAQS) Rules to regulate $PM_{2.5}$ and ozone.[9] These are provided below. Routinely exceeding the NAAQS will result in regulatory action including mandated completion of attainment plans.

Current U.S. EPA NAAQS for NOx, ozone and PM

Pollutant [final rule cite]	Primary/ secondary	Averaging time	Level	Form
Ozone [73 FR 16436, Mar 27, 2008]	Primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution $PM_{2.5}$ Dec 14, 2012	Primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
	Secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
	Primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years

Source: www.epa.gov/air/criteria.html 8/23/13

[9] It is important to consider that NAAQS are routinely revised and almost always become more stringent as scientific evidence builds. For instance, the Federal Clean Air Science Advisory Committee reviewing evidence before the 2008 EPA NAAQS rule of 0.075 ppm recommended a standard in the 0.060-0.070 ppm range. The court has upheld the 0.075 ppm rule, but most health experts would lower the standard to 0.060 ppm or below. The EU has a non-binding rule of no more than 25 days at or above 0.060 ppm; UK rules suggest levels below 0.050 ppm all but 10 days of the year.

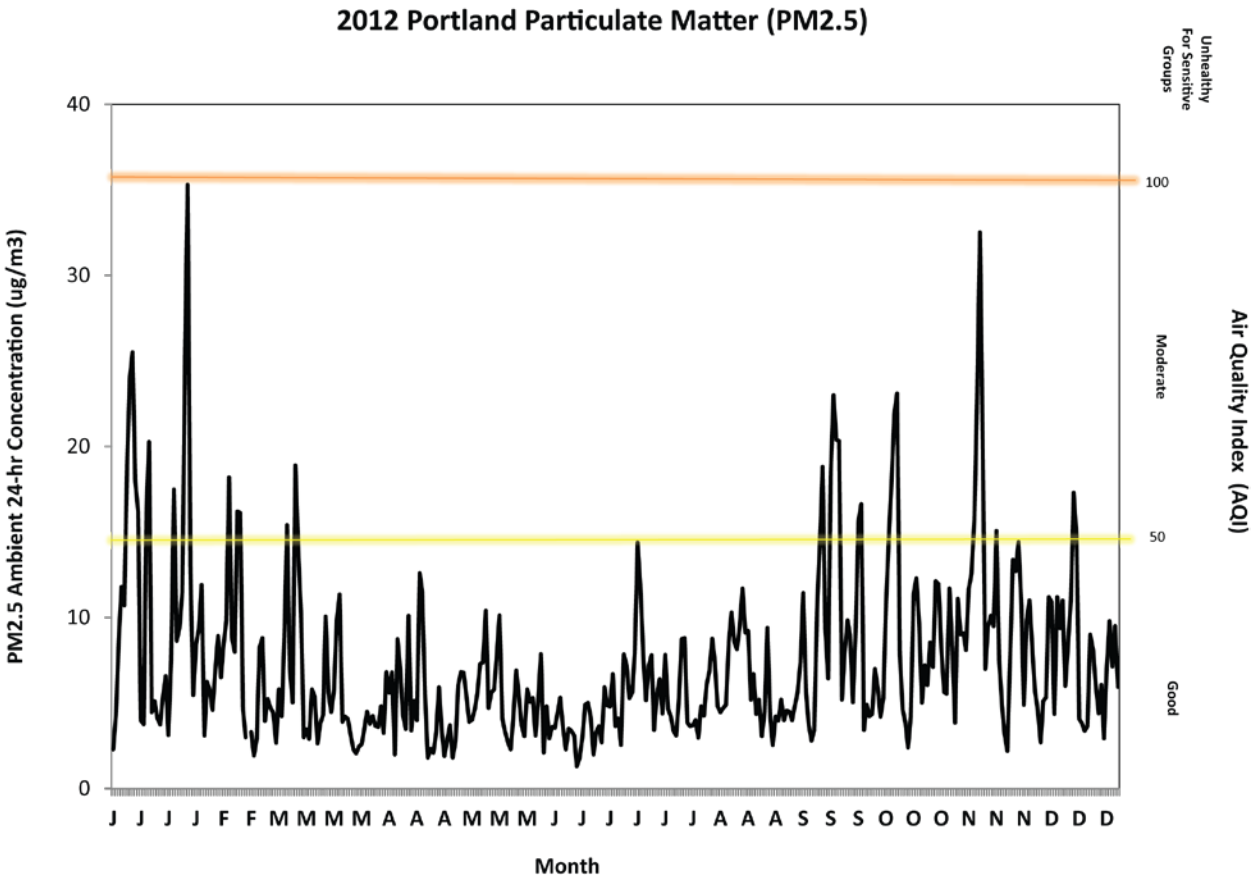
In general, the Portland metropolitan area is well within attainment. The yearly average of $PM_{2.5}$ has ranged between 6.3 and 9.8 $\mu g/m^3$ over the past decade. A yearly average of 2012 day-time ozone levels is approximately 0.033 ppm. While these levels are within attainment, this chronic exposure results in long-term illness and death.

The CDC's National Environmental Health Tracking [90] program provides county-specific estimates of mortality reduction in all-cause and coronary heart disease death associated with chronic exposure to $PM_{2.5}$. This tool estimates that a 10% reduction in $PM_{2.5}$ from 2009 levels (yearly mean = 7.8 $\mu g/m^3$) would result in a 0.5% decrease in all-cause mortality and a 2.2% decrease in cardiovascular mortality. This is the equivalent of 57 annual deaths, 31 of them from coronary heart disease, in the three-county Portland region [90]. Another highly influential and cited study found that every 10 ppb increase in ozone results in a 1.040 (1.013–1.067) relative risk of respiratory death even after controlling for $PM_{2.5}$ effects [73].

Another recent study used the epidemiological evidence to estimate sector-specific deaths attributed to long-term exposure to $PM_{2.5}$ and ozone. Oregon-specific mortality rates were estimated. According to this study, road transportation-related $PM_{2.5}$ — including both heavy duty diesel and light duty vehicles — causes more than 108 cardiovascular and lung cancer deaths and ozone causes more than 15 premature respiratory deaths within the UGB each year [87].

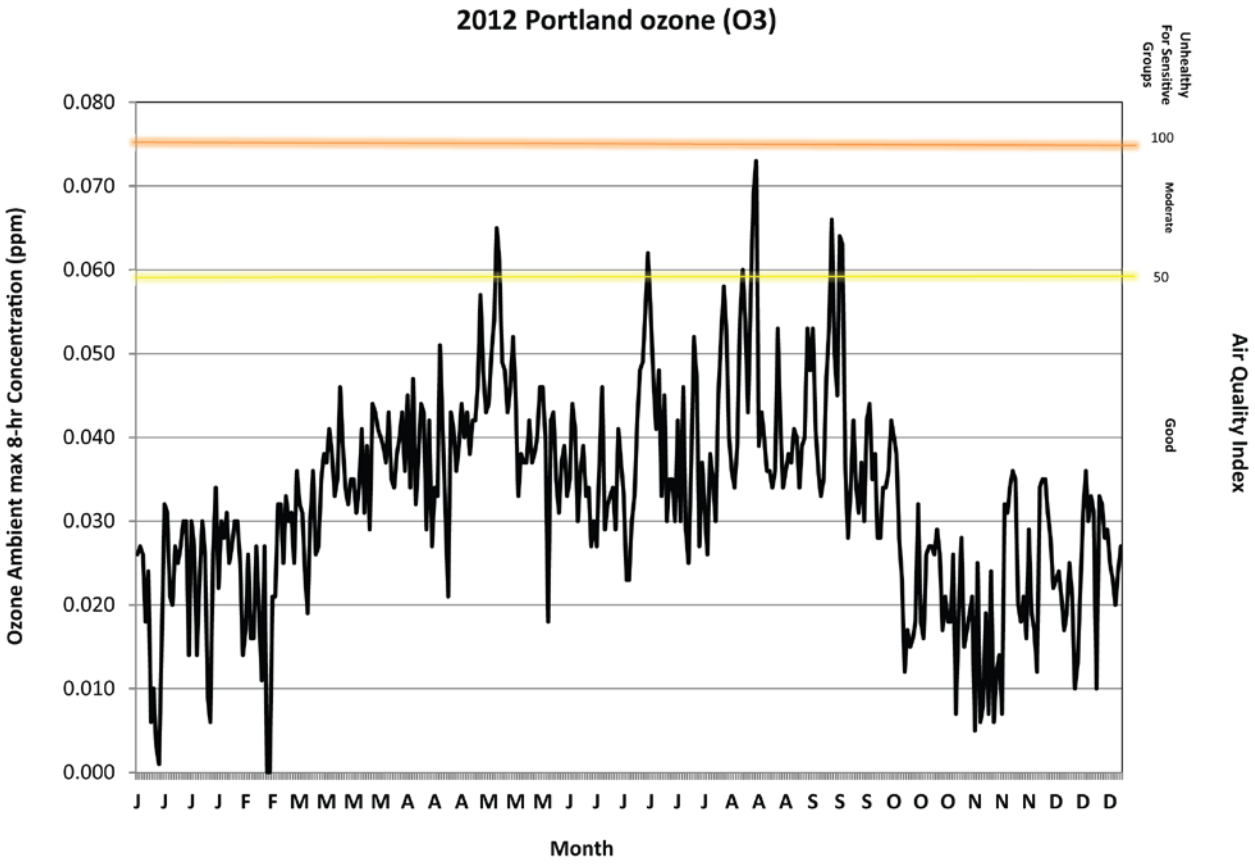
The NAAQS for $PM_{2.5}$ and ozone also help protect against acute health effects associated with high short-term exposure. The EPA has also developed an Air Quality Index (AQI) as a public communication tool to advise when air quality is poor enough to warrant behavior modification. AQIs are forecasted using meteorological data to predict when weather patterns will result in short term spikes in $PM_{2.5}$ (winter inversion layers) and ozone (hot summer days).

The graphs below provide daily maximum 24-hour $PM_{2.5}$ and 8-hour ozone averages and the associated AQI as recorded in the southeast Portland metropolitan region in 2012. The region is NAAQS compliant because there are few, if any, short-term spikes of $PM_{2.5}$ above 35 $\mu g/m^3$ or ozone above 0.075 ppm.



Source: Oregon DEQ, 2012

The AQI categories suggest that any value below 50 is 'good' for public health and values between 50 and 100 are only of 'moderate' concern. However, the public health literature increasingly suggests that all levels of $PM_{2.5}$ and ozone are of concern. There is no level at which $PM_{2.5}$ does not affect health. It is also widely recognized that any threshold for which ozone does not degrade health "is likely to lie below 0.045 ppm" and may be lower than even 0.035 ppm [71]. Warmer summers from weather events and climate change may result in even higher ozone levels.



Source: Oregon DEQ, 2012

Short-term AQI levels between 50 and 100 produce measurable impacts in cardiovascular and respiratory illness and death. These short-term air-quality 'episodes' may be weather-driven, but are still of great public health concern, particularly for vulnerable populations including those with high cardiovascular or respiratory risks and populations exposed to higher localized concentrations near busy roads and highways.

To understand the impact of short-term, acute exposure in the moderate AQI range, we considered the impact of $PM_{2.5}$ episodes[10] on one high-severity endpoint: death from a heart attack. A day or even hours of elevated $PM_{2.5}$ exposure can trigger a heart attack in populations with underlying heart disease risk factors. In 2012, the region recorded five $PM_{2.5}$ episodes where concentrations were well above 20 $\mu g/m^3$ for multiple days. For an area of 1.5 million people, every three-day $PM_{2.5}$ episode results in approximately one premature cardiovascular death triggered by a heart attack.[11] In the U.S., 15.2% of

[10] Defined as multiple days with $PM_{2.5}$>15 µg/m3 with at least one of the days >20 $\mu g/m^3$.

[11] The American Heart Association (Brook et al, 2010) states that every day with a 10 $\mu g/m^3$ increase in $PM_{2.5}$ results in a one day lag of one premature cardiovascular death per 5 million people.

heart attacks result in death within 30 days [91]. In 2012, the Portland region likely experienced approximately 30 preventable heart attacks, five resulting in death, due to elevated exposure during $PM_{2.5}$ episodes.

A comparable exercise could be carried out for other cardiovascular endpoints for $PM_{2.5}$ episodes. Additional analysis would also tell a similar story for respiratory conditions such as asthma during ozone episodes. For example, a recent study of 1.2 million children under age six in New York State found the risk of respiratory and asthma hospitalization increased by 22% for every 0.001 ppm increase in mean ozone during the warm season and 68% on days with ozone was greater than 0.070 ppm even after controlling for 13 socio-economic, familial and weather variables [92].

Air toxics

Air toxics refer to the suite of pollutants in the air from a variety of sources, including industrial processes, transportation and wood burning stoves. This section briefly summarizes the 2012 Oregon Department of Environmental Quality (DEQ) Portland Air Toxics Solutions (PATS) report and effort and focuses on air toxics most associated with light-duty cars and trucks [75]. The table below lists the pollutants associated with light duty vehicles. It also lists possible health effects including EPA's cancer risk classification and the toxicological evidence.

Onroad mobile air toxic pollutants and health effects

Pollutant	Health effects	Toxicological evidence - animal (A) or human (H)
Acrolein	General respiratory congestion; eye, nose, and throat irritation	A, H
Arsenic	Known (Class A) human carcinogen (lung); irritation of skin and mucous membranes	A, H
Benzene	Known (Class A) human carcinogen (leukemia); anemia, blood disorders, immune system damage	A, H
1,3-Butadiene	Probable human carcinogen (leukemia); cardiovascular disease	H
Chromium VI	Known (Class A) human carcinogen (lung); respiratory tract damage and disease	H
Ethyl benzene	Respiratory irritation, central nervous system	A
Formaldehyde	Probable (Class B1) human carcinogen (lung & nasal); respiratory irritation	H
Naphthalene	Possible (Class C) human carcinogen; eye and retina damage	A, H
Polycyclic aromatic hydrocarbons (PAH)	Varies depending on compound; 7 are probable (Class B2) carcinogens	

Inorganic arsenic, benzene, and chromium IV are all listed as Class A, known carcinogens. 1,3-Butadiene, a probable human carcinogen, is highly attributable to light-duty vehicle exposure. Epidemiological studies have shown arsenic and chromium increase the risk of lung cancer. Similar studies have shown that benzene increases the risk of blood disorders including leukemia. 1,3-Butadiene also increases the risk of leukemia and may increase cardiovascular effects. The EPA lifetime carcinogenic unit risks for each pollutant are shown below.

Lifetime carcinogenic risk for inhaled exposure

Pollutant	Primary cancer type	Unit risk
1, 3-Butadiene	Leukemia	3E-3 per µg/m^3 (0.08 per ppm)
Arsenic	Lung	4.3E-3 per 1 µg/m^3 (1)
Benzene	Leukemia, primarily acute myeloid	2.2E-6 to 7.8E-6 per 1 µg/m^3
Chromium VI	Lung	1.2E-2 per 1 µg/m^3

Source: www.epa.gov/iris/

(1) may increase in >2 µg/m^3 exposure settings

Current conditions

Oregon has adopted ambient benchmarks significantly lower than the lifetime carcinogenic risk in an effort to reduce health risks. (See www.deq.state.or.us/aq/toxics/docs/abcRuleFinal.pdf.) These

benchmarks are meant to protect the public — including more sensitive groups such as the elderly and children — from health outcomes beyond cancer.

Oregon's Department of Environmental Quality (DEQ) monitors air toxics within the Metro region. DEQ recently modeled expected pollutant levels in 2017 for 19 pollutants and compared the results to benchmarks. Select results of this modeling exercise are provided in the table below.

Air toxics in the Portland metropolitan region

Pollutant	Current levels	Oregon benchmark		Modeled 2017 (1)	
	µg/m^3	µg/m^3	% Reduction	% Attributable to onroad mobile	% Attributable to light duty
Acrolein	0.131	0.02	84.7%	3	1.9
Arsenic	0.000558	0.0002	64.2%	28	10.1
Benzene	0.956	0.13	86.4%	13	12.4
1,3-Butadiene	0.249	0.03	88.0%	64	56.3
Chromium VI	0.000107	0.00008	25.2%	59	54.9
Diesel pm	1.117	0.1	91.0%	16	0
Ethyl benzene	0.631	0.4	36.6%	32	30.4
Formaldehyde	0.667	0.077	88.5%	8	5.0
Naphthalene	0.159	0.03	81.1%	10	6.2
Polycyclic aromatic hydrocarbons (PAH)	0.018	0.0009	95.0%	10	2.8-6.2

(1) Oregon DEQ (2011) Air Toxics Pollutant Summaries. 6/2/11.

Metro's Climate Smart Communities Scenarios Project is focused on light-duty vehicles. Significant reductions in vehicle miles traveled and gasoline fuel consumption are expected to help reduce air toxic pollutants with large portions attributed to light-duty, gasoline vehicles. These pollutants include a suite of 15 PAHs (2.8–6.2%), arsenic (10.1%), benzene (12.4%), ethyl benzene (30.4%), chromium VI (54.9%), and 1,3 butadiene (56.3%).

The scenarios under consideration are projected to reduce GHG emissions by 12, 24 and 36% respectively. The corresponding estimated decrease in $PM_{2.5}$ is 2.8, 3.2 and 3.5%. It is beyond the scope of this analysis to determine how individual air toxic pollutants will change under the scenarios given the limitations of ODOT's GreenSTEP model and the ITHIM methodology. Air toxics should decrease by at least the amount projected for $PM_{2.5}$ and may follow a trajectory closer to the GHG reduction targets depending on the pollutant. Further analysis would be needed to determine how the preferred alternative aligns with Oregon adopted ambient benchmark concentrations for the pollutants monitored under PATS.

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Oregon Health Authority
PUBLIC HEALTH DIVISON
Environmental Public Health
Center for Prevention and Health Promotion

OHA 8613 (03/14)

4/01/14cw-05

From: Bob Stacey
Sent: Friday, March 28, 2014 3:28 PM
To: Craig Dirksen; Carlotta Collette; Shirley Craddick; Tom Hughes
Cc: Andy Cotugno; Elissa Gertler; John Williams; Tom Kloster; John Mermin; Ramona Perrault
Subject: REVISED CRC RTP description

Colleagues,

Andy Cotugno has already forwarded to you his much improved version of my original proposal to amend the CRC language in the RTP.

In addition, Andy points out that to keep the 2014 RTP on schedule, JPACT needs to hear about this proposed amendment at its April 11 meeting so that it can make an informed recommendation on it at the May JPACT meeting. JPACT Chair Craig Dirksen has agreed to put the amendment on the April 11 agenda for introduction of the concept.

I will brief Neil McFarlane on Monday about the proposed amendment and discuss it with Matt Garrett on Tuesday. I will brief the Council on those conversations at our Tuesday work session, and will seek the Council's "thumbs up" to proceed with this course.

Thanks for your thoughtful consideration of this concept already, and please let me know if I can clarify any part of it. I have resent Andy's version to you with this message.

Thanks,
Bob

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From: Andy Cotugno
Sent: Friday, March 28, 2014 2:51 PM
To: Bob Stacey; Metro Councilors; Council Office Staff; Martha Bennett; Elissa Gertler; John Williams; Tom Kloster; John Mermin; Randy Tucker
Subject: RE: CRC/RTP

Attached is a revised version of Councilor Stacey's proposed CRC amendment, starting on page 5-19. It does several things:

- It retains the current CRC project in the RTP
- It itemizes the various project elements
- It defines the Phase 1 "Oregon led" project as the scope to be included in the financially constrained RTP and defers the remainder to the full but unfunded section of the RTP
- It calls for consideration of project elements that can proceed to do so and not wait until the full project is built
- It defines key functions that the project is intended to address and calls for consideration of alternative approaches to accomplishing those functions to be included in the RTP as a future amendment; these could be small incremental projects that are added to the RTP or a full scale substitute for what is currently in the RTP if a substitute is agreed aupon.

Andy C.

- East Metro Connections Plan (Gresham/Fairview/Wood Village/Troutdale to Damascus – Mobility Corridor #15)
- TV Highway Corridor Plan (Beaverton to Forest Grove - Mobility Corridor #24)

5.3.2.1 ~~Columbia River Crossing Project (~~Mobility Corridor #1 – Portland Center City to Clark County~~)~~

This heavily traveled route is the main connection between Portland and Vancouver. In addition to providing access between the two states, it is a very significant access route to major freight terminals, including Port of Portland terminals in the Rivergate District, Port of Vancouver, air cargo terminals at PDX, truck terminals along Columbia Blvd., on Swan Island and below the Fremont Bridge at the UPSP rail yards.

The Metro Council ~~has~~ approved a Locally Preferred Alternative for the Columbia River Crossing Project (CRC)) in 2011 which has been approved by key federal agencies including approval of a Record of Decision by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The scope of the approved CRC project included in the Record of Decision and this RTP includes the following elements:

1. Removal and replacement of the existing lift span bridges with a new set of bridges of sufficient height to avoid a lift span constructed to current seismic standards;
2. Provision of three through lanes each direction on the replacement bridges plus two auxiliary lanes each direction to accommodate travel demand and to more safely provide for the large volume of merging and weaving traffic through the many interchanges approaching the bridges;
3. Reconstruction of the interchanges at Marine Drive, on Hayden Island in Oregon and in Washington at SR 14, Mill Plain Blvd., Fourth Plain Blvd. and to/from SR 500;
4. Implementation of tolls as both a financing mechanism and a demand management tool through the use of peak period pricing;
5. Extension of light rail transit from its current terminus at the Expo Center, across the Portland Harbor to a station on Hayden Island and then across the Columbia River on the lower deck of the new southbound bridge, then through downtown Vancouver, WA to a park-and-ride terminus near Clark College;
6. Improvement to and construction of new local access streets in the vicinity of the Marine Drive and Hayden Island interchanges, both to provide access to I-5 and provide alternate routes around the I-5 interchanges, including:
    a. Extension of North Expo Road adjacent to the Expo Light Rail Station and across a new local access bridge (shared with the Light Rail bridge across the Portland Harbor) and connecting into the local streets on Hayden Island;
    b. Reconstruction and realignment of North Expo Road along the south side of the Expo Center to Force Avenue;
    c. Reconstruction of North Vancouver Way and North Union Court and reconfiguration of their connections to NE Martin Luther King Blvd.;

d. Connection of North Marine Drive and North Vancouver Way under I-5 to the North Expo Road extension to the new Portland Harbor local access bridge;
e. Reconstruction of North Hayden Island Drive and North Jantzen Avenue on Hayden Island consistent with changes to the Hayden Island interchange;

7. Construction of new bicycle and pedestrian facilities providing connections to Delta Park, the Bridgeton Trail, the Marine Drive Trail, Hayden Island and across the Columbia River on the lower deck of the new northbound bridge.

~~. It creates a multi-modal solution for the Interstate 5 corridor between Oregon and Washington to address the movement of people and freight across the Columbia River. A replacement bridge with three through lanes in each direction, reconstructed interchanges, tolls priced to manage travel demand as well as provide financing of the project construction, operation and maintenance, light rail transit to Vancouver, and bicycle and pedestrian investments have been identified for this corridor.~~

Included in this RTP within the Federal RTP (which is fiscally constrained) is the scope of the phased Oregon led project which could be implemented with funding that can reasonably be expected within the 2040 horizon of the plan. Included within the full RTP Investment Strategy (to address state requirements to define needed transportation improvements to support the region's adopted land use vision) is the full project defined in the Record of Decision including deferred project elements beyond funding that can reasonably be expected. Key elements of the scope not in the Federal (fiscally constrained) RTP but reflected in the full RTP Investment Strategy are:

1. The reconstructed interchanges at Mill Plain Blvd., Fourth Plain Blvd. and to/from SR 500 (which would be tied to a funding commitment from the Washington Legislature).
2. Phase 2 of the Hayden Island interchange, incorporating the split diamond design; and
3. Phase 2 of the Marine Drive interchange adding a flyover ramp for the eastbound to northbound movement and a braided ramp between the Marine Drive southbound on-ramp and the I-5 off-ramp to Victory Blvd.

Although the Columbia River Crossing project is included in this RTP, ODOT has deferred the project at the direction of the Governor of Oregon after the failure of the Washington Legislature to approve funding for the project. While the Oregon Legislature did approve funding for the interchanges and local street improvements on the Oregon side of the river and ODOT completed an investment grade toll revenue analysis demonstrating the bridge itself could be funded through tolls and the Federal Transit Administration has recommended funding for the Light Rail extension to Clark College in its FY 2015 Annual Report on Funding Recommendations for the Capital Investment Grant Program (New Starts, Core Capacity, Small Starts), the Oregon Legislature was unwilling to proceed with an Oregon led first phase project without the full support and participation of Washington.

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Because of the size and cost of the Columbia River Crossing project and the uncertainty of timing, the region should pursue incremental implementation of smaller scale project elements of the preferred alternative (described above and defined in the Record of Decision). These early phases should be undertaken to address selected aspects of the full project based upon funding availability.

They should be project elements that have current independent utility while being compatible with eventual implementation of future phases of the project. Since these project elements are reflected in this RTP and the prospect of multiple phasing possibilities was acknowledged in the Final Environmental Impact Statement, early phases of the preferred alternative could be implemented without the need for an RTP amendment.

In addition, the region should evaluate and consider lower cost substitute project elements that accomplish the needed functions the Columbia River Crossing project is intended to provide. As agreement is reached, these projects could be added as amendments to this 2014 RTP or included in the next 2018 RTP Update. If there is agreement to individual functions and projects, they could be amended into the RTP to supplement the Columbia River Crossing preferred alternative. Further, if there is agreement to a full substitute project, it could be amended into the RTP to replace the current Columbia River Crossing preferred alternative.

Columbia River Crossing intended functions and associated alternative project descriptions to evaluate and consider:

1. Travel demand: Provide sufficient multi-modal capacity across the Columbia River to serve the growing demand through alternate bridge configurations.
2. Seismic response and recovery route across the Columbia River: Identify the most cost-effective way to provide emergency and recovery transport over the river in the aftermath of a major subduction earthquake.
3. Freight mobility: Improve freight movement to and from the numerous marine, rail and truck terminals in the area, with particular focus on the Marine Drive and Columbia boulevard connections to I-5.
4. Safety: Improve the interface between the freeway and the closely spaced interchanges to safely accommodate merging and weaving.
5. Congestion management: Develop a congestion pricing program or other demand management approach to maintain efficient traffic flow on I-5 and parallel and connecting highways.
6. Efficient interaction of highway and river traffic: Limit bridge lifts on the I-5 bridges and eliminate them during and between daytime peak periods. Consider public participation in funding improvements to the BNSF rail bridge to reduce the number of I-5 bridge lifts, as well as a new operating agreement with the Coast Guard, as parts of this strategy.
7. High Capacity Transit: Develop a bi-state strategy for extending high capacity transit to the Vancouver, Washington regional center. Give consideration to light rail, commuter rail, and bus rapid transit alternatives.
8. Serve Hayden Island neighborhoods: Extend high capacity transit, high quality bicycle and pedestrian access, and local traffic access from mainland Portland to Hayden Island, in a way that permits closure of the Hayden Island interchange on I-5. Identify strategies for providing local vehicle traffic and active transportation access from the island to downtown Vancouver, potentially as part of the bi-state high capacity transit strategy.

More generally in Mobility Corridor #1 – Portland City Center to Clark County ~~the I-5 corridor~~, the Portland Metro region should:

- Consider the potential adverse human health impacts related to ~~the~~ projects and existing human health impacts in the project area, including community enhancement projects to address environmental justice
- Consider managed lanes
- Maintain an acceptable level of access to the central city from Portland neighborhoods and Clark County
- Maintain off-peak freight mobility, especially to numerous marine, rail and truck terminals in the area
- Consider new arterial connections for freight access between Highway 30, port terminals in Portland and port facilities in Vancouver, Washington
- Maintain an acceptable level of access to freight intermodal facilities and to the Northeast Portland Highway
- Address freight rail network needs
- Develop actions to reduce through-traffic on MLK and Interstate to allow main street redevelopment
- Inform and coordinate with the Regional Transportation Council (RTC) and the Bi-State Coordination Committee prior to JPACT and Metro Council consideration of projects that have bi-state significance

5.3.2.2 Sunrise Project and Sunrise Jobs and Transportation Act Project (Mobility Corridor #12 -Clackamas to Rock Creek Junction and Mobility Corridor #13 – Rock Creek Junction to US 26))

In July 2009, the Sunrise Project's Policy Review Committee (PRC) selected a Preferred Alternative,shown in Figure 5.2. The Preferred Alternative is Alternative 2 as studied in the SDEIS with Design Options C-2 and D-3 and a portion of Design Option A-2 (Tolbert Overcrossing).

The Federal Highway Administration (FHA), the Oregon Department of Transportation (ODOT), and Clackamas County have completed the Final Environmental Impact Statement (FEIS) for the Sunrise Project. On February 22, 2011, the FHA signed a Record of Decision (ROD) that approves the $1.4 billion Sunrise Corridor Preferred Alternative. The Sunrise Project mainline is an approximately five-mile, east-west oriented, limited-access highway from I-205 to the Rock Creek Junction in Clackamas County.

A detailed description of the Sunrise Project Preferred Alternative is included in Appendix X.X. The RTP includes some phases of the projects in the preferred alternative and updates **Figures 2.5 and 2.7.**

The purpose of the Sunrise Jobs and Transportation Act (JTA) Project is to address congestion and safety problems in the OR 212/224 corridor by building a new 2.5 mile road from I-205 to 122nd Avenue (as part of the larger Sunrise Project mainline) and improving local roadway connections to Oregon Jobs and Transportation Act (JTA) to fund this first phase of the larger Sunrise Corridor Preferred Alternative.