Oregon Transportation Benefit-Cost Analysis
Mode-Based Benefit-Cost Analysis Calculator
PART 3 – Mode-Based BCA Calculator Technical Documentation

Final Report
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Abstract

This document is **Part 3 of the Oregon Transportation Benefit-Cost Analysis - Mode-Based Benefit-Cost Analysis Calculator.** This technical documentation summarizes how the simplified mode-based BCA calculator (OR Transportation BCA – Mode-Based BCA Calculator v1.0) operates, the assumptions and the exclusions embedded in the calculator, and how the main default parameters were constructed. Detailed methodological guidance and bibliographies can be found in the companion documents – Part 1 - Literature and Best Practices Review and Part 2 – BCA Framework.

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1 Introduction

Benefit-cost analysis (BCA) helps determine whether its expected benefits outweigh its costs. Building on a review of the literature and best practices and the Oregon Transportation BCA Framework, the project team developed the Mode-Based BCA Calculator to make this analysis more accessible. The calculator is designed to simplify the BCA process and reduce the amount of information and technical knowledge users need. Users can enter expected annual changes in automobile, transit, walking, and cycling miles to estimate transportation benefits. Using built-in assumptions and Oregon-specific data, the calculator estimates benefits related to travel time, safety, vehicle operating costs, emissions, health, and noise. It also supports calculating equity-focused benefits based on an income-based weighting approach. Users can also compare benefits with project costs and examine how results change under different assumptions. This technical documentation guides users through the required inputs, available default values, calculation methods, and interpretation of results. It also explains the assumptions and limitations of the simplified calculations and identifies when additional analysis may be needed.

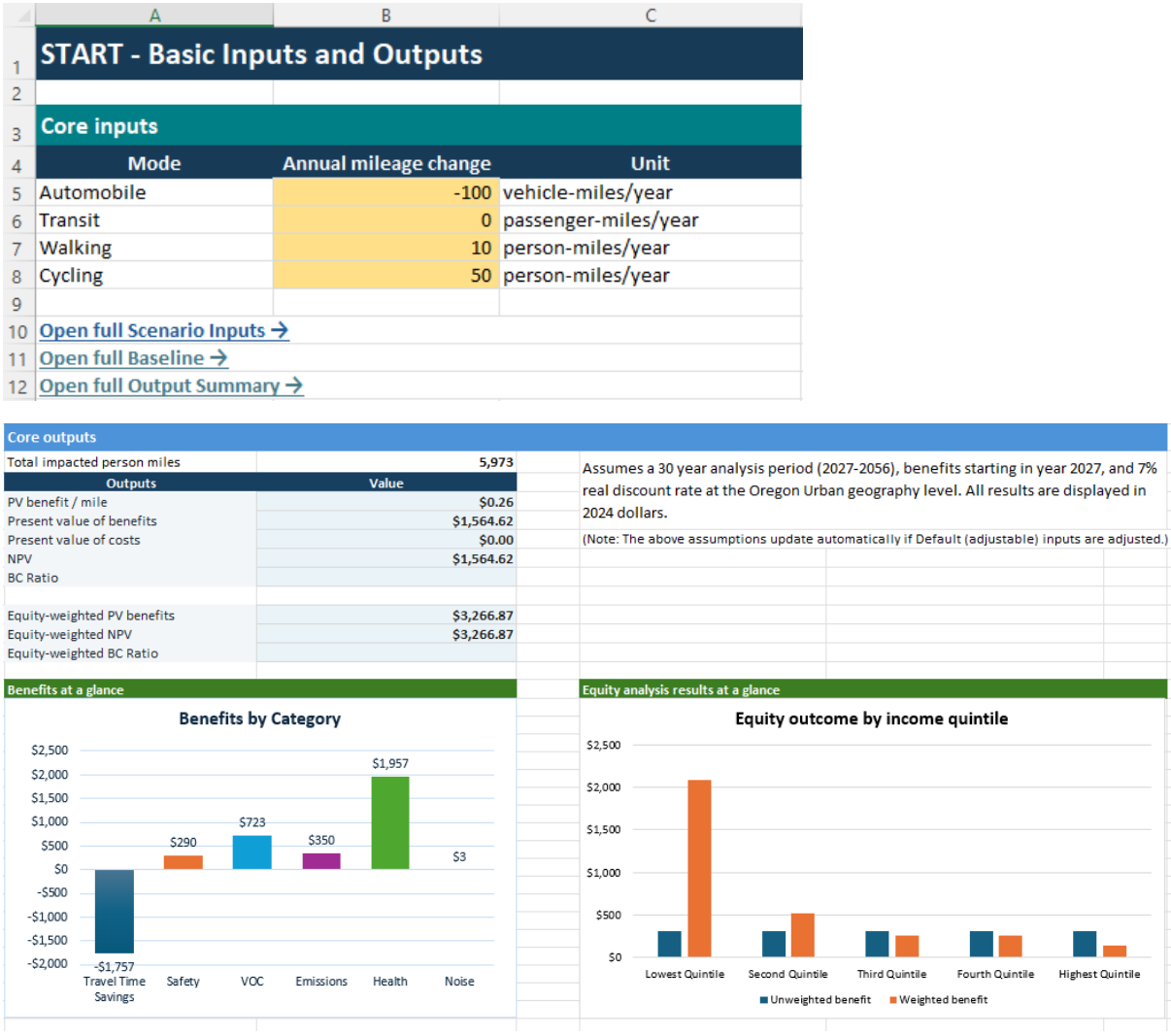
2 Calculator Structure

The following table describes the tabs that make up the calculator file.

Calculator tabs	Role
Read Me	Overview, structure of calculator and calculator legend
START	Core inputs and analysis results; equity analysis at a glance and benefits by category at a glance
Scenario Inputs	Central user-input interface for core settings, annual mileage changes, total PV net cost, benefit-specific controls, equity settings, and sensitivity test values.
Output Summary	Concise reporting of scenario inputs, baseline parameters, core economic results, benefit categories, equity results, sensitivity results, affected-mile measures, and visual summaries.
Baseline	Dollar year, opening year, analysis period, realization profile, growth assumption, and discounting timeline.
Parameter Library	Reusable Oregon-specific or adopted defaults used by the automated calculations.
Travel Time Savings; Safety; VOC; Emissions; Health; Noise	Benefit-specific calculation tabs that convert scenario mileage changes and selected settings into annual and present-value benefits.
Equity Welfare	Welfare weighting using income groups and elasticity values.
Sensitivity	One-at-a-time tests for discount rate, analysis period, and aggregate benefits.

Table 1 – Oregon Mode-Based BCA Calculator structure

3 Inputs, Outputs and Calculation Flow



START - Basic Inputs and Outputs

Core inputs

Mode	Annual mileage change	Unit
Automobile	-100	vehicle-miles/year
Transit	0	passenger-miles/year
Walking	10	person-miles/year
Cycling	50	person-miles/year

Open full Scenario Inputs →
Open full Baseline →
Open full Output Summary →

Core outputs

Total impacted person miles 5,973

Outputs	Value
PV benefit / mile	$0.26
Present value of benefits	$1,564.62
Present value of costs	$0.00
NPV	$1,564.62
BC Ratio	
Equity-weighted PV benefits	$3,266.87
Equity-weighted NPV	$3,266.87
Equity-weighted BC Ratio	

Assumes a 30 year analysis period (2027-2056), benefits starting in year 2027, and 7% real discount rate at the Oregon Urban geography level. All results are displayed in 2024 dollars.

(Note: The above assumptions update automatically if Default (adjustable) inputs are adjusted.)

Benefits at a glance

Equity analysis results at a glance

Figure 1 - BCA Calculator START tab screenshot

The Oregon Mode-Based BCA Calculator in its simplest form starts with the Read Me and START tabs. Within the START tab (see Figure 1 above), users must enter at least one value (which may be positive or negative) in the Core Inputs section to indicate annual mileage change for automobile, transit, walking or cycling travel in the scenario being analyzed.

The example screenshot above shows annual changes of -100 vehicle miles travelled using automobiles, 10 person miles by walking and 50 person miles by cycling, and the resulting Core Outputs show the benefit-cost analysis (BCA) results, assuming a 30 year analysis period (2027-2056) with benefits starting in year 2027, and a 7% real discount rate at the Oregon Statewide geography level. These results are displayed in 2024 dollars. The Benefits by Category graph shows how the resulting benefits are distributed across the Travel Time Savings, Safety, VOC

(Vehicle Operating Cost), Emissions, Health and Noise categories. The Equity outcome by Income Quintile graph compares the distribution of these total benefits across income quintiles in Oregon where benefits are unweighted versus where benefits are weighted using the welfare-weighting approach. The default assumption is that the changes in annual mileage (and the resulting benefits) are evenly spread across the statewide population, but these can be adjusted within the calculator tool. These inputs, default values and assumptions are documented in more detail in the following sections, and may be adjusted as necessary.

3.1 Scenario Inputs and input conventions

Scenario Inputs is the primary interface for scenario-specific entries. Reusable assumptions should remain in Baseline or the Parameter Library. To make the calculator easier to interpret, user inputs are divided into three types based on whether a value is already supplied and whether it is necessary for a complete calculation.

Input type	Description	Corresponding items
Input Required	A user must explicitly provide or confirm a value. The default value of 0 means no annual mileage change for that mode.	Annual mileage changes for Automobile, Transit, Walking, and Cycling
Default (adjustable)	A default is provided and the calculator can run without any adjustments. A user may adjust the value when a documented scenario-specific choice is more appropriate.	Primary real discount rate; Analysis period; Geography; Equity analysis required
Input Optional	Used only when the associated benefit or analysis requires scenario-specific adjustments. Existing defaults may be retained, and unused fields may remain unchanged or blank as appropriate.	Total PV net cost; All sections beginning with Travel Time Savings controls, including Safety/VOC/Noise controls, Emission controls, Equity analysis controls, and Sensitivity controls

Table 2 - Scenario Inputs

3.2 Core Required Inputs

Mileage inputs should be entered as steady-state annual changes (the difference between the scenario being analyzed and the baseline), not cumulative totals over the analysis period. These values may be left as the default 0 when no change is expected; a negative value indicates an annual decrease in the number of miles for that mode, while a positive value indicates an annual increase.

Mode	Input unit	How it is used
Automobile	vehicle-miles/year	Used directly to estimate Safety, VOC, Emissions, and Noise benefits. Converted to person-miles with occupancy rates when TTS or multimodal affected-person-mile reporting requires a common user-travel basis.
Transit	passenger-miles/year	Represents passenger travel, and not transit vehicle service-miles. It is used to estimate transit operating-cost changes in VOC and converted to transit travel time for TTS.
Walking	person-miles/year	Used in TTS and converted to trips for Health using average trip length.
Cycling	person-miles/year	Used in TTS and converted to trips for Health using average trip length.

Table 3 - Core Required Inputs

3.3 Default (adjustable) Inputs

Default (adjustable) inputs should be changed only when the associated benefit or analysis applies and a different value or classification is supported by the scenario. Otherwise, the calculator default may be retained.

Variable	Default Value	Adjustable Choices	Sensitivity Analysis Value(s)
Primary real discount rate	7%	Fully adjustable	3%
Analysis period	30 years	Fully adjustable	20 years
Geography	Statewide	Urban; Rural	-
Equity Analysis	Yes	No	See Equity controls below
Travel Time Savings controls			
Travel scope	Local	Intercity	
Travel purpose	All purposes	Personal; Business	
Safety, VOC and Noise controls			
Facility type	Interstate	Other state highway; Off system	
VOC vehicle type	Passenger vehicle	Motorcycle; Truck	
Noise vehicle type	Automobile	Pickups and vans	
Emission controls			
Include CO2e?	Yes	No	
Social Cost of Carbon case	Reference 2.0%	2.5% case; 1.5% case	
Equity controls			
Primary elasticity	1.4	Fully adjustable	
Lower elasticity	1.0	Fully adjustable	
Higher elasticity	1.8	Fully adjustable	
Income basis	Calculator default	Scenario-specific input (see Optional Inputs section below)	
Distribution method	Equal	Selected quintile	
Allocation treatment	2 lowest quintiles selected	Choose income quintiles to allocate benefits	
Sensitivity controls			
Discount rate	Yes; 3%	Fully adjustable	
Analysis period	Yes; 20 years	Fully adjustable	
Aggregate benefits	Yes; 80%	Fully adjustable	

Baseline		
Dollar year	2024	Fully adjustable
Analysis start year	2024	Fully adjustable
Open/Implementation year	2027	Fully adjustable
Real annual benefit growth	0%	Fully adjustable
First-year benefit realization	80%	Fully adjustable
Second-year benefit realization	90%	Fully adjustable
Full-effect year	100%	Fully adjustable

Table 4 - Default (adjustable) Inputs

3.4 Optional Inputs

Optional inputs provide scenario-specific values when needed, but may be left blank.

- Total PV net cost: Enter the externally calculated present value of net costs when the core metrics such as NPV and BCR are needed. It may be left blank or excluded for benefit-only analysis.
  - The calculator accepts one Total PV net cost in 2024 dollars. Users should first follow the cost estimation procedures outlined in the framework document, including any costs of implementation, operations, residual-value, closeout, or phasing adjustments that are relevant, and then enter the resulting present value into the calculator.
  - Total PV net cost is a required input for a complete BCA. If it is left blank, benefit modules may still calculate because they do not depend on the cost, but cost-dependent summary metrics will be incomplete. In the case of a blank cost, net present value equals the present value of the total benefits, and the benefit-cost ratio is not calculated. Enter 0 only when a true zero net cost is justified; in that case the benefit-cost ratio is undefined because the denominator is zero.
- Travel Time Savings controls: Travel time savings are derived from mileage changes, but users may choose to enter additional time savings by mode or substitute the mileage-derived time savings with direct scenario-based time savings when available.
- Equity analysis controls: Scenario-specific income values across income quintiles may be entered if desired. The calculator has built-in default income quintiles and average incomes for each quintile at statewide, urban and rural levels of geography.

3.5 Equity Analysis and Sensitivity Analyses

Area	Current treatment
Equity	Applies the Welfare-Weighting Standard Approach for equity analysis, with the primary elasticity of the marginal utility of income (*e*) set at 1.4. Sensitivity analysis is conducted using default values of 1.0 and 1.8. The elasticities and income quintiles may be adjusted by the user to capture scenario-specific values. The calculator default is set to apply benefits equally to all the quintiles within the chosen geography (Statewide; Urban; Rural); and may be adjusted in the Scenario Inputs tab.
Sensitivity	One-at-a-time tests hold other assumptions constant while changing one parameter. The default tests compare the 7% primary real discount rate with 3%, the 30-year primary analysis period with 20 years, and 100% aggregate benefits with an 80% aggregate-benefit multiplier. Users may replace these test values when a documented scenario-specific range is more appropriate in the Scenario Inputs tab.

Table 5 - Equity and Sensitivity Analyses

3.6 Calculator Outputs

Core calculator outputs are displayed in the START tab, and are described in Table 6 below. Two summary graphs are displayed in the START tab to show benefits at a glance (Figure 2 left) across Travel Time Savings, Safety, VOC (Vehicle Operating Costs), Emissions, Health and Noise categories; and equity analysis results at a glance (Figure 2 right) to compare between unweighted benefit and weighted benefit distribution across income quintiles, based on inputs, assumptions and defaults in the calculator.

Output	Description
PV benefit / mile	Estimated present value of benefits per person-mile
Present value of benefits	Total present value of benefits
Present value of costs	Total present value of costs
NPV	Net present value = PV of benefits – PV of costs; only calculated when PV of costs is entered
BC Ratio (BCR)	PV of benefits / PV of costs; amount of benefits per dollar of cost; only calculated when PV of costs is entered
Equity-weighted PV benefits	Welfare-weighted estimation of present value of benefits
Equity-weighted NPV	Welfare weighted estimation of NPV
Equity-weighted BC Ratio	Welfare-weighted estimation of BCR; only calculated when PV of costs is entered

Table 6 - Main Calculator Outputs

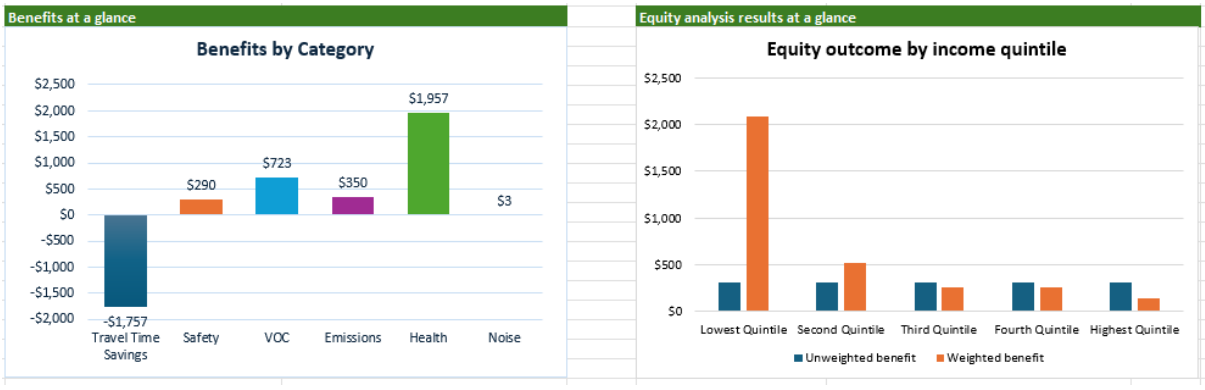


Figure 2 – START tab Benefits and Equity Analysis At-a-Glance sample figures

4 Major Assumptions and Limitations

The calculator applies simplified calculation methods (with simplified inputs) to estimate major benefit categories. The following sections summarize the calculation flow and the principal assumptions or limitations that affect interpretation.

4.1 General Calculation Assumptions

- Annual mileage changes: Mode-specific mileage inputs represent steady-state annual changes (the difference between the scenario being analyzed and the baseline), not cumulative totals over the analysis period.
- Geography: Default geographies include Oregon Statewide, Urban, or Rural. More detailed geographic conditions require scenario-specific inputs or external analysis.

4.2 Automated benefit calculation modules

a. Travel Time Savings
   - Mileage change → Travel time change → VOTT → Travel time benefit
     - Automobile mileage is converted to person travel using vehicle occupancy.
     - Transit mileage is converted to travel time change using an aggregate transit operating speed for Oregon.
     - Active transportation (walking or cycling) mileage is converted to travel time change using Oregon-specific average trip duration (ATD) and average trip length (ATL).
     - Travel time and VOTT are estimated using mode-specific travel characteristics and selected conditions, or direct time-savings inputs when available.

b. Safety
   - Automobile VMT change → Change in crashes → Crash costs → Safety benefit
     - Crash rates and costs are applied by severity, geography, and facility type. The calculator uses the VMT-based method, while project-specific CMF/CRF analysis requires separate calculations.

c. Vehicle Operating Costs
   - Automobile VMT change → Fuel/energy and non-fuel costs → VOC benefit; Transit passenger-mile change → Transit operating-cost change
     - Automobile costs use default fuel shares, fuel economy, and operating costs. Transit costs use average operating costs per passenger-mile rather than marginal costs.

d. Emissions
   - Automobile VMT change → Emission change → Monetary value of emissions → Emissions benefit
     - Criteria pollutants are valued using emission rates and damage costs, while CO2e uses the year-specific Social Cost of Carbon. Transit vehicle emissions are not estimated.

e. Health
   - Walking/cycling mileage change → Active trips → Eligible users/trips → Health benefits
     - Mortality benefits account for age eligibility and shifts from non-active modes. Absenteeism benefits use commuting, employment, sick-day reduction, and wage assumptions.

f. Noise
   - Automobile VMT change → Marginal noise cost per vehicle-mile → Noise benefit
     - Marginal costs are selected by geography and vehicle class. Statewide values use Urban/Rural VMT weighting

4.3 Externally calculated parameters

The Oregon Transportation BCA Framework documents numerous methods that are excluded from this simplified calculator. Exclusion from the automated calculator does not mean that an impact is excluded from the framework. When a scenario has reliable information for a method not implemented in the simplified workbook, the framework method should be applied externally. Any externally calculated value should be documented with its method, source, units, price year, geographic basis, and scenario definition before it is incorporated into final BCA reporting.

5 Parameter Development Approach

The Parameter Library provides consistent default Oregon-specific values. This section summarizes the construction logic, processes and key assumptions for the major parameter families used by the automated modules in this calculator. Data sources are detailed in the Parameter Library tab and ODOT BCA Framework document.

5.1 Travel behavior and conversion parameters

Parameter group	Construction method	Key assumption
Travel pattern	Oregon Travel Survey linked trips are used to calculate trip-purpose shares, mode shares, average trip length and duration, and active commuting patterns, including commute shares and annual trips per worker.	Trip modes and purposes are consistently reclassified. Records with zero survey weights are excluded, and missing or implausible distance and duration values are screened. Refer to the detailed assumptions below this table.
Vehicle occupancy	Oregon Travel Study unlinked trips are used to construct weighted person-trip	Only “Car” and “Car-share” modes are accounted. The trips between

	and vehicle-trip totals.	6-9 AM and 4-7 PM are treated as weekday peak trips; Weekend vehicle occupancy rate is adopted from the USDOT guidance.
Transit operating speed	FTA National Transit Database revenue miles are divided by revenue hours for the applicable Oregon transit aggregation.	Only selected surface transit modes are included, excluding Demand Response, Vanpool, and Aerial Tramway.
Active-trip conversion	Walking and cycling person-miles are divided by average trip length to estimate trips.	Trip lengths are calculated separately for walking and cycling using eligible linked-trip records. Missing or implausible distance observations are screened before calculating weighted averages.

Table 7 – Travel behavior parameter conversions

Oregon Travel Study (2024) processing rules

- Trip length, duration, mode, purpose, and local/intercity classifications use linked-trip records. Vehicle occupancy uses unlinked-trip records.
- Business travel includes only 'Went to work-related activity' and 'Other work-related' in the d_purpose category; Three trip-purpose categories are not included (Not imputable, Loop trip, Missing response). Personal travel includes all other categories.
- Intercity travel is defined as distance_miles greater than or equal to 50 miles.
- Automobile linked trips include SOV, HOV (2 people), and HOV (3+ people); car and car-share records are retained for the applicable automobile mode classification.
- Mode shares are calculated through trip mode reclassification: Auto, Transit-linked, Walk, Bike, Micromobility, Ride-sharing, School bus, Long Distance Passenger, and Other categories, with missing values included in Other.
- Urban/Rural designation is assigned using destination county and the applicable OHSU geographic designation.
- Weighted person trips equal the sum of trip_weight. Weighted vehicle trips equal the sum of trip_weight divided by num_travelers. For non-missing num_travelers, the top-coded value of 5 is treated as five travelers.
- Records with zero trip_weight are excluded from representative weighted averages.

Trip length and duration calculation and quality control

$$\text{Average trip length}_m = \frac{\sum_i \text{Distance}_i \times \text{Weight}_i}{\sum_i \text{Weight}_i}$$

$$\text{Average trip duration}_m = \frac{\sum_i \text{Duration}_i \times \text{Weight}_i}{\sum_i \text{Weight}_i}$$

- Missing distance or duration values are excluded from the corresponding averages. Zero-duration records are not used when valid travel time is required.
- For modes (m), implausible observations are screened, including automobile trips over 411.55 miles and cycling trips with zero duration and distances over 0.5 mile. Flagged records are excluded only when determined to be invalid.
- Vehicle occupancy is calculated as weighted person trips divided by weighted vehicle trips.

5.2 Income, wage, and value-of-time parameters

Household income and income-quintile values are obtained from Census data, while median hourly wages come from BLS Occupational Employment and Wage Statistics (OEWS). Urban/Rural wage estimates are constructed using Oregon employment and geographic information.

Value of Travel Time (VOTT) components are calculated as follows:

$$\text{VOTT}_{\text{personal, local}} = \frac{\text{Median household income}}{2080} \times 50\%$$

$$\text{VOTT}_{\text{personal, intercity}} = \frac{\text{Median household income}}{2080} \times 70\%$$

$$\text{VOTT}_{\text{business}} = \text{Median hourly wage} \times \text{ECEC factor} \times 100\%$$

$$\text{VOTT}_{\text{all}} = \text{VOTT}_{\text{personal}} \times \text{Share}_{\text{personal}} + \text{VOTT}_{\text{business}} \times \text{Share}_{\text{business}}$$

To convert annual mileage changes into person-miles (PM) and person-hours (T), the calculator uses:

$$\Delta\text{PM}_{\text{auto}} = \Delta\text{VMT}_{\text{auto}} \times \text{Occupancy}$$

$$\Delta\text{T}_{\text{auto}} = - \frac{\Delta\text{PM}_{\text{auto}} \times \text{ATD}_{\text{auto}}}{\text{ATL}_m \times 60}$$

$$\Delta\text{T}_{\text{transit}} = - \frac{\Delta\text{PM}_{\text{transit}}}{\text{Transit operating speed}}$$

$$\Delta\text{T}_{\text{active}} = - \frac{\Delta\text{PM}_{\text{active}} \times \text{ATD}_{\text{active}}}{\text{ATL}_{\text{active}} \times 60}$$

- Personal VOTT is based on hourly household income, while business VOTT applies the BLS compensation-to-wage factor.
- All-purpose VOTT combines personal and business values using OTS trip-purpose

shares. The resulting values vary by geography, trip scope, and purpose.

- For active transportation, VOTT is equal to the all-purpose local travel VOTT. This definition assumes that walking and cycling time has the same general opportunity cost as other local travel.

5.3 Safety parameters

Crash rates are derived from the Oregon Traffic Crash Database and corresponding VMT. Crash costs are based on ODOT Benefit Cost Analysis Form values by severity, geography, and facility type.

Crash rates and avoided crashes are calculated as follows:

$$\text{Crash rate}_{s,\,g} = \frac{\text{Annual crashes}_{s,\,g}}{\text{Annual VMT}_{g}}$$

$$\text{Avoided crashes}_{s} = -\,\Delta\text{VMT} \times \frac{\text{Crash rate}_{s}}{1{,}000{,}000}$$

In the calculations, *s* indicates Fatal/Serious, Moderate/Minor Injury, PDO and *g* indicates geographies (statewide, urban, rural). Statewide crash unit value is weighted using number of crashes and costs by geography.

- Statewide crash unit values are calculated using crash-frequency-weighted urban and rural values.

5.4 VOC and fleet parameters

Vehicle fleet shares and fuel economy are constructed from Oregon DMV registration data. Fuel and non-fuel operating costs are based on the applicable resource costs and adopted operating-cost data.

Fleet share, fuel economy, and fuel/non-fuel costs by fuel type and geography are calculated as follows:

$$\text{Fleet share}_{f,\,g} = \frac{\text{Registrations}_{f,\,g}}{\sum_{f \in \{\text{Gas, Diesel, EV}\}} \text{Registrations}_{f,\,g}}$$

$$\text{Fuel economy}_{f,\,g} = \frac{\sum \text{Registrations}_{f,\,g} \times \text{average MPGe}_{f,\,g}}{\sum \text{Registrations}_{f,\,g}}$$

Fuel cost = Retail price - Federal tax - State tax - Local tax

Non-Fuel cost = Annual depreciation/15,000 + Maintenance/Repair/Tire cost

$$\text{Transit operating cost} = \frac{\sum \text{Operating expenses}_m}{\sum \text{Passenger miles}_m}$$

- Gasoline, diesel, and electric fleet shares are normalized through fuel type reclassification: Gasoline type including gasoline, flexible fuel vehicle, and ethanol (E85); Diesel, and Electric; Not applicable and Others are excluded.
- Registration shares are used as a proxy for VMT shares, and fuel economy is estimated by geography and vehicle type. Gasoline and diesel prices exclude fuel taxes, while EV energy and non-fuel costs use adopted per-mile values.
- Transit operating cost per passenger-mile is derived as a passenger-mile-weighted average using 2024 Oregon FTA National Transit Database (NTD) Metrics for Bus, Bus Rapid Transit, Light Rail, Streetcar Rail, and Hybrid Rail (m). Demand Response, Vanpool, and Aerial Tramway are excluded. This approach is also reflected in calculating transit operating speed. The statewide rate is calculated by dividing total operating expenses by passenger miles across the applicable services.

5.5 Emissions and carbon parameters

Criteria-pollutant emission rates are calculated using EPA Oregon emissions data and corresponding VMT. CO2e rates are constructed from EPA vehicle-class emission factors.

Emission rates are calculated as follows:

$$\text{Emission rates}_{p,g} = \frac{\text{Emissions}_p \times 1{,}000}{1.10231 \times \text{VMT}_g}$$

$$\text{CO2e rate} = \text{CO2} + 28 \times \text{CH4} + 265 \times \text{N2O}$$

In the calculations, p indicates each criteria pollutant type.

- Criteria-pollutant emission rates are expressed in grams per vehicle-mile and valued using fixed real-dollar damage costs per metric ton.
- CO2e combines CO2, CH4, and N2O using 100-year global warming potentials and is valued using the year-specific Social Cost of Carbon. The resulting rates are expressed as grams CO2e per vehicle-mile.

5.6 Health and noise parameters

Health parameters use Oregon Travel Survey commuting patterns, population eligibility assumptions, and wage data. Noise parameters use FHWA marginal external costs by vehicle class and geography.

$$\text{Active trips}_m = \frac{\Delta\text{Person miles}_m}{\text{ATL}_m}$$

$$\text{Eligible trips}_m = \text{Active trips}_m \times \text{Age share}_m \times \text{Non-active shift share}$$

$$\text{Commute trips}_m = \text{Active trips}_m \times \text{Commute share}_m$$

$$\text{Employed active users}_m = \frac{\text{Commute trips}_m}{\text{Annual commute trips per worker}_m}$$

$$\text{Reduced sick days} = \text{Annual absences} \times \text{Short term sick leave share} \times \text{Physical activity reduction}$$

- Health trip eligibility applies the framework age-range shares and the assumed share of induced walking/cycling trips shifted from non-active modes.
- Commute shares and annual trips per employed worker from OTS dataset are used to estimate active commuters. Reduced sick days are valued using geographic wages and an eight-hour workday. The default reduction is 0.1386 days per worker per year.
- Noise uses FHWA marginal external costs for urban and rural highways. Statewide values are calculated using urban/rural VMT-weighted averages.

6 Calculator Exclusions

This Oregon Mode-Based BCA calculator is a simplified tool that implements a subset of the overall framework. The following items are currently excluded from the calculator and should be documented separately when relevant:

- Detailed implementation, operating-cost, residual-value, sunk-cost, and phasing calculations. The calculator receives one Total PV net cost rather than rebuilding the full cost ledger.
- Safety analysis using scenario-specific CMFs/CRFs or detailed KABCO severity data.
- Direct trip/time modeling and rule-of-half treatment for induced transit demand when those data are available.
- Speed-based fuel-consumption modeling and vehicle-type-specific fuel-mix estimation beyond the simplified VOC defaults.
- Transit vehicle emissions, and noise unless vehicle activity is separately estimated.
- Exposure-based noise analysis using modeled dBA, affected housing units, and property values.
- Ecosystem services, wildlife impacts, and journey-quality calculations described in the framework.
- ODOT SEI/GIS equity analysis and detailed benefit- or cost-category incidence allocation.
- Combined or probabilistic risk scenarios beyond the current one-at-a-time sensitivity tests.