



US Department of Transportation



# RAISE Grants

Rebuilding American Infrastructure with Sustainability and Equity

Preparing a Benefit-Cost Analysis for the RAISE Discretionary Grant Program

January 26, 2024



# Webinar Information

## Audio

- To listen via computer:
  - Select "Computer Audio"
- To listen via phone:
  - Call: 669-254-5252
  - Webinar ID: 161 224 1906
  - Passcode: 762773
- All participants automatically join on mute, with cameras off

## Technical Support

- Email
  - [corey.martin.ctr@dot.gov](mailto:corey.martin.ctr@dot.gov)
  - [webconference@dot.gov](mailto:webconference@dot.gov)

## Questions for Presenters

- Please type your questions in the Q&A box

## More Information

- This webinar is being recorded and will be posted on the RAISE Grants website at <https://www.transportation.gov/RAISEgrants/outrreach>



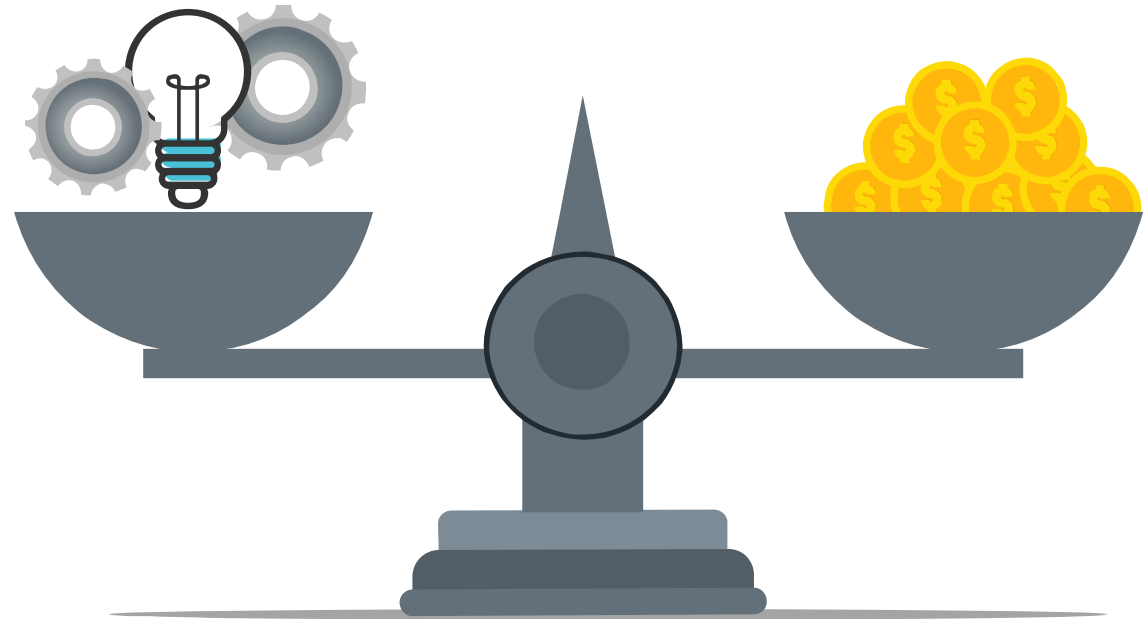
## Today's Presenters

- **Darren Timothy, Chief Economist, USDOT**
- **Jordan Riesenberg, Economist, USDOT**



## What is BCA?

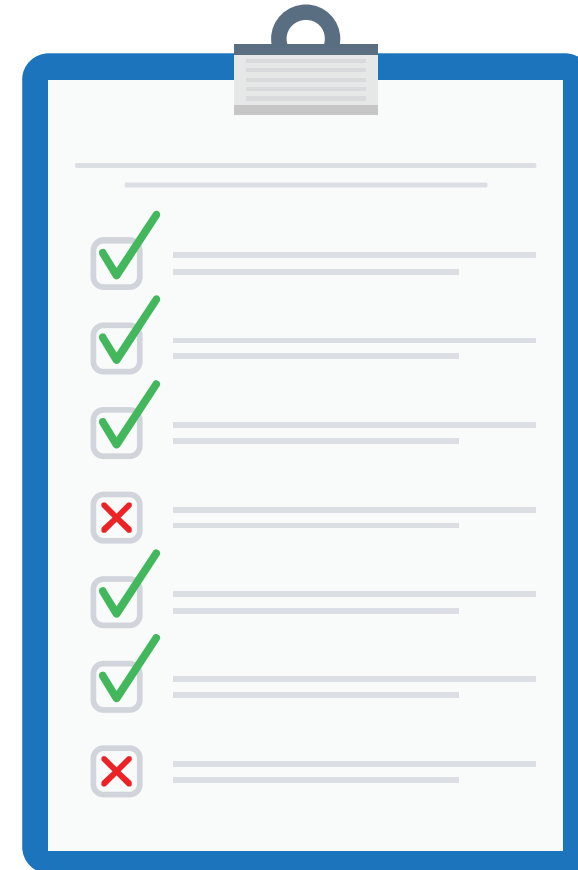
- Benefit-cost analysis (BCA) is a systematic process for identifying, quantifying, and comparing expected economic benefits and costs of a proposed infrastructure project.





## Why do we do BCA?

- Provides a useful benchmark from which to evaluate and compare potential transportation investments
- Adds a degree of rigor to the project evaluation process
- Required by executive orders, OMB guidance, and by statute for certain programs and Department activities.





## BCA and RAISE

- All sponsors of capital projects should submit a benefit-cost analysis (BCA) as part of their RAISE grant application
- Use of the BCA in RAISE
  - Required to consider the extent to which the project is cost effective
- Planning grant applications **do not need** to include a benefit-cost analysis



## Use of the BCA in RAISE Project Evaluation

- USDOT will consider the relative magnitude of estimated project benefits and costs in its evaluation
- Assign projects one of two ratings
  - Positive net benefits (benefits exceed costs)
  - Negative net benefits (costs exceed benefits)
- Projects with a negative BCA rating will not be selected for an award, unless the project receives a “Highly Recommended” rating and demonstrates exceptional benefits for underserved or disadvantaged communities.



## USDOT BCA Review

- USDOT economists will review the applicant's BCA
  - Examine key assumptions
  - Correct for any technical errors
  - Perform sensitivity analysis on key inputs
  - Consider any unquantified benefits





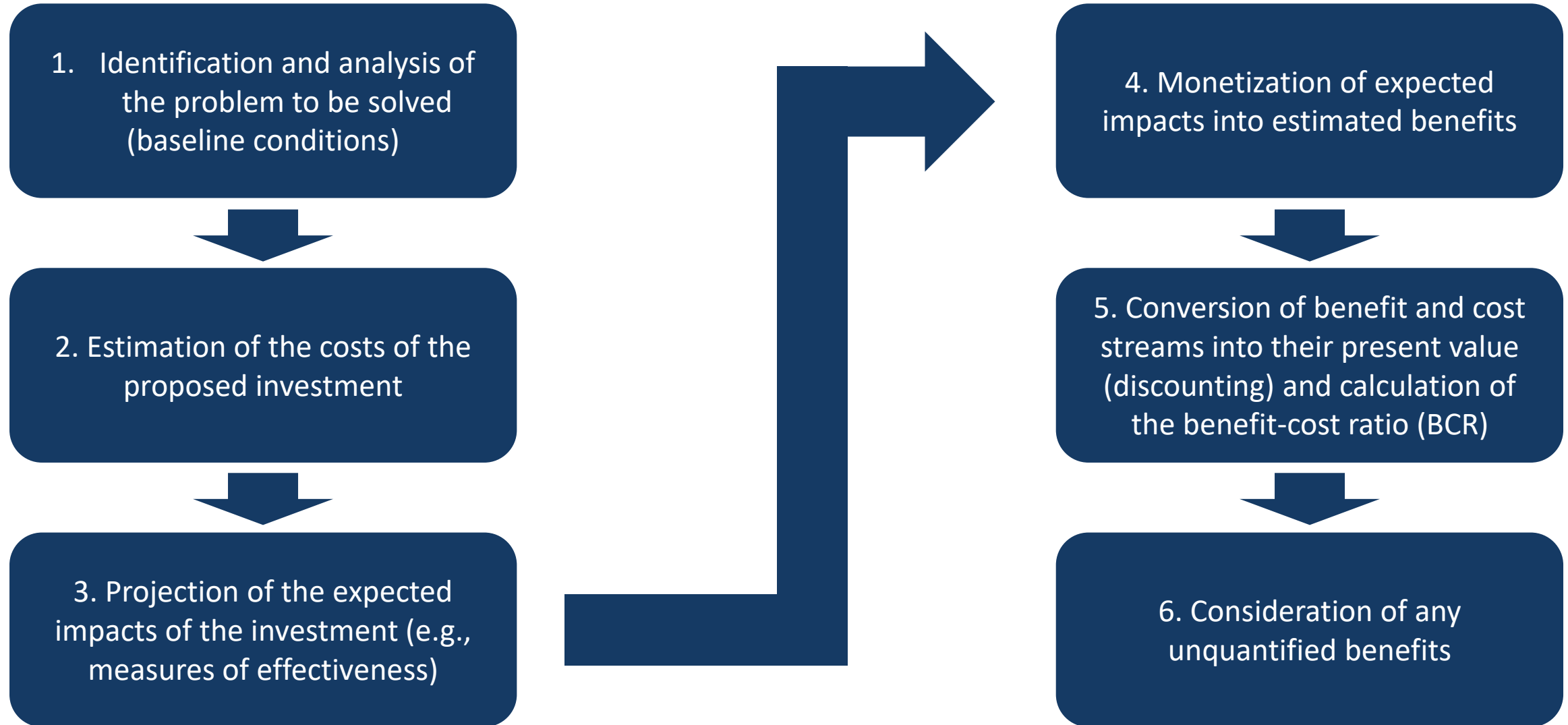


## What do I need to do BCA?

- **Clear understanding of:**
  - The problem the project is intended to solve (baseline conditions)
  - How the project addresses the problem (measures of effectiveness)
- **Well-defined project scope and cost estimate**
- **Monetization factors for key project benefits**



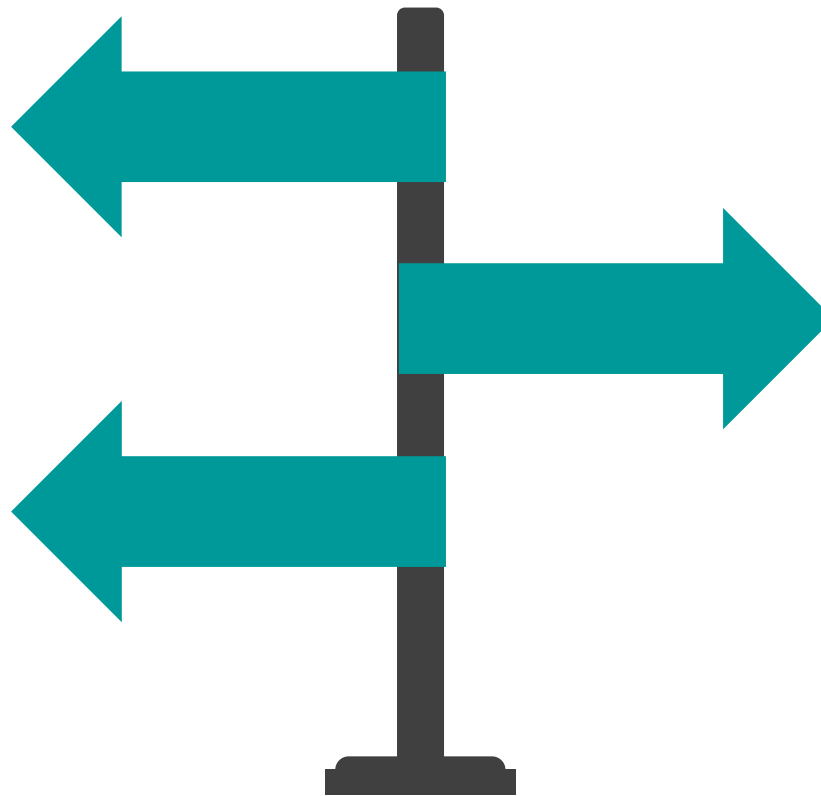
# Developing a BCA





## What do I need to do BCA?

- Sources of information may include:
  - Project planning and engineering documents
  - Industry technical references and analytical tools
  - DOT BCA Guidance
  - Partners





# USDOT BCA Guidance

- Covers all USDOT discretionary grant programs
- Structure of the Guidance
  - Overview of BCA (“how to get started”)
  - BCA methodologies
  - Recommended input values
  - Sample calculations
- Available at <https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance>



U.S. Department  
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## Benefit-Cost Analysis Guidance for Discretionary Grant Programs

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Office of the Secretary

U.S. Department of Transportation

December 2023



## What's new for 2024?

- **The 2024 update to the BCA Guidance includes:**
  - Revised discount rates in accordance with updates to OMB Circular A-94
  - Revised values for the social cost of CO<sub>2</sub> emissions
  - Other new and updated monetization values
    - Includes commuter, intercity passenger, and freight rail per-hour operating and social costs
  - Simplified measure of emission costs per vehicle mile traveled
  - Links to two new documents to aid applicants in their BCA
    - [FHWA Bridge Improvement Program BCA Tool](#)
    - [USDOT BCA Spreadsheet Template](#)



## What should my BCA submission include?

- Technical memo/discussion describing the analysis, including any unquantified benefits, and documenting sources of information used (assumptions and inputs)
  - If provided as an appendix, does not count against page limit for the application narrative
- An unlocked spreadsheet (e.g., an Excel workbook) showing the calculations used to produce the estimates of benefits and costs



# Baselines

- **Should measure costs and benefits of a proposed project against a baseline alternative (“base” or “no build”)**
- **“Do’s”**
  - Factor in any projected changes that would occur even in the absence of the requested project
  - Factor in ongoing routine maintenance
  - Consider the full long-term impacts of the no build
  - Explain and provide support for the chosen baseline
- **“Don’t’s”**
  - Assume that the same (or similar) improvement will be implemented later
  - Use unrealistic assumptions about alternative traffic flows or travel



## Demand Forecasts

- **Most benefit estimates depend on ridership or usage, including for walking and cycling projects**
- **Provide supporting info on forecasts**
  - Geographic scope, assumptions, data sources, methodology
- **Provide forecasts for intermediate years**
  - Or at least interpolate –don't apply forecast year impacts to interim years
- **Exercise caution about long-term growth assumptions**
  - Consider underlying capacity limits of the improved and/or replacement facility





## Analysis Period

- **Should cover both initial development/construction and a subsequent operational period**
- **Generally tied to the expected service life of the improvement or asset**
  - I.e., the number of years until you would anticipate having to take the same action again
  - Lesser improvements should have shorter service lives
  - Recommend 20 years maximum for capacity expansion or other operational improvements
- **Avoid excessively long analysis periods (over 30 years of operations)**
  - Use residual value to cover out-years of remaining service life for long-lived improvements



# Inflation and Discounting

- **Inflation Adjustments**

- Recommend using a 2022 base year for all cost and benefit data
- Index values for the GDP Deflator included in the BCA guidance

- **Discounting**

- Use a 3.1% discount rate for all benefits and costs (except CO<sub>2</sub>, which should be discounted at 2.0%).
- Recommend using a 2022 base year for discounting



## Scope of the Analysis

- **Project scope included in estimated costs and benefits must match**
  - Don't claim benefits from an entire project, but only count costs from the grant-funded or other, lesser portion
- **Scope should cover a project that has independent utility**
  - May need to incorporate costs for related investments necessary to achieve the projected benefits
- **Project elements with independent utility should be individually evaluated in the BCA**
  - BCA evaluation will cover both independent elements and the submitted project as a whole



## Benefits

- **Should be presented on an annual basis**
- **Avoid double-counting benefits**
- **Negative outcomes should be counted as “disbenefits”**
- **Any estimated benefits should be clearly tied to the project scope and expected outcomes**
- **Some common benefit categories estimated in BCAs for transportation projects are presented in the following slides**
  - Applicants may also include other benefit categories or approaches in their BCAs



## Safety Benefits

- **Typically associated with reducing fatalities, injuries, and property damage**
- **Projected improvements in safety outcomes should be explained and documented**
  - Justify assumptions about expected reductions in crashes, injuries, and/or fatalities
  - Document any crash modification factors (CMFs) used
  - Show clear linkage between project and improved outcomes
  - Use facility-specific data history for the baseline where possible
- **Crash-related injury and fatality data may be available in different forms**
  - KABCO injury scales
  - Fatal/Injury crashes vs. fatalities/injuries
  - BCA Guidance provides values covering all of these



## Travel Time Savings

- **Recommended monetization values found in BCA Guidance**
  - See footnotes for discussion of value of time for walking, cycling, waiting, standing, transfers, long-distance travel, business travel
- **Can be a function of both changes in travel speed and/or travel distance (e.g., new connections across a highway allowing for shorter walking or cycling trips)**
- **Consider vehicle occupancy where appropriate**
  - Local/facility-specific values preferred
  - National-level values provided in BCA Guidance
- **If valuing travel time reliability:**
  - Carefully document methodology and tools used
  - Show how valuation parameters are distinct from general travel time savings



## Operating Cost Savings

- **Avoid double counting operating savings and other impacts**
  - E.g., truck or rail travel time savings, reduced fuel consumption
- **Localized, specific data preferred**
- **Standard per-mile values for light duty vehicles and commercial trucks**
  - Should not be converted to per-hour values
- **Values for hourly operating costs for commuter, intercity, and freight rail provided in BCA Guidance**



## Emissions Reduction Benefits

- **For infrastructure improvements, emission reductions will typically be a function of reduced fuel consumption**
- **Recommended year by year unit values for CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>, and PM<sub>2.5</sub> found in BCA Guidance**
  - Be careful about the measurement units being applied
  - Check for PM<sub>2.5</sub> versus PM<sub>10</sub>
- **Values for reduced CO<sub>2</sub> emissions should be discounted at 2.0 percent, while all others should be discounted at 3.1 percent**





## Amenity Benefits

- **Pedestrian, cycling, and transit facility/vehicle improvements can improve the quality or comfort of journeys**
- **Recommended values for different types of improvements found in BCA Guidance**
  - Pay attention to whether value is on a “per-trip” or “per-person-mile” basis
- **Carefully document baseline amenities, as well as specifically how the proposed project will add any amenity benefit categories being claimed**



## Health Benefits

- **Trips diverted to active transportation (walking and cycling) from other modes may yield health benefits to users**
- **Recommended monetization values, on a per trip basis, are found in DOT BCA Guidance**
- **Absent local data on existing mode share and estimated age profiles of users, applicants may apply national averages included in the BCA Guidance**



## Work Zone Impacts

- **Transportation infrastructure improvements often involve work zones that can have a negative impact on travelers during the construction period**
  - Ex: travel times, safety
- **Applicants should account for any work zone impacts in their analysis**
  - If expected to be minimal, the analysis should describe characteristics of the project or delivery method that would mitigate such impacts



## Benefits to Existing and Additional Users

- **Primary benefits typically experienced directly by users**
- **Includes both “existing” users (under baseline) and “additional” users attracted as a result of the improvement**
  - Standard practice in BCA values benefits to additional users less than those for existing users (see BCA Guidance)



# Modal Diversion

- **Projected magnitude**
  - Should be based on careful analysis of local conditions and potential for shift from other modes that might be attributable to the project
- **Benefit estimates should not be based on comparing user costs of “old” and “new” mode**
  - Would be reflected in benefits to additional users
- **Reductions in external costs would be relevant**
  - E.g., emissions costs, congestion reduction, noise reduction
  - Values for congestion, noise and safety costs included in BCA Guidance



## Other Benefits Topics

- **Agglomeration Economies**
- **Noise, Stormwater Runoff, and Wildlife Impact Reduction**
- **Emergency Response**
- **State of Good Repair**
- **Resilience**
  - Consider expected frequency of events and their consequences
- **Property Value Increases**
  - Is a measure rather than a benefit –avoid double-counting



## Unquantified Benefits

- **Many potential benefits of RAISE projects may be difficult to quantify and monetize**
- **Any claimed unquantified benefits should be explained as well as possible**
  - Should clearly link specific project outcomes to any claimed unquantified benefits
  - Should quantify magnitudes/timing of the impacts wherever possible
  - Should only include impacts that would be counted as benefits, if quantified



## Capital Costs

- **Include all costs of implementing the project**
  - E.g., design, ROW acquisition, construction
  - Regardless of funding source
  - Include previously incurred costs
- **Total capital costs for the project should be clearly presented in three forms**
  - Nominal dollars (project budget)
  - Real dollars (base year)
  - Discounted Real dollars (use in BCA)





## Maintenance Costs

- **Net maintenance costs may be positive or negative**
  - New facilities would incur ongoing maintenance costs over the life of the project
  - Rehabilitated/reconstructed facilities may result in net savings in maintenance costs between the build/no-build



## Residual Value

- **For assets with remaining service life at the end of the analysis period, may calculate a “residual value” for the project**
  - Recall that service life does not necessarily match the physical life of the asset
- **Simple approach: assume linear depreciation**
- **Be sure to properly apply discounting**



## Comparing Benefits to Costs

- **Net Present Value (Benefits – Costs)**
- **Benefit-Cost Ratio (Benefits / Costs)**
  - Denominator should only include capital costs (i.e., net maintenance costs and residual value should be in the numerator)
  - Dis-benefits should be subtracted from the numerator



## Other Types of Economic Analysis

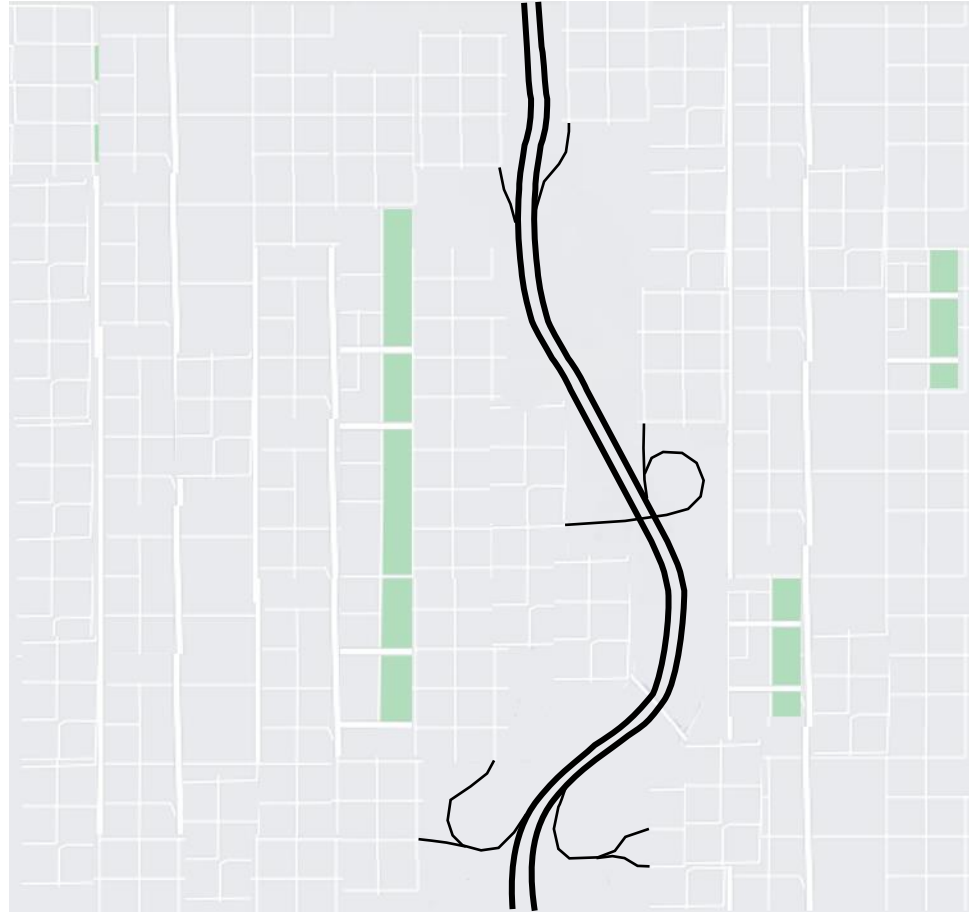
- BCA considers the **increased economic efficiency** resulting from a project, and assesses the net change to overall societal welfare
- This is distinct from other types of economic analysis, such as
  - Economic Impact Analysis (e.g., job creation)
  - Financial Analysis (e.g., revenue impacts)
  - Distributional Analysis (e.g., equity impacts)
- These other types of analysis can be used to answer important questions and aid in decision-making; however, they use different approaches and answer fundamentally different questions than does BCA
- Importantly, these analyses do not provide estimates of additive benefits to be considered in BCA

A blue-tinted photograph showing the silhouettes of several people sitting around a long table in a meeting room. The room has large windows in the background, and the overall atmosphere is professional and collaborative.

# QUESTIONS?

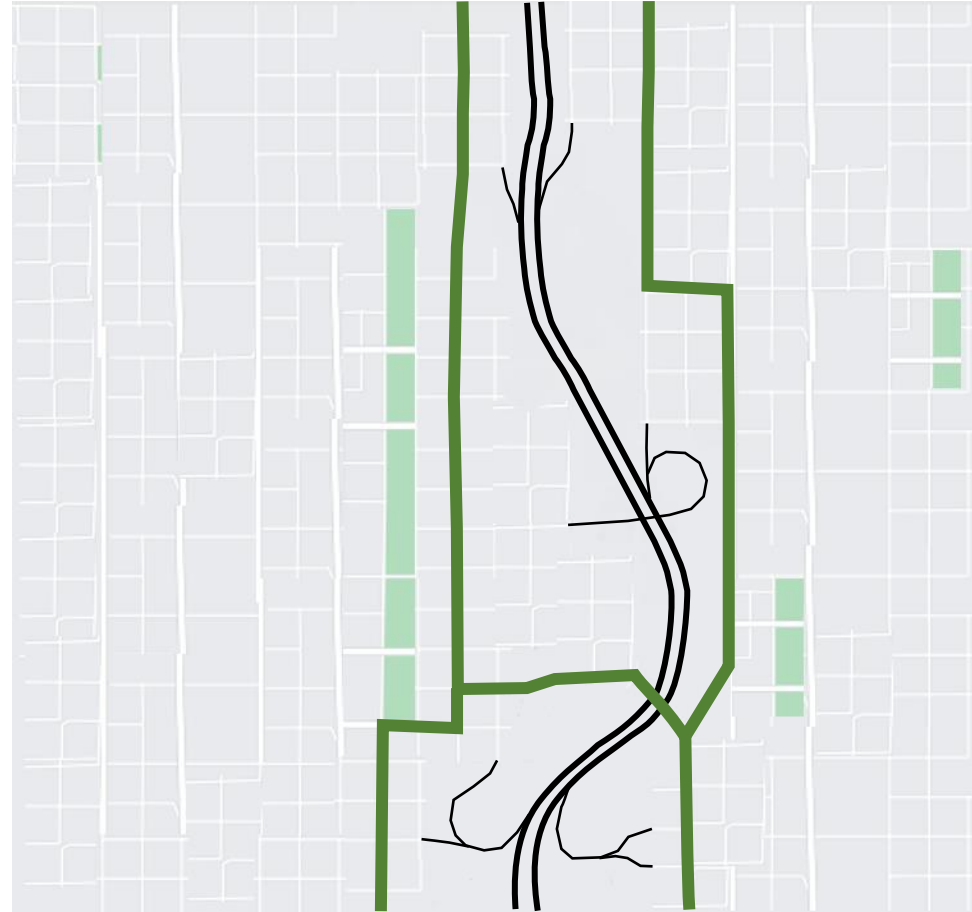


# Hypothetical BCA Example #1





# Hypothetical BCA Example #1





# Hypothetical BCA Example #1

Proposed Project: Add new bike/pedestrian bridge over freeway to reconnect local neighborhoods.

Project Cost: \$10.0 million



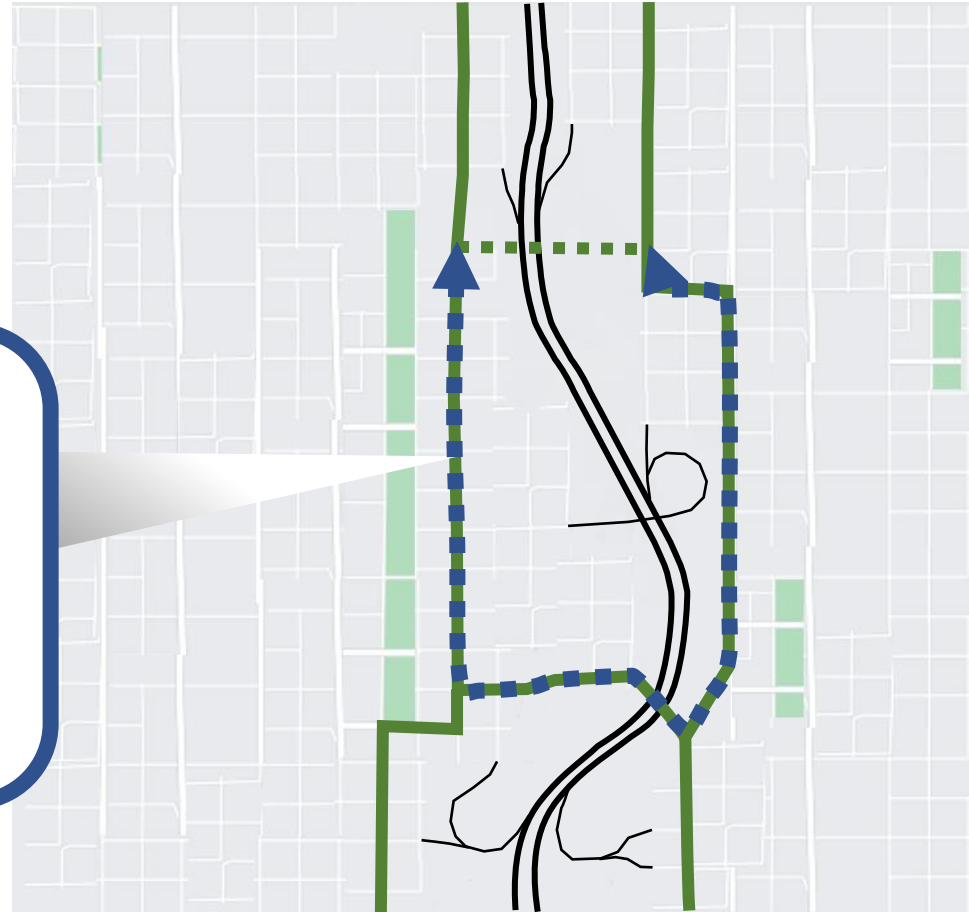




# Hypothetical BCA Example #1

No-Build Scenario: Cyclists and pedestrians continue to use crossing to the south.  
(2.6-mile route)

Daily users doing this route:  
1,000 cyclists (Trail Counters)

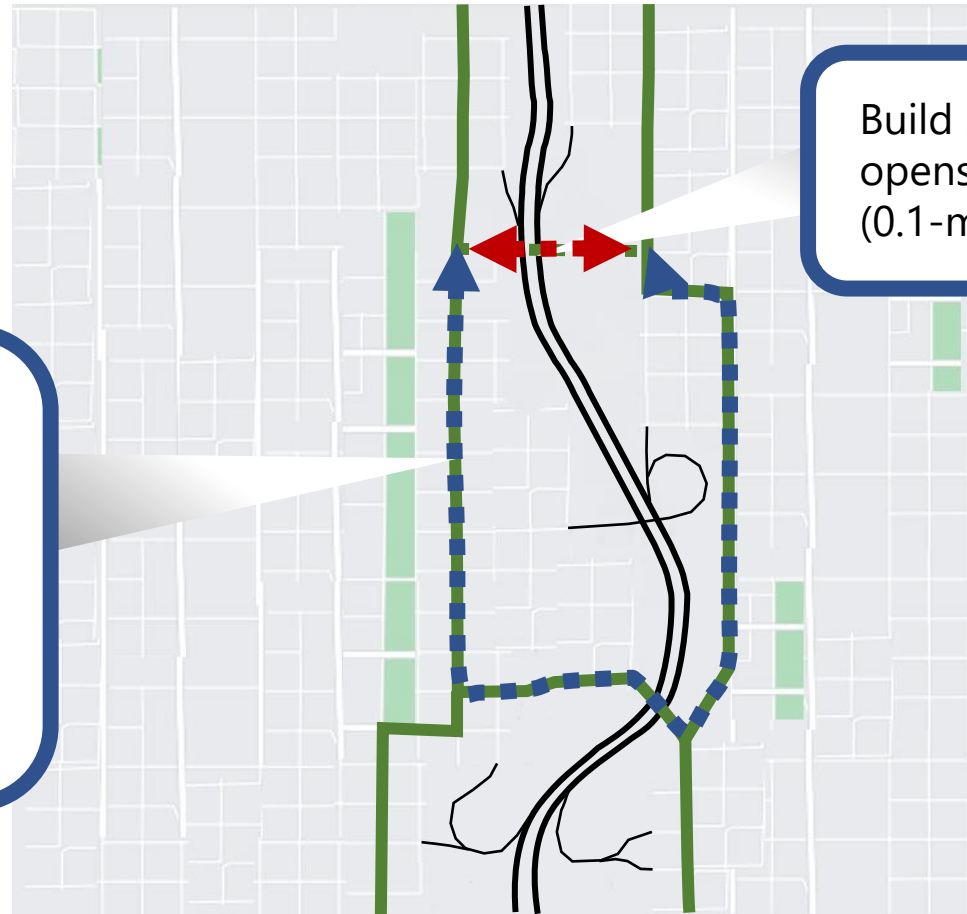




# Hypothetical BCA Example #1

No-Build Scenario: Cyclists and pedestrians continue to use crossing to the south.  
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Daily users doing this route:  
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Build Scenario: Bridge opens.  
(0.1-mile route)



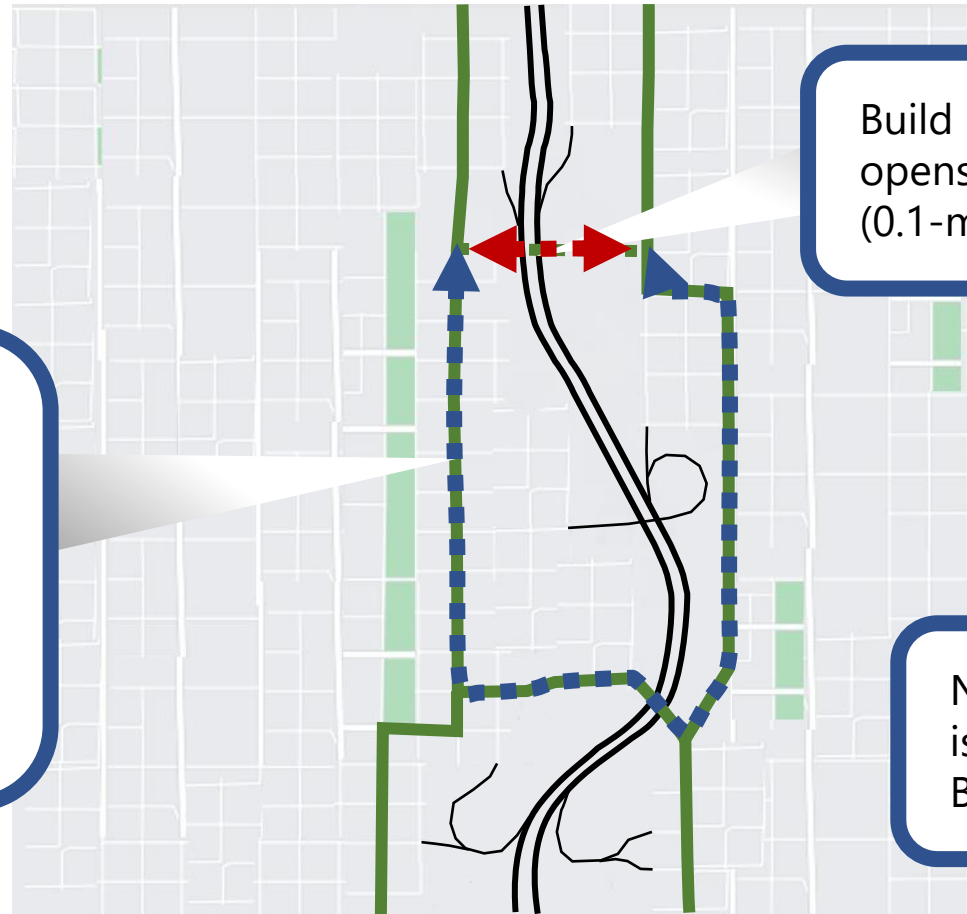
# Hypothetical BCA Example #1

No-Build Scenario: Cyclists and pedestrians continue to use crossing to the south.  
(2.6-mile route)

Daily users doing this route:  
1,000 cyclists (Trail Counters)

Build Scenario: Bridge opens.  
(0.1-mile route)

No-Build Scenario route  
is 2.5 miles longer than  
Build Scenario route.





## Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Cyclists use 2.6-mile route.
  - Build Scenario: Bridge opens, new route is 0.1 miles.
- **The expected major benefit category in this case would be the travel time savings for mitigating 2.5-miles of additional travel, starting when the project opens**



# Travel Time Savings Example

- **For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time**

$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

\*Undiscounted.



# Travel Time Savings Example

- **For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time**

$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings*} = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times$$

No-Build Scenario route: 2.6 miles  
Build Scenario route: 0.1 miles

Speed: Observed average speed on both routes

\*Undiscounted.



# Travel Time Savings Example

- For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time

$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings*} = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times$$

Recent trail count

\*Undiscounted.

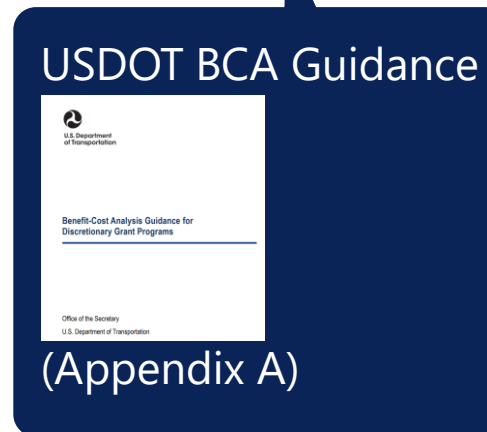


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$$\text{Annual Travel Time Savings*} = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$35.80 \times$$



\*Undiscounted.





# Travel Time Savings Example

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$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings*} = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$35.80 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).

\*Undiscounted.



# Travel Time Savings Example

- **For simplicity, let's assume no pedestrians, an average cycling speed of 9.8 mph, and no cycling growth over time**

$$\text{Annual Travel Time Savings*} = \text{Marginal Detour Time} \times \text{Daily Users} \times \text{Hourly Value of Time} \times \text{Annualization Factor}$$

$$\text{Annual Travel Time Savings*} = \frac{2.5 \text{ Miles}}{9.8 \text{ mph}} \times 1,000 \times \$35.80 \times 365$$

$$= \$3,333,418 \text{ Per Year}$$

\*Undiscounted.



# Hypothetical BCA Example #1

- Assume construction in 2025, ten years of project operations, and \$10,000 in annual maintenance costs for the project

Year	Capital Cost	Discounted Costs	Travel Time Savings	O&M Costs	Discounted Benefits
2025	\$10,000,000		\$0	\$0	
2026	\$0		\$3,333,418	\$10,000	
2027	\$0		\$3,333,418	\$10,000	
2028	\$0		\$3,333,418	\$10,000	
2029	\$0		\$3,333,418	\$10,000	
2030	\$0		\$3,333,418	\$10,000	
2031	\$0		\$3,333,418	\$10,000	
2032	\$0		\$3,333,418	\$10,000	
2033	\$0		\$3,333,418	\$10,000	
2034	\$0		\$3,333,418	\$10,000	
2035	\$0		\$3,333,418	\$10,000	



# Hypothetical BCA Example #1

- Next, we discount costs and benefits using a 3.1% discount rate

**Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)**

Year	Capital Cost	Discounted Costs	Travel Time Savings	O&M Costs	Discounted Benefits
2025	\$10,000,000	<b>\$9,124,814</b>	\$0	\$0	\$0
2026	\$0	\$0	\$3,333,418	\$10,000	<b>\$2,941,375</b>
2027	\$0	\$0	\$3,333,418	\$10,000	\$2,934,000
2028	\$0	\$0	\$3,333,418	\$10,000	\$2,917,152
2029	\$0	\$0	\$3,333,418	\$10,000	\$2,883,950
2030	\$0	\$0	\$3,333,418	\$10,000	\$2,833,249
2031	\$0	\$0	\$3,333,418	\$10,000	\$2,764,975
2032	\$0	\$0	\$3,333,418	\$10,000	\$2,677,054
2033	\$0	\$0	\$3,333,418	\$10,000	\$2,567,416
2034	\$0	\$0	\$3,333,418	\$10,000	\$2,441,992
2035	\$0	\$0	\$3,333,418	\$10,000	<b>\$2,234,716</b>

$\$10,000,000 / (1+0.031)^{(2025-2022)}$

$(\$3,333,418-\$10,000) / (1+0.031)^{(2026-2022)}$

$(\$3,333,418-\$10,000) / (1+0.031)^{(2035-2022)}$

Note: Totals may differ slightly due to rounding



# Hypothetical BCA Example #1

- Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs

Year	Capital Cost	Discounted Costs	Travel Time Savings	O&M Costs	Discounted Benefits
2025	\$10,000,000	\$9,124,814	\$0	\$0	\$0
2026	\$0	\$0	\$3,333,418	\$10,000	\$2,941,375
2027	\$0	\$0	\$3,333,418	\$10,000	\$2,852,934
2028	\$0	\$0	\$3,333,418	\$10,000	\$2,767,152
2029	\$0	\$0	\$3,333,418	\$10,000	\$2,683,950
2030	\$0	\$0	\$3,333,418	\$10,000	\$2,603,249
2031	\$0	\$0	\$3,333,418	\$10,000	\$2,524,975
2032	\$0	\$0	\$3,333,418	\$10,000	\$2,449,054
2033	\$0	\$0	\$3,333,418	\$10,000	\$2,375,416
2034	\$0	\$0	\$3,333,418	\$10,000	\$2,303,992
2035	\$0	\$0	\$3,333,418	\$10,000	\$2,234,716
<b>TOTAL</b>		<b>\$9,124,814</b>			<b>\$25,736,812</b>

Note: Totals may differ slightly due to rounding



## Results – The NPV and BCR

- **Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)**

$$\begin{aligned}\text{Net Present Value (NPV)} &= \text{Total Discounted Benefits} - \text{Total Discounted Costs} \\ &= \$25,736,812 - \$9,124,814 \\ &= \mathbf{\$16,611,999}\end{aligned}$$

$$\begin{aligned}\text{Benefit-Cost Ratio (BCR)} &= \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} \\ &= \frac{\$25,736,812}{\$9,124,814} \\ &= \mathbf{2.8}\end{aligned}$$

Note: Totals may differ slightly due to rounding

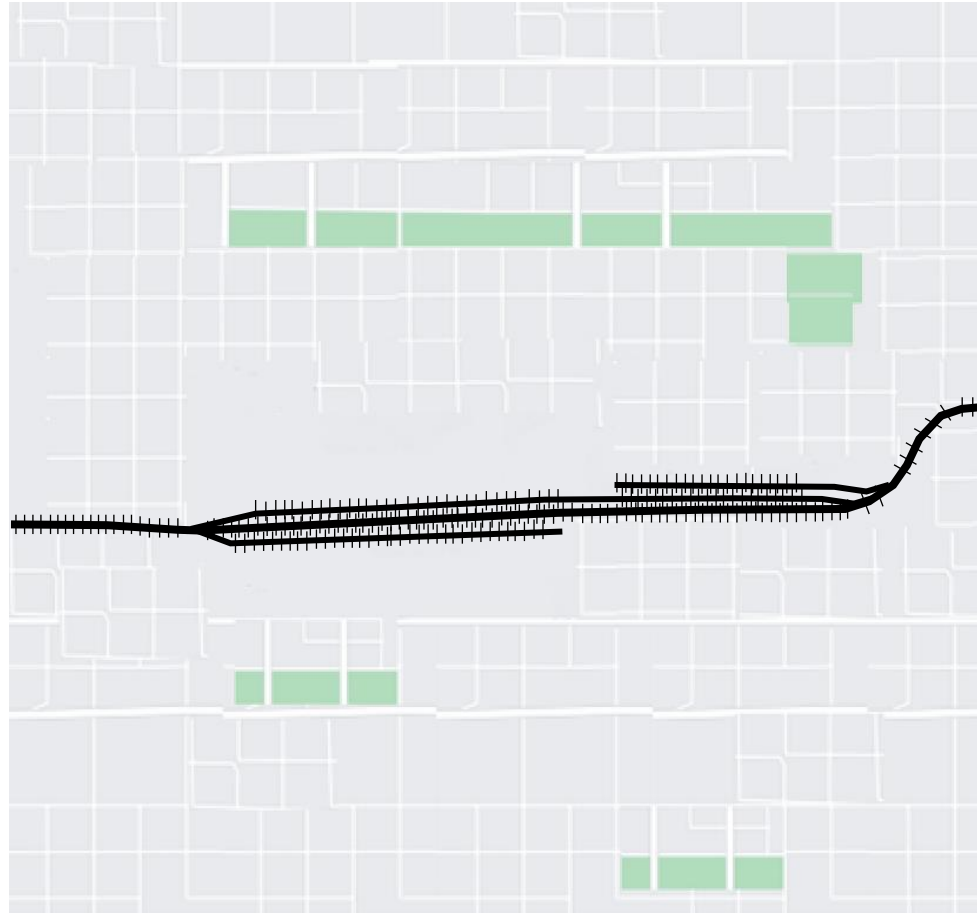


# Hypothetical BCA Example #1

- **Other potential benefits such a project might have:**
  - Travel time savings for pedestrians
    - Different speed assumptions and number of users as the example just given, but otherwise the method would be the same
  - Mortality reduction from induced walking and cycling trips
  - Reduced emissions from modal shift to active transportation
  - Amenity benefits
    - If the no-build route did not already have a dedicated cycling or pedestrian facility
  - Safety benefits
    - Shorter walking and cycling distances for existing users
  - Residual value
- **This is not meant to be an exhaustive list**



## Hypothetical Example #2







# Hypothetical Example #2

Proposed Project: Convert 2.0 miles of an abandoned rail line to a cycling path and sell 40 acres of excess right-of-way for future mixed-use development.

Project Cost: \$20.0 million

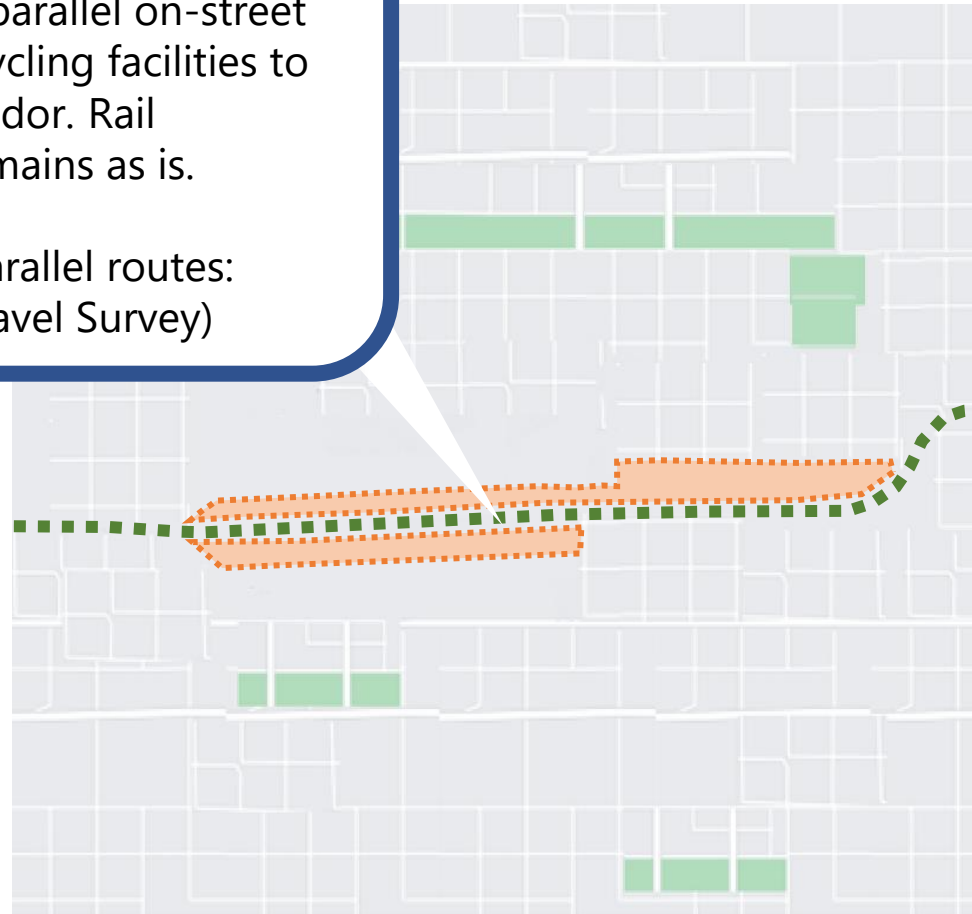




## Hypothetical Example #2

No-Build Scenario: Cyclists continue to use parallel on-street routes with no cycling facilities to traverse the corridor. Rail infrastructure remains as is.

Daily users on parallel routes:  
3,000 cyclists (Travel Survey)

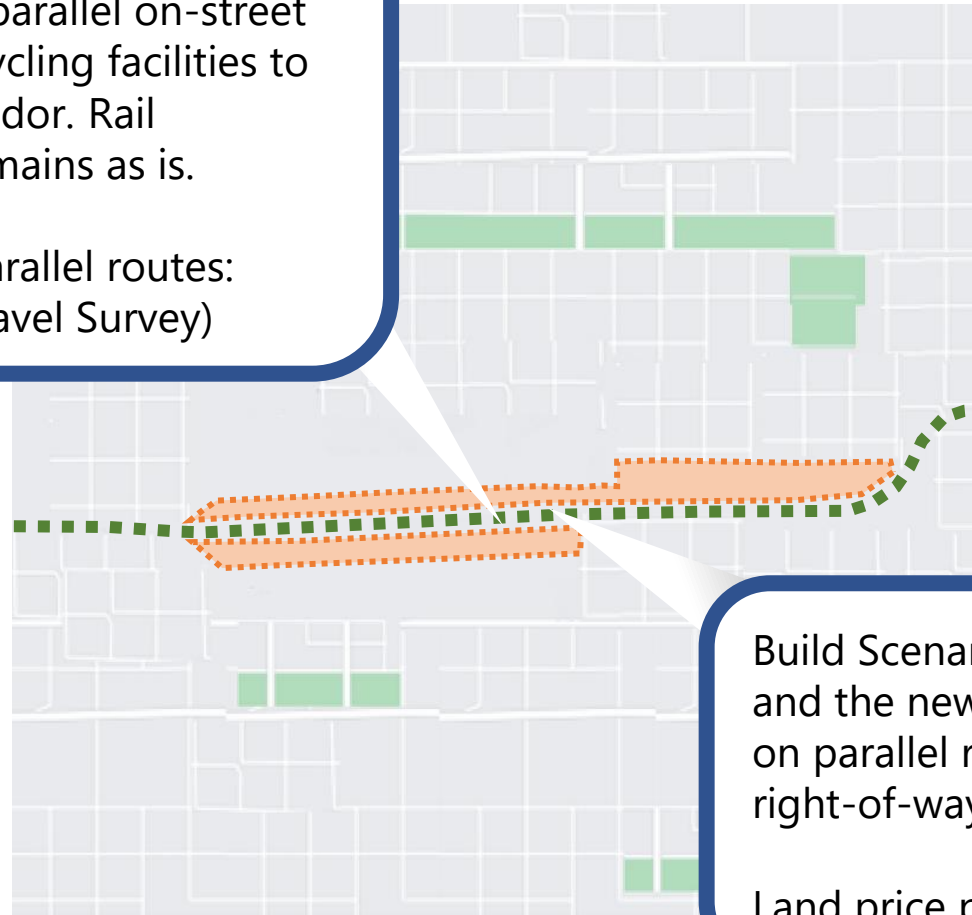




## Hypothetical Example #2

No-Build Scenario: Cyclists continue to use parallel on-street routes with no cycling facilities to traverse the corridor. Rail infrastructure remains as is.

Daily users on parallel routes:  
3,000 cyclists (Travel Survey)



Build Scenario: The rail infrastructure is removed and the new cycling path is completed. Cyclists on parallel routes shift to new facility. Excess right-of-way of 40 acres is sold.

Land price per acre: \$90,000 (Local Sale Comps)



## Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Abandoned rail infrastructure remains as is and cyclists use on-street parallel routes
  - Build Scenario: 2.0 miles of the abandoned rail line are converted to a cycling path for use by 3,000 daily cyclists and 40 acres of excess right-of-way are sold for future mixed-use development
- **The expected major benefit categories in this case would be:**
  - Amenity benefits to users given the addition of 2.0-miles of off-street cycling path, starting when the project opens
  - The sale of unused right-of-way for other purposes



## Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits*} = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

\*Undiscounted.



# Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times$$

Distance traveled over new cycling path per user

\*Undiscounted.



# Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times$$

Estimate based on travel survey

\*Undiscounted.



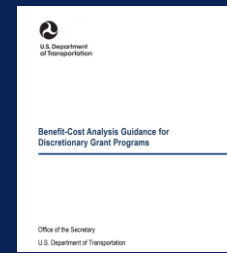
# Amenity Benefits Example

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$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.57 \times$$

USDOT BCA Guidance



(Appendix A)

\*Undiscounted.





# Amenity Benefits Example

- For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.57 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).

\*Undiscounted.



# Amenity Benefits Example

- **For simplicity, let's assume that all cyclists use the entire length of the facility, and no cycling growth over time**

$$\text{Annual Amenity Benefits}^* = \text{Improved Facility Length} \times \text{Daily Users} \times \text{Amenity Value Per Mile Cycled} \times \text{Annualization Factor}$$

$$\text{Annual Amenity Benefits}^* = 2.0 \text{ Miles} \times 3,000 \times \$1.57 \times 365$$

$$= \$3,438,300 \text{ Per Year}$$

\*Undiscounted.



## Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\begin{array}{l} \text{Excess ROW} \\ \text{Benefits*} \end{array} = \begin{array}{l} \text{Amount of Land} \\ \text{Made Available} \\ \text{for Sale} \end{array} \times \text{Land Price}$$

\*Undiscounted.



# Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\text{Excess ROW Benefits}^* = \text{Amount of Land Made Available for Sale} \times \text{Land Price}$$

$$\text{Excess ROW Benefits}^* = 40 \text{ Acres} \times$$

Excess right-of-way remaining after project

\*Undiscounted.



# Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\text{Excess ROW Benefits}^* = \text{Amount of Land Made Available for Sale} \times \text{Land Price}$$

$$\text{Excess ROW Benefits}^* = 40 \text{ Acres} \times \$90,000 \text{ per Acre}$$

Based on recent  
land sale comps  
in the area

\*Undiscounted.



# Excess Right-of-Way Sale Example

- **For simplicity, let's assume all excess land is sold at a single price per acre after project completion**

$$\text{Excess ROW Benefits}^* = \text{Amount of Land Made Available for Sale} \times \text{Land Price}$$

$$\text{Excess ROW Benefits}^* = 40 \text{ Acres} \times \$90,000 \text{ per Acre}$$

$$= \$3,600,000 \text{ after Project Completion}$$

\*Undiscounted.



## Hypothetical BCA Example #2

- Assume construction in 2025, ten years of project operations, and no change in maintenance costs

Year	Capital Cost	Discounted Costs	Amenity Benefits	Excess Land Sale	Discounted Benefits
2025	\$20,000,000		\$0	\$0	
2026	\$0		\$3,438,300	\$3,600,000	
2027	\$0		\$3,438,300	\$0	
2028	\$0		\$3,438,300	\$0	
2029	\$0		\$3,438,300	\$0	
2030	\$0		\$3,438,300	\$0	
2031	\$0		\$3,438,300	\$0	
2032	\$0		\$3,438,300	\$0	
2033	\$0		\$3,438,300	\$0	
2034	\$0		\$3,438,300	\$0	
2035	\$0		\$3,438,300	\$0	



# Hypothetical BCA Example #2

- Next, we discount costs and benefits using a 3.1% discount rate

**Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)**

Year	Capital Cost	Discounted Costs	Amenity Benefits	Excess Land Sale	Discounted Benefits
2025	\$20,000,000	<b>\$18,249,627</b>	\$0	\$0	\$0
2026	\$0	\$0	\$3,438,300	\$3,600,000	<b>\$6,229,212</b>
2027	\$0	\$0	\$3,438,300	\$0	\$2,802,805
2028	\$0	\$0	\$3,438,300	\$0	\$2,776,727
2029	\$0	\$0	\$3,438,300	\$0	\$2,693,236
2030	\$0	\$0	\$3,438,300	\$0	\$2,612,256
2031	\$0	\$0	\$3,438,300	\$0	\$2,533,711
2032	\$0	\$0	\$3,438,300	\$0	\$2,457,528
2033	\$0	\$0	\$3,438,300	\$0	\$2,383,635
2034	\$0	\$0	\$3,438,300	\$0	\$2,311,964
2035	\$0	\$0	\$3,438,300	\$0	\$2,311,964

$\$20,000,000 / (1+0.031)^{(2025-2022)}$

$(\$3,438,300 + \$3,600,000) / (1+0.031)^{(2026-2022)}$

$\$3,438,300 / (1+0.031)^{(2035-2022)}$

Note: Totals may differ slightly due to rounding





## Hypothetical BCA Example #2

- Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs

Year	Capital Cost	Discounted Costs	Amenity Benefits	Excess Land Sale	Discounted Benefits
2025	\$20,000,000	\$18,249,627	\$0	\$0	\$0
2026	\$0	\$0	\$3,438,300	\$3,600,000	\$6,229,212
2027	\$0	\$0	\$3,438,300	\$0	\$2,951,552
2028	\$0	\$0	\$3,438,300	\$0	\$2,862,805
2029	\$0	\$0	\$3,438,300	\$0	\$2,776,727
2030	\$0	\$0	\$3,438,300	\$0	\$2,693,236
2031	\$0	\$0	\$3,438,300	\$0	\$2,612,256
2032	\$0	\$0	\$3,438,300	\$0	\$2,533,711
2033	\$0	\$0	\$3,438,300	\$0	\$2,457,528
2034	\$0	\$0	\$3,438,300	\$0	\$2,383,635
2035	\$0	\$0	\$3,438,300	\$0	\$2,311,964
<b>TOTAL</b>		<b>\$18,249,627</b>			<b>\$29,812,627</b>

Note: Totals may differ slightly due to rounding



## Results – The NPV and BCR

- **Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)**

$$\begin{aligned} \text{Net Present Value (NPV)} &= \text{Total Discounted Benefits} - \text{Total Discounted Costs} \\ &= \$29,812,627 - \$18,249,627 \\ &= \mathbf{\$11,562,999} \end{aligned}$$

$$\begin{aligned} \text{Benefit-Cost Ratio (BCR)} &= \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} \\ &= \frac{\$29,812,627}{\$18,249,627} \\ &= \mathbf{1.6} \end{aligned}$$

Note: Totals may differ slightly due to rounding



## Hypothetical BCA Example #2

- **Other potential benefits such a project might have:**
  - Travel time savings for cyclists and pedestrians
    - If the new cycling path provides new shorter-distance connections
  - Mortality reduction from induced walking and cycling trips
  - Reduced emissions from modal shift to active transportation
  - Benefits to any induced cyclists
    - Remember to apply the “rule of half,” see Appendix B of BCA Guidance
- **This is not meant to be an exhaustive list**



## Key Resources for BCA

- **DOT BCA Guidance**
  - <https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance>
- **Additional project examples provided in BCA webinars for previous USDOT discretionary grant programs**
  - <https://railroads.dot.gov/rail-network-development/training-guidance/webinars-0>
  - <https://www.transportation.gov/office-policy/rural/routes-webinar-bca>
  - <https://www.transportation.gov/grants/rcnprogram/rcn-webinars>
  - Note that parameter values are updated each year
- **Project engineering and planning documents**



## Remember Key Resources

- **Local traffic counts and travel survey data**
- **U.S. Census Bureau**
- **Project partners (higher levels of government, MPOs, universities, etc.)**
- **Many BCAs submitted for other programs are publicly available via web search**
- **FRA's Crossing Inventory and Accident Reports**
  - <https://safetydata.fra.dot.gov/OfficeofSafety/PublicSite/Crossing/Crossing.aspx>
- **NHTSA's Fatality Analysis Reporting System**
  - <https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars>
- **The Crash Modification Factors Clearinghouse**
  - <https://www.cmfclearinghouse.org/>
- **Technical questions can be submitted to [RAISEgrants@dot.gov](mailto:RAISEgrants@dot.gov)**



## Key Resources for BCA

- **DOT BCA Spreadsheet Template**

- Developed by DOT as an optional template to aid applicants in structuring their BCA and performing certain calculations common to all analyses.
- Designed as an open-ended template that can handle any project type
- Available at: <https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-spreadsheet-template>

- **Bridge Investment Program BCA Tool**

- Supports estimates of the benefits of bridge preservation or replacement investments using National Bridge Inventory data
- Also provides a default methodology consistent with DOT BCA Guidance
- Applicable to roadway bridge projects for any DOT program where BCA is required
- Available at: <https://www.fhwa.dot.gov/bridge/bip/bca/>



Q&A

# RAISE Grants

Rebuilding American Infrastructure with Sustainability and Equity

A dark blue background featuring silhouettes of several people sitting around a long table in a meeting room, with large windows in the background. The scene is dimly lit, emphasizing the shapes of the individuals.

# QUESTIONS?