November 17, 2023

TO: Federal Highway Administration

FROM: Joe Cortright, City Observatory

RE: Analysis of Interstate Bridge Replacement Benefit Cost Study

City Observatory has reviewed the Benefit Cost Study for the Interstate Bridge Replacement project submitted in connection with the Oregon Department of Transportation (ODOT) and Washington State Department of Transportation (WSDOT) application for Federal funding for the Interstate Bridge Replacement Project (IBR).

Our review shows that there are numerous errors, omissions and undocumented assumptions in this study, and that the true benefit cost ratio for this project is much less than one. This is important because the benefit cost analysis is used by FHWA to determine whether a project is cost-effective. ODOT's study claims that this project will have a benefit cost ratio of 1.5 to 1, therefore meeting the requirement that it demonstrate that this project is cost-effective. USDOT may approve an Infra Grant request only if it is shown to be cost-effective:

As federal statute creating INFRA (23 U.S.C. 117 (g) (2)) provides:

> (g) Project Requirements. The Secretary may select a project described under this section (other than subsection (e)) for funding under this section only if the Secretary determines that-
> . . .
> (2) the project will be cost effective,

As USDOT responded to GAO audit of the program,

> . . . DOT clarified that it would determine a project to be cost-effective if its benefit cost ratio was greater than or equal to one.
> GAO, DISCRETIONARY TRANSPORTATION GRANTS DOT Should Clarify Application Requirements and Oversight Activities, April 2022.
> https://www.gao.gov/assets/gao-22-104532.pdf, page 1

This requirement is clearly laid out by USDOT in its public application materials explaining the INFRA program.

> **What are the requirements for large projects that receive INFRA grants?**
>
> The Department may select a large project under the INFRA Grant Program only if the Department determines that:

> . . .
>
> - the project will be cost effective,
>
> . . .

https://www.transportation.gov/policy-initiatives/infra/infra-grants-faqs

The materials submitted by ODOT and WSDOT in support of this claim contain significant and material errors and omissions which exaggerate benefits and understate costs. After correcting ODOT's calculations for these errors, the proposed project has a benefit cost ratio of less than one, meaning that it is not economically cost effective.

This memorandum details the errors in the submitted estimates of project benefits and costs, and also identifies other issues in the benefit cost analysis that fail to comply with USDOT guidance.

Benefits

ODOT has overstated the benefits of this project

A majority percent of the calculated benefits of this project are attributed by the BCA to travel time improvements and congestion reduction, seismic resiliency and safety benefits.

Travel Time and Congestion Cost Benefits

The BCA claims that the project will produce travel time benefits with a net present value of approximately $2.4 billion. These estimates are derived from highly aggregated reported modeling from the regional travel demand model. The BCA offers the following description of its analysis:

> The IBR Program **study area** is the approximately 5-mile section of I-5 between the State Route (SR) 500/39th Street interchange in Vancouver to the north and the Interstate Avenue/Victory Boulevard interchange in Portland to the south. . . .
>
> The Program will benefit the tens of thousands of private travelers, commuters, and commercial vehicles projected to use the I-5 corridor and surrounding roadway network on a daily basis. The BCA relies on summary of results derived from the Regional Travel Demand Model (RTDM), which focuses on regional travel, and a separate microsimulation (VISSIM) model, which provides an enhanced simulation of traffic operations **in study area**. The RTDM is run by Oregon Metro (Metro), the metropolitan planning organization (MPO) for the Portland, Oregon, region and Southwest Washington Regional Transportation Council (RTC), the MPO for Clark County,

> Washington. As part of project development and National Environmental Policy Act (NEPA) process, the RTDM and VISSIM models were used to estimate impacts of the IBR Program on vehicular, transit, and active transportation trips **in the study area**.
> (BCA, page 16, emphasis added).

The BCA provides a map of the study area, as follows:

Benefit-Cost Analysis Narrative

Figure 2. IBR Study Area

1. Travel speed improvements are imperceptible and may have no economic value

According to the Benefit Cost Analysis, the average travel speed in the study area will change by less than one mile per hour between the Build and No-Build Alternatives. According to the BCA, average travel speeds in the study area will be 32.7 miles per hour if the project is built, and 32 miles per hour if it is not. This level of improvement is likely to be imperceptible to most travelers. For example, on a typical five-mile trip, the difference between 32 miles per hour and 32.7 miles per hour is just 20 seconds—time savings that are not large enough to have any meaningful utility to consumers. In economic terms, the benefits are "infra-marginal"—too small to be perceived as economically significant.

I-5 Study Area-Build and No-Build Travel Distances and Times, 2045

	Build	No-Build	Change
Miles (VMT)	14,211,373	14,921,079	-709,706
Hours (VHT)	434,037	466,199	-32,162
Average Speed	32.7	32.0	0.7
Time to Travel 5 Miles	9:18	9:38	0:20

BCA Spreadsheet, Tab: Automobile Travel

2. Vehicle occupancy is overstated

The IBR Project uses a passenger vehicle occupancy estimate of 1.67 persons per passenger vehicle to compute the number of hours of delay. The FHWA guidance directs that benefit cost analyses use factors more narrowly appropriate for the time period of travel. Specifically: for peak hour travel, FHWA directs agencies to use a factor of 1.48 persons in peak hour travel (USDOT Benefit cost Guidance, Table A-4). This factor alone would reduce benefits associated with travel time reduction by 11 percent.

3. Traffic diversion to I-205 is not analyzed

As described in the BCA, the study area is shown to be I-5 in Vancouver and North Portland and adjacent roads. IBR, in a response to a public records request, admits that it did not analyze traffic volumes on I-205 in its benefit cost analysis:

> BCA Traffic Projections- **river crossing volumes** for the no-build/no-bridge scenario and volume **for any I-205 scenario were not analyzed**.

Washington State Department of Transportation, Response to P013510, October 30, 2023.

In its benefit cost analysis, IBR concedes that the effect of tolling will be to divert traffic to I-205.

> The Build scenario assumes tolling for the highway river crossing. The added cost from inclusion of tolls causes a reduction in I-5 auto trips as people shift to transit, **use the alternative I-205 crossing**, or change their destination to avoid the crossing.
> *Benefit Cost Analysis Narrative*, page 7. (Emphasis added).

While IBR did not include any analysis of diversion in the Benefit Cost Analysis, modeling done by and for IBR as part of its planning efforts confirms that tolling I-5 will divert substantial volumes of traffic to I-205.

IBR has commissioned Stantec to prepare a "Level 2" traffic and revenue study for the IBR. This "Level 2" travel demand modeling predicts that traffic on IBR tolling will reduce traffic on I-5 to an annual level 40.7 million vehicles, which corresponds to an average weekday traffic count of approximately 116,000 vehicles. The IBR forecasts that in the "No-Build" scenario that 176,000 vehicles per average weekday will use I-5. That means that about 60,000 fewer vehicles will use the I-5 bridge in the tolled, build scenario.

Metro, the regional government and maintainer of the region's travel demand model used by IBR and Stantec for their forecasts, predicts that reductions in traffic on I-5 result in about 55 percent of the reduced traffic shifting to the I-205 bridge. This means that in 2045, about 33,000 vehicles (.55 * 60,000) that would otherwise use I-5 would divert to I-205. For nearly all of the vehicles shifting from the I-5 bridge to the I-205 bridge, this means a longer trip (the logic of the transportation demand model is that the shift is caused by persons who value their time at less than the proposed toll levels; absent the IBR project tolls they choose the shorter of the two routes).

Tolling I-5 will increase traffic on I-205 33,000 vehicles per day are diverted from the I-5 bridges to the I-205 crossing this will increase total travel times, increase total vehicle miles traveled and increase pollution associated with these journeys.

The IGA is deficient because it only reports on travel in the project area, which maps show is a narrow corridor corresponding to I-5 in Portland and Vancouver, and excluding the parallel I-205 corridor to which trips would be diverted. Nothing in the cost benefit analysis acknowledges or examines the extent to which diverted trips would increase travel times, vehicle miles traveled, and pollution.

This modeling confirms the results of Investment Grade Analysis prepared for the earlier iteration of this project by CDM Smith shows that traffic will divert from I-5 to I-205. The CDM Smith Study showed that tolling I-5 would divert tens of thousands of trips per day to I-205.

This diversion effect was also documented by other research, including some performed by ODOT and WSDOT, that anticipated toll levels would cause traffic to shift to the I-205 bridge.

Survey research commissioned by the Oregon and Washington transportation departments (and paid for in part with federal transportation funds) disclose that many travelers currently using the I-5 bridge will divert to other routes, notably the I-205 bridge.

ODOT and WSDOT commissioned focus groups of area travelers; the study concluded:

> "Over half of the participants said they would not be willing to pay a $2-$3 toll to cross the bridge "if you also gained more dependable travel time between Vancouver and Portland."
> DHM Research, Columbia River Crossing Project/Washington & Oregon Focus Groups Report, October 2006, page 6.

Local news media organization KATU also paid for a scientific random sample poll conducted by Survey USA). It asked how regular bridge users would respond to tolls.

> "If a new bridge is built and a toll is charged, what would you be most likely to do? Use the bridge? Drive out of your way to avoid the bridge? Take mass transit? Or do something else?"
>
> Of regular bridge users:
>
> Use the bridge: 41%
> Drive out of your way to avoid paying the toll: 42%
> Take Mass Transit 9%
> Don't Know 8%
>
> Geography: Portland, OR DMA Sponsor:
> Data Collected: 01/23/2008
> Release Date: 01/23/2008
> Results of SurveyUSA New Poll #13244 – Page 2

Added delay for travelers on I-205

The addition of 30,000 vehicles to I-205 represents not merely longer trips and additional travel time for those cars that divert, the added level of traffic will create congestion on I-205 and cause slower speeds and longer travel times for the estimated 220,000 vehicles per day that will travel on I-205 in the future.

In its public comments on this question, IBR officials maintain that congestion on I-205 can be reduced by extending tolls (and/or congestion pricing, through the proposed Regional Mobility Pricing Program) to I-205. If tolling I-205 is required to mitigate this diversion, then these tolls should be viewed as an additional cost of the I-5 project, and should be included in the cost-benefit analysis. Absent the construction of the IBR, and its imposition of tolls on I-5, there would be no toll-driven diversion, and hence no need to impose tolls to manage additional congestion.

Safety Benefits

The IBR project claims that the IBR project will produce $53 million (present value) in safety benefits because of a purported 17 percent reduction in crashes on I-5.

1. The source 17 percent crash reduction figure is not documented. The IBR project benefit cost spreadsheet attributes the reduction to an analysis based on the purported application of the ISATe methodology, but the attached report doesn't document how the 17 percent crash reduction was calculated using ISATe. The narrative contains no analysis explaining which features of the IBR project are supposed to generate this reduction in crash levels.

   In addition, the ISATe methodology does not apply to freeways with ramp-metering. The ISATe Manual (page 3) states:

   > The predictive method for freeways does not account for the influence of the following conditions on freeway safety: . . .
   >
   > - Ramp metering. . . .

   The existing I-5 freeway has ramp-meters which mean that the ISATe methodology does not accurately predict the effect of safety improvements.

   Also, to be valid, the ISATe model has to be calibrated to the roadway in question: There is no evidence indicating that the ISATe model has been properly calibrated to predict future year crashes on I-5. The ISATe model was developed based on data from other locations and time periods. According to the ISATe documentation, the model has to be adjusted or "calibrated" to reflect the level of crash risks when applied to other locations. The ISATe documentation says:

   > **Modifying Calibration Factors and Distributions**
   > The predictive models in ISATe have each been developed with data from specific jurisdictions and time periods. **Calibration to local conditions** will account for any differences between these conditions and those present at the sites being evaluated. It **ensures that the evaluation results are meaningful and accurate** for the jurisdiction.
   > A calibration factor is applied to each predictive model. **It is important that each model be calibrated for application in the jurisdiction in which the sites being evaluated are located**. A procedure for calibrating these models is described in Appendix A.
   > (ISATe User Manual, Page 14, emphasis added).

There is no indication in the benefit cost analysis that the ISATe values were calibrated to I-5. The BCA narrative makes no mention of calibration.

2. The 17 percent crash reduction figure applies only to traffic traveling in the study area on I-5, and not to traffic that diverts to other routes. Consequently, this doesn't represent the *net* change in crashes. According to the IBR's own traffic modeling, the effect of the project tolling will be to shift traffic from the I-5 to I-205, which will result in longer vehicle travel. Because vehicle miles traveled are a risk factor, the addition of VMT will likely increase crashes. The benefit cost analysis includes estimated lower numbers of crashes on I-5, but omits any calculation of the number and value of losses due to increased crashes from increased travel on I-205 and other roads. The safety "benefit" of the project can only be established by including the effects of increased crashes elsewhere.

In short, there is no valid basis for estimating $53 million (present value) crash reduction benefits from the I-5 project.

Seismic Resilience Benefits

The IBR estimates that the project will produce about $863 million (net present value) benefits by reducing the potential costs associated with the failure of the existing I-5 bridges in the event of a major earthquake in the Portland metropolitan area. These benefits would almost entirely come from three sources:

- The value of lives saved by avoiding collapse of the existing bridges ($336 million)
- The value of travel time savings avoided due to traffic delays caused by collapsed bridges ($364 million)
- The value of savings from not having to rebuild the collapsed bridges ($125 million)

Seismic Benefits: Reduced Fatalities

The BCA asserts that avoided fatalities from a bridge collapse have a net present value of $336 million. These estimates are a product of estimating the probability of a major event, estimating the likelihood of catastrophic failure of the existing bridges, estimating how many people would be on the bridge at the time of any collapse, the fatality rate for those on the bridge, and the time and cost to replace the bridge in the event of a failure. Also, the project uses a simple-minded "expected value" calculation to evaluate this complex and extremely low-probability set of events.

Several of the IBR's assumptions are not independently documented, i.e. the likelihood of a major seismic event, the probability of bridge failure, the likely fatality rate on the bridge. Instead, IBR consultants have inserted their own undocumented assumptions. In addition, the IBR has over-estimated the number of vehicles and persons on the I-5 bridges, because they over-stated the length of the bride structures.

Probability of a major seismic event. IBR has settled on 1.06 percent as the likelihood of a major seismic event affecting the bridges. A recent study commissioned by the Washington State Department of Transportation (Kortum, et al, 2022) has revised previous seismic vulnerability estimates for highway structures in Washington State and finds that the Vancouver area (which includes the I-5 bridges) is at substantially lower risk of a severe seismic event than previously thought. The IBR benefit cost analysis makes no mention of this study. The Oregon Department of Geology and Mineral Industries reports that the estimated likelihood of a major Cascadia Subduction event is 7-12 percent in the next 50 years—this is considerably lower than the probability used in the IBR assessment. DOGAMI also reports that major earthquakes in similar zones have been preceded by substantial foreshocks that may provide an opportunity to minimize casualties from a major quake.

Probability of bridge collapse. IBR has assumed that in *any* major seismic event, both bridges will collapse completely. While there is a risk that both bridges collapse completely, this cannot be known with any certainty. The bridges may avoid a collapse entirely, or may experience only a partial failure, or loss of one or two spans, or structural damage other than a complete collapse. IBR officials have no reasonable basis for asserting that both bridges would collapse fully in a 100-year probability event.

Probability of fatalities: IBR assumes that 90 percent of those on the bridge will die. The IBR offers no basis for this estimate. We correct this estimate by assuming only 50 percent fatalities in the event of a bridge collapse.

Number of vehicles and persons on the bridge. IBR estimates that there will be about 342 people on the bridge, on average, at any time. This is based on vehicle travel times on the bridge and the length of the bridge. IBR uses unrealistically low travel speeds (averaging 30 MPH), and treats the bridge as if it were 1.5 miles long, when in fact the bridge structure is just 3,500 feet long. Correcting for these errors reduces the number of people on the bridge at any one time to 150. In addition, the IBR estimates vehicle occupancy at 1.67 persons per passenger vehicle; US DOT benefit cost guidelines direct 1.48 persons per passenger vehicle should be used in benefit cost analyses. The IBR spreadsheet indicates that this adjustment to vehicle occupancy would reduce estimated fatalities by a further 11 percent.

Consequently, because of all of the extreme assumptions used by the IBR BCA, the results presented are not robust. If the likelihood of serious quake is 0.5 percent (once in 200 years, more consistent with the geological evidence) rather than one percent, if just half of the span collapses, if the death rate on the collapsed spans is 50 percent rather than 90 percent, then the total number of deaths would be fewer than 40 rather than more than 300. The following table shows that more realistic assumptions about the probability of a major seismic event, the fatality rate on the bridge, and corrected estimates of the number of persons on the bridge at any one time (with the correct length of the bridge and correct automobile occupancy) would reduce the net present expected value of life lost due to a seismic event by more than $300 million.

	IBR Estimate	Corrected
Value of a Life	$ 11,800,000	$ 11,800,000
Persons On Bridge	342	150
Fatality Rate	90%	50%
Annual Probability of Major Seismic Event	0.0106	0.005
Fatalities	308	75
Occupancy Adjustment		-11%
Adjusted Fatalities		67
Net Present Value	335,716,721.28	34,501,923.55

Seismic Benefits: Avoided additional travel time if bridges collapse

The IBR BCA asserts that travelers will incur costs with an expected net present value of $364 million for in the event of a collapse of the I-5 bridges due to a seismic event. This estimate is based on modeling that assumes no changes in travel demand for trips across the Columbia River. The IBR modeling asserts that closure of the I-5 bridges in 2045 would produce an 45 percent increase in total vehicle hours of travel in the study area—195,000 additional vehicle hours of travel per day (Intermediate Calculations: G629:G630) compared to a base estimate of 425,000 vehicle hours (Automobile Travel:I45) of travel per day in 2045.

This assumption flies in the face of demonstrated scientific knowledge about the responsiveness of travel demand to the availability of infrastructure. Reduced capacity and longer travel times will result in lower trip-making and shorter trips. There is a wide body of literature establishing the scientific basis of "induced demand"—that the provision of highway capacity induces additional vehicle travel (see Duranton & Turner, 2011). In addition, there is an inverse phenomenon: the elimination or removal of road capacity results in a reduction in vehicle travel. People substitute alternate means of travel, go to other destinations, take fewer trips, and over long periods of time, have different home and work locations. The well-studied experience with "carmaggedons" shows that a significant portion of observed traffic simply evaporates in the face of reduced roadway capacity (Goodwin 2002, Levinson 2010). That has been exactly the experience with past closures of the I-5 bridges for maintenance in 1997 and 2010. ODOT predicted extensive congestion and travel delays, but traffic almost immediately adapted and long delays did not occur (Cortright, 2020). If the I-5 bridges were unavailable, there would be a significant decline in traffic across the Columbia River, and travelers would not experience the predicted prolonged travel times erroneously forecast in this model (which does not allow demand to decline in response to a reduction in capacity). There is no evidence that these foregone trips would be valued as equal to the travel time losses associated with the unrealistic assumptions about demand not responding to a lack of infrastructure. As a result, claims that there would be extensive benefits to preventing lengthy travel times in the event of a bridge collapse should be deeply discounted.

Regardless of the accuracy of the travel forecasting, the estimated value of added travel time due to a possible bridge collapse is inflated by two other factors: the overstated risk of bridge collapse due to a seismic event and the incorrect vehicle occupancy assumptions. If the seismic risk is 0.5 percent per year rather than the 1.06 percent per year used in the BCA, the net present value of time savings is reduced by half. In addition, these estimates are also exaggerated by the use of a vehicle occupancy factor of 1.67, which is 13 percent higher than the 1.48 vehicle occupancy factor prescribed by US DOT. Correcting for the exaggerated seismic risk and the exaggerated vehicle occupancy would reduce the estimated time loss by 58 percent, even before correcting for the failure to correctly model the behavioral response to reduced capacity.

Seismic Benefits: Avoided Bridge Replacement Costs

The IBR asserts that in the event of a major earthquake the entire bridge would be destroyed and could not be repaired, and would have to be replaced. It asserts that the cost of a replacement bridge would be $2,155 million. (BCA, page 33). Given the predicted likelihood of a collapse the net present value of these savings is asserted to be worth about $125 million.

The IBR has estimated that the construction cost of replacing the existing river span is about $500 million. In November of 2022, the Interstate Bridge Replacement team (a collaboration of the Oregon and Washington highway departments), released a document called the “River Crossing Option Comparison” sketching out the advantages and disadvantages of several different alternatives crossing the Columbia River. The alternatives examined included tunnels under the river, and a series of bridge designs—two different moveable span bridges, and two fixed spans, a high level and mid-level (116-foot clearance crossing.) Here’s the bottom line of the report—buried away on page 50 of a 68-page PDF file—the IBR’s preferred design, a mid-level fixed span, is supposed to cost $500 million.

Mid-level Fixed

- Construction cost of two 450-foot fixed spans: $70 million
- Total bridge cost (Pier 1-8): **$500 million**

Total bridge replacement cost would be much lower than estimated by IBR. Given that any potential replacement would occur in some later year, the net present value of the cost of replacement would be lower. The net present value of the replacement cost of the bridge at a $500 million price tag in 2021$ would be approximately $29 million, not the $125 million estimated in the Benefit Cost Analysis. This results in a further reduction in the estimate of resiliency benefits by $96 million.

Inappropriate Use Expected Value

Instead of using expected value, IBR should use a Monte Carlo simulation to test the combined effects of all these very low probability events and accurately assess the actual distribution of risks, rather than applying a simple and misleading linear computation. IBR should include a sensitivity analysis of each of its assumptions.

Fictitious Repair and Renovation Cost Savings

The IBR BCA assumes that the existing bridges will require $450 million in repair and rehabilitation expenses in 2034-2035, and that saving these expenses constitutes a benefit of the project.

Table 7. I-5 No Build Bridge O&M and R&R Forecasts, Millions of 2021 Dollars

Calendar Years	River Bridge		Harbor Bridge		Total No Build O&M and R&R
	O&M	R&R	O&M	R&R	
2033	$5.0 M	$0.0 M	$0.1 M	$0.0 M	$5.1 M
2034	$5.0 M	$50.0 M	$0.1 M	$0.0 M	$55.1 M
2035	$5.0 M	$350.0 M	$0.1 M	$50.0 M	$405.1 M
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The BCA provides no link to any external documentation as to the need for or plans for this expenditure or the dollar amount of the expenditure—which does not appear in any ODOT or WSDOT spending plans, such as the Regional Transportation Plan adopted by Metro. The assumption in the BCA is conveniently timed to maximize its impact on the benefit-cost analysis (any earlier expenditure would not be saved by construction of the IBR; any later expenditure would have a much lower present value). Absent valid independent documentation that such expenditures would be needed and would actually occur if the IBR was not built, these "savings" from avoided $450 million in "repair and replacement" should be excluded from the analysis. Excluding these expenditures from the analysis would reduce the net present value of project benefits by $176.5 million.

Effect of longer construction period on present value of benefits

All benefits will be reduced by a longer than expected construction schedule. The Interstate Bridge project is expected to commence construction no early than the first quarter of 2026.

The Cost-Benefit Analysis asserts that the project will be complete, and full benefits will commence in July 2033
(IBR, Written Testimony to Joint Oregon-Washington Legislative Interstate Bridge Committee Legislature, October 2023, https://apps.oregonlegislature.gov/liz/2023I1/Downloads/CommitteeMeetingDocument/277581).

IBR staff testified that construction may take as long as ten years. Testimony of IBR project deputy administrator Ray Mabey to the Oregon Legislature Joint Ways and Means Committee November 7, 2023:

> ". . . two dozen construction contracts spaced out over a period of over ten years."

If the project commences in 2026 and continues for ten years, it will not be completed until 2036, which means that all of the benefits of the project will be delayed for a further three years.

There is considerable risk to the project schedule from as yet unresolved environmental issues. Construction of the proposed river crossing requires drilling multiple shafts into the bed of Columbia River. The river is protected habitat for endangered salmon, and federal agencies restrict drilling activity to a limited "In-Water Work Window" which ranges from four months (Army Corps of Engineers) and two months (National Oceanographic and Atmospheric Administration). Yet Interstate Bridge project officials have asserted that they will be able to use a six month in-water work window, stretching from September through February. (IBR Administrator Greg Johnson). The IBR Benefit-Cost analysis omits inclusion of the project's Cost Estimate Validation Process (CEVP) report, which contains a risk register of cost and schedule risks. These risks are large, and vastly more likely than seismic risk, but are not considered in the Benefit Cost Analysis.

According to the IBR Benefit-Cost Analysis, 25 percent of the net present value of all benefits from the project occur in six months of calendar year 2033 and in the succeeding three calendar years (2034, 2035 and 2036). If, as conceded by Assistant Administrator Mabey, construction of the project takes 10 years rather than the six to seven years contemplated in the benefit cost analysis, the total benefits of the project will be reduced by that amount.

BCA_Calculations-BCA_Model-WA-Interstate_Bridge_Replacement_Program, Tab BCA Summary, Range V39:X39. NPV of benefits, 2033-2036: $1,045,366,824; NPV of all benefits $4,134,538,751.

Costs

The IBR project has understated the actual cost of the project. The IBR project 's benefit cost analysis asserts that the year of expenditure cost of the project is $4.963 billion and that this has a present value cost of $2.743 billion. A more correct and complete analysis, based on figures produced by the IBR project, shows that the actual cost (on a year of expenditure basis) of the project ranges as high as $7.5 billion. In addition, the benefit cost analysis omits other costs that will be paid besides construction costs.

FHWA guidelines provide:

- Cost data used in the BCA should reflect the **full cost** of the project(s) **necessary to achieve the benefits** described in the BCA. Applicants should include all costs **regardless of who bears** the burden of specific cost item (including costs paid for by State, local, and private partners, as well as the Federal government).
  USDOT Guidance, page 27, (Emphasis added).

The IBR project has failed to correctly state initial capital costs, has omitted excess tolling costs and has omitted operating and maintenance costs and periodic capital costs.

1. **Capital costs of highway and bridge construction are understated.**

The IBR project claims that the cost of Phase 2 capital construction is $4.9 billion in year of expenditure terms. Actual costs, per IBR, range as high as $7.5 billion.

The IBR project claims that the cost of the project is $2.7 billion in present value terms based on total construction costs of $4.9 billion in year of expenditure dollars. This estimate is not accurate or complete and is inconsistent with other cost estimates presented by The IBR project. For example, The IBR project 's own cost estimates say the cost of the project is as much as $7.5 billion (year of expenditure), which is almost 50 percent higher than the figure used in the Benefit Cost Analysis.

On a present value basis, this $7.5 million initial capital expenditure for highway construction is equal to roughly $4.15 billion.

2. **Excess Toll Collection Costs.**

Tolls constitute a major and ongoing private cost of the project and need to be fully incorporated in the benefit cost analysis. IBR has likely underestimated the amount of tolls people will have to pay, assuming its stated traffic projections are accurate. The IBR traffic projections predict that the "Build" alternative will have 175,000 vehicles per day in 2045. The IBR "Level 2" traffic and revenue survey estimates that tolls in 2045 will average about $4.40 per vehicle, and will produce about $1.78 million annual gross toll revenues per 1,000 vehicles per day traveling across the I-5 bridge.

To be clear, IBR has produced two mutually exclusive projections of future traffic on the I-5 bridges. Its "Level 2" projections predict traffic will be just 115,000 vehicles per day in 2045, while its promotional projections for the project claim that traffic will be 175,000 vehicles per day. If IBR's higher figures—which are being used to justify the size of the project and the expenditure of federal funds—are accurate, this means that it will collect considerably more toll revenue than described in the Level 2 forecasts.

At 175,000 vehicles per day in 2045, and with a growth in traffic consistent with the Level 2 forecast through 2055, the net present value of total toll collections for the Interstate Bridge Project from 2026 through 2055 would be about $2.3 billion. This is approximately $1 billion more in toll collections that the expected contribution of toll revenues to net project construction costs ($1.3 billion, per IBR financial plans.). These excess toll revenue collections represent a cost to the public for this project.

In addition to excess toll collection costs associated with the I-5 bridge, it is likely, as explained above, that once the IBR project begins tolling on I-5, there will be massive diversion to the I-205 bridge, and that in order to manage that level of congestion, Oregon and/or Washington will have to impose tolls on the I-205 bridge. These toll costs should be included in the benefit-cost analysis of the IBR project.

3. Operating and maintenance and periodic capital costs of toll system are omitted.

The IBR project 's "cost" estimate for the IBR project includes only initial capital costs. This is contrary to USDOT guidance:

> "The O&M costs of the new or improved facility throughout the entire analysis period should be included in the BCA, and should be directly related to the proposed service plans for the project." (USDOT Benefit Cost Guidance)

The IBR project 's Level 2 Toll and Revenue Forecast reports that The IBR project will spend between $30 and $60 million annually operating the toll collection system, including, including contracting for toll assessment and collection, bank fees, and maintenance and staffing of the toll operation. The present value of these costs is $300 million.

Corrected Benefit Cost Analysis

The following table summarizes our analysis of the errors in The IBR project 's benefit cost analysis. Data are drawn from the preceding text. The IBR project analysis overstates the actual benefits of the project by about $2 billion in present value. The IBR project analysis understates the costs of the project by $2.3 billion in present value. As a result, the project has a negative benefit cost outcome: The costs of the project exceed its benefits by $3 billion in present value**. The benefit cost ratio is well below one (the minimum for meeting the statutory requirement of cost-effectiveness).** Each dollar spent this project costs produces only 40 cents in benefits for society. In the event that the project is delayed, three years, as seems likely given the track record of the sponsoring agencies and the challenges of the In-Water Work Window, the extended construction period would reduce the present value of benefits by about 25 percent, lowering the benefit/cost ratio to about .30. This is a value-destroying project that makes us worse off.

IBR and Corrected Benefit Cost Summary		
Millions of 2021$, Net Present Value		
	IBR BCA	*Corrected*
BENEFITS		
Travel Time Savings	2,513	2,237
I-205 Diversion		(404)
I-205 Congestion		(586)
Resiliency		
Life Lost	335	35
Added Congestion	364	153
Replacement Cost	125	29
Repair Savings	177	-
All Other	621	621
TOTAL BENEFITS	4,134	2,084
Delay in Benefits @25%	3,101	1,563
COST		
Construction Cost	2,740	4,150
Excess Toll Revenue Collections		1,000
TOTAL COSTS	2,740	5,150
B/C Ratio	1.51	0.40
Net Benefits	1,394	(3,066)
With Delay in Construciton		
B/C Ratio	1.13	0.30
Net Benefits	361	(3,587)

Failure to separately analyze different project components.

Many of the asserted benefits are attributable only to the tolling portion of the project. The IBR project has combined a freeway expansion (which produces few if any benefits, and which accounts for most project costs) with a tolling project (which accounts for nearly all of the travel time benefits, and little of the project's capital costs). Each of these components of the project have independent utility as transportation investments, and should be assessed separately, rather than combined.

The USDOT rules governing the INFRA grant program call for separately reporting the eligibility, including cost-effectiveness, of each of the independent parts of a proposed project.

> VIII. Statutory Project Requirements
> To select a project for award, the Department must determine that the project—as a whole, as well as each independent component of the project— satisfies statutory requirements relevant to the program from which it will receive an award. The application should include sufficient information for the Department to make these determinations for both the project as a whole and for each independent component of the project. Applicants should use this section of the application to summarize how their project meets applicable statutory requirements and, if present, how each independent project component meets each of the following requirements.
> Federal Register/Vol. 87, No. 58/Friday, March 25, 2022/17108 at 17122.

This requirement is echoed in the US DOT Benefit Cost Guidance.

1. USDOT discretionary grant programs often allow for a group of related projects to be included in a single grant application. In many cases, each of these projects may be related, but also have independent utility as individual projects. Where this is the case, each component of this package should be evaluated separately, with its own BCA.

   Highlight the results of the benefit cost analysis, as well as the analyses of independent project components if applicable. The Department will base its determination on the ratio of project benefits to project costs as assessed by the Economic Analysis Team.
   USDOT Benefit Cost Guidance, page 11: (Emphasis supplied)

Congestion pricing has independent utility from the reconstruction and widening of the roadway. The Oregon Legislature directed that tolling be applied to this and other portions of I-5, irrespective of whether this project was built. Elsewhere in this region, ODOT has separately analyzed the implementation of road pricing and freeway widening. The tolling and highway widening/bridge reconstruction portions of the project have independent utility and therefore should be evaluated separately under FHWA guidelines.

The IBR project has combined two distinct projects—road pricing and freeway widening—into a single project. Nearly all of the supposed benefits from the project stem from the congestion reducing aspects of road pricing. The fact that these are two independently useful projects is proven by the fact that tolling is planned to be implemented in 2027, at least five years before the remaining work on the project is completed; tolling is slated to commence even prior to construction of the river crossing and freeway widening. As a legal matter, Oregon already has authority under the value pricing demonstration project to implement tolling on I-5, and has legislative direction to implement pricing (enacted in 2017).

The BCA makes it clear that essentially all of the travel time benefits come from tolling I-5, not widening the roadway. The principal source of benefits in the BCA is travel time savings, estimated at a net present value of $2.4 billion (60% of total benefits). These travel time savings are claimed based on a reduction in hours of travel between the "Build" and "No-Build" Alternatives. The BCA presents travel time estimates for the "Build" and "No-Build" scenarios for the year 2027. Because the new crossing will be under construction, and not completed until 2033 (or later), the only difference between the "Build" and "No-Build" traffic estimates has to do with the imposition of pre-completion tolling on I-5. The BCA makes it clear than all of the net benefits in terms of vehicle hours of travel reduction occur in 2027, due to tolling, not due to construction. (BCA, Tab:AutomobileTravel:F6:M13).

Daily Vehicle Hours of Travel Study Area	
BCA: Tab: Automobile Travel	
Scenario	Daily VHT
2027 Build	353,106
2027 NoBuild	408,913
2045 Buld	385,795
2045 No Buid	436,514
2027 Savings	32,688
2045 Savings	27,601

In 2027, the "Build" scenario—which in this year consists only of tolling, and no added capacity—results in savings of more than 32,000 vehicle hours of travel per day (the difference between the "No-Build" travel of 408,000 and the Build travel of 386,000). The difference between the two scenarios is even less in 2045. Consequently, it is the tolling, and not the expenditure on capacity expansion, that results in travel time savings.

This is a general finding for tolled projects: road pricing, not capacity expansion, produces travel time savings. In a similar project proposed for federal funding, The Oregon Department of Transportation told USDOT:

> Demand management through **tolling significantly improves congestion outcomes** . . .
>
> Value of Travel Time savings, or Vehicle Hours of Driving (VHD) benefits are calculated from traffic studies on pre-pandemic traffic levels and modeled traffic volumes **under the addition of tolling**. These traffic figures are provided by WSP USA and their Transportation Engineering team. Volume growth under the baseline is limited by congestion and lack of additional lanes, while **volume growth under the Build scenario sees slower growth over time due to the ability of tolling to manage demand.**
> ODOT, I-205 Benefit Cost Analysis Narrative, 2022 (Emphasis supplied)

Most of the costs of the IBR are associated with capacity expansion (i.e. widening the river crossing, and expanding the capacity of intersections and approach roads). If the IBR project were to separately analyze these two project components—pricing and capacity expansion--each of which has independent utility, it would show that tolling alone has a much more favorable cost-benefit ratio than tolling combined with added capacity. What the IBR project has done is to combine tolling (which produces the lion's share of benefits) with additional costs which produce few benefits.

The IBR project should re-submit its benefit cost analysis, showing separately the benefits and costs for the tolling component and the road-widening component. Based on the figures presented above, the tolling-only project would have a much more favorable benefit cost ratio than the road expansion/bridge replacement portion of the project.

Failure to Analyze Distribution of Benefits and Costs

FHWA's Guidance on Benefit Cost Analyses recognizes that projects can impose undue costs on some groups and encourages applicants to submit an analysis of the distributional effects of any project:

> Projects may even result in some parties being made worse off, even in cases where the proposed project would deliver positive net benefits in the aggregate. While these distributional impacts would not affect the overall evaluation of benefits and costs, applicants are encouraged to provide information (such as the demographics of the expected users or by distinguishing between public and private benefits) that would help USDOT better understand how the project can meet these other public policy goals. (USDOT, Benefit Cost Guidance Page 31).

The IBR project 's benefit cost analysis provides no information on the distributional effects of the I-5 project.

The IBR project 's report contains no analysis of how the benefits and costs of the project inure to different demographic groups. According to the IBR project, the bulk of congestion occurs during AM and PM peak hours; In off peak hours, traffic moves at (or above) the posted speed limit. Consequently, the travel time savings from the project will chiefly accrue to peak hour travelers, and not to off-peak travelers. Yet non-peak travelers will also have to pay tolls to finance the project, even though the bulk of benefits go to peak hour travelers.

The IBR project omits an analysis of toll payments by hour of day so it is not possible to disaggregate toll payments made by peak and non-peak hour travelers. However, ODOT's own Level 2 study for the nearby I-205 project shows that peak hour travelers will reap 100 percent of the travel time benefits of the project, but will pay only about 46 percent of the tolls charged to weekday users. Conversely, off-peak hour travelers will get zero travel time benefit (their travel times will remain unchanged from No-Build conditions), but they pay the majority (54 percent) of the tolls to finance the project. This imbalance would be even wider if we were to include tolls paid by weekend travelers who are also expected to get no travel time savings, but pay the same tolls as weekday travelers.

Distribution of Benefits & Costs, Weekday Travelers (I-205 project)

Annual Weekday Traffic, Toll Collections and Travel Time Benefits, 2027			
	Daily Vehicles	Annual Tolls	Travel Time Benefits
Peak	54,000	$ 29,800,000	$ 18,400,000
Off-Peak	94,000	$ 44,300,000	$ -
Total	148,000	$ 74,200,000	$ 18,400,000

Vehicles include counts of numbers of vehicles crossing Tualatin and Abernethy Bridges. Source: ODOT I-205 Traffic & Revenue Study data.

Roughly 60 percent of all toll revenue will come from off-peak travelers (on weekdays). Off-peak users are more numerous (about 64 percent of users). Yet all of the travel time benefits of the project accrue to peak hour users. Notably: even peak hour users have to pay more in tolls ($29.8 million) than they get in travel time benefits ($18.4 million). These calculations omit tolls paid by weekend travelers, who would also pay according to the hourly toll schedule, but according to ODOT's analysis, would also get no travel time benefits.

Census journey-to-work data indicate that higher income workers are much more likely to travel during the peak hour than lower income workers. Workers commuting to work by automobile who leave their homes during peak hours (6:30 AM to 8:30AM) have median household incomes that are about 9 percent higher than all commuter households. Those who leave for work during the off-peak hours (9:30 AM to 3:30 PM) have median household incomes that are about 21 percent below the average for all commuter households

Time Left for Work	Median Household Income, Difference from All Commuters	
Before 6.30	-3%	
630 to 830	9%	
830 to 930	4%	
930A to 330P	-21%	
330 to 530	-13%	
530 to 630	-2%	
After 630	-12%	
American Community Survey, IPUMS, 2015-19		

In effect, the toll financing structure chosen for this project taxes lower income commuters (who disproportionately travel during off-peak hours and get no travel time savings) to pay for time savings for higher income commuters. ODOT and WSDOT should be directed to provide information on the amount of tolls paid by peak and non-peak travelers, and estimate the benefits that each group receives, and provide a distributional analysis of who pays for the project as opposed to who receives its benefits.

Conclusion

The submitted benefit cost analysis is plagued with errors and mistakes that systematically overstate benefits and understate project costs. Calculated correctly, this project has a benefit cost ratio well below one, which means that it is not cost effective as required by 23 USC 117. As a practical matter, this is a value destroying project: It costs more in economic resources than it provides in economic benefits. The IBR cost benefit analysis fails to follow the guidance issued by USDOT for determining cost-effectiveness. USDOT cannot rely on this document as an accurate assessment of compliance with federal law. Approving a grant for this project relying on the submitted Benefit Cost study would be arbitrary and capricious.

Errors and Misrepresentations Violate 18 USC 1020

Moreover, the systematic and consistent nature of the omissions and false assumptions presented in the ODOT application serve to represent an unqualified project as qualified for federal funding. These materially false statements constitute a fraudulent attempt to qualify a project for federal funds for which it is not eligible. This matter should be submitted to the USDOT Inspector General to determine whether the applicants have violated the terms of 18 U.S.C. 1020, by submitting materially false information in application for federal highway construction funds.

The Preparer of the Benefit-Cost Analysis has an Undisclosed Conflict of Interest

It is concerning that the benefit-cost analysis is prepared by a private sector contractor with a direct financial interest in the construction of the IBR. The Benefit-Cost Narrative report indicates that the report was “Prepared by WSP.” Financial records obtained from the IBR project pursuant to a public records request show that WSP has current contracts to perform paid work on the Interstate Bridge Replacement Project valued at $76,282,807.03. Indeed, WSP is the single largest contractor for the project. In the event that federal funding is not forthcoming, it is unlikely that the project will proceed, and WSP will lose this lucrative source of income. WSP is not, and cannot be, an independent and objective evaluator of the benefits and costs of this project. It has a blatant conflict of interest, which is not disclosed. Inasmuch as preparation of the benefit-cost analysis relies substantially on assumptions and opinions made by the preparer for which there is considerable reasonable uncertainty and even disagreement, WSP cannot be relied up on to make such judgements. The US DOT should disregard the Benefit-Cost Analysis, and insist on the preparation of a benefit-cost analysis by a firm with no financial interest in the Interstate Bridge Project, and which is selected by a process that assures that the contractor has no present or future interest in the project or in the outcome of the benefit cost analysis.

References

Cortright, Joseph, Carmaggedon does a no show in Portland, again, City Observatory, September 28, 2020. https://cityobservatory.org/carmaggedon_trunnion/

FHWA, Notice of Funding Opportunity, https://www.federalregister.gov/documents/2022/03/25/2022-06350/notice-of-funding-opportunity-for-the-department-of-transportations-multimodal-project-discretionary

Interstate Bridge Replacement Program, *Benefit-Cost Analysis Narrative,* National Infrastructure Project Assistance (Mega) Program, August 2023. https://www.interstatebridge.org/media/1polmnhz/bca-narrative.pdf

Interstate Bridge Replacement Program, Benefit-Cost Analysis Spreadsheet.

https://www.interstatebridge.org/media/bhji01rc/bca-calculations-bca-model-wa-interstate-bridge-replacement-program.xlsx

Interstate Bridge Replacement Program, "**IBR Response to PDR P013644,"** [**Consultant contracts and billing through 9/29/2023}, November 2023.**

Goodwin, Phil, Carmen Hass-Klau and Sally Cairns, Evidence on the Effects of Road Capacity Reduction on Traffic Levels, Disappearing traffic? The story so far, Proceedings of the Institution of Civil Engineers - Municipal Engineer 2002 151:1, 13-22https://nacto.org/docs/usdg/traffic_impact_highway_capacity_cairns.pdf

Kortum, et al, 2022, "Impacts of Cascadia Subduction Zone M9 Earthquakes on Bridges in Washington State, SDOF Idealized Bridges, Final Report, Agreement T1461, Task 74 M9 WSDOT Bridges, University of Washington.

Levinson, Davd, et al, Traffic Flow and Road User Impacts of the Collapse of the I-35W Bridge over the Mississippi River, University of Minnesota, 2010, https://www.lrrb.org/pdf/201021.pdf

ODOT, Benefit Cost Narrative, I-205 Corridor Widening: Stafford Road to OR43 Benefit Cost Analysis Description, Assumptions, and Factors. (https://www.oregon.gov/odot/About/INFRAI205/I-205%20Narrative.pdf)

Oregon Department of Geology and Mineral Industries, DOGAMI Fact Sheet Cascadia Earthquake Knowledge Points for Emergency Managers and the Public, June, 2022, https://pubs.oregon.gov/dogami/fs/cascadia-planning-for-em-and-public.pdf

USDOT, 2022. Benefit Cost Guidance, "Benefit cost Analysis Guidance for Discretionary Grant Programs"

WSP, I-5 Interstate Bridge Replacement (IBR) Program, DRAFT Traffic and Net Toll Revenue Projections, Scenario A, February 15, 2023. (File obtained by public records request from WSDOT).