

CALIFORNIA LIFE-CYCLE BENEFIT/COST INTERMODAL FREIGHT ANALYSIS MODEL (Cal-B/C IF)

INTRODUCTION

This spreadsheet model provides a method for preparing a simple economic analysis of intermodal freight projects. Given input data for a project, the model calculates its life-cycle costs, life-cycle benefits, net present value, benefit/cost ratio, internal rate of return, and payback period. Annual benefits are also calculated.

The model is arranged by worksheets and contains the following information, data, and results:

<u>Worksheets</u>	<u>Contents</u>
Instructions	General model description and assumptions
1) Project Information	Project input data
2) Model Inputs	Distance traveled by mode, shipper costs, crash rates, and idle/dwell times estimated by the model
3) Results	Summary results of analysis
Shipper Costs	Calculation of shipper cost impacts
Accident Costs	Calculation of accident and crash cost impacts
Emissions	Calculation of emission impacts
Final Calculations	Calculation of net present value, internal rate of return, and payback period
Parameters	Economic assumptions, lookup tables, and other model parameters consistent across all Cal-B/C models

The model is designed so that the user generally needs to enter data only in the **green boxes** on the Project Information worksheet. The model estimates detailed shipment information and accident data for the user to review on the Model Inputs worksheet. Shipment distances are estimated from inputted freight volumes, capacity by mode and average distance to destination. Adjustments are made for the number of empty-haul trips returning to point of origin. Crashes for freight trucks are estimated from statewide averages, while accidents for rail are derived from national-level data. If available, project-specific inputs for truck crashes can be entered to override model default inputs. Summary results are shown in Results worksheet. The remaining worksheets are provided for the user to see, but the model performs the calculations automatically.

After reading the instructions in this worksheet, the user should proceed to the Project Information worksheet and input data for the specific project in the **green boxes**. The model provides default values in the **red boxes**, which can be changed by the user, if project-specific information is available. The model calculates some values based on relationships or assumptions, with results shown in the **blue boxes**. These values can be changed by the user.

INSTRUCTIONS

The user can analyze most projects simply by entering relevant data on the Project Information Sheet and getting results on the Results page. The Model Inputs page allows the user to enter more detailed data to adjust estimated distances, volumes, and crash rates, and check the various costs estimated for project.

PROJECT DATA (Box 1A)

This section provides general information about the intermodal freight project. At the top of the sheet, the user can enter information about the project, such as project name, and Caltrans district.

Project Location

- 1 Insert a 1, 2, or 3 for the appropriate region of California. This information is used to estimate the emission values per short ton.

Current Year

- 2 Enter the current year. All benefits and costs are discounted to the year entered in this cell.

Year Project Development Begins

- 3 Enter the first year in which initial project costs are incurred.

Year Project Opens (Year 1)

- 4 Enter the first year in which benefits are expected to occur.

FREIGHT CAPACITY (Box 1B)

This section allows the user to enter average capacity and distance traveled by mode and type of freight. The user is required to enter information for the type of freight and modes of transportation relevant to the project.

Average Bulk / Break Bulk Shipments (Short Tons)

- 5 **Average Short Tons per Truck:** Enter the average short tons hauled by a single freight truck in the no build case. The build case assumes the same capacity, but this may be adjusted by the user.
- 6 **Average Trip Distance (Miles, 1-Way):** Enter the average distance traveled by freight trucks to reach their destination in the no build case. The build case assumes the same one-way distance, but this may be adjusted by the user.
- 7 **Average Short Tons per Railcar:** Enter the average capacity of a railcar used to move bulk/break bulk commodities in the no build case. The build case assumes the same capacity, but this may be adjusted by the user.
- 8 **Average Number of Railcars per Train:** Enter the average number of railcars hauled by a freight train in the no build case. The build case assumes the same number of railcars, but this may be adjusted by the user.

- 9 **Average Trip Distance (Miles, 1-Way):** Enter the average distance traveled by freight trains to reach their destination in the no build case. The build case assumes the same one-way distance, but this may be adjusted by the user.

Average Container Shipments (TEUs)

- 10 **Average Number of TEUs per Truck:** Enter the average containers in Twenty-Foot-Equivalent Units (TEUs) hauled by a single freight truck in the no build case. The build case assumes the same capacity, but this may be adjusted by the user.
- 11 **Average Trip Distance (Miles, 1-Way):** Enter the average distance traveled by freight trucks shipping containers to reach their destination in the no build case. The build case assumes the same one-way distance, but this may be adjusted by the user.
- 12 **Average Number of TEUs per Railcar:** Enter the average capacity of railcars used to move containers in Twenty-Foot-Equivalent Units (TEUs) in the no build case. The build case assumes the same capacity, which may be adjusted by the user.
- 13 **Average Number of Railcars per Train:** Enter the average number of railcars hauled by a freight train in the no build case. The build case assumes the same number of railcars, but this may be adjusted by the user.
- 14 **Average Trip Distance (Miles, 1-Way):** Enter the average distance traveled by freight trains shipping containers to reach their destination in the no build case. The build case assumes the same one-way distance, but this may be adjusted by the user.
- 15 **Average Short Tons per TEU:** Adjust the conversion factor between the average freight in short tons per container (TEU) in the no build case. The default value used in the model is 10 short tons per TEU, and it assumes the conversion is the same in the build case. Both values can be adjusted by the user.

FREIGHT VOLUMES BY MODE (Box 1C)

Volumes of bulk / break bulk and containers shipped by mode relevant to the project must be entered by the user. Enter data consistent with the years defined in Box 1A. Users must ensure that total freight forecast volumes (in terms of short tons or TEUs) entered in the no build and build cases are equivalent. In other words, the Cal-B/C IF model is set up to assess modal changes for a specific amount of freight, and does not account for impacts from induced freight volumes.

Annual Bulk / Break Bulk Shipments (Short Tons)

- 16 **Current Year:** Enter the total short tons shipped by truck and rail in the current year.
- 17 **Base Year (Year 1):** The model presents calculated total short tons shipped by truck and rail in the year the project opens for both the no build and build cases once values are entered in the forecast year. The user may change these values.
- 18 **Forecast Year (Year 20):** Enter the forecasted total short tons shipped by truck and rail in the final year of the project life-cycle, defined as 20 years after the project opens.

Annual Container Shipments (TEUs)

- 19 **Current Year:** Enter the total TEUs shipped by truck and rail in the current year.
- 20 **Base Year (Year 1):** The model presents calculated total TEUs shipped by truck and rail in the year the project opens for both the no build and build cases once values are entered in the forecast year. The user may change these values.

- 21 Forecast Year (Year 20):** Enter the forecasted total TEUs shipped by truck and rail in the final year of the project life-cycle, defined as 20 years after the project opens.

Annual Increases in Freight Volumes

- 22 Bulk / Break Bulk Shipments:** The model calculates an annual increase in total bulk/break bulk volumes shipped for the no build and build cases. The values may be changed by the user to a value of higher magnitude. If the magnitude of the changed value is greater than the calculated growth rates based on the forecasted freight volumes entered by the user, the model responds by reaching the forecasted capacity (i.e., Year 20 volumes) earlier. For a lower growth rate, actual forecasted freight volumes should be revised downwards in the section above. The user is advised to use caution when changing growth rates to make sure that the no build rate is equivalent to the build rate in order to avoid generating induced volumes, resulting in an under/overestimation of benefits.
- 23 Container Shipments:** The model calculates an annual increase in container volumes shipped for the no build and build cases. The values may be changed by the user to a higher value of higher magnitude. If the magnitude of the changed values is greater than the calculated growth rates based on the forecasted freight volumes entered by the user, the model responds by reaching the forecasted capacity (i.e., Year 20 volumes) earlier. For a lower growth rate, actual forecasted freight volumes should be revised downwards in the section above. The user is advised to use caution when changing growth rates to make sure that the no build rate is equivalent to the build rate in order to avoid generating induced volumes, resulting in an under/overestimation of benefits.

FREIGHT SHIPMENTS BY MODE (Box 1D)

This section presents calculated values for total number of trucks and trains used to ship freight, the number of empty-haul returns to the point of origin, and average truck speeds. Only the average truck speeds are required to calculate emission benefits for projects involving freight trucks. All other inputs are generated by the model and can be modified.

Number of Loaded Shipments per Year

- 24 Current Year:** The model presents the total of trucks and trains in the current year, defined in Box 1A.
- 25 Base Year (Year 1):** The model presents the calculated total number of trucks and trains in the year the project opens for the no build and build cases.
- 26 Forecast Year (Year 20):** The model provides the calculated total number of trucks and trains in the final year of the project life-cycle for the no build and build cases.

Number of Empty-Haul Return Trips for Every Full Truck / Carload

- 27 Bulk / Break Bulk Shipments:** The user may adjust the number of empty-haul return trips for bulk/break bulk shipments by mode. The default value (1.0) implies that for every full shipment, there is an empty truck/train returning without carrying freight, which is a common occurrence in the industry. The empty returns generate additional safety and emission costs to the project. Values less than 1.0 imply that the trains/trucks are utilized more efficiently to carry other freight and are thus not captured as a project impact.

- 28 Container Shipments:** The user may adjust the number of empty-haul return trips for container shipments by mode. The default value (1.0) implies for every full shipment, there is an empty truck/train returning without carrying freight, which is a common occurrence in the industry. The empty returns generate additional safety and emission costs to the project. Values less than 1.0 imply that the trains/trucks are utilized more efficiently to carry other freight and are thus not captured as a project impact.

Average Truck Speed (mph)

- 29 Freight Truck Shipments:** Enter the expected average speed of freight trucks in the no build case for the year the project opens. The model assumes that the average speed remains constant over time (Year 1 and Year 20) and between the no build and build cases. This may be changed by the user.

HIGHWAY CRASH DATA (Box 1E)

This section allows the user to enter project-specific highway crash data, if available, to construct project-specific crash rates. The model uses California statewide crash rates as default values if the user does not provide information. Differences in rates between the no build and build cases can be accounted for in the Model Inputs worksheet.

Actual Historical Crash Data

- 30** In order to calculate project-specific crash rates, the user must enter the total count of observed crashes, by type of crash, for a given period of time. The total vehicle-miles traveled by trucks over the reporting period must be entered for the model to calculate the expected crash rates per vehicle-miles traveled within the project area. Counts for property damage only (PDO) crashes are derived from the total crash counts less fatal and injury crash counts.

FREIGHT SHIPPING COSTS (Box 1F)

This section allows the user to enter shipping cost information to calculate benefits from projects that involve modal diversion. Costs to ship bulk / break bulk and containers in the current year must be entered. The user may also adjust the annual increase in shipper costs. Differences between current and future costs for shipping can be adjusted in the Model Inputs worksheet.

Shipper Costs

- 31 Bulk / Break Bulk Shipping Costs:** Enter the cost per truckload and carload for the no build case. The model assumes the costs between the no build and build cases are equal, but this may be adjusted by the user.
- 32 Container Shipping Costs:** Enter the cost per TEU moved by truck and rail for the no build case. The model assumes the costs between the no build no build cases are equal, but this may be adjusted by the user.
- 33 Annual Increase in Shipper Costs (Net of Inflation):** The expected annual increase in shipping costs for long-haul trucks and freight rail for both the no build and build cases may be adjusted by the user. The model default value assumes no change in costs and no difference between the no build and build cases.

TRANSLOAD OPERATIONS DATA (Box 1G)

This section is for freight projects that include changes in transloading operations or drayage. The user should note that benefits are generated only if there is a difference in the volume transloaded / drayed between modes, or if costs or distance for transloading or drayage change between the no build and build cases.

Transload Operations

- 34 **Proportion of Volumes Transloaded:** Adjustments can be made to the proportion transloaded by mode and by shipment type. The model assumes the proportion transloaded for each mode remains constant throughout the project life-cycle. The default proportion that is transloaded is set to 100% for both modes and for both shipment types.
- 35 **Transload Costs:** The user must enter the cost to transload bulk/break bulk freight and containers per ton and per TEU respectively. Though the model assumes unit costs are equal between the no build and build cases, the user can adjust the unit costs across cases.
- 36 **Annual Increase in Transload Costs (Net of Inflation):** The expected annual increase in transload costs for both types of shipments can be adjusted by the user. The model assumes the change in costs are constant between the no build and build cases. The default value is set to 0%.

Freight Drayage

- 37 **Proportion of Volumes Drayed:** Adjustments can be made to the proportion of volume drayed by mode and by shipment type. The model assumes the proportion drayed for both modes remains constant throughout the project life-cycle. The default proportion drayed is set to 100% for both modes and shipment type.
- 38 **Distance Drayed (Miles, 1-Way):** The user must enter the distance drayed for the no build case. Though the model assumes the distance is the same across the no build and build cases, the user can adjust the distances across cases.
- 39 **Drayage Costs per Truck:** The user must input the drayage cost per truck for the no build case. The model assumes costs are the same between the no build and build cases, but this may be adjusted by the user.
- 40 **Annual Increase in Drayage Costs (Net of Inflation):** The expected annual increase in drayage costs for both the no build and build cases may be adjusted by the user. The model default assumes no annual increase in costs and no difference between the no build and build cases.

Average Freight Truck Speed for Drayage (mph)

- 41 Enter the average speed for trucks used to dray freight in the no build case for the year the project opens. The default model assumption is that truck speeds are constant throughout the project life-cycle in both the no build and build cases. This may be changed by the user.

CHANGES IN TERMINAL EFFICIENCY (Box 1H)

This section is for freight projects that impact terminal efficiencies, captured through reduced delay or dwell time.

Average Delay / Dwell Time per Vehicle

- 42 **Average Minutes:** Enter the average minutes of delay per truck and per train for the no build and build cases.
- 43 **Annual Increase in Average Delay / Dwell Time:** The model assumes that for each mode, the annual increase in delay/dwell time is the same between the no build and build cases. The default is set to 0%, and can be changed by the user. The user should note that a positive rate would imply an increase in delay/dwell times, while a negative rate would imply a decrease in delay/dwell time.

Average Operator Cost per Hour of Delay

- 44 **Average Operator Cost per Hour of Delay:** The user enters the average cost of freight truck and train delays for both the no build and build cases.
- 45 **Annual Increase in Operator Costs (Net of Inflation):** The model assumes that the annual increase in the cost of delays for both modes are the same between the no build and build cases. While the default is set to 0%, it may be adjusted by the user.

PROJECT COSTS (Box 1I)

Net project costs should be entered in the years they are expected to occur. Costs can be entered from the start of the project development period through 20 years after the project opens. All costs should be entered in thousands of dollars.

Average Delay / Dwell Time per Vehicle

- 46 Enter project's initial costs in constant dollars for project development, right-of-way, and construction.
- 47 Enter estimated future incremental maintenance/operating and rehabilitation costs in constant dollars. These figures should be entered in the years after the project opens.
- 48 Enter estimated mitigation costs (e.g., wetlands, community, and sound walls) in constant dollars during construction and for 20 years after construction completion.
- 49 Enter any other agency costs or (savings) not already included.

FREIGHT VOLUME INPUTS (Box 2A)

This sections allows the user to review the detailed trips, volumes, and shipping costs by mode and shipment type, estimated by the model. The values are estimated from the inputs provided in boxes 1B, 1C, and 1F in the Project Information sheet.

- 50 The user may enter new distance values and ton-mileage by mode and by shipment type. The user values should be entered in the green boxes to override model calculations, if project-specific values are available. The model estimates distance traveled (full and empty-haul), and ton-mileage in Year 1 and Year 20, under the no build and build cases. Distance traveled is estimated using total volume, freight capacity, and adjustments for empty-hauls. Ton-mileage is estimated using freight volumes and the average distance traveled.
- 51 The user may enter new shipping costs by mode and by shipment type. The user values should be entered in the green boxes to override model calculations, if project-specific shipping cost values are available. The model estimates shipping costs in Year 20.

TRANSLOAD OPERATIONS INPUTS (Box 2B)

This sections allows user to review detailed transload costs, distance drayed by shipment type, number of trucks used for drayage, and dray costs. These values are estimated from information provided in boxes 1B, 1C, and 1G in the Project Information tab.

- 52 The user may enter new transload costs per ton/TEU and drayage costs per truck movement. The user values should be entered in the green boxes to override model calculations, if project-specific data on transload and drayage costs are available. The model estimates the respective costs in Year 20 under the no build and build cases. The costs are estimated using the Year 1 user-defined costs and the annual increase in costs.
- 53 Distance drayed and trucks used for drayage can be adjusted by the user. The user may enter new values in the green boxes to override model-calculated distances and number of trucks, if project-specific information on drayage is available. The model estimates these values in Year 1 and Year 20, under both the no build and build cases. The distance drayed is calculated using the total volume drayed, truck capacity, and the average distance drayed. The number of trucks is derived using total volumes drayed and average freight truck capacity. The user should note that the model assumes truck capacity for long-haul movements and drayage are the same.

TERMINAL EFFICIENCY INPUTS (Box 2C)

This sections allows the user to review detailed annual idle/dwell time estimates and the operating cost per hour by mode. These values are estimated from information in boxes 1B, 1C, and 1H.

- 54 The model estimates operating costs per hour by mode. The user may enter new values in the green boxes to override model-calculated operating costs. While the model presents the hourly operating costs in both Year 1 and Year 20, the Year 1 values are extracted directly from the Changes in Terminal Efficiency section (Box 1H). The model calculates the Year 20 values for both the no build and build cases, using Year 1 operating costs and the associated annual growth rate.
- 55 The calculated annual idle / dwell time per mode can be replaced with project-specific values. The user may enter new values in the green boxes to override model-calculated values. The model calculates the idle / dwell time for Year 1 and Year 20, in both the no build and build cases. These values are estimated using the volumes and freight capacity by mode, along with their respective average delay times and annual increase in delays. The values are annualized to provide a value of idle / dwell time per year.

CRASH RATE INPUTS (Box 2D)

Users may adjust the crash rates for freight trucks used by the model. These values are calculated from box 1E.

- 56 **No Build:** Fatal, injury, and PDO crash rates for no build case are extracted from the values in Highway Crash Data (Box 1E) in the Project Information sheet. The user may change these rates in the green boxes.
- 57 **Crash Reduction Factors:** If the project is expected to change the crash rates for fatal, injury, and/or PDO crashes the user can adjust the Crash Reduction Factors. The default is set to 1.00 implying there is no difference between the no build and build cases.

The user should note that a factor greater than 1 implies an increase in crashes, while a factor between 0 and 1 implies a reduction in crashes.

- 58 **Build:** The user may modify the fatality, injury, and PDO crash rates for freight trucks in the build case. The model estimates these crash rates using the crash rates under the no build case and the crash reduction factors for the respective crash types.

NEXT STEPS

- 59 Summary results are available immediately in the Results worksheet.