
Executive Order B-30-15 requires state agencies to consider climate change in planning and investment decisions. In order to address this Executive Order, Caltrans now requires project-level Greenhouse Gas (GHG) emission calculations for all SHOPP projects.

“Under the new requirements of Executive Order B-30-15, Caltrans will need to define project-level performance in the Project Initiation Document (PID) work plan and SHOPP Tool, and PIDs must demonstrate project-level performance to be eligible for programming into the 2018 SHOPP. Project level performance needs to include a definition of condition improvement, complete streets components, climate change mitigation/adaptation elements, system performance, operational improvements, safety improvements or other tangible project level benefits.” Kome Ajise, Chief Deputy Director-January, 22nd 2016

Federal Highway Administration (FHWA) Infrastructure Carbon Estimator (ICE) Tool

The FHWA Infrastructure Carbon Estimator (ICE) Tool will be used to quantify lifecycle GHG emissions for SHOPP projects during PID development when determined appropriate. This tool is designed to allow users to create preliminary estimates of GHG emissions using planning-level data. It does not require detailed data from engineering documents or construction plans.

The FHWA ICE Tool is located at the following link:


All SHOPP Project Initiation Documents (PID) for the 2018 & Future SHOPP, will require a Climate Change analysis to include, but not limited to an analysis of Greenhouse Gas (GHG) emissions. The following guidance provides instructions on completing the process to incorporate the GHG analysis into the PID & SHOPP Asset Management Tool, for both: PIDs completed in Fiscal Year (FY) 16/17 and PIDs completed in Fiscal Year (15/16).
Figure 2: GHG emissions Analysis process

GHG Emission Analysis

CE/CE Environmental Determination or Document?

YES

Can FHWA ICE tool be used to calculate GHG emissions?

(Attachment A)

NO

DEFER to future phases

NO

QUALITATIVE description of GHG emissions

YES

QUANTITATIVE GHG Calculations using the FHWA ICE tool:
- Unmitigated
- Proposed Mitigated

Figure 2: GHG emissions Analysis process
I. Process for including GHG Analysis for 2018 & Future SHOPP Active PIDs

Once the PID is close to completion, the Project Engineer (PE), stamping the PID, will determine from the following three available GHG analysis options.

A. Defer
B. Qualitative
C. Quantitative

It is important to note that for both the GHG quantitative and qualitative analysis, the project must have a Categorical Exemption/Categorical Exclusion (CE/CE) Environmental determination or document, otherwise the analysis is deferred to the future phase.

Concurrently, the District SHOPP Tool Coordinator will need to work with district staff to update the Performance Tab of the SHOPP Asset Management Tool and incorporate the GHG Analysis. Both the role of the PE and the District SHOPP Tool coordinator is crucial in addressing and capturing the GHG analysis in the PID.

A. DEFER

The GHG analysis is deferred to future phases when an Environmental Determination or Document other than the CE/CE is anticipated. To DEFER GHG analysis in active and proposed PIDs:

1) The PE will add a justification in the PID for the deferred calculation, for example:

   **Greenhouse Gas (GHG) Emissions:**

   GHG Emissions Analysis is being deferred to the future Environmental Phase (PA&ED) since an in-depth GHG Analysis will be performed with Environmental Document.

2) In the SHOPP Tool, the District SHOPP Tool Coordinator will:
   a. Update the Performance Tab
   b. Check the Greenhouse Gas Category Box
   c. Select Defer in the Activity Detail and input “not a CE/CE” in comment field.

B. QUALITATIVE

The FHWA ICE tool, presently, does not calculate GHG Emissions for all type of SHOPP projects. Attachment A, provides a list of SHOPP projects that are not covered by the FHWA ICE tool (e.g. landscaping, culverts and ramp metering, signs and lighting).

The following describes the process to incorporate the QUALITATIVE GHG analysis Active PID Documents:

1) The PE will need to provide a qualitative description of how the project will consider the reduction of GHG throughout the project development process in the Climate Change section of the PID document. Refer to #3 of Attachment B for an example of a qualitative description.
2) In the SHOPP Asset Management Tool, the **District SHOPP Tool Coordinator** will:

   a. Update the Performance Tab
   b. Check the **Greenhouse Gas** Category Box
   c. Select Qualitative Activity Detail & Provide Comment in an **abbreviated format**\(^1\) (max 40 Characters) with the associated Qualitative statement listed in [Attachment B, Item 3](#).

### C. QUANTITATIVE

For project types, which are not listed in [Attachment A](#), a quantitative GHG analysis will be required. An example of GHG quantitative analysis performed using the FHWA ICE Tool is provided in [Attachment C](#).

The following describes the process to incorporate the **QUANTITATIVE** GHG analysis in the active and proposed documents.

1) The **PE** will:

   a. Use the FHWA ICE Tool to run the calculations to obtain total *unmitigated* and if Mitigation Strategies are chosen, also the **proposed mitigated** Construction & Maintenance GHG emissions.
   b. Run the analysis for the No-Build option with the following fields (orange only) completed in the **General Information** Section and **Roadway System** Section.
      
      i. Infrastructure Location- CA
      
      ii. Analysis timeframe (Years). **Always set cell to 1**, for estimating the total emissions associated with a **construction** project.
      
      iii. Average daily traffic per lane mile- **Leave Empty**, This is used to calculate fuel savings from increased smoothness, used with the vehicle operation portion, a different analysis.
      
      iv. Total existing centerline miles- Project limits in miles
      
      v. Total existing lane miles- Project limits in miles **multiply** by total lanes in both direction.
      
      vi. Click the Results Tab to obtain the “Result Summary” of **Routine Maintenance** of the existing System.
      
      vii. Record the Total Routine Maintenance in MT CO2e per year.
      
      viii. Save and obtain a hardcopy printout of the No-Build Result Summary which will be attached as a part of the completed PID
   c. In the copy of this same spread sheet, begin adding the new infrastructure associated with the Build option.
      
      i. The tool evaluates emissions associated with three categories of facilities: roadways, bridges and rail, bus, bicycle, and pedestrian facilities.
      
      ii. Please refer to the FHWA ICE Tool User Guidelines for additional information regarding inputs.
      
      iii. Input information about Construction and Maintenance of each category for different combinations of activities (e.g., new construction, rehabilitation) and transportation facilities of different types, in terms of amount of facilities that are subject to each activity (e.g., lane miles, track miles).

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\(^1\) Note: Presently, the comment field in the SHOPP Asset Management Tool is limited to 40 characters. Associated suggested verbiage is listed along the suggested Qualitative statement listed in [Attachment B, Item 3](#) which will be used to input the comment field.
iv. Skip the information about construction delay section as this is used to calculate fuel savings from increased smoothness which is presented in the Impacts on Vehicle Operation Sheet, which is separate from the Results Summary Sheet and is presently out of our scope in determining the total construction and maintenance Emissions for the project.

v. However, in the Mitigation Inputs Sheets Section, it is highly encouraged that the PE apply at least one or a combination of the available Mitigation Strategies within the Tool which may apply to their projects.

vi. Click the Results Tab to obtain the Unmitigated and the Proposed Mitigated Results. The result represents the Total Unmitigated and Mitigated construction emissions, plus the higher maintenance emissions associated with the expanded infrastructure.

vii. Save and obtain a hardcopy printout of the Build Result Summary which will also be attached along the No-Build Result Summary as a part of the completed PID.

viii. The higher maintenance emissions associated with the expanded infrastructure is subtracted from the routine maintenance from the existing system and multiplied by the analysis period (in years). It is then added to the sum of construction emissions from embodied materials and equipment to obtain the Total both the Construction and Maintenance GHG Emissions for the project.

d. Follow the process addressed in Attachment B, Item 5

2) In SHOPP Asset Management Tool, the District SHOPP Tool Coordinator will:

1. Update the Performance Tab
2. Check the Greenhouse Gas Category Box
3. Select the following Quantitative Activity Detail and complete the Quantity Field
   a. Unmitigated GHG Emission
   b. Proposed Mitigated GHG Emission with associated % Reduce comment

Figure 3: SHOPP tool screens
II. Including GHG Analysis into the 2018 SHOOP PIDs that Were Previously Completed and Signed

If the PID is already completed and signed by the District Director and GHG Emissions analysis was not included in the body of the PID document, proceed as described below, provided it follows the same conditions described in Figure 2.

A. If deferring the GHG calculations to future phases, the District SHOOP Tool Coordinator will need to work with the PE to update the Performance Tab GHG Emission Activity. **Defer Activity Detail** should be selected and a comment should be provided. There is no need to provide attachments to the PID document.

B. If a Qualitative analysis is selected, the District SHOOP Tool Coordinator will need to work with the PE to update the Performance Tab GHG Emission Activity. **Qualitative Activity Detail** should be selected in the SHOOP Tool and a comment should be provided. No need to include attachments to the PID document.

C. If performing a Quantitative analysis, proceed as follows:
   1. PE performs the GHG calculations using the FHWA ICE Tool, as previously described.
   2. PE attaches both the hardcopy build and no-build FHWA ICE Tool GHG emissions **“Result Summary”** to the completed PID document. Refer to item number 5 in **Attachment B** for sample results. Provide a copy of the completed PID with hardcopy results to the District PID Manager. The District manager will update the link to the completed PID in the PID work plan and forward to the Headquarters PID Liaison.
   3. District SHOOP Tool Coordinator will need to work with PE to update the Performance Tab GHG Emission Activity. **Quantitative-Mitigated and/or Proposed Mitigated** (only if Mitigation Strategies is chosen) Activity Detail should be selected and quantity fields completed respectively with an associated comment.

III. Process for Timesheet Charges

Please use “**PIDGHG**” reporting code to account for the GHG Emission effort when completing timesheets for the project.

*Figure 4: Timesheet example*
RESOURCES:

1. Webinar Training Presentation for the FHWA ICE Tool provided to the Districts by the FHWA subject matter expert - Jeff Houk on September 2\textsuperscript{nd}, 2016 located at the following link:


A June 2017 webinar at the following link also provides an overview of the tool, including a general background, information on underlying data analysis, a brief tutorial, and some examples use cases.

https://www.fhwa.dot.gov/exit.cfm?link=https://connectdot.connectsolutions.com/p54pxga7gi/?OWASP_CSRFTOKEN=e3ea7f7d01a1bec54b2521f87776f9cc245d8d13d73ebf93007d55c900185a3e

2. FHWA ICE Tool Final Report and User Guide


3. SHOPP Compliance B-30-15 Memo- January 22\textsuperscript{nd}, 2016


4. Caltrans Headquarters PID Program Contact:
   Pritpall Bhullar, Sr. TE
   (916) 654-5708
   Pritpall.Bhullar@dot.ca.gov

5. FHWA Contact:
   Jeff Houk
   (720) 963-3203
   jeff.houk@dot.gov
ATTACHMENT A

List of Project Types that FHWA Tool Specifically Does Not Cover

1. Drainage System- Replacement, in-place or rehabilitation of culverts and highway drainage systems
2. Highway Planting- Replacement, restoration and rehabilitation of existing highway plantings
3. Transportation Management System- Traffic sensors, Changeable message signs, Close circuit television cameras, Ramp meters Communications systems, Highway advisory radio
4. Signs and Lighting Rehabilitation
5. Roadway Protective Betterments- Rock slope protection, Rock fall prevention (rock nets, etc.) Stabilization trenches, Pumps, pumping stations at depressed sections, Retaining walls and Soil Nailing
6. Collision Severity Projects-Guardrail end treatments and crash cushions, install rumble strips, glare screen, rock fall mitigation, over crossing pedestrian fencing, crosswalk safety enhancements, and Clean Up the Roadside Environment (CURE) projects
7. Bridge Rail Replacement & Upgrades
9. Roadway Safety Improvements- Vegetation control treatment under existing guardrail
10. Storm Water Mitigation- Erosion Control, water quality storm water runoff and drainage systems.
ATTACHMENT B

Information to Be Included in Climate Change Section of PID Document

1. **Quantitative Analysis:** Describe the Total Unmitigated and Proposed Mitigated GHG Emissions output from the results of the FHWA ICE Tool calculations in the Climate Change section of the PID document.

   **Greenhouse Gas (GHG) Emissions:**

   This project will generate the following Construction & Maintenance GHG Emissions:

   1. ______ MT CO2e Unmitigated GHG Emission
   2. ______ MT CO2e Proposed Mitigated GHG Emission, ___% reduction in GHG Emission due to alternative construction and maintenance techniques.

   Disclaimer: The resulting GHG emission calculation was obtained using the FHWA Carbon Estimator Tool. This is an estimate using data inputs in the planning phase, before details about specific facility dimensions, materials and construction practices are known. The tool may not be appropriate to inform engineering analysis and pavement selection. Although Caltrans will continue considering the benefits of utilizing the FHWA Carbon Estimator Tool, at this time this estimate should not be used as a benchmark for GHG calculations in future phases of project development beyond the PID phase. The term mitigation relates only to the limited amount of items used in the FHWA ICE tool as GHG reduction measures and does not necessarily reflect all measures that could be included in the development process to reduce greenhouse gas emissions. Nor does the use of the word mitigation apply to the CEQA or NEPA process/determination for the proposed project.

2. **REQUIRED LANGUAGE:** Include the following disclaimer with the Quantitative Analysis as described in #1 above.

   “The resulting GHG emission calculation was obtained using the FHWA Carbon Estimator Tool. This is an estimate using data inputs in the planning phase, before details about specific facility dimensions, materials and construction practices are known. The tool may not be appropriate to inform engineering analysis and pavement selection. Although Caltrans will continue considering the benefits of utilizing the FHWA Carbon Estimator Tool, at this time this estimate should not be used as a benchmark for GHG calculations in future phases of project development beyond the PID phase. This term mitigation relates only to the limited amount of items used in the FHWA ICE tool as GHG reduction measures and does not necessarily reflect all measures that could be included in the development process to reduce greenhouse gas emissions. Nor does the use of the word mitigation apply to the CEQA or NEPA process/determination for the proposed project.”

3. **Qualitative Analysis:** Here is an example of qualitative analysis for use on projects that the FHWA Tool cannot calculate GHG emissions and included in the PID

   **Reduce Greenhouse Gas (GHG) Emissions:**

   Where available, it is recommended that material within a local radius of the project area and/or locally available building material be utilized to reduce GHG emissions.

   This project will reduce GHG emissions by reducing the frequency of maintenance vehicle idle times associated with traffic control, to maintain the roadway.
The following are some Qualitative Strategies for Reducing GHG Emissions which can also be used. District SHOPP coordinators must input in the SHOPP Asset Management Tool comment field the abbreviated format (in brackets):

A. The purpose of the proposed project is to [insert purpose of project] and is not expected to result in increased operational emissions as no additional roadway capacity will be added. (do not expect increase oper. emissions)

B. Construction emissions are unavoidable, but will be reduced to the extent possible through planning and implementation of best practices throughout the project delivery process. (employ best practices in PD)

C. The following items should be considered as appropriate or applicable:

- Reduction of roadway construction / demolition waste (reduc. Rdwy const./demo waste)
- Energy efficient construction methodologies (ener. eff. const. method)
- Water efficient construction methodologies (water eff. Const. method)
- Fuel efficient measures both for construction equipment and traffic management during delays or detours. (fuel eff. For const. equip) & (TMP during delay & detours)
- Where available, it is recommended that material within a local radius of the project area and/or locally available building material be utilized to reduce GHG emissions. (use local mat’l within local radius)
- This project will reduce GHG emissions by reducing the frequency of maintenance vehicle idle times associated with traffic control, to maintain the roadway. (reduc. emission by reduc. maint. veh.)

4. **Defer:** Here is an example of a project which requires an Environmental Document other than the Categorical Exemption/Categorical Exclusion (CE/CE) for Project Approval.

**Greenhouse Gas (GHG) Emissions:**

GHG Emissions Analysis is being deferred to the future Environmental Phase (PA&ED) since an in-depth GHG Analysis will be performed with Environmental Document.

5. **GHG Summary Results Attachment to PID Document:** Attach both Build & No-Build hardcopy printouts of “Result Summary” from the FHWA ICE Tool to the completed PID document.
ATTACHMENT C

Example of GHG Calculations Using the FHWA ICE Tool

Truck Climbing Lane Project
- Four miles of I-80 in mountainous terrain of California
- Three lanes each direction
- Add a truck climbing lane
- Reconstruct a two-span bridge with two lanes
- Add a lane to a single-span bridge
- Analysis Time 20 years.

Prerequisites

1. User must be a PE (Project Engineer) stamping the PID.


3. Project must be an anticipated Categorical Exemption/Categorical Exclusion (CE/CE) Environmental Determination or Document type project.

Output

1. Two Hardcopy Printouts of both the No-Build and Build Result Summary Sheets and attached to the completed PIDs.

Procedure

Step 1.
- Complete one spreadsheet with No-Build roadway lane and centerline miles.

Begin first, by inputting in the General Information - Orange fields only.

Enter one year- For determining Total GHG emissions.
Centerline Miles = 4 Miles.
Four miles and Three lanes each direction, hence 24 lane miles

Click on the Results Tab.

– This will provide No-Build emissions, e.g., maintenance of the existing system
  - No-Build
    - Maintenance of existing roadway miles:
      - 40 MT of GHG emissions per year

Save File in Project History File and Print Hardcopy of the No-Build Results.
Line 22. Always set cell to 1, for estimating the total emissions associated with a construction project.

Line 24. Note that Average daily traffic per lane mile input field is left empty always. This is used to calculate fuel savings from increased smoothness which is presented in the Impacts on Vehicle Operation Sheet, which is separate from the Results Summary Sheet and is presently out of our scope in determining Total GHG Emission.

Line 28. These are total number of lane miles in both direction.
Step 2.
• In a copy of this spreadsheet, add the new infrastructure associated with the Build alternative.
  – Results will include construction emissions for the new infrastructure, and maintenance emissions for both existing and new infrastructure.

Continue to input, the following information, in the orange fields only, in Roadways and Bridge Sections.

- Add a truck climbing line- 4 lane miles (Rural Interstate)
- Reconstruct a two-span bridge with two lanes
- Add a lane to a single-span bridge
- 100%- Mountainous Terrain
On the Mitigation Input Tab, Employ the following GHG Reduction Strategies, Planned Deployment Column.

1. Alternative Vegetation-Yes
2. Snow Removal Strategy- Wing plows-Yes
3. In-place Roadway recycling- 60%
4. Full depth reclamation- 60%
5. Recycled and reclaimed materials- Use industrial byproducts as substitutes for Portland cement-33%
6. Preventative Maintenance- 50%

*****The PEs have some of the following available Mitigation Strategies within the Tool which may apply to their projects to obtain reduction in GHG Emissions.

1. Warm Mix Asphalt
2. Preventive Maintenance
3. Recycled and Reclaimed materials- Certain industrial byproducts (coal ash, ground granulated blast furnace slag and other industrial waste products) can be used as substitutes for GHG and energy intensive Portland cement in concrete mixes. According to data collected by ICF for Caltrans, which has been a leader in amending specifications to allow for greater use of industrial byproducts in concrete mixes, these byproducts account for 33% of cement in the average statewide mix).
4. Snow Management- Snow removal fleet in Caltrans employs wing plows that increase the width of the roadway that can be cleared by a single plow.
5. Vegetation Management
## Energy / GHG reduction strategies

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<tr>
<th>Strategy</th>
<th>Baseline deployment</th>
<th>Planned deployment</th>
<th>Maximum potential deployment</th>
<th>Applied to</th>
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<td>Alternative fuels and vehicle hybridization</td>
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<td>0%</td>
<td>44%</td>
<td>Fuel use by maintenance equipment</td>
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<tr>
<td>Hybrid maintenance vehicles and equipment</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>Fuel use by maintenance equipment</td>
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<tr>
<td>Switch from diesel to E20 in maintenance vehicles and equipment</td>
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<td>0%</td>
<td>100%</td>
<td>Fuel use by maintenance equipment</td>
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<td>0%</td>
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<td>44%</td>
<td>Fuel use by construction equipment</td>
</tr>
</tbody>
</table>

### Vegetation management
- Alternative vegetation management strategies (hardscaping, alternative mowing, integrated roadway/vegetation management): No, Yes, N/A
- Fuel use by vegetation management equipment

### Snow fencing and removal strategies
- Alternative snow removal strategies (snow fencing, wing plows): No, Yes, N/A

### In place roadway recycling
- Cold in-place recycling: 0%, 60%, 95%
- Full depth reclamation: 0%, 60%, 95%

### Warm-mix asphalt
- Warm-mix asphalt: 0%, 50%, 100%

### Recycled and reclaimed materials
- Use recycled asphalt pavement as a substitute for virgin asphalt aggregate: 0%, 0%, 25%
- Use recycled asphalt pavement as a substitute for virgin asphalt binder: 0%, 0%, 40%
- Use industrial byproducts as substitutes for Portland cement: 0%, 50%, 33%
- Use recycled concrete aggregate as a substitute for basalt stone: 0%, 50%, 100%

### Preventive maintenance
- Preventive maintenance: 0%, 50%, 100%

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Click on the Results Tab

Save File in project History File and Print the Hardcopy of the Build Results.
Build Results

• **Unmitigated**
  • Construction of additional lane and reconstruction/widening of two bridges:
    – 2147 MT of GHG emissions (Total) Construction Material & Equipment (1475+672)
  • Maintenance of existing and new roadway miles:
    – 44 MT of GHG emissions per year

• **Proposed Mitigated**
  • Construction of additional lane and reconstruction/widening of two bridges:
    – 1967 MT of GHG emissions (Total) Construction Material & Equipment (1295+672)
  • Maintenance of existing and new roadway miles:
    – 33 MT of GHG emissions per year

Step 3

**Background Calculations**

For Construction and Maintenance impacts over 20 years

**Overall Results**

**Unmitigated GHG Emissions**

• **No-Build**
  • Maintenance of existing roadway miles:
    – 40 MT of GHG emissions per year

• **Build- Unmitigated**
  • Construction of additional lane and reconstruction/widening of two bridges:
    – 2147 MT of GHG emissions (Total) Construction Material & Equipment
  • Maintenance of existing and new roadway miles:
    – 44 MT of GHG emissions per year

*Calculations:*

\[
\text{Construction + Maintenance (20 years)} = 2227 \text{ MT CO}_2\text{e Unmitigated GHG Emissions}
\]
Proposed Mitigated GHG Emissions

- **No-Build**
  - Maintenance of existing roadway miles:
    - 40 MT of GHG emissions per year

- **Build-Proposed Mitigated**
  - Construction of additional lane and reconstruction/widening of two bridges:
    - 1967 MT of GHG emissions (Total) Construction Material & Equipment
  - Maintenance of existing and new roadway miles:
    - 33 MT of GHG emissions per year

**Calculations:**

\[
\text{Construction + Maintenance (20 years)}
\]

\[
1967 + ((33-40)*20) = 1967 - 140 = \mathbf{1827 \text{ MT CO}_2e}\text{ Proposed Mitigated GHG Emissions}
\]

**Reduction**

\[
\frac{(1827-2227)}{2227} \times 100 = 18\% \text{ (approx.)}
\]

Hence, following the Guideline, for Quantitative Analysis, Attachment B, Item 1

**Greenhouse Gas (GHG) Emissions:**

This project will generate the following Construction & Maintenance GHG Emissions:

1. **2227 MT CO2e Unmitigated** GHG Emissions.
2. **1827 MT CO2e Proposed Mitigated** GHG Emission, 18% reduction in GHG Emission due to alternative construction and maintenance techniques.
3. **Disclaimer:** The resulting GHG emission calculation was obtained using the FHWA Carbon Estimator Tool. This is an estimate using data inputs in the planning phase, before details about specific facility dimensions, materials and construction practices are known. The tool may not be appropriate to inform engineering analysis and pavement selection. Although Caltrans will continue considering the benefits of utilizing the FHWA Carbon Estimator Tool, at this time this estimate should not be used as a benchmark for GHG calculations in future phases of project development beyond the PID phase. The term mitigation relates to only the limited amount of items used in the FHWA ICE tool as GHG reduction measures and does not necessarily reflect all measures that could be included in the development process to reduce greenhouse gas emissions. Nor does the use of the word mitigation apply to the CEQA or NEPA process/determination for the proposed project.